D2: Aquatic Biodiversity

Aquatic Biodiversity Impact Assessment

Proposed Carpe Diem Solar Photovoltaic Plant, Merafong City, Gauteng Province

Legacy Environmental Management Consulting

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Report Information

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Executive Summary

The renewable energy firm, JUWI, is investigating the feasibility of developing a Solar Photovoltaic (PV) plant and Battery Energy Storage System (BESS) on Portion 5 of Farm Varkenlaagte No. 119 and Portion 27 of Farm Doornfontein No. 118, Merafong City, Gauteng. In addition, an overhead line will be installed from the proposed development site to the adjacent Eskom Carmel MTS Substation. The proposed development area is approximately 741 ha in size.

According to the national web-based environmental screening tool report generated for the proposed development site, the Combined Aquatic Biodiversity Theme Sensitivity is classified as "Very High" (DFFE, 2022). The classification trigger is the location of the proposed development area within a Strategic Groundwater Source Area (SWSA) for Groundwater (Far West Karst Region), as well as the presence of aquatic Critical Biodiversity Areas (CBAs) and watercourses within the proposed development area. After the field assessment conducted on the 27th and 28th of October 2022; as well as the 16th and 17th of February 2023, the majority of the development area was determined to be of "Low" aquatic sensitivity, apart from areas where the proposed activities traverse wetland areas which were subsequently deemed to be of "Very High" aquatic sensitivity.

Desktop resources indicate no aquatic features within Portion 5 of Farm Varkenlaagte No. 119 which was confirmed during the site assessments. Desktop resources indicate the presence of several aquatic features within Portion 27 of Farm Doornfontein No. 118 which include three non-perennial drainage lines, two CVBWs, and a depression wetland. Following an aquatic biodiversity assessment of the proposed site, one UVBW associated with one of the mapped non-perennial drainage lines, one CVBW associated with two of the mapped non-perennial drainage lines, and a depression wetland were confirmed and delineated onsite.

Wetland delineation was carried out using indicators present such as saturated soils, hydromorphic soil indicators, vegetation, and topography. In this study, the onsite wetlands were assessed using current best practice assessment methodologies to determine the PES, EIS, WES, and REC metrics. The results of these assessments are as follows:

Table i: Results of the wetland status quo assessment.

	PES	EIS	WES (Highest)	REC
Depression Wetland	B	Moderate	Moderately High	Maintain B
UVBW	D	Moderate	Moderate	Maintain D
CVBW	E	Moderate	Moderate	D

The condition of the onsite wetlands varied from largely natural to seriously modified. The VBWs exhibited a high degree of transformation due to the surrounding catchment land uses (industrial and agricultural), and infestation of alien vegetation; whilst the depression wetland was found to be in a largely natural condition. The Moderate EIS and Moderate to Moderately High WES scores indicated that the wetlands are sensitive and may be important in terms of conservation planning (specifically the depression wetland) or provision of ecosystem services (VBWs).

Aquatic biodiversity impacts associated with the development were identified and assessed using both an impact assessment methodology compliant with NEMA requirements and the Risk Assessment Matrix prescribed by GN509 of 2016. The results of the assessment of wetland loss and 5 additional impacts during the construction and operational phases, given implementation of the listed mitigation measures, are summarised in **Table ii.**

Table ii: Summary of impact/risk assessment results (with mitigation).

	Rating	Risk Class	Applicable to	Mitigation Measures
Construction Phase				
Impact 1: Wetland Loss	No Impact	No Impact	Depression, UVBW, & CVBW	It is recommended that the wetlands and recommended buffer zones are avoided by all construction and operational activities. **Should the wetlands be avoided there will be no impact.**
Impact 2: Altered flow	Very Low	Low	Depression, UVBW, & CVBW	Vegetation clearance should be restricted to the relevant development components. Ensure that vegetation cover within the PV plant area is maintained as far as practically possible. Ensure that effective stormwater management measures are implemented during construction. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales.
Impact 3: Increased sediment input	Very Low	Low	Depression, UVBW, & CVBW	During construction, cover cleared areas with straw to minimise sedimentation by wind. Vegetation clearance should be restricted to the relevant development components. Ensure that vegetation cover within the PV plant area is maintained as far as practically possible to reduce runoff and sedimentation of wetland areas. Ensure that effective stormwater management measures are implemented during construction. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales.
Impact 4: Water Quality Impairment	Very Low	Low	Depression, UVBW, & CVBW	Bunded, impervious areas must be designated by an Environmental Control Officer for temporary toilets,

				vehicle parking/servicing areas and for pouring and mixing of concrete/cement, paint, and chemicals. These bunded areas must be located at least 15 m from the demarcated wetland boundaries. The site manager / ECO must check the No Go area for pollution/spills, erosion damage and sedimentation weekly and after every heavy rainfall event. Should pollution, erosion or sedimentation be noted, immediate corrective measures must be undertaken. Fuel, chemicals, and other hazardous substances should preferably be stored offsite, or as far away as possible from the no-go area. These substances must be stored in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding, or storm damage. Clean up any spillages immediately with the use of a chemical spill kit and dispose of contaminated material at an appropriately registered facility. Inspect all storage facilities, vehicles, and machinery daily for the early detection of deterioration or leaks and strictly prohibit the use of any vehicles or machinery from which leakage has been detected.
Operational Phase				
Impact 5: Altered Flow Regime	Very Low	Low	Depression, UVBW, & CVBW	Vegetation clearance should be restricted to the relevant development components. Ensure that control measures are undertaken onsite to prevent and manage erosion such as: • maintaining a 15 m buffer around onsite wetlands, • Ensure that effective stormwater management measures are implemented during operation. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter

				the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales. • maintain adequate vegetation cover within the PV plant area as far as practically possible, • plant indigenous wetland vegetation should erosion occur in wetland areas, and • incorporate rock riprap / gabions as a last measure should erosion continue once vegetation is established.
Impact 6: Water quality impairment	Very Low	Low	Depression, UVBW, & CVBW	Ensure that all potentially significant pollution sources are listed in the Environmental Management Plan. Ensure that all activities that may lead to pollution take place indoors or on bunded impervious surfaces such that the pollutants cannot enter the stormwater system or downstream watercourses.
"No Go" Scenario				
"No Go" Scenario	Low	Not Assessed	Depression, UVBW, & CVBW	None

Five out of six of the pre-mitigation scores fell within the "Low" impact categories, while post-mitigation scores fell within the "Very Low" impact categories. Wetland loss was rated as "Medium" significance prior to mitigation. It is recommended that the wetlands, along with a 15 m buffer zone, are avoided by all construction and operational activities. Should the proposed project avoid the wetlands, this impact will not be applicable.

The "No Go" Alternative would result in a "Low" significance impact score to wetlands onsite. Although it is unknown whether the site would be developed in future, it is assumed that the "No Go" scenario would result in a continuation of current impacts such as water quality impairment and alteration of flow because of the gold mine slimes dam upstream, as well as within-wetland impacts including the existing plantations and dams.

The Low-risk rating indicates that a General Authorisation will be required for this project, provided that all mitigation measures are implemented. Should there be construction of 100 m^2 or more of infrastructure within the onsite wetlands or within 32 m thereof; or if there is removal, deposition, or movement of 10 m^3 or more of sediment or any other substance within the delineated wetlands, a Basic Assessment will be required.

It should also be noted that the DHSWS apply a 'no net loss' policy to wetlands. The 'no net loss' policy implies that losses due to project impacts and wetland offset gains need to balance out. The DHSWS are therefore not likely to authorise any development application that encroaches on a wetland unless an acceptable wetland offset plan forms part of the development application. Offsets involve rehabilitation and management of wetlands in perpetuity, which can be costly and

administratively complex and there is no guarantee of approval. It is therefore recommended that all onsite wetlands, along with the 15 m buffer area as determined in the current report, are demarcated as "No Go" areas and avoided entirely.

The current layout is supported from an aquatic perspective, and no further aquatic assessments are required. It is therefore the opinion of the specialist that the proposed development should be approved subject to the implementation of the mitigation measures listed in this report.

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Kimberley van Zyl is an ecologist and environmental scientist with over 9 years' experience in the environmental management field. She holds a MSc. degree in Water Resource Management from the University of Pretoria and her professional affiliations include the South African Council for Natural Scientific Professions (SACNASP) and the South African Society for Aquatic Scientists. Kimberley's work experience has exposed her to a range of projects across various business sectors such as mining, agriculture, and construction, as well as the public sector.

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Olivia Brunings is a SACNASP registered candidate ecologist with a BSc in Conservation Ecology from the University of Stellenbosch. Throughout her studies, internships, and consultancy experience, she has gained valuable and informed insight into the functioning of natural and socio-ecological systems, as well as many key research and monitoring skills. Olivia specialises in aquatic ecology and is currently working for Delta Ecology as a junior associate under the guidance of Joshua Gericke.

A signed statement of independence will be provided as a separate document.

1. Introduction

The renewable energy firm, JUWI, is investigating the feasibility of developing a Solar Photovoltaic (PV) plant and Battery Energy Storage System (BESS) on Portion 5 of Farm Varkenlaagte No. 119 (referred to as Carpe Diem North) and Portion 27 of Farm Doornfontein No. 118 (referred to as Carpe Diem South), Merafong City, Gauteng (**Figure 1-1** - **Figure 1-3**). In addition, an overhead line will be installed from the proposed development site to the adjacent Eskom Carmel MTS Substation (**Figure 1-1** - **Figure 1-3**). The proposed development area is approximately 741 ha in size.

An environmental screening was conducted in July 2022 for several properties in the vicinity of the Carmel MTS Substation including Portion 5 of Farm Varkenlaagte No. 119 and Portion 27 of Farm Doornfontein No. 118 (Legacy Environmental, 2022). No surface water resources were identified within Portion 5 of Farm Varkenlaagte No. 119; however, the screening report did identify several aquatic constraints within Portion 27 of Farm Doornfontein No. 118. Mapped aquatic resources identified within Portion 27 of Farm Doornfontein No. 118 include several non-perennial rivers, two Channelled Valley Bottom Wetlands (CVBWs), and a depression wetland. Furthermore, the proposed sites are underlain by a high yielding aquifer (Far West Karst Region) and are both located within a region that has a "Very High" aquatic biodiversity sensitivity rating (Legacy Environmental, 2022 and DFFE, 2022).

Given the likelihood of potential aquatic biodiversity constraints associated with the proposed development area, an aquatic biodiversity assessment was conducted on the 27th and 28th of October 2022 assessing Portion 5 of Farm Varkenlaagte No. 119, while Portion 27 of Farm Doornfontein No. 118 was assessed on the 16th and 17th of February 2023. Following the site assessments, one Unchanneled Valley Bottom wetland (UVBW), one Channelled Valley Bottom wetland (CVBW), and a depression wetland were confirmed and delineated on Portion 27 of Farm Doornfontein No. 118. Given the confirmed presence of wetlands intersecting with the proposed development area, the area as a whole was determined to be of "Very High" aquatic sensitivity.

If the specialist determines that the Aquatic Biodiversity sensitivity of the proposed development area is "Very High", the GN320 of 2020 requires that a full aquatic biodiversity impact assessment must be submitted as set out by the National Environmental Management Act (NEMA) (Act No. 107 of 1998) Regulations of 2020 (as amended) (GN R. 320 of 2020). Delta Ecology was appointed to undertake an aquatic biodiversity impact assessment of the proposed development area.

The aim of this aquatic biodiversity impact assessment is to (1) determine the Present Ecological State (PES) and ecological importance of the wetland systems present within the proposed development area, (2) to assess the potential impact of the proposed development on the mapped and confirmed wetland systems, and (3) to provide recommendations for impact mitigation.

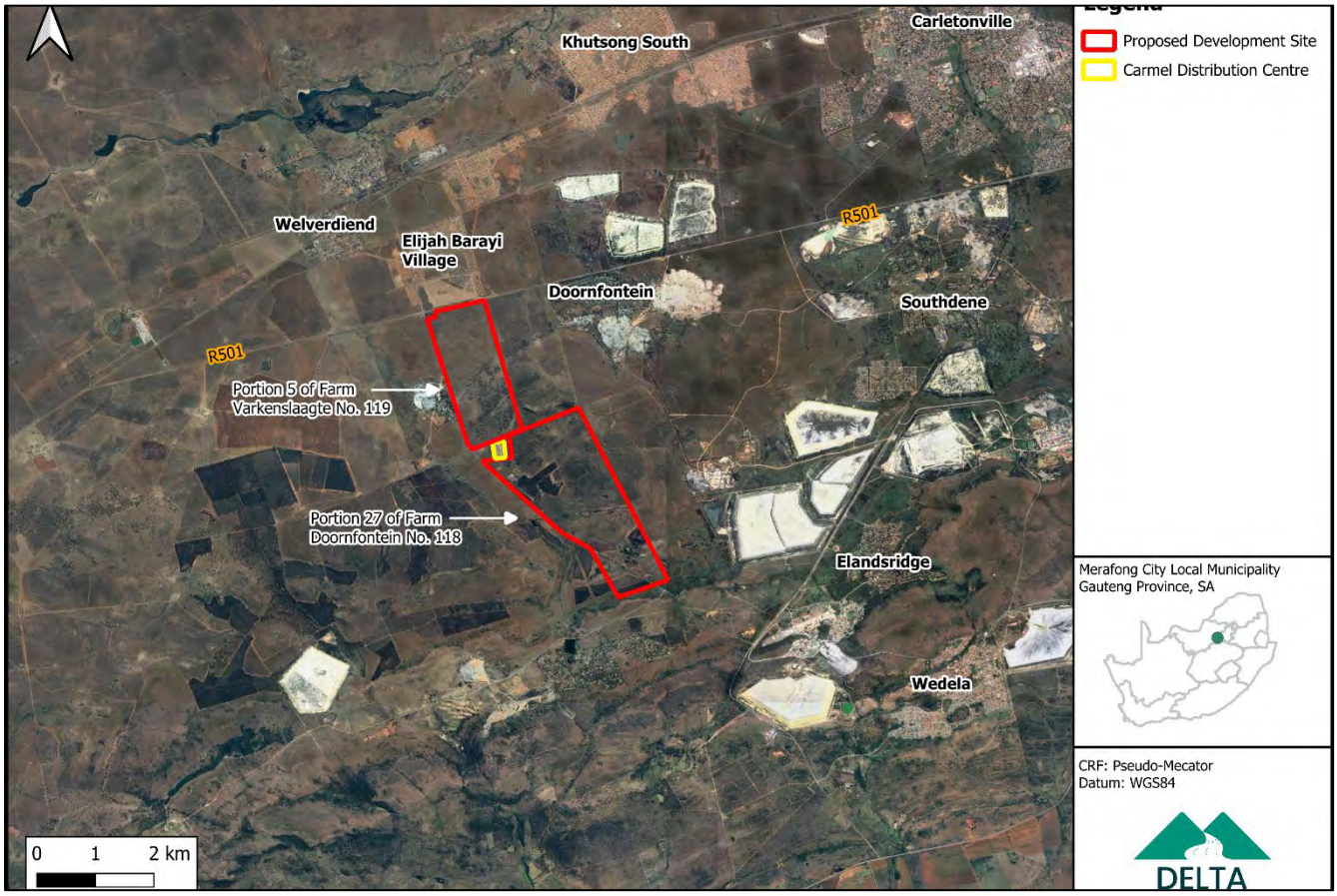

Figure 1-1: Location of the proposed development area, southwest of Carletonville, Gauteng.

1.1. Terms of Reference

The terms of reference for this aquatic biodiversity assessment include the following:

- A desktop background and site assessment to identify potential aquatic biodiversity constraints within the proposed development area.
- Delineation of all watercourses likely to be impacted by proposed infrastructure development activities using a combination of site-based and desktop methodologies as appropriate.
- Verification of the aquatic site sensitivity as either "Very High", "High", "Medium", or "Low".
- Drafting of an aquatic biodiversity impact assessment report including the following:
    - General site description;
    - Site sensitivity verification;
    - Determination of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and the contribution to Wetland Ecosystem Services (WES);
    - Assessment of potential aquatic biodiversity impacts of the proposed development on the watercourses present onsite;
    - Application of the Risk Assessment matrix stipulated by GN509 of 2016 promulgated in terms of the National Water Act (Act 36 of 1998) to determine the risk of the proposed development activities to the delineated watercourses onsite;
    - Provision of mitigation measures to reduce aquatic biodiversity impact as far as possible.

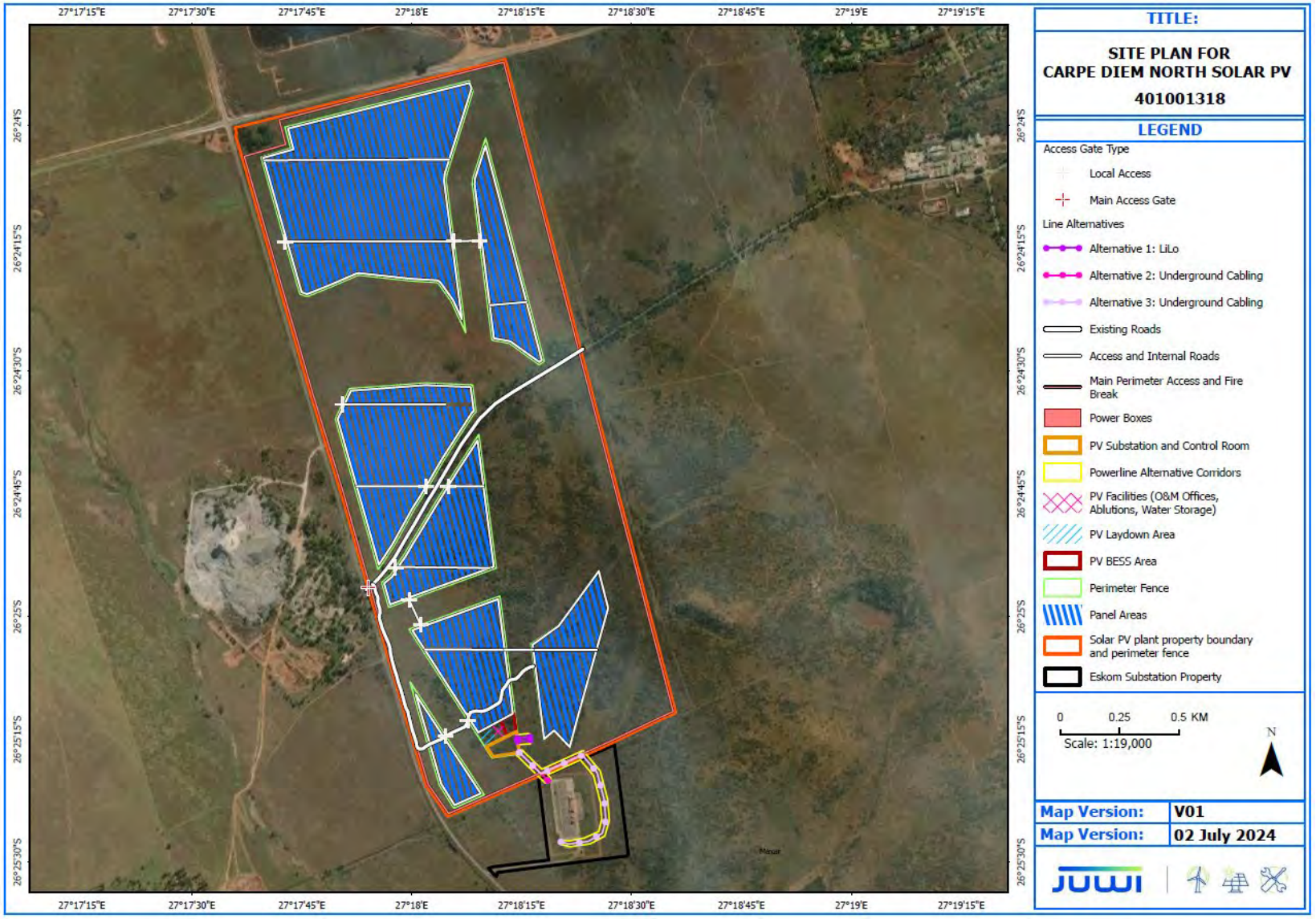

Figure 1-2: Proposed layout for Carpe Diem North.

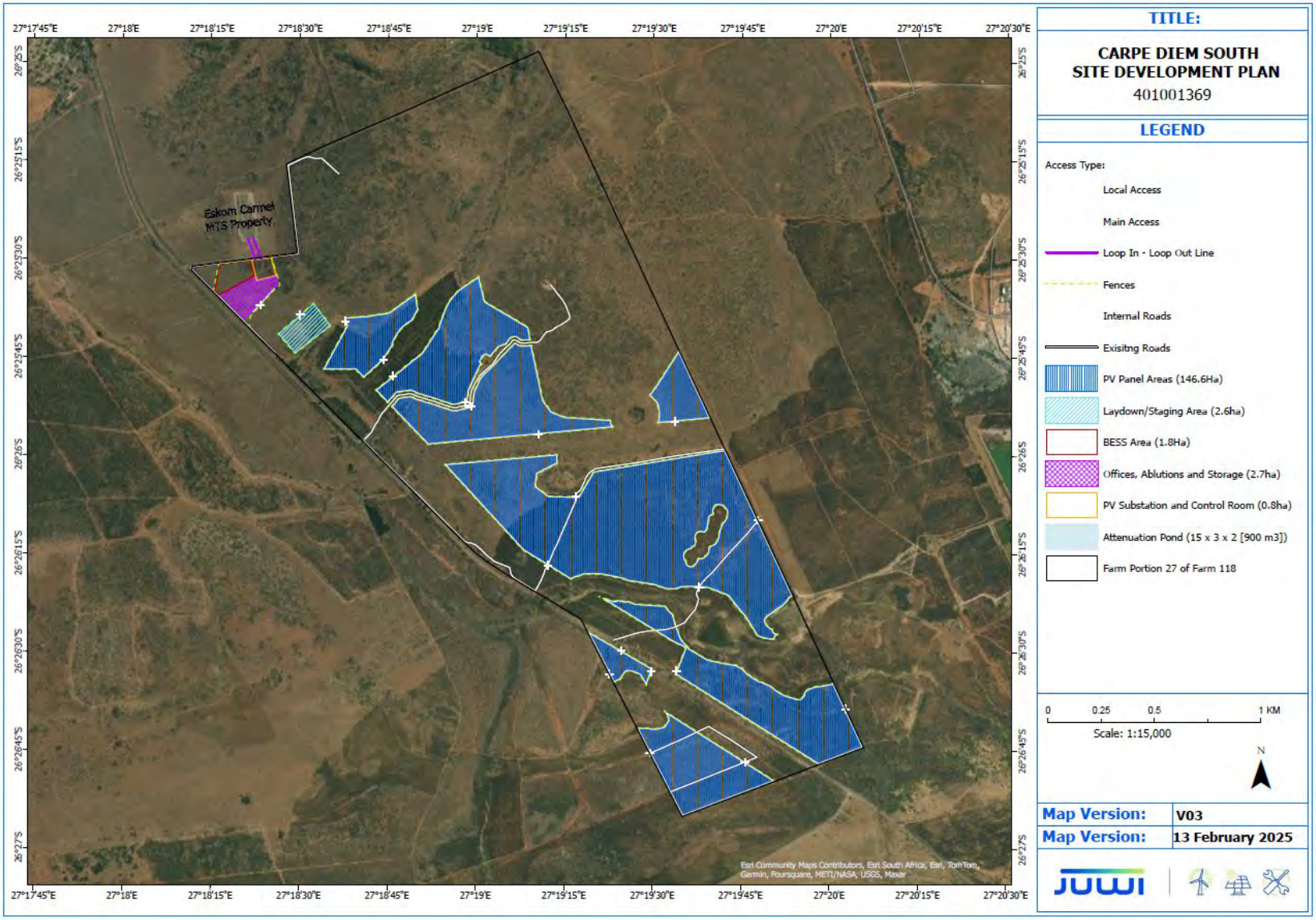

Figure 1-3: Proposed layout for Carpe Diem South.

1.2. Limitations and Assumptions

The following limitations and assumptions apply to the aquatic biodiversity impact assessment:

- Several site assessments were conducted on the 27th and 28th of October 2022 (Portion 5 of Farm Varkenlaagte No. 119), as well as the 16th and 17th of February 2023 (Portion 27 of Farm Doornfontein No. 118). The dates fall within Spring and Summer, at the beginning - and within - the region's rainfall months, and do not cover complete seasonal variation in conditions at the two sites. This will however not have an impact on the aquatic assessment outcome since hydrology, soil, topography, and vegetation indictors were present and adequate for the delineation and assessment of the watercourses.
- The disturbed nature of the sites, particularly the plantation areas within the UVBW and CVBW, and the previously ploughed areas within the CVBW, resulted in areas that were difficult to delineate. This will however not have a significant impact on the conclusion made regarding the potential impacts of the proposed activities.
- Watercourses were delineated using a Garmin GPS with an expected accuracy of 3 m or less at the 95% confidence interval. In the opinion of the specialist, this limitation is of no material significance to the assessment and all aquatic biodiversity constraints have been adequately identified.

Notwithstanding the above limitations, the specialist is of the opinion that the aquatic biodiversity constraints for the site have been adequately identified for the purposes of this aquatic biodiversity assessment.

1.3. Use of this report

This report reflects the professional judgment of its authors. The information and recommendations presented in this report are specific to the project at hand and do not extend to future developments. Use of this report beyond the scope of the current development is not permitted.

2. Site Sensitivity Verification

According to the national web-based environmental screening tool report generated for the proposed development area, the Combined Aquatic Biodiversity Theme Sensitivity is classified as "Very High" (DFFE, 2022). The classification trigger is the location of the proposed development area within a Strategic Groundwater Source Area (SWSA) for Groundwater (Far West Karst Region), as well as the presence of aquatic Critical Biodiversity Areas (CBAs) and watercourses within the proposed development area. After the field assessment conducted on the 27th and 28th of October 2022; as well as the 16th and 17th of February 2023, the majority of the development area was determined to be of "Low" aquatic sensitivity, apart from areas where the proposed activities traverse wetland areas which were subsequently deemed to be of "Very High" aquatic sensitivity.

Desktop resources indicate no aquatic features within Portion 5 of Farm Varkenlaagte No. 119. This was confirmed by the site assessments conducted on the 27th and 28th of October 2022. Desktop resources indicate the presence of several aquatic features within Portion 27 of Farm Doornfontein No. 118 which include three non-perennial drainage lines, two CVBWs, and a depression wetland. Following an aquatic biodiversity assessment of the proposed site conducted on the 16th and 17th

of February 2023, one UVBW associated with one of the mapped non-perennial drainage lines, one CVBW associated with two of the mapped non-perennial drainage lines, and a depression wetland were confirmed and delineated onsite. The onsite watercourses may face direct impacts from the proposed development activities. However, implementing appropriate mitigation measures can minimise and, in some cases, eliminate potential aquatic impacts, and the nature of the proposed development creates good opportunities for effective mitigation.

Several mapped watercourses occur within the 500 m regulated proximity of the proposed development area according to National Wetlands Map 5 (NWM5), National Freshwater Ecological Priority Areas (NFEPA), and National Geographical Information Service (NGI). These aquatic features are located >150 m away from the development area and, given the nature of the proposed activities, will not be impacted.

The Gauteng Conservation Plan (GDARD, 2014) indicates several CBAs and ESAs located within the proposed development area and within the regulated 500 m proximity thereof. According to the Gauteng Conservation Plan (GCP), the CBAs located within the development area have biodiversity feature descriptions which include red listed bird habitat, primary vegetation, and orange listed plant habitat. It is unlikely that the onsite priority areas will be impacted by the proposed development provided that adherence to appropriate mitigation measures as specified in this impact assessment report takes place.

The proposed SPP and BESS may impact upon the quantity and quality of an important groundwater source (Far West Karst Groundwater Region) considered to have a "Very High" vulnerability to contamination. The proposed activities may require the use of groundwater for cleaning and cooling operations. In addition, during construction and operation of the SPP and BESS, there is potential for leakages and spills of hydrocarbons and electrolytes. With suitable mitigation measures in place during the proposed development lifecycle, it is likely that the potential impacts to groundwater can be minimised. Recommended mitigation measures may include containing electrolyte storage tanks within an adequately bunded area which prevents the migration of any spillage or leakage to the surrounding environment, amongst others.

Given the confirmed presence of wetlands intersecting with the proposed development activities, the area as a whole was determined to be of "Very High" aquatic sensitivity as per the screening tool. If the specialist determines that the Aquatic Biodiversity sensitivity of the site is "Very High", the GN320 of 2020 requires that a full Aquatic Biodiversity Impact Assessment must be submitted as set out by the National Environmental Management Act (NEMA) (Act No. 107 of 1998) Regulations of 2020 (as amended) (GN R. 320 of 2020).

3. Methodology

The methodology used in this report, including a background desktop assessment, and several site assessments, is outlined in the subsections that follow.

3.1. Desktop Assessment

A review of desktop resources was undertaken to determine the nature of the proposed site, the presence of watercourses in the vicinity, and the significance of the site in terms of biodiversity planning. The following desktop resources were consulted:

- Topographical information from the National Geographical Information Service (NGI);

- The South African Atlas of Climatology and Agrohydrology (1997, 2007 and 2009);
- The SANBI (2018) National Vegetation Map (NVM);
- The South African National Biodiversity Institute National Wetlands Map 5 (NWM5 – CSIR 2018);
- The National Freshwater Ecological Priority Areas (NFEPA – CSIR, 2011) wetland, wetland vegetation group classification, river and FEPA datasets;
- The Gauteng Conservation Plan (GDARD, 2023); and
- The Natural Agricultural Resource Atlas of South Africa: Version 1.2 (NAR, 2022).

3.2. Wetland Delineation

The wetland boundaries were delineated at the outer edge of the wetland temporary zone using the method described in the Manual for the Identification and Delineation of Wetlands and Riparian Areas for field-based delineation (DWAF, 2008). This method is the accepted best practice method for delineating wetlands in South Africa and its use is required by GN 509 of 2016 for wetland assessments related to National Water Act section 21 (c) and (i) water uses. The method makes use of four key field indicators to guide the delineation process (refer to **box 1**):

Box 1. Four indicators of wetland presence as described in DWAF (2008):

1. The **position in the landscape** – Identifies parts of the landscape where wetlands are more likely to occur;
2. The **soil form** – Wetlands are generally associated with certain soil types;
3. The presence of **aquatic vegetation communities**;
4. The presence of **hydromorphic soil features**, which are morphological signatures that appear in soils with prolonged periods of saturation (associated with anaerobic conditions). Key hydromorphic features include:
    a. Mottling – Formation of clumps of iron oxide within the soil matrix in the form of orange, yellow, black or reddish-brown speckling. Mottling occurs in most soils and reaches maximum density in the centre of the seasonal zone with sparse mottling in the temporary zone and no mottling in the permanent zone.
    b. Gleying – Shift in soil colour from the terrestrial baseline towards a blue, green or grey colour and an overall reduction in soil chroma. This phenomenon is normally difficult to identify in the temporary zone, noticeable in the seasonal zone and most significant in the permanent zone.
    c. Organic Surface Layers – surface layers with very high organic content that typically occur in the wetland seasonal and permanent zones.
    d. Organic Streaking – Streaks of organic matter within the soil column which may be present in all zones, but particularly the temporary and seasonal zones.

Soil samples were taken for inspection by hand augering to determine soil form and presence of redoximorphic and other hydromorphic soil features. Aquatic vegetation communities were identified using the (DWAF, 2008) classification of wetland plant species and descriptions of communities, along with auxiliary information from (Van Ginkel *et al.*, 2011). Wetland plant species classification categories are as follows:

- Obligate species (occurring in wetlands >99% of the time – usually in the permanent or seasonal zone);
- Facultative Positive species (67 to 99% of the population occurs within wetlands – typically in the seasonal and temporary zones with the remaining 1 to 33% in the adjacent area on the wetland periphery);
- Facultative Species (33 – 67% of the population occurs within wetlands – usually in seasonal or temporary zones with the remaining 67 – 33% in the adjacent area on the wetland periphery);
- Facultative Negative Species (1 – 33% of the population occurs within wetlands – usually in the temporary zone with the remaining 99 to 67% in the adjacent area on the wetland periphery);
- Wetland Cosmopolitan Species (No specific affinity for wetlands and colonise wetland and terrestrial areas).

The soil composition at the proposed site allowed for wetland indicators such as periodic mottling indicative of the temporary and seasonal zones to be detected, such that the outer edge of the temporary zone could be confirmed for delineation.

3.3. Wetland Classification

The Ollis *et al* (2013) Classification System for Wetlands and Other Aquatic Ecosystems in South Africa, as used in this assessment, is a tiered structured classification system that provides a uniform description of wetland types based on their hydrogeomorphic characteristics. This classification system categorises wetlands into 7 distinct hydrogeomorphic units described in **Figure 3-1**.

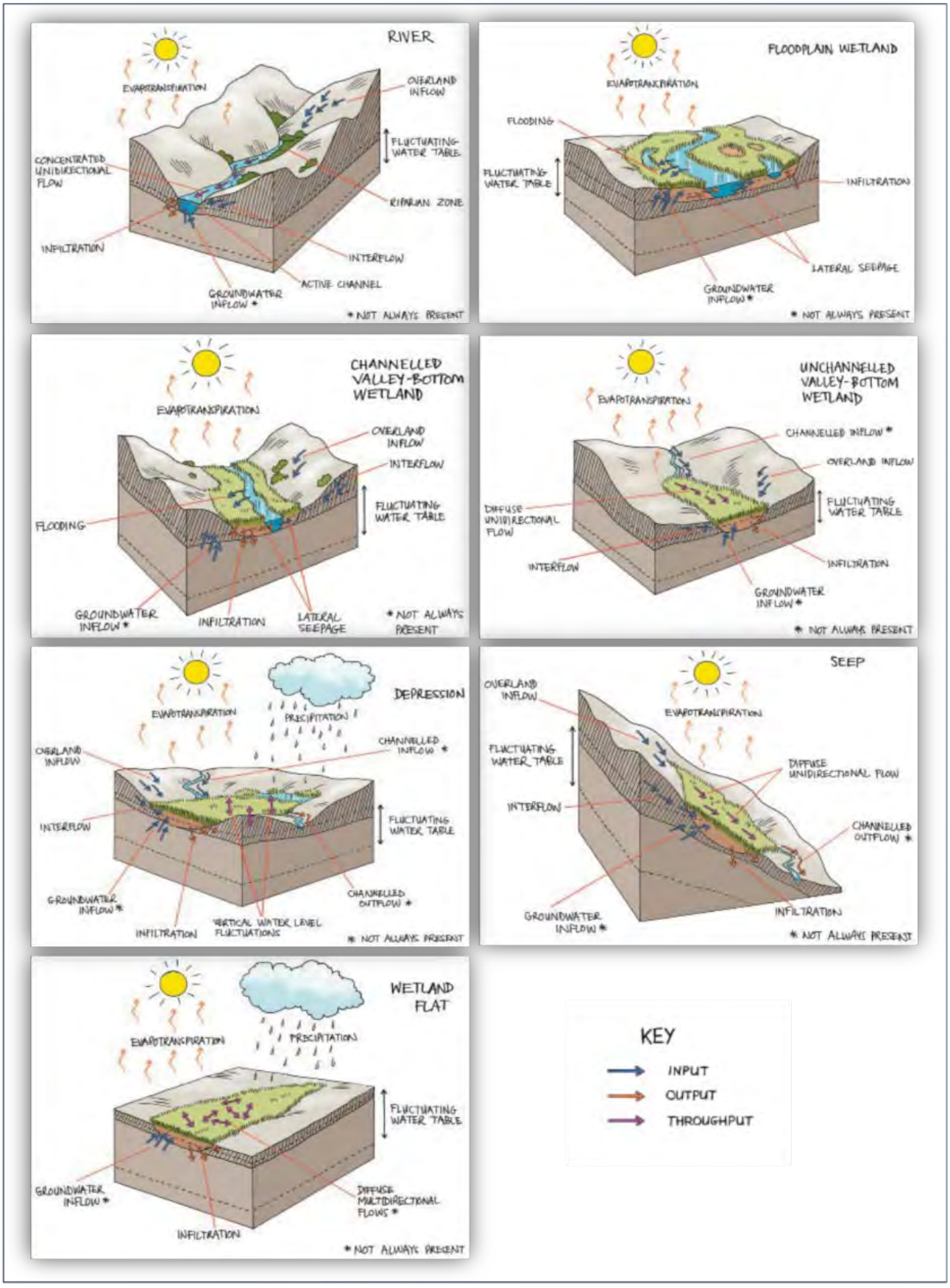

Figure 3-1: Wetland Hydrogeomorphic Types as defined in the Classification System for Wetlands and Other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013).

3.4. Present Ecological State Assessment

WET-Health Version 2 (Macfarlane *et al.*, 2020) is a modular tool designed to evaluate and assess the Present Ecological State (PES) of wetland hydrogeomorphic units based on the degree to which the wetland has deviated from its natural reference condition. The tool accounts for four inter-related components that influence wetland health. These consist of three core drivers of wetland change namely hydrology, geomorphology, and water quality, along with vegetation as a responding variable. A separate PES score is derived for each of these components, which are then combined into a single PES score for the wetland hydrogeomorphic unit. The scores for each component and the overall score fall into one of six Ecological Categories defined in **Table 3-1** below.

The tool offers three levels of assessment:

1. Level 1A, a low-resolution desktop-based assessment;
2. Level 1B, a high-resolution desktop-based assessment, and
3. Level 2, a detailed rapid field-based assessment.

Level 1A is applied to provincial and national scale assessments of many wetlands, while Level 1B is applied to catchment scale assessments or to rapid individual assessments. The Level 2 assessment incorporates information from a direct onsite assessment of the wetland and its catchment and adds detail by separately assessing the various disturbance units within the wetland. The level 2 PES assessment was applied in this case.

Table 3-1: Present Ecological Status Categories Scores as defined WET-Health Version 2 (Macfarlane *et al.*, 2020).

Ecological Category	Description	Impact Score	PES Score (%)
A	Unmodified, natural.	0-0.9	90-00
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	80-89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19

3.5. Ecosystem Service Assessment

WET-EcoServices Version 2 (Kotze *et al.*, 2021) is a structured and rapid field-based evaluation tool designed to assess the wetlands ecosystem services based on its Hydrogeomorphic (HGM) unit. The tool accounts for 16 ecosystem services which are derived from regulating (e.g., flood attenuation), provisioning (e.g., water supply), supporting (e.g., biodiversity maintenance), and cultural (e.g., tourism and recreation) services (refer to Annexure 1). The tool evaluates the scale of ecosystem services supplied (in terms of a score out of 4 per service) relative to other wetlands and furthermore compares the scale of service supply to the demand for each service. The scores are divided into seven categories as per **Table 3-2**.

The tool offers two levels of assessment, namely Level 1 (a rapid desktop assessment) and Level 2 (a detailed field-based indicator assessment). Level 1 is designed for conducting rapid desktop assessments of many wetlands across provincial and national scales. Ratings are assigned based on the Hydrogeomorphic unit of the wetland. Level 2 is designed for conducting robust in-field assessments of ecosystem services for respective wetland types. The level 2 Ecosystem Service assessment was applied in this case.

Table 3-2: Ecosystem Services Importance Categories Scores as defined in WET-EcoServices Version 2 (Kotze *et al.* 2020).

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

3.6. Ecological Importance and Sensitivity Assessment

The Ecological Importance and Sensitivity (EIS) method (Rountree *et al.*, 2013) is a rapid scoring system designed to identify the ecological importance and sensitivity of wetlands to disturbances across multiple scales (i.e., catchment to international scales). The full EIS method integrates three important components, namely, ecological importance and sensitivity, hydro-functional importance, and basic socio-economic importance. The hydro-functional and socio-cultural

benefits were however assessed using the updated WET-EcoServices assessment methodology and these two components were therefore omitted from this EIS assessment. The EIS score ranges from 0-4, and it provides an index for prioritisation and management of water resources. The EIS categories are presented in **Table 3-3.**

Table 3-3: Ecological Importance and Sensitivity Categories (DWAF, 1999).

EIS Category	Description	Range of Median
Very high	Ecologically important and sensitive on a national or even international level. These river systems and their biota are usually very sensitive to flow and habitat modifications and provide only a small capacity for use.	>3 and <=4
High	Ecologically important and sensitive on a regional or national scale. These river systems may be sensitive to flow and habitat modifications.	>2 and <=3
Moderate	Watercourses that are considered to be ecologically important and sensitive on a provincial or local scale. The biota of these watercourses is not usually sensitive to flow and habitat modifications.	>1 and <=2
Low/marginal	Watercourses that are not ecologically important and sensitive at any scale. The biota within these watercourses is not sensitive to flow and habitat modifications.	>0 and <=1

3.7. Recommended Ecological Category

The method for determining the Recommended Ecological Category (REC) for water resources is described in Rountree *et al.* (2013). The REC is determined once the PES and EIS scores for the wetland have been determined. The objective of the REC is to define the management objective for wetlands and does so in accordance with the following rules:

- A wetland within PES Category A (unmodified) cannot be rehabilitated. The management objective will therefore always be to maintain the existing PES Category.
- A wetland within PES Category B, C or D with a "Low-marginal" or "Moderate" EIS score must also be maintained in the pre-development PES category.
- A wetland within PES Category B, C or D with a "High" or "Very High" EIS score must, where practically possible, be rehabilitated to a PES category that is one higher than the pre-development category. E.g. a wetland with a pre-development PES score of C and a "High" EIS score must be rehabilitated to a PES category B. Where this is not practically possible, maintenance of the pre-development PES category will be the management objective.
- PES Categories E or F are considered unsuitable and always require rehabilitation to a PES Category D.

3.8. Buffer Determination

The Buffer Zone Tool (Macfarlane & Bredin, 2017) is a rapid, excel based, scoring tool designed to determine an appropriate buffer around rivers, wetlands and estuaries.

The tool offers two levels of assessment:

1. A desktop-based assessment and
2. A detailed rapid field-based assessment.

All three watercourse types (river, wetland, and estuary) can be assessed using the desktop-based assessment tool. When a field-based assessment is undertaken, different tools are available for each watercourse type. In this case, field-based assessments were undertaken.

3.9. Impact and Risk Assessment

The impact assessment utilised the Delta Ecology impact assessment methodology as specified in Annexure B. The risk assessment utilised the methodology and risk matrix specified in GN. 509 of 2016.

4. Desktop Assessment

A brief review of desktop resources was undertaken during the aquatic biodiversity assessment. A summary of key desktop information relevant to this assessment is provided below.

4.1. Biophysical Context

The elevation across Portion 27 of Farm Doornfontein No. 118 ranges from approximately 1647 m.a.s.l in the northeast to approximately 1554 m.a.s.l in the south with an average gradient of 3-19% across the majority of the site. Portion 5 of Farm Varkenlaagte No. 119 slopes from approximately 1598 m.a.s.l in the southeast corner to 1527 m.a.s.l in the northwest portion with an average gradient of 3-12% across the majority of the site. The mean annual rainfall received in the area is between 595 - 600 mm, mostly during the summer months with the highest mean rainfall occurring in November-March and the lowest mean rainfall occurring in May-September (Schultz, 2009) (**Table 4-1**).

The soils in this region consist of shallow Mizpah and Glenrosa soil forms with limited pedological development. The soil is derived from and underlain by dolomite and chert of the Chuniespoort Group and shale, some coarser clastic sediments and significant andesite from the Pretoria Group (Mucina & Rutherford, 2006). The site falls within soil group 6 which is characterised as carbonate or gypsum enriched soils (Fey, 2010) (**Table 4-1**).

According to the National Geospatial Information Landcover database, the proposed development area and surrounds consists primarily of grasslands with few patches of natural wooded land and shrubland. The natural vegetation type in this area consists of Gauteng Shale Mountain Bushveld and Carletonville Dolomite Grassland (SANBI, 2018) (**Figure 4-1**). Both vegetation types are classified as Least Concern (LC) and Poorly Protected (PP) with 21-25% of these vegetation types already transformed (Mucina & Rutherford, 2006) (**Table 4-1**).

According to the National Freshwater Ecological Priority Areas spatial dataset (SANBI, 2011), the depression, UVBW and CVBW are located within the Central Bushveld Group 1. The Central Bushveld Group 1 UVBW and CVBW wetland vegetation is classified as Critically Endangered (CR), while the Central Bushveld Group 1 depression wetland vegetation is classified as Endangered (EN). The level of protection for wetlands within the wetland vegetation types ranges from hardly protected to zero protection depending on wetland type (**Table 4-1**).

The general biophysical characteristics of the proposed development area is summarised in **Table 4-1**.

Table 4-1: General characteristics of the proposed development area.

Site attribute	Description	Data source
Eco-region	Highveld	Department of Water Affairs Level 1 Ecoregions (Department of Water and Sanitation, 2011)
Terrestrial Vegetation Type	Carletonville Dolomite Grassland (LC – PP) & Gauteng Shale Mountain Bushveld (LC – PP)	National Vegetation Map of South Africa, 2018 (SANBI, 2018)
Dominant Geology and Soils	This region has shallow Mispah and Glenrosa soil forms with limited pedological development. The geology of the region consists of dolomite and chert of the Chuniespoort Group and shale, some coarser clastic sediments and significant andesite from the Pretoria Group.	(Mucina & Rutherford, 2006; NAR, 2022)
Soil Erodibility Factor (K)	Moderate-Moderately Low susceptibility to wind and water erosion.	Natural Agricultural Resource Atlas of South Africa: Version 1.2 (NAR, 2022)
Mean Annual Precipitation (mm)	595 - 600 mm	SA Atlas of Climatology and Agrohydrology (Schultz, 2009)
Rainfall seasonality	Summer rainfall	
Mean Annual Temperature (°C)	16 °C	
Water Management Area	Upper Vaal WMA	Water Management Areas (DWAF, 2011)
Quaternary Catchment	C23E	South African Quaternary Catchments Database (Schulze et al., 2007)
Wetland Ecosystem Group	Depression Central Bushveld Group 1 (EN – no protection) UVBW & CVBW Central Bushveld Group 1 (CR – hardly protected)	NFEPA Wetland Vegetation Types (SANBI, 2011)

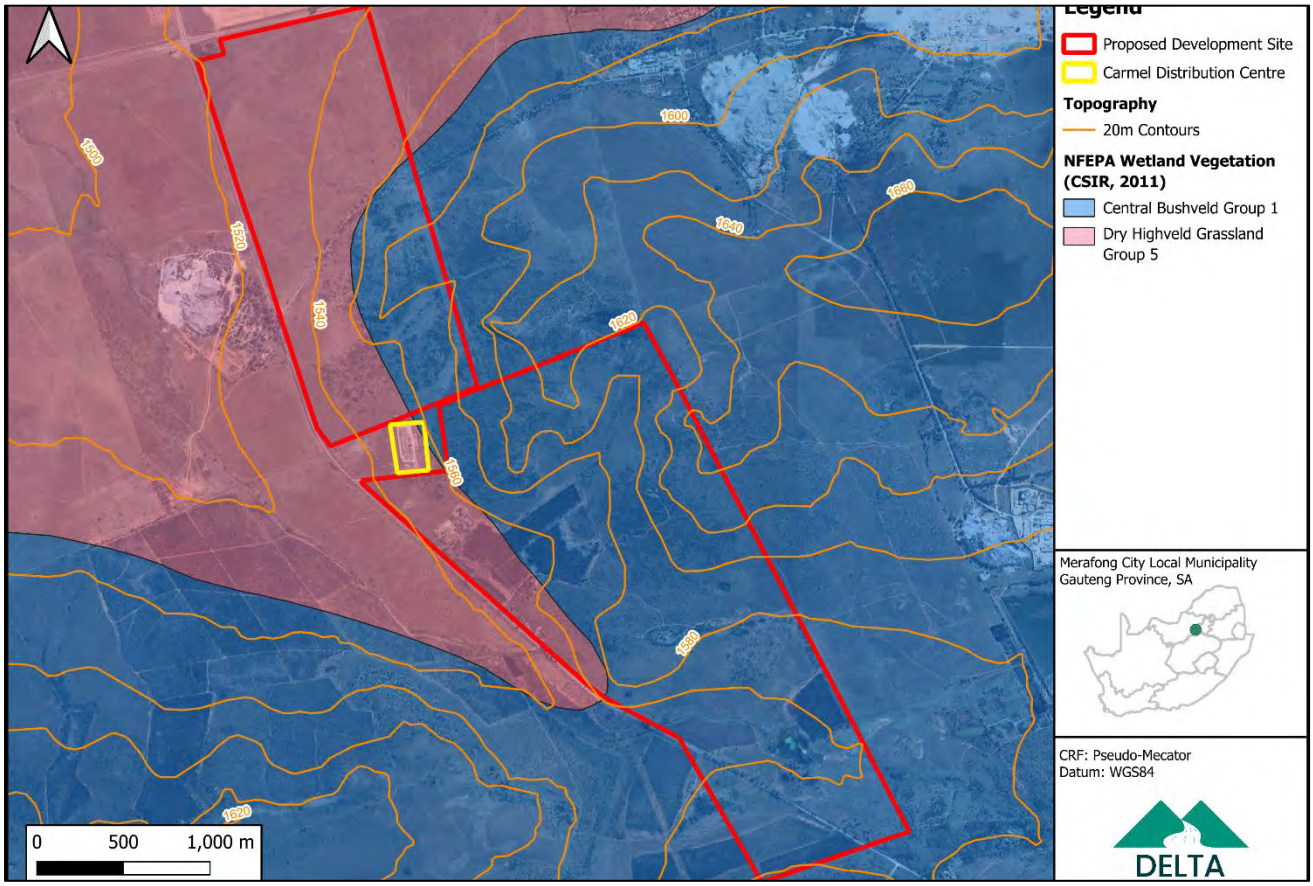

Figure 4-1: Wetland Vegetation Map (SANBI, 2018).

4.2. Biodiversity Planning Context

The proposed development area under evaluation is located within the Upper Vaal Water Management Area, quaternary catchment C23E. The regional setting, in terms of the Level 1 Department of Water Affairs (DWA) (now Department of Water and Sanitation) Ecoregions, is within the Highveld (Department of Water and Sanitation, 2011). The area under evaluation is located within a sub-quaternary catchment demarcated as an Upstream Freshwater Priority Area (FEPA) (NFEPA, 2011). Thus, potential human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.

Desktop resources indicate no aquatic features within Portion 5 of Farm Varkenlaagte No. 119. This was confirmed by the site assessments conducted on the 27th and 28th of October 2022. According to the NWM5 there is a CVB wetland system to the west (downslope) of Portion 5 of Farm Varkenlaagte No. 119 (**Figure 4-2**). A very small portion of this CVB wetland occurs within the 500 m regulated proximity of the proposed site. Additionally, the NFEPA wetlands map indicates an artificial seep wetland located to the southwest (downslope) of Portion 5 of Farm Varkenlaagte No. 119. Again, a small portion of this wetland occurs just within the 500 m regulated proximity of the proposed site (**Figure 4-2**).

Desktop resources indicate the presence of several aquatic features within Portion 27 of Farm Doornfontein No. 118 (**Figure 4-2**). These mapped watercourses include three non-perennial drainage lines according to the NGI (CD:NGI, 2010), a natural seep NFEPA wetland (NFEPA, 2011), as well as two CVBWs and a depression wetland according to the NWM5 (**Figure 4-2**). Following an aquatic biodiversity assessment of the proposed site conducted on the 16th and 17th of February

2023, one UVBW associated with one of the mapped non-perennial drainage lines, one CVBW associated with two of the mapped non-perennial drainage lines, and a depression wetland were confirmed and delineated onsite. Additional watercourses are mapped within the 500 m regulated proximity of the site according to NWM5, NFEPA, and NGI. These aquatic features are located >150 m from the proposed site and, given the nature of the proposed activities, will not be impacted significantly.

The area under evaluation is also located within the Far West Karst Region groundwater SWSA (WRC, 2017). The proposed activities may require the use of groundwater for cleaning and cooling operations. In addition, during construction and operation of the SPP and BESS, there is potential for leakages and spills of hydrocarbons and electrolytes. With suitable mitigation measures in place during the proposed development lifecycle, it is likely that the potential impacts to groundwater can be minimised. Recommended mitigation measures may include containing electrolyte storage tanks within an adequately bunded area which prevents the migration of any spillage or leakage to the surrounding environment, amongst others.

According to the Gauteng Conservation Plan (GCP), CBAs and ESAs are located within the proposed development area (**Figure 4-3**). The onsite priority areas are unlikely to be impacted by the proposed development provided that mitigation measures as recommended in this report are implemented and adhered to.

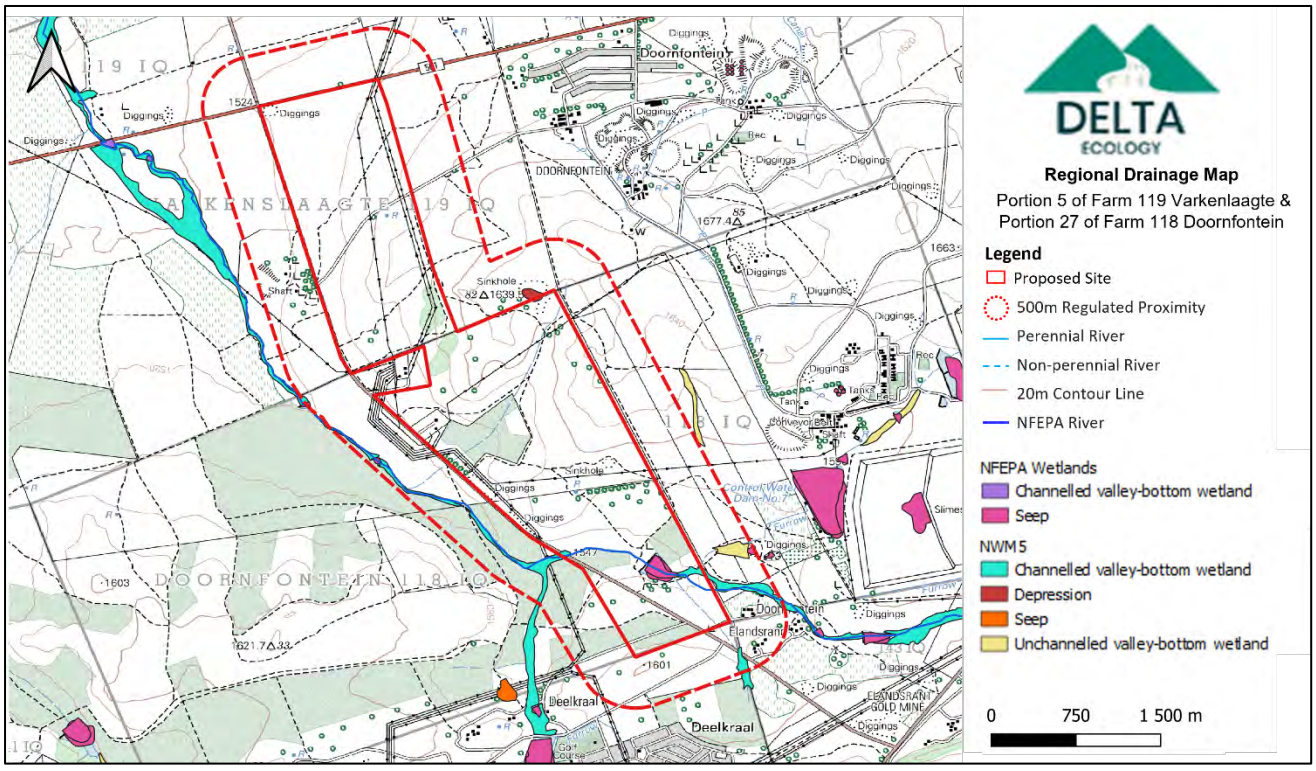

Figure 4-2: Regional Drainage Map.

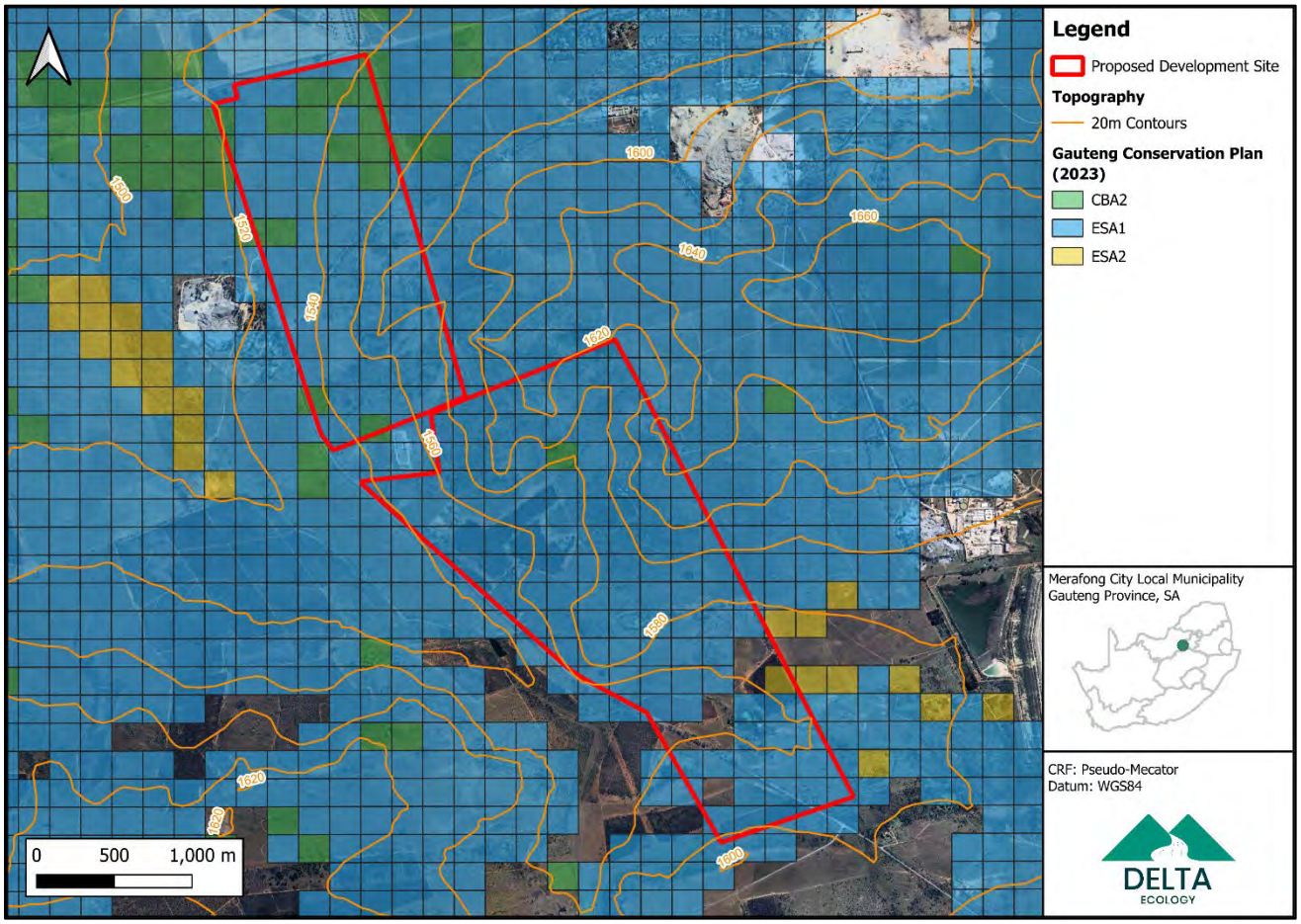

Figure 4-3: CBAs and ESAs (GDARD, 2023).

5. Site Description

5.1. Portion 5 of Farm Varkenlaagte No. 119

During the two site visits for Portion 5 of Farm Varkenlaagte No. 119 conducted on the 27th and 28th of October 2022, it was confirmed that there were no wetlands, rivers, or drainage lines present on the proposed site (**Figure 5-1** and **Figure 5-2**). Hydromorphic soil indicators were absent from the proposed site (**Figure 5-3**). The grassland vegetation present in the north of the site, included *Cynodon dactylon* (Bermuda Grass), *Elephantorrhiza elephantina* (Eland's wattle), invasive weed *Tagetes minuta* (Khaki bush), *Seriphium plumosum* (Bankrupt bush), and *Themeda triandra* (Red Grass) (**Figure 5-1**) whilst the bushveld vegetation towards the southeast was dominated by *Senegalia caffra* (Hook-Thorn) (**Figure 5-4**). Although several of these can occur in wetland temporary zones, the composition of the vegetation communities were not indicative of wetlands.

The site slopes from approximately 1598 m.a.s.l in the southeast corner to 1527 m.a.s.l in the northwest portion. The site was noted to be disturbed by agricultural activities including livestock grazing, particularly in the central and northern portions of the site. Several livestock feeding and watering troughs are located within and adjacent to the proposed site (**Figure 5-5**). Located in the north-western corner of the proposed site is an area which has previously been excavated (**Figure 5-6**). A concrete culvert is located along the road bordering the west of the proposed site, which likely receives stormwater from the road and runoff from rill erosion occurring in the northwest of

the proposed site (**Figure 5-7** & **Figure 5-8**). However, no wetland or riparian indicators were observed to be present within these areas which were assessed during the site visits (**Figure 5-3**).

Figure 5-1: Overview of the northern section of Portion 5 of Farm Varkenlaagte No. 119.

Figure 5-2: Overview of the southern section of Portion 5 of Farm Varkenlaagte No. 119.

Figure 5-3: Soil samples from Portion 5 of Farm Varkenlaagte No. 119 indicating an absence of hydromorphic soil indicators.

Figure 5-4: Bushveld vegetation dominated by *Senegalia caffra* (Hook-Thorn) in the southeast of Portion 5 of Farm Varkenlaagte No. 119.

Figure 5-5: Livestock trough within Portion 5 of Farm Varkenlaagte No. 119.

Figure 5-6: Excavated area/diggings located in the north-western corner of Portion 5 of Farm Varkenlaagte No. 119.

Figure 5-7: Culvert located along the western border of Portion 5 of Farm Varkenlaagte No. 119.

Figure 5-8: Upstream of the culvert located along the western border of Portion 5 of Farm Varkenlaagte No. 119.

5.2. Portion 27 of Farm Doornfontein No. 118

At the time of the field assessment of Portion 27 of Farm Doornfontein No. 118, undertaken on the 16th and 17th of February 2023, much of the site consisted predominately of largely undisturbed grassland and bushveld vegetation (**Figure 5-9**), with some *Eucalyptus* plantations (**Figure 5-10**), residential areas and dams (**Figure 5-111**).

An Unchanneled Valley Bottom wetland (UVBW) and a depression wetland were confirmed and delineated in the north- northeast of the site (**Figure 5-12** & **Figure 5-13**). While a CVBW was confirmed and delineated in the south of the site (**Figure 5-14**).

The soil morphology in the proposed development area allowed for hydromorphic soil indicators to be detected including saturated soil (**Figure 5-16A**) and periodic mottling (**Figure 5-15** & **Figure 5-16B**).

Vegetation present within the UVBW and depression wetlands included *Nidorella hottentotica* (Grassland Vleiweed), *Cynodon dactylon* (Bermuda Grass), *Cymbopogon caesius* (Turpentine Grass), *Themeda triandra* (Red Grass), invasive weed *Tagetes minuta* (Khaki bush), *Elephantorrhiza elephantina* (Eland's wattle), and *Seriphium plumosum* (Bankrupt bush), and *Senegalia caffra* (Hook-Thorn) (**Figure 5-12 & Figure 5-13**). Although none of the species present within the UVBW and depression are obligate wetland species, some species specifically *Nidorella hottentotica, Cynodon dactylon, Themeda triandra*, and *Tagetes minuta* are often found in moist habitats and may be considered wetland facultative species. Vegetation present within the CVBW included indigenous obligate wetland species *Typha capensis (***Figure 5-14**), *Phragmites australis* (**Figure 5-14**) and *Cyperus congestus* (Purple Umbrella Sedge) (**Figure 5-17A&B**).

Soil morphology (hydromorphic soil indicators), topography, obligate wetland vegetation and vegetation assemblages that differ from that of surrounding areas, were used in combination as wetland indicators within the proposed development area. The CVBW is dominated by the permanent zone, while the UVBW and depression wetlands are dominated by the temporary and seasonal zones, as indicated by soil and vegetation. The wetland delineation map is provided in **Figure 5-20**.

Several excavation/digging areas were noted along the eastern boundary of the site, along with a sinkhole located in the centre of the site (**Figure 5-18 & Figure 5-19**). The excavation areas were deemed to be artificial in nature, heavily disturbed and therefore lacking wetland functionality, and were not evaluated further as this assessment focused on natural watercourses which may be impacted by the proposed development. The sinkhole displayed no indicators typical of a wetland (i.e. lacked wetland vegetation and hydromorphic soil indicators).

Figure 5-9: Overview of Portion 27 of Farm Doornfontein No. 118, consisting of largely undisturbed grassland and bushveld vegetation.

Figure 5-10: Several patches of *Eucalyptus* plantations are found in Portion 27 of Farm Doornfontein No. 118.

Figure 5-11: Farm dam on Portion 27 of Farm Doornfontein No. 118.

Figure 5-12: UVBW located in the north of Portion 27 of Farm Doornfontein No. 118.

Figure 5-13: Depression wetland located in the northeast of Portion 27 of Farm Doornfontein No. 118.

Figure 5-14: CVBW located in the south of Portion 27 of Farm Doornfontein No. 118.

Figure 5-15: Soil sample from UVBW indicating mottling.

Figure 5-16: Soil samples from the CVBW indicating A) saturated soil & B) hydromorphic soil features.

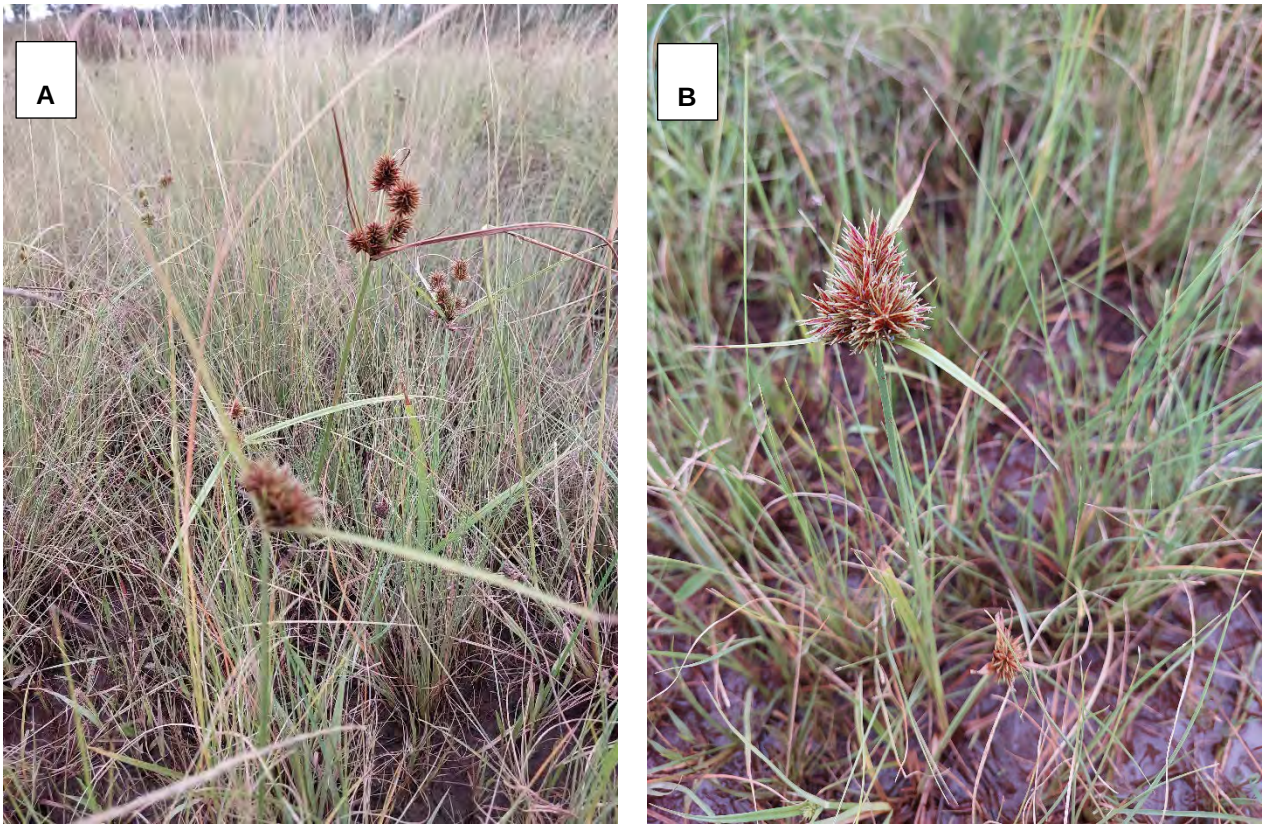

Figure 5-17: Wetland obligate species in CVBW includes *Cyperus congestus* (Purple Umbrella Sedge).

Figure 5-18: Excavations/diggings present along the eastern boundary of Portion 27 of Farm Doornfontein No. 118.

Figure 5-19: Sinkhole within Portion 27 of Farm Doornfontein No. 118.

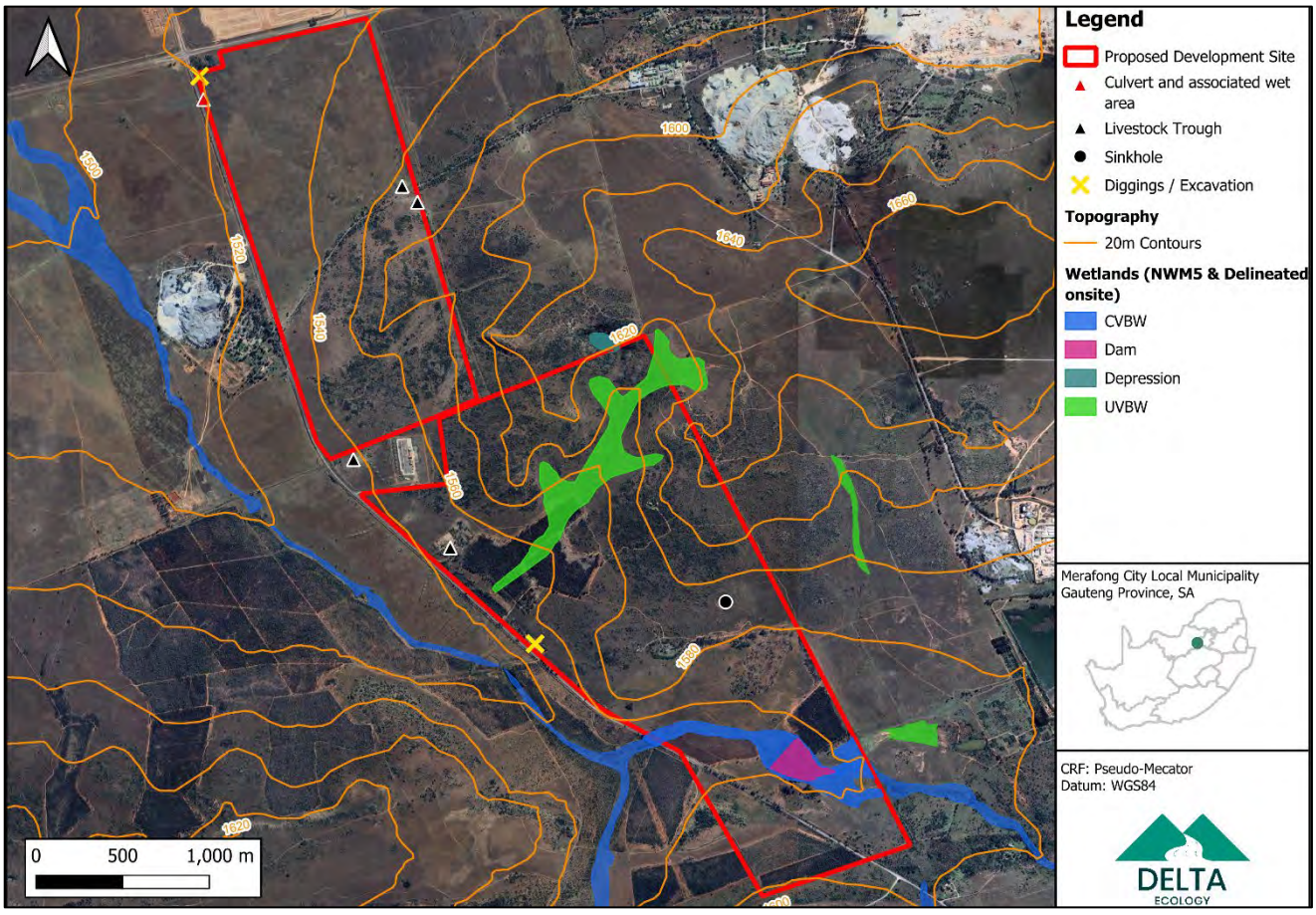

Figure 5-20: Wetland delineation map. Wetlands delineated infield are those within the proposed development area (shown as a red polygon).

6. Wetland Status Quo Assessment

In this study, the depression, UVB, and CVB wetlands present within the proposed development area were assessed to determine their Present Ecological State (PES), Ecological Importance and Sensitivity (EIS), and contribution to Wetland Ecosystem Services (WES). These metrics were used to determine the management objective expressed in terms of the Recommended Ecological Category (REC).

6.1. Present Ecological State

The Present Ecological State (PES) of the depression and the VB wetlands were assessed using the Macfarlane *et al*. (2020) WET-Health Version 2.0 method which includes four assessment units, namely hydrology, geomorphology, water quality, and vegetation.

The assessments produced an overall Present Ecological State (PES) score within Category B for the depression wetland, Category D for the UVBW, and Category E for the CVBW. This indicates that the depression wetland is in a largely natural condition, the UVBW is in a largely modified condition, while the CVBW is in a seriously modified condition.

The assessment results for the wetlands are presented in **Table 6-1,** and **Table 6-2**. The definitions of the ecological categories are presented in **Table 6-3**. The key factors that influenced the scoring are summarised below.

Hydrology

- The depression wetland and the VB wetlands are fed largely by surface runoff and interflow.
- The hydrology of the depression wetland has been minimally impacted by the presence of dirt tracks and residential land use in the wetland's catchment area which concentrates and diverts flow, altering the natural hydrology of the system.
- The hydrology of the UVBW has been influenced by the dirt track through the centre of the wetland area, and the *Eucalyptus* plantation located in the southern portion of the wetland area. The dirt track has concentrated and diverted flow in certain areas, while the *Eucalyptus* plantation has removed all the natural vegetation within the wetland. The replacement of natural vegetation with *Eucalyptus spp.* has caused reduced surface roughness and reduced infiltration rates. This results in increased runoff, erosion, and storm peak flows. Additionally, *Eucalyptus spp.* are associated with high rates of water use consequently causing a reduction in flow within wetland areas.
- The hydrology of the CVBW is similarly influenced by the *Eucalyptus* plantations within the wetland area itself and the catchment area. Additionally, the CVBW's hydrology has been significantly impacted by the presence of an instream dam, and dams located within the catchment area, including gold mine tailing dams located upstream of the wetland. These dams impound flow and alter the natural hydrology of the system. Similarly, a tar road and dirt tracks are located within the wetland area itself, and within the catchment area of the wetland which alter the natural flow patterns within the wetland.
- Catchment land uses for both VBWs potentially result in the release of highly nutrient rich effluent. Nutrient enrichment of soils that are naturally nutrient poor such as those on the proposed site, are associated with the dominance of invasive grass species (*Pennisetum*

clandestinum (Kikuyu), and other invasive vegetation, which leads to altered flow regimes in the wetland.

- The hydrology of the three wetlands has been impacted by the surrounding catchment area's land use which includes mining, residential areas, agricultural activities, and roads. These catchment land uses have resulted in flow diversion and catchment hardening which is associated with increased runoff and storm peak flows.

Water Quality

- The water quality within the two VBWs has been impaired because of the *Eucalyptus* plantations within the wetlands and located immediately adjacent to the wetland areas. Decomposing *Eucalyptus spp.* leaves release oils and polyphenols that are not native to the system, influencing soil chemical characteristics and nutrient content. Agricultural activities such as fertiliser and pesticide use results in contaminated runoff which enters the wetland areas and degrades water quality.
- The water quality within the CVBW has been impaired because of the Gold Mines located immediately upstream. Run off from the slimes dam and tailings may likely contain radioactive and trace heavy metals (such as Arsenic, nickel, etc.), pyrite which oxidizes to form sulphuric acid (furthermore sulphates) and iron hydroxide (furthermore iron oxide), and sediments.
- Additionally, infilling associated with the construction of the tar road in the west of the wetland has resulted in water quality impairment as follows:
    - Leaching of toxicants and nutrients from the tar road including petrochemicals, and tyre rubber.
    - The addition of nutrient rich laterite-based fill material would have further favoured alien invasive vegetation, leaving only those natural wetland species that tolerate, disturbance, high nutrient loads and the presence of shading alien species such as *Acacia mearnsii* and *Eucalyptus spp.* that have been noted in the area.
- Several dirt roads and tracks are present within the UVB and CVB wetland areas and the catchment areas of all three of the wetlands. Runoff from the dirt roads and tracks leads to sedimentation within the wetland areas. The CVBW also receives runoff from the tar road located within the west of the wetland. Runoff from these roads likely contains contaminants such as laterite, oil, fuel, rubber from car tires and other pollutants.
- Several industrial and residential land uses are located within the upslope catchment of the three wetlands. Runoff and effluent from these facilities indirectly impacts the water quality of the wetlands.

Vegetation

- The vegetation in the depression wetland is largely natural, while the two VBWs have largely modified vegetation.
- Vegetation in the northern portion and centre of UVBW consisted predominantly of *Nidorella hottentotica* (Grassland Vleiweed). Natural vegetation has been almost entirely excluded

from the southern portion of UVBW which currently consists of dense stands of *Eucalyptus spp*..

- Vegetation in the CVBW consists primarily of indigenous wetland species *Typha capensis, Phragmites australis, Cyperus congestus,* and alien invasives such as *Eucalyptus spp.*
- Vegetation in the CVBW has been significantly impacted by the construction of the instream dam, historical agricultural activities such as ploughing, and existing agriculture (*Eucalyptus* plantations).
- No species of conservation concern were noted.

Geomorphology

- The geomorphology in the depression wetland is largely natural, while the two VBWs have moderately (UVBW) to largely modified (CVBW) geomorphology.
- Excavation for the instream dam within the CVBW, as well as infilling associated with the dam wall and tar road has significantly impacted upon the geomorphology of the CVBW.
- The geomorphology of the two VBWs has been impacted by previous and current agricultural activities, such as ploughing and construction of dirt roads/tracks.
- Decreased natural vegetation and the associated reduced surface roughness has allowed minimal erosion to take place in the UVBW.

Table 6-1: Outcome of the WET-Health Assessment for the depression wetland.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.0	0.7	1.0	1.5
PES Score (%)	90%	93%	90%	85%
Ecological Category	**B**	**A**	**B**	**B**
Combined Impact Score	1.0			
Combined PES Score (%)	90%			
Combined Ecological Category	**B**			
Hectare Equivalents	1.1 Ha			

Table 6-2: Outcome of the WET-Health Assessment for the UVBW.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	7.8	2.3	3.5	4.2
PES Score (%)	22%	77%	65%	58%
Ecological Category	**E**	**C**	**C**	**D**
Combined Impact Score	5.6			
Combined PES Score (%)	44%			
Combined Ecological Category	**D**			
Hectare Equivalents	13.3 Ha			

Table 6-3: Outcome of the WET-Health Assessment for the CVBW.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.9	5.7	6.5	4.5
PES Score (%)	31%	43%	35%	55%
Ecological Category	**E**	**D**	**E**	**D**
Combined Impact Score	6.2			
Combined PES Score (%)	38%			
Combined Ecological Category	**E**			
Hectare Equivalents	7.9 Ha			

Table 6-4: Descriptions and definitions of the impact scores.

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

6.2. Ecosystem Services

The onsite depression and VB wetlands were assessed for their contribution to ecosystem services using the WET-EcoServices Version 2 methodology. The method includes the assessment of sixteen potential ecosystem services including both direct and indirect human benefits.

The majority of importance scores fell within the "Very Low" and "Low" category for onsite wetlands indicating negligible contribution to ecosystem services. Exceptions include the depression wetland's regulating and supporting biodiversity maintenance service which fell within the "Moderately High" category and the provision of cultural and spiritual services, which fell within the "Moderately Low" category.

The VBWs both reflect "Moderate" importance scores for toxicant assimilation services. The UVBW has "Moderate" sediment trapping, phospate and nitrate assimilation services due to the vegetated nature of the wetland, and its relatively large catchment area which is dominated by agricultural, residential, and mining landuses. The importance of these services in the UVBW is limited by the fact that the demand is low due to the immediate catchment area being largely natural. The CVBW has "Moderate" erosion control and harvestable resources due to the vegetated nature of the wetland dominated by *Typha capensis* and *Phragmites australis*, and its moderate sized catchment.

The assessment results are summarised in **Table 6-5** to **Table 6-7.** The score categories and their descriptions are provided in **Table 6-8.**

The reasoning behind the ecosystem services scores obtained for the depression and VB wetlands is summarised below:

- Although depression wetlands can trap solutes during wet periods, which disperse in dry periods, the onsite depression wetland is not linked to a stream network (no outflow), and has a small, largely natural catchment area. Both factors reduce the demand for this potential service.
- The regulating and supporting biodiversity maintenance service for the depression wetland fell within the "Moderately High" category due to the largely natural condition of the wetland and the EN status of Central Bushveld Group 1 depression wetland vegetation (SANBI, 2011).
- Due to the largely natural condition of the depression wetland, and the presence of residential and/or holiday homes on the property, the depression can provide cultural and spiritual services, however the importance score is "Moderately Low" as the number of people who would potentially use this wetland as a cultural area is limited.
- The VB wetlands have relatively large – moderate sized catchments and receive substantial stormwater input. The southern portion of UVBW has been transformed into plantations, while the central portion of the CVBW contains an instream dam, both of which alters the natural hydrology of these two wetland systems. The two VBWs can potentially provide moderate levels of flood attenuation and stream flow regulation services, but the degraded nature of the two wetlands limits this service. The significance of this ecosystem service in the wetlands is therefore "Very Low".
- UVBWs are known to provide high levels of sediment trapping, and phosphate, nitrate, and toxicant removal services, while CVBWs provide moderate levels. The UVBW is able to supply these services to a moderate - moderately high degree although the demand for this service is limited due to the largely natural catchment area. The importance of toxicant

assimilation within the CVBW is moderate, due to the elevated demand for this service as a result of upstream gold mine activities.

- The VBWs provide limited – moderate erosion control ecosystem services due to the vegetated nature of the systems and diffuse peak flows. There is however a low demand for this service within the UVBW given the natural catchment, moderate slope, and the moderate to low soil erosion risk. The net result is a "Very Low" to "Low" importance score in the UVBW. The presence of the instream dam and roads through the CVBW, as well as the transformed upstream catchment area results in a "Moderate" importance score for the CVBW.
- The VBWs received an importance score within the "Very Low" range for the supply of Biodiversity Maintenance. This is due to the degraded nature of the onsite wetland systems, and the lack of threatened species. Although the demand for biodiversity maintenance is high for the CVBW as portions of this wetland are demarcated as a natural NFEPA wetland, the overall importance of this service is within the 'Very Low' category.
- The onsite wetlands received a score within the "Very Low" importance range for Carbon Storage supply. There is a global demand for storage of carbon, thereby reducing total atmoshpheric greenhouse gas concentrations. However, there was a lack of organic soil which provides a direct indicator of carbon storage.
- Direct human use of the water from the depression wetland was not observed during the site visit. The dam located at the southwest end of UVBW and the game present on the property (Wildebeest observed) indicates that this water may be used for agricultural purposes, however, it is unlikely that there is dependance on this water source in particular. The water from CVBW is considered unsafe due to runoff from the upslope (and adjacent) gold mine and tar roads draining into the wetland system. Therefore the net importance score for this service in onsite wetlands is "Very Low".
- No harvestable resources were noted within the depression and UVB wetlands, although there were some palatable grasses within the UVBW which could be used for livestock (Wildebeest observed on the farm). There were harvestable resources present in the CVBW including sedges, *Typha capensis* and *Phragmites australis*. The wetland areas could potentially be used for cultivated foods as seen from previous agricultural activities in the area (however this is not the intended purpose of the development area). The low demand results in an overall importance score of "Low" to "Very Low" for these three ecosystem services.
- The VBWs are not used for tourism or recreation, education or research purposes (beyond this wetland study) and have no known cultural or spiritual uses. These scores were all considered to be of "Very Low" significance.

Table 6-5: The outcome of the ecosystem services assessment for the delineated depression wetland.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.0	1.1	0.0	Very Low
	Stream flow regulation	0.0	1.3	0.0	Very Low
	Sediment trapping	0.9	0.0	0.0	Very Low
	Erosion control	1.9	0.0	0.4	Very Low
	Phosphate assimilation	1.0	0.3	0.0	Very Low
	Nitrate assimilation	0.9	0.0	0.0	Very Low
	Toxicant assimilation	0.9	0.0	0.0	Very Low
	Carbon storage	1.7	0.7	0.5	Very Low
	Biodiversity maintenance	2.7	2.5	2.5	Moderately High
PROVISIONING SERVICES	Water for human use	0.0	1.3	0.0	Very Low
	Harvestable resources	0.0	1.3	0.0	Very Low
	Food for livestock	1.5	0.7	0.3	Very Low
	Cultivated foods	1.7	0.0	0.2	Very Low
CULTURAL SERVICES	Tourism and Recreation	1.5	1.3	0.7	Very Low
	Education and Research	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	3.0	0.0	1.5	Moderately Low

Table 6-6: The outcome of the ecosystem services assessment for the delineated UVBW.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.1	0.8	0.0	Very Low
	Stream flow regulation	0.6	1.3	0.0	Very Low
	Sediment trapping	3.3	0.8	2.1	Moderate

	Erosion control	1.7	0.5	0.4	Very Low
	Phosphate assimilation	3.4	0.5	2.1	Moderate
	Nitrate assimilation	3.0	0.7	1.8	Moderate
	Toxicant assimilation	3.4	0.0	1.9	Moderate
	Carbon storage	1.1	0.7	0.0	Very Low
	Biodiversity maintenance	0.3	3.0	0.3	Very Low
PROVISIONING SERVICES	Water for human use	0.4	1.3	0.0	Very Low
	Harvestable resources	1.5	1.3	0.7	Very Low
	Food for livestock	2.0	0.7	0.8	Low
	Cultivated foods	2.3	0.0	0.8	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.3	1.3	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

Table 6-7: The outcome of the ecosystem services assessment for the delineated CVBW.

		Present State			
ECOSYSTEM SERVICE		**Supply**	**Demand**	**Importance Score**	**Importance**
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.7	0.9	0.6	Very Low
	Stream flow regulation	0.8	1.3	0.0	Very Low
	Sediment trapping	2.5	0.8	1.4	Moderately Low
	Erosion control	2.2	2.0	1.7	Moderate
	Phosphate assimilation	2.6	0.8	1.4	Moderately Low
	Nitrate assimilation	2.5	0.7	1.3	Moderately Low
	Toxicant assimilation	2.6	1.3	1.8	Moderate
	Carbon storage	1.8	0.7	0.6	Very Low
	Biodiversity maintenance	0.2	3.0	0.2	Very Low

PROVISIONING SERVICES	Water for human use	0.0	1.3	0.0	Very Low
	Harvestable resources	3.0	1.3	2.2	Moderate
	Food for livestock	1.0	1.3	0.2	Very Low
	Cultivated foods	1.3	0.0	0.0	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.5	1.3	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

Table 6-8: Ecosystem services score categories and descriptions.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

6.3. Ecological Importance and Sensitivity

The EIS method used to assess the wetland was based on the Rountree *et al*. 2013 method. Hydro-functional importance and direct human benefits were assessed using the updated and more detailed 2020 WET-EcoServices method and these sections were therefore omitted from the EIS assessment. The depression wetland and UVBW achieved a score of 2.0, while the CVBW achieved a score of 1.7, all of which fall within the "Moderate" category. The results of the assessment and the reasoning behind the scores are presented in **Table 6-9**.

Table 6-9: Results of the EIS assessment.

Ecological Importance and Sensitivity	Depression	UVBW	CVBW	Reason
Biodiversity Support (Median)	**0.67**	**0.33**	**0.33**	
Presence and status of Red Data species:	0	0	0	None noted.
Populations of unique species/uncommonly large populations of wetland species:	0	0	0	None noted.
Migration/breeding/feeding sites: (Importance of the unit for migration, breeding sites and/or feeding):	2	1	1	Given the largely natural condition of the depression wetland, it could be an important migration/breeding/feeding site, although no specific evidence of this was noted. The VBWs could be a breeding site for hardy amphibians. Given the modified nature of the VBWs, particularly the seriously modified water quality within CVBW, it is unlikely that the VBWs are important migration/breeding/feeding sites.
Landscape Scale (Median)	**2.00**	**1.40**	**1.40**	
Protection status of the wetland: (National (4), Provincial/ Private (3), municipal (1 or 2), public area (0 or 1)	2	2	2	The wetlands are not protected; however, portions are recognised in the GCP as CBAs - biodiversity feature descriptions including red listed bird habitat, primary vegetation, and orange listed plant habitat.
Protection status of the vegetation type: (SANBI guidance on the protection status of the surrounding vegetation)	0	0	0	SANBI, 2018: Gauteng Shale Mountain Bushveld & Carletonville Dolomite Grassland = Least Concern (LC) and Poorly Protected (PP) for surrounding vegetation.

Ecological Importance and Sensitivity	Depression	UVBW	CVBW	Reason
Regional context of the ecological integrity: (Assessment of the PES (habitat integrity), especially in light of regional utilisation)	3	2	2	Depression: PES / Habitat Integrity within category B. UVBW: PES / Habitat Integrity within category D. CVBW: PES / Habitat Integrity within category E.
Size and rarity of the wetland type/s present: (Identification and rarity assessment of wetland types)	3	1	1	Depression: The CBA/ESA classification & Central Bushveld Group 1 depression wetland vegetation being classified as Endangered (EN) indicates rarity. VBWs: The CBA/ESA classification of the wetlands indicates rarity, but degraded status (particularly hydrology and water quality) has left only common, tolerant elements of the ecosystem intact.
Diversity of habitat types: (Assessment of the variety of wetland types present within a site)	2	2	2	Two wetland types present within the site, within a largely natural to seriously modified ecological condition. All three wetlands are likely naturally seasonal in nature, although flow in the CVBW has been augmented because of instream dams.
Sensitivity of the Wetland (Median)	**2.00**	**2.00**	**1.67**	
Sensitivity to changes in floods: (Floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1)	1	2	2	Depression wetlands have small catchments, UVBWs have moderately large catchments, and CVBW have small-moderate sized catchments. All three wetlands are fed by mainly surface runoff. Both VBWs are however largely – seriously modified.
Sensitivity to changes in low flows/dry season: (Unchanneled VB's probably most sensitive)	2	3	2	Onsite wetlands are fed by mostly surface runoff; changes in low flows/dry season could affect water quality/hydrology. The UVBW will be most sensitive to changes.
Sensitivity to changes in water quality: (Especially natural low nutrient waters – lower nutrients likely to be more sensitive)	3	1	1	Both the largely natural depression and the UVBW may be sensitive to changes in water quality; CVBW is situated downslope of a gold mine and is unlikely to be as sensitive to changes in water quality when compared to the other two wetlands.
Ecological Importance and Sensitivity Score	**2.0**	**2.0**	**1.7**	
Ecological Importance and Sensitivity Category	**Moderate**	**Moderate**	**Moderate**	

6.4. Recommended Ecological Category

According to the Rountree *et al.* (2013) method for determining REC, the management objective for any wetland within the EIS 'Moderate' category with a PES score within category D to B must be to maintain the wetland's ecological state within the pre-construction category. Category E or F scores are considered unsuitable, and the management objective must be to improve the condition of the wetland to a category D if feasible. In this case, the depression and UVBW have a PES of B and D respectively, and the management objective is to maintain the wetland's ecological state within the pre-construction category. The CVBW has a PES score of E, and therefore requires rehabilitation to category D, where possible, as a management objective.

6.5. Buffer Determination

An appropriate buffer of 15 m for all the wetlands onsite, during the construction and operational phases of the proposed development, has been determined using the method described in the Buffer Zone Guidelines for Rivers, Wetlands and Estuaries (Macfarlane and Bredin, 2016). The recommended buffer is shown in **Figure 6-1** below.

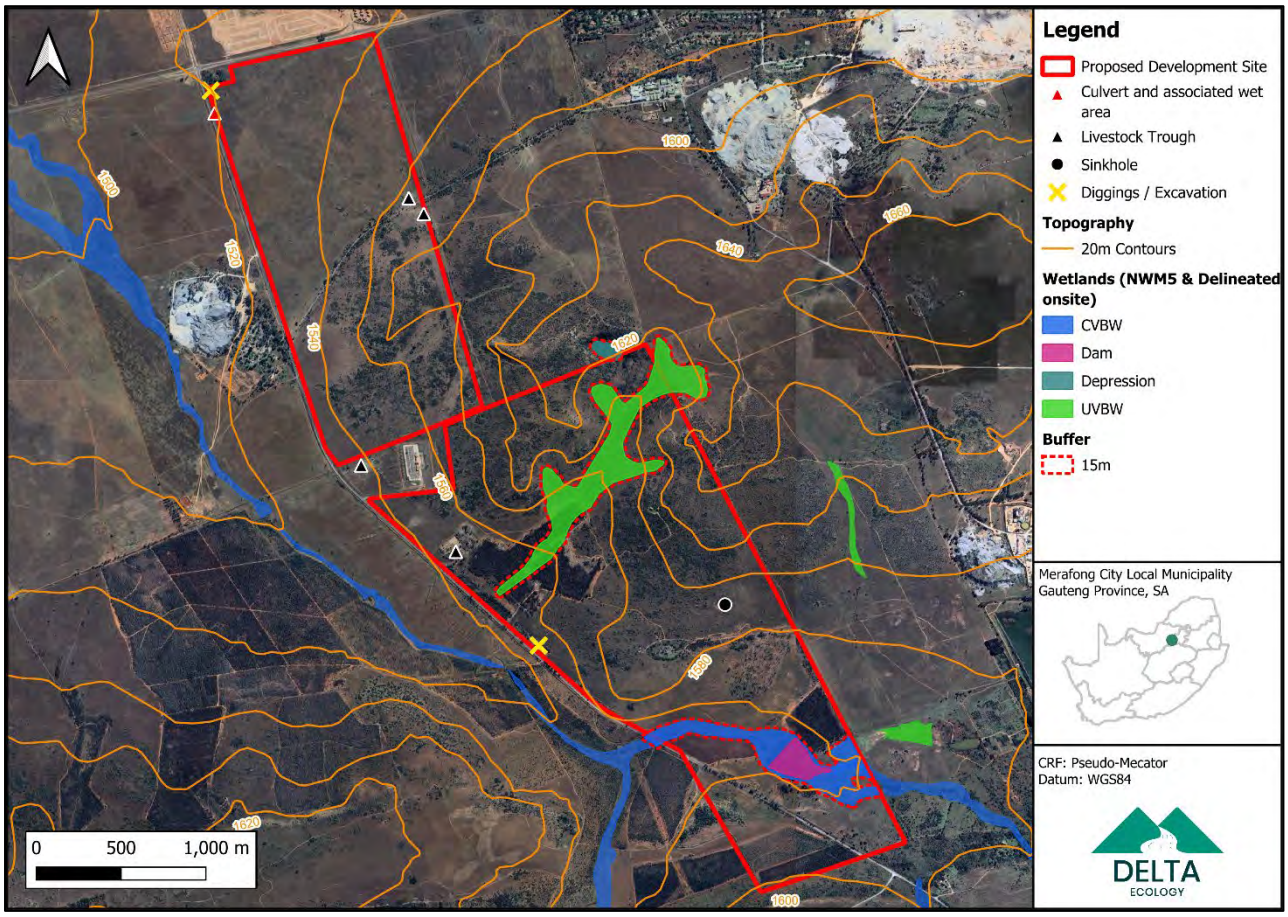

Figure 6-1: Delineated onsite wetlands with a 15 m buffer.

7. Aquatic Impact Identification

The proposed project entails developing a Solar PV plant and BESS on Portion 5 of Farm Varkenlaagte No. 119 and Portion 27 of Farm Doornfontein No. 118, Merafong City, Gauteng. The proposed development area is approximately 741 ha in size and contains three wetlands that could potentially be impacted by the proposed development. The development activities include the installation of the Solar Photovoltaic Plant infrastructure (including single or double axis tracking Photo-voltaic (PV) modules, electrical cables, and BESS), access roads, a substation, storage area for construction materials, as well as machinery and/or vehicles related to the establishment of the proposed Solar PV plant and BESS. Refer to the proposed Layout map for the development overlain with the wetland delineation in **Figure 7-1** below.

The proposed SPP and BESS may impact upon the quantity and quality of an important groundwater source (Far West Karst Groundwater Region) considered to have a "Very High" vulnerability to contamination. The proposed activities may require the use of groundwater for cleaning and cooling operations. In addition, during construction and operation of the SPP and BESS, there is potential for leakages and spills of hydrocarbons and electrolytes. With suitable mitigation measures in place during the proposed development lifecycle, it is likely that the potential impacts to groundwater can be minimised. Recommended mitigation measures may include containing electrolyte storage tanks within an adequately bunded area which prevents the migration of any spillage or leakage to the surrounding environment, amongst others.

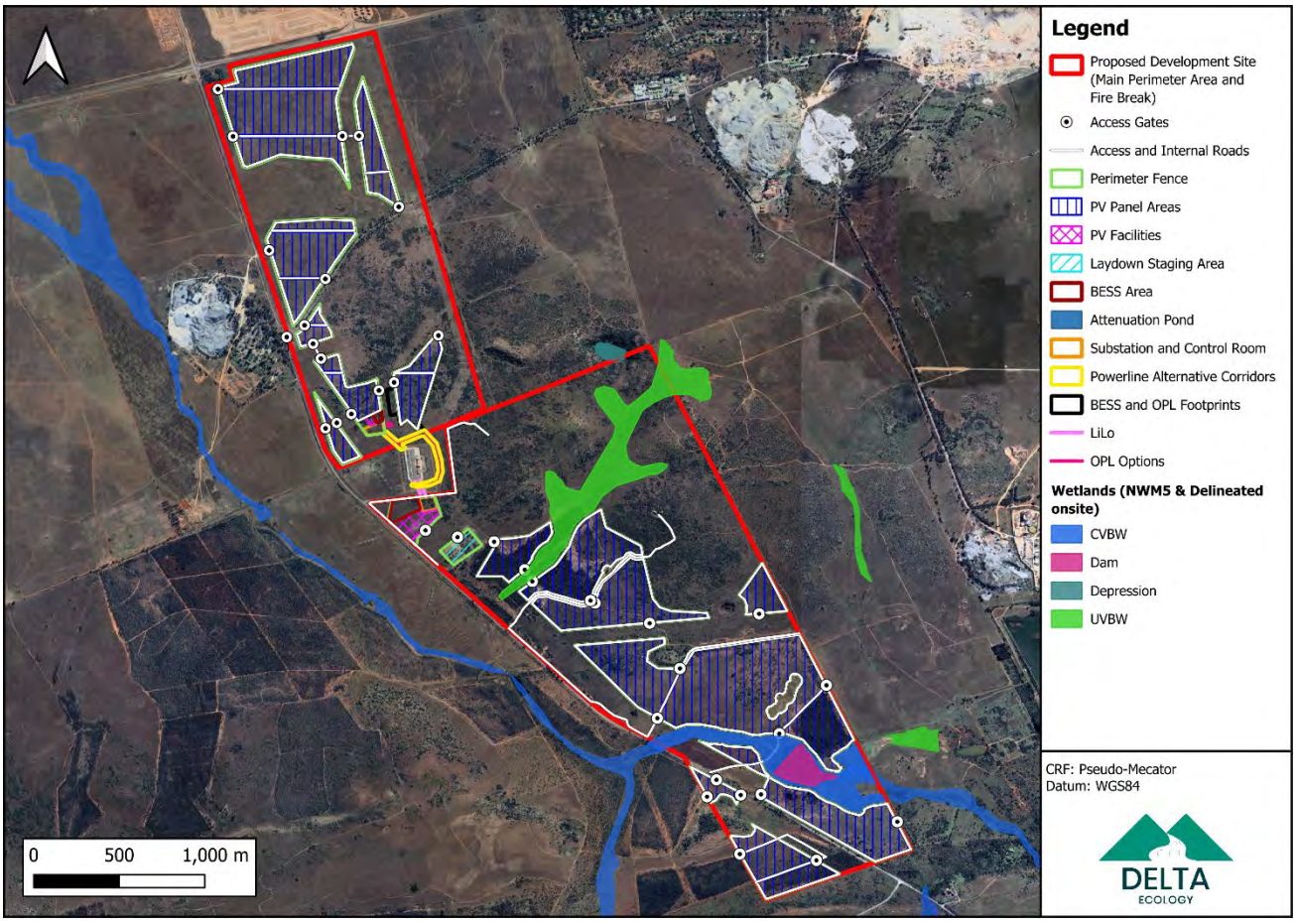

Figure 7-1: The proposed layout for the development overlain with the delineated wetlands.

In the absence of suitable mitigation measures, the potential construction and operational phase impacts are as follows:

Construction Phase

- Wetland loss associated with construction of the proposed development within the CVBW, UVBW, and depression wetland.
- Increased runoff and resulting alteration of the flow regime, sedimentation, and erosion within onsite wetlands as a result of vegetation clearing and catchment hardening.
- Increased sedimentation within the onsite wetlands due to vegetation clearing and earth moving associated with construction of the proposed development.
- Water quality impairment due to accidental leakage or spillage of cement, hydrocarbons, and electrolytes within wetlands or within the associated catchment areas.

Operational Phase

- Solar photovoltaic modules may result in increased runoff into the onsite wetlands, leading to associated increase in sedimentation, erosion, and alteration of the flow regime within watercourses onsite.
- Water quality impairment due to accidental leakage or spillage of hydrocarbons and/or electrolytes associated with the BESS within the associated catchment area of the wetlands.

8. Impact Assessment

The six potential aquatic impacts identified in Section 7 were assessed first without and then with application of mitigation measures. Five out of six of the pre-mitigation scores fell within the "Low" impact categories, while post-mitigation scores fell within the "Very Low" impact categories. Should any wetland loss occur, this impact would be of "Medium" significance without mitigation, though with mitigation - which includes the avoidance of onsite wetlands - this impact would not be applicable.

The 'no go' scenario was assessed and found to be of "Low" impact significance as this scenario would result in continuation of current impacts such as water quality impairment and alteration of flow because of the gold mine slimes dam upstream, as well as within-wetland impacts including the existing plantations and dams. No indirect impacts were noted.

8.1. Construction Phase

Table 8-1: Assessment results for Impact 1.

Impact 1: Wetland loss						
Description	Potential wetland loss will occur should any of the project components encroach into the delineated wetland areas. The delineated wetlands within the proposed development area have a PES score in the B (depression), D (UVBW), & E (CVBW) categories, exhibit Moderate EIS and offer Low – Moderately High ecosystem services. The historical wetland vegetation types are CR (UVBW & CVBW) & EN (Depression). There is also some connection to other natural areas, particularly for the depression wetland. Therefore, this impact is rated as "Medium" for the UVBW & CVBW; and "Medium – High" for any wetland loss within the largely natural depression wetland.					
Mitigation Measures	It is recommended that the onsite wetlands, along with a 15 m buffer area, are avoided by the proposed development. Should the watercourses be avoided there will be no impact.					
	Impact Without Mitigation			**Impact With Mitigation**		
	CVBW	**UVBW**	**Depression**	**CVBW**	**UVBW**	**Depression**
Consequence						
Intensity of Impact	3 Medium / Harmful	3 Medium / Harmful	4 High / Very Harmful	-	-	-
Duration of Impact	5 Beyond 20 years / Permanent	5 Beyond 20 years / Permanent	5 Beyond 20 years / Permanent	-	-	-
Extent / spatial scale of impact	1 Limited to project site	1 Limited to project site	1 Limited to project site	-	-	-
Reversibility	3 Moderate cost / Low likelihood of success	3 Moderate cost / Low likelihood of success	5 Very High-cost rehabilitation / Very Low likelihood of success	-	-	-

Loss of irreplaceable resources	1 Very Low	1 Very Low	3 Medium	-	-	-
Cumulative Impact	5 Very High	5 Very High	5 Very High	-	-	-
Probability						
Frequency of the Activity	5 Weekly to monthly	5 Weekly to monthly	5 Weekly to monthly	-	-	-
Likelihood of the Incident / Impact occurring	4 Likely	4 Likely	4 Likely	-	-	-
Impact Significance						
	CVBW	**UVBW**	**Depression**	**CVBW**	**UVBW**	**Depression**
Consequence	2,63 Low	2,63 Low	3,36 Medium	-	-	-
Probability	4,5 High	4,5 High	4,5 High	-	-	-
Impact Significance	**3,00 Medium**	**3,00 Medium**	**3,58 Medium - High**	**NA**	**NA**	**NA**

Table 8-2: Assessment results for Impact 2.

Impact 2: Altered flow regime				
Description		PV modules create hardened surfaces which may increase runoff during rainfall events. Similarly, potential site clearance, compaction, and infilling associated with construction camps, offices, and the BESS may result in catchment hardening and associated alteration of the flow regime for the wetlands onsite.		
Mitigation Measures		Vegetation clearance should be restricted to the relevant development components. Ensure that vegetation cover within the PV plant area is maintained as far as practically possible. Ensure that effective stormwater management measures are implemented during construction. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales.		
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		-		-
Consequence				
Intensity of Impact	2	Low / Slightly Harmful	1	Very Low / Non-harmful
Duration of Impact	5	Beyond 20 years / Permanent	5	Beyond 20 years / Permanent
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	1	Passive restoration / High likelihood of success	1	Passive restoration / High likelihood of success
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	1	Very Low	1	Very Low
Probability				
Frequency of the Activity	1	Once off activity / less than once in 20 years	1	Once off activity / less than once in 20 years
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				

Consequence	1,72	Low	1,36	Very Low
Probability	2	Low	1,5	Very Low
Impact Significance	**1,78**	**Low**	**1,39**	**Very Low**

Table 8-3: Assessment results for Impact 3.

Impact 3: Increased Sediment Input				
Description		**Site clearance, infilling and compaction associated with construction camps, offices, and the BESS may result in increased runoff and associated sediment input. The conversion of semi-natural grassland/bushveld into a PV plant within the wetland catchment areas may result in increased sediment input within the wetlands. Erosion is possible considering the soil properties in the surrounding catchment and wetlands, as well as the rainfall intensity during summer months.**		
Mitigation Measures		**During construction, cover cleared areas with straw to minimise sedimentation by wind. Vegetation clearance should be restricted to the relevant development components. Ensure that vegetation cover within the PV plant area is maintained as far as practically possible to reduce runoff and sedimentation of wetland areas. Ensure that effective stormwater management measures are implemented during construction. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales.**		
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		**-**		**-**
Consequence				
Intensity of Impact	2	Low / Slightly Harmful	1	Very Low / Non-harmful
Duration of Impact	5	Beyond 20 years / Permanent	5	Beyond 20 years / Permanent
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	1	Passive restoration / High likelihood of success	1	Passive restoration / High likelihood of success
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	1	Very Low	1	Very Low

Probability				
Frequency of the Activity	4	Monthly to annually	3	1 – 5 Years
Likelihood of the Incident / Impact occurring	3	Possible	1	Highly unlikely
Impact Significance				
Consequence	1,72	Low	1,36	Very Low
Probability	3,50	Medium	2,00	Low
Impact Significance	**2,08**	**Low**	**1,49**	**Very Low**

Table 8-4: Assessment results for Impact 4.

Impact 4: Water quality impairment				
Description		**Accidentally spilled cement, construction chemicals, sewage from temporary toilets or petrochemicals from construction vehicles may enter onsite wetlands.**		
Mitigation Measures		**Bunded, impervious areas must be designated by an Environmental Control Officer for temporary toilets, vehicle parking/servicing areas and for pouring and mixing of concrete/cement, paint, and chemicals. These bunded areas must be located at least 15 m from the demarcated wetland boundaries. The site manager / ECO must check the No Go area for pollution/spills, erosion damage and sedimentation weekly and after every heavy rainfall event. Should pollution, erosion or sedimentation be noted, immediate corrective measures must be undertaken.** **Fuel, chemicals, and other hazardous substances should preferably be stored offsite, or as far away as possible from the no-go area. These substances must be stored in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding, or storm damage. Clean up any spillages immediately with the use of a chemical spill kit and dispose of contaminated material at an appropriately registered facility.** **Inspect all storage facilities, vehicles, and machinery daily for the early detection of deterioration or leaks and strictly prohibit the use of any vehicles or machinery from which leakage has been detected.**		
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		-		-
Consequence				
Intensity of Impact	3	Medium / Harmful	1	Very Low / Non-harmful
Duration of Impact	1	Up to 1 month	1	Up to 1 month

Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	1	Passive restoration / High likelihood of success	1	Passive restoration / High likelihood of success
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	1	None	1	None
Probability				
Frequency of the Activity	1	Once off activity / less than once in 20 years	1	Once off activity / less than once in 20 years
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	1,72	Low	1,00	Very Low
Probability	2,00	Low	1,50	Very Low
Impact Significance	**1,78**	**Low**	**1,10**	**Very Low**

8.2. Operational Phase

Table 8-5: Assessment results for Impact 5.

Impact 5: Altered flow regime		
Description		**PV modules create hardened surfaces and may increase runoff and sedimentation into onsite wetlands. Potential site clearance, compaction, and infilling associated with management offices and the BESS may result in alteration of the flow regime for the wetlands onsite. The conversion of semi natural grassland / bushveld into PV areas in the wetlands catchment areas will result in increased sediment input within the wetlands.**
Mitigation Measures		**Vegetation clearance should be restricted to the relevant development components. Ensure that control measures are undertaken onsite to prevent and manage erosion such as:** • **maintaining a 15 m buffer around onsite wetlands,** • **Ensure that effective stormwater management measures are implemented during operation. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the**

		downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales. • maintain adequate vegetation cover within the PV plant area as far as practically possible, • plant indigenous wetland vegetation should erosion occur in wetland areas, and incorporate rock riprap / gabions as a last measure should erosion continue once vegetation is established.		
	Impact Without Mitigation		Impact With Mitigation	
Factor		-		-
Consequence				
Intensity of Impact	2	Low / Slightly Harmful	1	Very Low / Non-harmful
Duration of Impact	5	Beyond 20 years / Permanent	5	Beyond 20 years / Permanent
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	1	Passive restoration / High likelihood of success	1	Passive restoration / High likelihood of success
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	1	Very Low	1	Very Low
Probability				
Frequency of the Activity	1	Once off activity / less than once in 20 years	1	Once off activity / less than once in 20 years
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	1,72	Low	1,36	Very Low
Probability	2	Low	1,5	Very Low
Impact Significance	**1,78**	**Low**	**1,39**	**Very Low**

Table 8-6: Assessment results for Impact 6.

Impact 6: Water quality impairment				
Description		**Water quality impairment may occur due to accidental leakage or spillage of hydrocarbons and electrolytes associated with the operation /maintenance of the BESS within the associated catchment area of the wetlands.**		
Mitigation Measures		**Ensure that all potentially significant pollution sources are listed in the Environmental Management Plan. Ensure that all activities that may lead to pollution take place indoors or on bunded impervious surfaces such that the pollutants cannot enter the stormwater system or downstream watercourses.**		
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		**Initial Layout**		**Initial Layout**
Consequence				
Intensity of Impact	3	Medium / Harmful	1	Very Low / Non-harmful
Duration of Impact	1	Up to 1 month	1	Up to 1 month
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	1	Passive restoration / High likelihood of success	1	Passive restoration / High likelihood of success
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	1	None	1	None
Probability				
Frequency of the Activity	1	Once off activity / less than once in 20 years	1	Once off activity / less than once in 20 years
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	1,72	Low	1,00	Very Low
Probability	2,00	Low	1,50	Very Low

Impact Significance	**1,78**	**Low**	**1,10**	**Very Low**

8.3. "No Go" Scenario

Table 8-7: Assessment results for the "No Go" Scenario.

"No Go" Scenario				
Description		**The proposed development area is currently in a largely natural to disturbed condition. Although it is unknown whether the area would be developed in future, it is assumed that the site would remain as is, consisting of unused agricultural land / semi-natural grassland / bushveld. The No-Go option would result in the continued negative impacts to wetlands onsite by various land uses noted onsite or adjacent to the proposed development area, but not to further substantial degradation of the wetlands.**		
Mitigation Measures		**None**		
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		**Initial Layout**		**Initial Layout**
Consequence				
Intensity of Impact	3	Medium / Harmful	0	Not Applicable
Duration of Impact	1	Up to 1 month	0	Not Applicable
Extent / spatial scale of impact	1	Limited to project site	0	Not Applicable
Reversibility	1	Passive restoration / High likelihood of success	0	Not Applicable
Loss of irreplaceable resources	1	None	0	Not Applicable
Cumulative Impact	1	None	0	Not Applicable
Probability				
Frequency of the Activity	1	Once off activity / less than once in 20 years	0	Not Applicable
Likelihood of the Incident /	3	Possible	0	Not Applicable

Impact occurring				
Impact Significance				
Consequence	1,72	Low	0,00	Not Applicable
Probability	2,00	Low	0,00	Not Applicable
Impact Significance	**1,78**	**Low**	**0,00**	**Not Applicable**

9. Risk Assessment

The Risk Assessment Matrix prescribed by GN 509 of 2016 was applied to the proposed development with the following outcomes:

1. The risks (with recommended mitigation measures) associated with the proposed development were all found to fall within the Low-Risk category. The key factors included:
    - The potential impact significance of the proposed development - a Solar Photovoltaic Plant (SPP) and Battery Energy Storage System (BESS) – are limited in nature, in particular post-mitigation measures as recommended in this report.
2. Should the proposed development encroach within the wetlands causing wetland loss, the impact significance would be "Medium" - "High". However, should the proposed project components avoid the wetlands this impact will be avoided entirely.

The completed risk assessment matrix is attached as **Annexure 3**.

10. Conclusions and Recommendations

This report sets out the results from the aquatic biodiversity assessment of the proposed development of a PV plant and BESS on Portion 5 of Farm Varkenlaagte No. 119 and Portion 27 of Farm Doornfontein No. 118, Merafong City, Gauteng.

Two VBWs and a depression wetland were confirmed and delineated onsite during a field assessment on the 27th and 28th of October 2022, as well as the 16th and 17th of February 2023. Wetland delineation was carried out using indicators present such as saturated soils, hydromorphic soil indicators, vegetation, and topography. In this study, the onsite wetlands were assessed using current best practice assessment methodologies to determine the PES, EIS, WES, and REC metrics. The results of these assessments are as follows:

Table 10-1: Results of the wetland status quo assessment.

	PES	EIS	WES (Highest)	REC
Depression Wetland	B	Moderate	Moderately High	Maintain B
UVBW	D	Moderate	Moderate	Maintain D
CVBW	E	Moderate	Moderate	D

The condition of the onsite wetlands varied from largely natural to seriously modified. The VBWs exhibited a high degree of transformation due to the surrounding catchment land uses (industrial and agricultural), and infestation of alien vegetation; whilst the depression wetland was found to be in a largely natural condition. The Moderate EIS and Moderate to Moderately High WES scores indicated that the wetlands are sensitive and may be important in terms of conservation planning (specifically the depression wetland) or provision of ecosystem services (VBWs).

Aquatic biodiversity impacts associated with the development were identified and assessed using both an impact assessment methodology compliant with NEMA requirements and the Risk Assessment Matrix prescribed by GN509 of 2016.

The results of the assessment of wetland loss and 5 additional impacts during the construction and operational phases, given implementation of the listed mitigation measures, are summarised in **Table 10-2.**

Table 10-2: Summary of impact/risk assessment results (with mitigation).

	Rating	Risk Class	Applicable to	Mitigation Measures
Construction Phase				
Impact 1: Wetland Loss	No Impact	No Impact	Depression, UVBW, & CVBW	It is recommended that the wetlands and recommended buffer zones are avoided by all construction and operational activities. **Should the wetlands be avoided there will be no impact.**
Impact 2: Altered flow	Very Low	Low	Depression, UVBW, & CVBW	Vegetation clearance should be restricted to the relevant development components. Ensure that vegetation cover within the PV plant area is maintained as far as practically possible. Ensure that effective stormwater management measures are implemented during construction. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales.
Impact 3: Increased sediment input	Very Low	Low	Depression, UVBW, & CVBW	During construction, cover cleared areas with straw to minimise sedimentation by wind. Vegetation clearance should be restricted to the relevant development components. Ensure that vegetation cover within the PV plant area is maintained as far as practically possible to reduce runoff and sedimentation of wetland areas. Ensure that effective stormwater management measures are implemented during construction. Stormwater management must ensure that no runoff, which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during

				storm events, such as through vegetated swales.
Impact 4: Water Quality Impairment	Very Low	Low	Depression, UVBW, & CVBW	Bunded, impervious areas must be designated by an Environmental Control Officer for temporary toilets, vehicle parking/servicing areas and for pouring and mixing of concrete/cement, paint, and chemicals. These bunded areas must be located at least 15 m from the demarcated wetland boundaries. The site manager / ECO must check the No Go area for pollution/spills, erosion damage and sedimentation weekly and after every heavy rainfall event. Should pollution, erosion or sedimentation be noted, immediate corrective measures must be undertaken. Fuel, chemicals, and other hazardous substances should preferably be stored offsite, or as far away as possible from the no-go area. These substances must be stored in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding, or storm damage. Clean up any spillages immediately with the use of a chemical spill kit and dispose of contaminated material at an appropriately registered facility. Inspect all storage facilities, vehicles, and machinery daily for the early detection of deterioration or leaks and strictly prohibit the use of any vehicles or machinery from which leakage has been detected.
Operational Phase				
Impact 5: Altered Flow Regime	Very Low	Low	Depression, UVBW, & CVBW	Vegetation clearance should be restricted to the relevant development components. Ensure that control measures are undertaken onsite to prevent and manage erosion such as: • maintaining a 15 m buffer around onsite wetlands, • Ensure that effective stormwater management measures are implemented during operation. Stormwater management must ensure that no runoff,

				which will impair the water quality and lead to increased sedimentation, may enter the downstream watercourses. Additionally, clean SW which does enter the downstream watercourses should do so in a manner that ensures no erosion occurs, specifically during storm events, such as through vegetated swales. • maintain adequate vegetation cover within the PV plant area as far as practically possible, • plant indigenous wetland vegetation should erosion occur in wetland areas, and • incorporate rock riprap / gabions as a last measure should erosion continue once vegetation is established.
Impact 6: Water quality impairment	Very Low	Low	Depression, UVBW, & CVBW	Ensure that all potentially significant pollution sources are listed in the Environmental Management Plan. Ensure that all activities that may lead to pollution take place indoors or on bunded impervious surfaces such that the pollutants cannot enter the stormwater system or downstream watercourses.
"No Go" Scenario				
"No Go" Scenario	Low	Not Assessed	Depression, UVBW, & CVBW	None

Five out of six of the pre-mitigation scores fell within the "Low" impact categories, while post-mitigation scores fell within the "Very Low" impact categories. Wetland loss was rated as "Medium" significance prior to mitigation. It is recommended that the wetlands, along with a 15 m buffer zone, are avoided by all construction and operational activities. Should the proposed project avoid the wetlands, this impact will not be applicable.

The "No Go" Alternative would result in "Low" significance impact score to wetlands onsite. Although it is unknown whether the site would be developed in future, it is assumed that the "No Go" scenario would result in continuation of current impacts such as water quality impairment and alteration of flow because of the gold mine slimes dam upstream, as well as within-wetland impacts including the existing plantations and dams.

The Low-risk rating indicates that a General Authorisation will be required for this project, provided that all mitigation measures are implemented. Should there be construction of 100 m^2 or more of infrastructure within the onsite wetlands or within 32 m thereof; or if there is removal, deposition, or movement of 10 m^3 or more of sediment or any other substance within the delineated wetlands, a Basic Assessment will be required.

It should also be noted that the DHSWS apply a 'no net loss' policy to wetlands. The 'no net loss' policy implies that losses due to project impacts and wetland offset gains need to balance out. The DHSWS are therefore not likely to authorise any development application that encroaches on a wetland unless an acceptable wetland offset plan forms part of the development application. Offsets involve rehabilitation and management of wetlands in perpetuity, which can be costly and administratively complex and there is no guarantee of approval. It is therefore recommended that all onsite wetlands, along with the 15 m buffer area as determined in the current report, are demarcated as "No Go" areas and avoided entirely.

The current layout is supported from an aquatic perspective, and no further aquatic assessments are required. It is therefore the opinion of the specialist that the proposed development should be approved subject to the implementation of the mitigation measures listed in this report.

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Annexure 1: Ecosystem Services

Table A1: Ecosystem Services included in the WET-EcoServices v.2 (Extracted from Kotze *et al.*, (2020)).

Services contributing to indirect benefits	**Regulating and supporting services**	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland/riparian area, thereby reducing the severity of floods downstream (Adamus et al. 1987; MEA 2005)
		Streamflow regulation		Sustaining streamflow during low flow periods (McInnes and Everard 2017)
		Water quality enhancement services	Sediment trapping	The trapping and retention in the wetland/riparian area of sediment carried by runoff water (Adamus et al. 1987)
			Phosphate assimilation	Removal by the wetland/riparian area of phosphates carried by runoff water, thereby enhancing water quality (O'Geen et al. 2010)
			Nitrate assimilation	Removal by the wetland/riparian area of nitrates carried by runoff water, thereby enhancing water quality (O'Geen et al. 2010)
			Toxicant assimilation	Removal by the wetland/riparian area of toxicants (e.g. metals, biocides and salts) carried by runoff water, thereby enhancing water quality (O'Geen et al. 2010)
			Erosion control	Controlling of erosion at the wetland/riparian area, principally through the protection provided by vegetation (MEA 2005).
		Carbon storage		The trapping of carbon by the wetland/riparian area, principally as soil organic matter (Kumar et al. 2017)
	Biodiversity maintenance[1]			Through the provision of habitat and maintenance of natural process by the wetland/riparian area, a contribution is made to maintaining biodiversity (Liquete et al. 2016)
Services contributing to direct benefits	**Provisioning services**	Provision of water for human use		The provision of water which is taken directly from the wetland/riparian area for domestic, agriculture or other purposes (Kumar et al. 2017)
		Provision of harvestable resources		The provision of natural resources from the wetland/riparian area - including craft plants, fish, wood, etc. (McInnes and Everard 2017)
		Food for livestock		The provision of grazing for livestock (McInnes and Everard 2017)
		Provision of cultivated foods		The provision of cultivated foods from within the wetland/riparian area (McInnes and Everard 2017)
	Cultural (non-material) services	Cultural and spiritual experience		Places of special cultural significance in the wetland/riparian area - e.g. for baptisms or gathering of culturally significant plants (McInnes and Everard 2017)
		Tourism and recreation		Sites of value for tourism and recreation in the wetland/riparian area, often associated with scenic beauty and abundant birdlife (McInnes and Everard 2017)[2]
		Education and research		Sites of value in the wetland/riparian area for education or research (McInnes and Everard 2017)

[1]It is recognized that biodiversity maintenance is not an ecosystem service in the strict sense (Liquete *et al.* 2016) and is framed in less anthropocentric terms than all the other services, but it underpins many other services and is widely acknowledged as having high value to society broadly, even in the absence of any local or downstream beneficiaries.

[2]WET-EcoServices focuses on recreational services which are specifically nature-based, e.g., bird watching. It does not account specifically for recreational services from wetland/riparian areas that have been converted into sports grounds, children's playgrounds, or other built infrastructure.

Annexure 2: Impact Assessment Methodology

Impact assessment methodologies are based on qualitative ratings of the various factors and represent a standardised method for presenting a substantiated specialist opinion regarding the significance of a particular class of impact. Delta Ecology has developed a rapid numerical impact assessment methodology, applied in this report, that incorporates a range of factors commonly assessed to which numerical values from 1 to 5 are assigned to each rating category. Six primary factors are used to determine Consequence and two primary factors are used to determine Probability. These two secondary factors are used to determine Impact Significance for each identified impact. Consequence, Probability, and Impact Significance are determined by a set of formulae which incorporate weightings for each primary and secondary factor.

The weightings for each factor were determined by application of the formulae to over 50 pre-existing ecological impact assessments. These assessments employed other methodologies and were accepted by the relevant environmental authorities. These assessments were primarily from reports drafted by Delta Ecology staff during previous employment, but also included unrelated ecological impact assessments freely available on the internet. The weighting system has therefore been derived as a means of real-world formula calibration rather than by logic alone. The final methodology achieves impact significance ratings that are consistently in line with industry standards.

Key elements of the approach include a detailed description of the nature of the impact and of the proposed mitigation measures, assessment of each factor for both the "with mitigation" and "without mitigation" scenarios and includes the provision of a rationale for each rating where appropriate. The resulting impact significance ratings may be adjusted, if necessary, in accordance with specialist opinion, given adequate motivation for the deviation from the standard methodology.

The various factors, formulae and weightings are provided in the table below:

Scoring of impacts			
Factor	**Weighting**	**Score**	**Description/Rating**
Consequence	**8**		
Intensity	4	1	Very Low / Non-harmful
		2	Low / Slightly Harmful
		3	Medium / Harmful
		4	High / Very Harmful
		5	Very High / Disastrous
Duration	1	1	Up to 1 month
		2	1 month to 1 year
		3	One year to 5 years
		4	5 to 20 years
		5	Beyond 20 years / Permanent
Spatial scale/extent	3	1	Limited to project site
		2	Limited to local catchment
		3	Multiple local catchments
		4	Limited to quaternary catchment
		5	Regional, National, International
Reversibility	1	1	Passive restoration / High likelihood of success

		2	Low cost rehabilitation / Moderately high likelihood of success
		3	Moderate cost / Moderate likelihood of success
		4	High cost / Low likelihood of success
		5	Very high cost / Very low likelihood of success
Loss of irreplaceable resources	1	1	None
		2	Low
		3	Medium
		4	High
		5	Very High
Cumulative Impact	1	1	Very Low
		2	Low
		3	Medium
		4	High
		5	Very High
Probability	**2**		
Frequency of the activity	1	1	Once off activity / less than once in 20 years
		2	5 to 20 years
		3	1 to 5 years
		4	Monthly to annually
		5	Weekly to Monthly
Likelihood of the Incident / Impact occuring	1	1	Highly unlikely
		2	Unlikely
		3	Possible
		4	Likely
		5	Definite
Consequence = (Intensity x 4) + Duration + (Extent x 3) + Reversibility + Loss of Irreplaceable Resources + Cumulative Impact) / 11			
Probability = (Frequency + Probability) / 2 OR = 5 where likelihood is definite			
Impact Significance = (Consequence x 8) + (Likelihood x 2) / 10			
Impact Significance Categories			
0 - 1.5			Very Low
1.6 - 2.5			Low
2.6 - 3.5			Medium
3.6 - 4.5			High
4.5 and above			Very High

Annexure 3: DWS RISK ASSESSMENT

Project Phase	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
Construction Phase	Increased runoff and resultant alteration of the flow regime of the wetlands onsite as a result of catchment hardening associated with the construction of the proposed development.	Alteration of the flow regime	3	1	1	1	1.5	1	3	5.5	1	3	5	1	10	55	L	80%	Refer to Section 8	N	PES – B, D & E
Construction Phase	Site clearance, infilling and compaction associated with construction camps, offices, and the BESS may result in increased runoff and sediment into the wetlands onsite. The conversion of semi-natural grassland into PV areas in the wetland catchment areas may result in increased sediment input within the wetlands.	Increased sediment input	1	3	1	1	1.5	1	3	5.5	1	3	5	1	10	55	L	80%	Refer to Section 8	N	

Construction Phase	Accidentally spilled cement, construction chemicals, sewage from temporary toilets or petrochemicals from construction vehicles may find their way into the wetlands onsite.	Water quality impairment.	1	3	1	1	1.5	1	3	5.5	1	3	5	1	10	55	L	80%	Refer to Section 8	N	EIS – Moderate
Operational Phase	PV modules create hardened surfaces and may increase runoff and sedimentation into wetlands onsite. The conversion of semi natural grassland into PV areas in the wetlands catchment areas will result in increased sediment input within the watercourses.	Alteration of the flow regime & Increased sedimentation	3	1	1	1	1.5	1	3	5.5	1	3	5	1	10	55	L	80%	Refer to Section 8		

Operational Phase	Water quality impairment due to accidental leakage or spillage of hydrocarbons and electrolytes associated with the BESS within the associated catchment area of the wetlands.	Water quality impairment.	1	3	1	1	1.5	1	3	5.5	1	3	5	1	10	55	L	80%	Refer to Section 8	N	

RISK MATRIX (Based on DWS 2015 publication: Section 21 C and I water use Risk Assessment Protocol):
NAME and REGISTRATION No of SACNASP Professional member: K van Zyl Reg no. 117097

Signature:
Date: 25 April 2023