Tiffany's Centre Expansion in Salt Rock, KwaDukuza Local Municipality, KwaZulu-Natal

WETLAND IMPACT ASSESSMENT REPORT

28th October 2022

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Project Details

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Expertise of Specialists

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Declaration of Independence

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 40772 Government Gazette, 4 December 2014 (as amended);
- Meet the general requirements to be independent and have no business, financial, personal or either interest in the proposed development and that no circumstances have occurred that may have compromised my objectivity; and
- I am aware that a false declaration is an offence in terms of regulation 48 of the EIA regulations (2014).

I, **Ryan Edwards**, as the appointed wetland scientist, hereby declare/ affirm the correctness of the information provided in compliance statement

Signed:

Date:
28th October 2022

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1. Introduction & Background

1.1. Location and Description of the Proposed Development Activities

The applicant intends to expand the existing Tiffany's Retail Centre in the suburb of Salt Rock in the KwaDukuza Local Municipality, KwaZulu-Natal. The relevant property is Portion 158 of Lot 71 of Farm No. 1524 that is adjacent to the existing Tiffany's Centre located on Portion 173 of Farm No. 1524. The location of the proposed development site is shown in Figure 1. The site development plan is included in **Annexure A** of this report.

In terms of civil services, a stormwater management plan (SiVEST, 2022) was provided to the author. The proposed stormwater management system will include the following:

- The stormwater system shall consist of a combination of internal drainage collection points from the roof, and the stormwater drainage of the surrounding parking lot. The minor stormwater network servicing the designated rainwater downpipes will connect into the new piped stormwater conveyance system in the parking area and roads circulating the building. The stormwater runoff will then be conveyed into an attenuation facility, from where it will be released in a controlled manner, through an outlet structure, into the existing river system.
- The on-site piped stormwater network is to connect to the existing river network via energy dissipating outlet structures, after being attenuated. The stormwater network will drain both the retail centre, as well as the parking lot and roads surrounding it. The parking area should be adequately shaped to fall to several low points, where runoff will be collected by grid inlets.
- The rainwater downpipes will discharge into gullies, (for maintenance access) and then into the site's piped stormwater network.

- The design of the general stormwater piped conveyance network for the parking lot and new retail centre should be based on a 10-year return period design storm from the direct surface runoff.
- Attenuation needs to be achieved using appropriate attenuation structure(s) and outlet controls. Such structures may include an attenuation pond, underground tank, and/or making use of temporary storage in the parking lot. The approximate required attenuation volume for the site has been determined by calculating the difference between the pre- and post-development runoff hydrograph for a 50-year return period.
- Once the stormwater runoff has been attenuated, the water will need to be released back into the existing river in a controlled manner. This will be achieved using outlet structures and stilling basins.

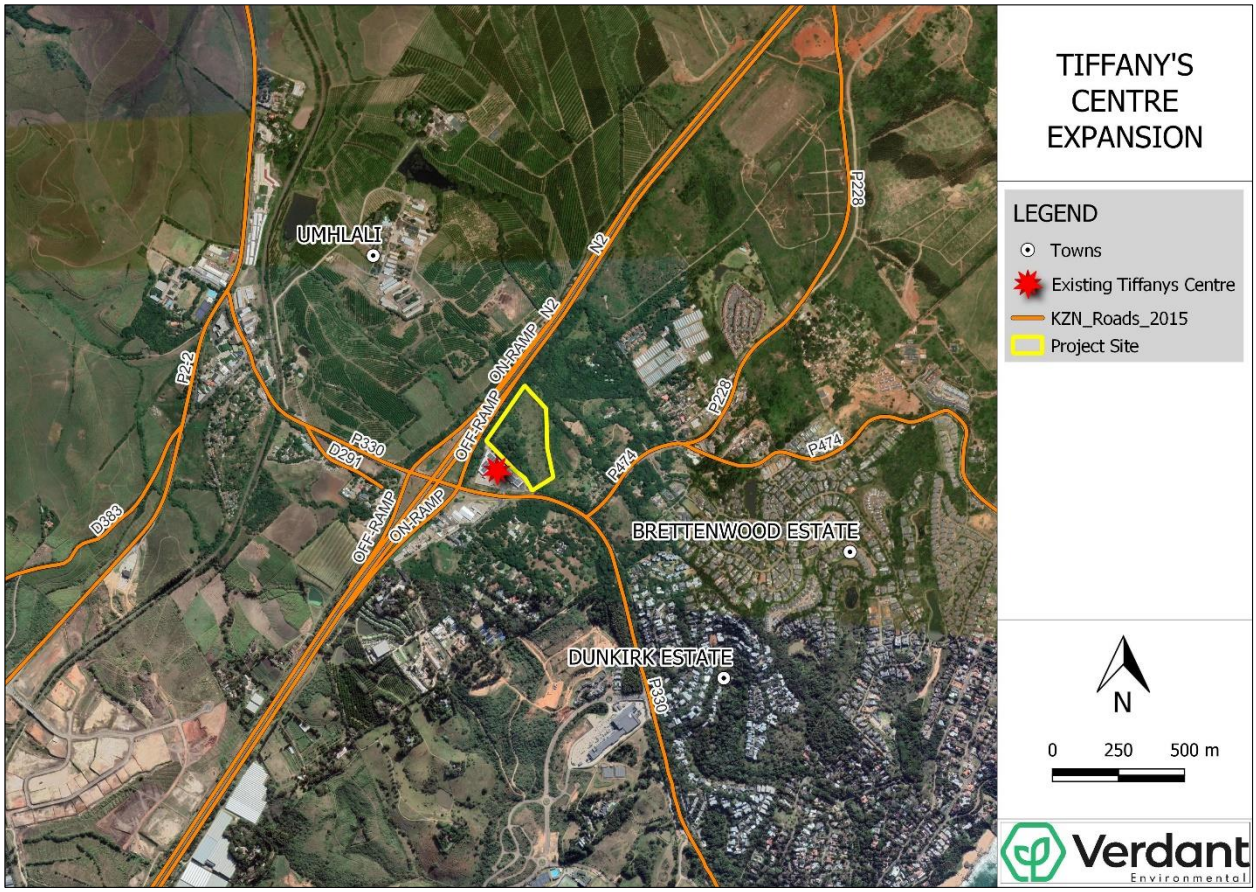

Figure 1. Location of study area.

1.2. Scope of Work

Verdant Environmental have been appointed by SiVEST to undertake a wetland impact assessment for the proposed expansion. The scope of work completed as part of this assessment was as follows:

- Onsite wetland delineation.
- Assessment of the Present Ecological State (PES), Ecosystem Services Importance and Ecological Importance and Sensitivity (EIS) of the wetland areas to be affected.
- Identification, description and assessment of the impacts of the proposed development activities on wetland ecosystems.
- Provision of planning / design, construction, and operational phase mitigation measures to avoid, minimize and rehabilitate the potential new impacts to wetlands.

1.3. Key definitions and concepts

An ecosystem is a group of plants, animals and other organisms interacting with each other and with non-living (abiotic) components of their environment. Ecosystems can be classified broadly into terrestrial and aquatic ecosystems. Terrestrial ecosystems occur on land where water is a limiting factor, whereas aquatic ecosystems occur within landforms that are permanently or periodically inundated with flowing or standing water (Ollis et al., 2013). Freshwater ecosystems are a subset of the Earth's aquatic ecosystems and include all inland freshwater rivers, streams, wetlands, lakes, ponds and springs. This broad range of freshwater ecosystem types contains a multitude of habitats of varying ecological complexity and diversity (Wrona et al., 2016). Wetlands, streams and rivers fall under the umbrella term of "freshwater ecosystems".

Wetlands, streams and rivers fall under the umbrella term of 'watercourse' in the National Water Act (Act No. 36 of 1998) (NWA) of South Africa. Section 1(1)(xxiv) of the NWA defines a 'watercourse' as:

- a river or spring;
- a natural channel in which water flows regularly or intermittently;
- a wetland, lake or dam into which, or from which, water flows; and

- any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

This assessment focusses on the assessment of natural watercourses and their associated habitats / ecosystems likely to be measurably affected by the proposed development, focussing specifically on wetlands. For the purposes of this assessment, wetlands, streams and rivers are defined as follows:

- **Wetlands** are areas that have water on the surface or within the root zone for extended periods throughout the year such that anaerobic soil conditions develop which favour the growth and regeneration of hydrophytic vegetation (plants which are adapted to saturated and anaerobic soil conditions). In terms of Section 1 of the NWA, wetlands are legally defined as: (1) "…land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."
- **Rivers and streams** are natural channels that are permanent, seasonal or temporary conduits of freshwater. In terms of ecological habitats, rivers and streams comprise in-stream aquatic habitat and riparian habitat. Generally, riparian zones mark the outer edge of stream and river systems. Streams and rivers are differentiated in terms of channel dimensions and generally fall within the broad category of rivers / riverine ecosystems in this report.
- **Instream habitat** is the aquatic habitat (or alluvial in the case of intermittent / ephemeral watercourses) within the active channel that includes the water column, river bed and the inundated active channel margins, and associated vegetation. In terms of Section 1 of the NWA, instream habitat is legally defined as habitat that includes "…the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse."
- A **riparian zone** is a habitat, comprising bare soil, rock and/or vegetation that is: (i) associated with a watercourse; (ii) commonly characterised by alluvial soils; and (iii) inundated or flooded to an extent and with a frequency sufficient to support vegetation species with a composition and physical structure distinct from those of adjacent land areas (DWAF, 2005). In terms of Section 1 of the NWA, riparian habitat is legally defined

as: 'habitat that "…includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."

1.4. Legislative Context Relevant to Freshwater Ecosystems

Rivers and wetlands are not formally protected by law but their alteration is regulated by three different pieces of legislation, namely:

- National Water Act (No. 36 of 1998) ('NWA').
- National Environmental Management Act (No. 107 of 1998) ('NEMA').
- Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA').

1.4.1. National Water Act (Act No. 36 of 1998) ('NWA')

Section 21 of the National Water Act (No 36 of 1998) lists eleven (11) activities that constitute water uses that require a Water Use License (WUL) prior to the activities commencing, unless the use is excluded. The water uses included in Section 21 are:

a) taking water from a water resource;
b) storing water;
c) impeding or diverting the flow of water in a watercourse;
d) engaging in a stream flow reduction activity contemplated in section 36;
e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) disposing of waste in a manner which may detrimentally impact on a water resource;
h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) altering the bed, banks, course or characteristics of a watercourse;

j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) using water for recreational purposes.

Typically, development activities that directly and indirectly alter the characteristics of watercourses are considered Section 21(c) and 21(i) water uses and are the most common water uses.

1.4.2. National Environmental Management Act (No. 107 of 1998) ('NEMA')

Listed Activities that may negatively affect watercourses are included in three (3) Listing Notices in the EIA Regulations (2017) published under Section 24(5) and 44 of NEMA. Listed activities require Environmental Authorisation (EA) subject to conducting either a basic assessment or full Environmental Impact Assessment (EIA) prior to the project activities commencing.

1.4.3. Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA')

Regulated activities that may negatively affect watercourses are included in the CARA Regulations as amended (2001) published under Section 29 the CARA. Formal approval / permission from an executive officer is required before such regulated activities can take place.

2. Methods

2.1. Desktop Assessment

2.1.1. Desktop Review of Freshwater Ecosystem Context

Freshwater ecosystems are typically linear features that are connected over regional scales in the landscape and embedded in the terrestrial matrix. Furthermore, freshwater ecosystems are typically located at topographical low points in the landscape, thereby collecting and conveying materials (water and dissolved and particulate matter) from within their entire catchment (UN Environment, 2018). It is thus important to first contextualise the onsite freshwater ecosystems in terms of local and regional setting, and conservation planning. An understanding of the biophysical and conservation context of the site will assist in the assessment of the importance and sensitivity of the onsite freshwater ecosystems, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information listed in Table 3 was consulted to inform the specialist assessment. The data type, relevance to the project and source of the information is provided.

Table 1. Data sources and GIS information consulted to inform the freshwater ecosystem assessment.

Data/Coverage Type		Relevance	Source
Biophysical / Ecological Context	**Latest Google Earth ™ imagery**	*To supplement available aerial photography where needed and to inform catchment level impacts*	Google Earth™ On-line
	National Rivers (GIS Coverage)	*Highlight potential onsite and local rivers and map local drainage network*	DWS
	South African Quaternary catchments	*Locates the project area within the principal water resource management units in South Africa*	DWS
	South African Quinary catchments	*Locates the project area within the principal water resource management units in South Africa*	DWS

Data/Coverage Type		Relevance	Source
	DWA Eco-regions (GIS Coverage)	*Understand the regional biophysical context in which water resources within the study area occur*	DWA (2005)
	South African Vegetation Map (GIS Coverage)	*Classify vegetation types and determination of reference vegetation*	SANBI (2006 - 2018)
	South African Inventory of Inland Aquatic Ecosystems (SAIIAE), 2018 – River Ecosystems	*Shows location of river within the relevant inventories*	Van Deventer *et al.* (2018a)
	South African Inventory of Inland Aquatic Ecosystems (SAIIAE), 2018 – Wetland Ecosystems	*Shows location of wetlands within the relevant inventories*	Van Deventer *et al.* (2018a)
Conservation Context	**The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (2011)** – Wetland FEPAs	*Shows location of national wetland ecosystem conservation priorities*	CSIR (2011)
	The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011) – River FEPAs	*Shows location of national river ecosystem conservation priorities*	CSIR (2011)
	National Biodiversity Assessment – Terrestrial Realm (GIS Coverage)	*Terrestrial ecosystem / vegetation type threat status*	Skowno et al. (2018)
	National Biodiversity Assessment – Inland Aquatic / Freshwater Realm (GIS Coverage)	*Freshwater ecosystem / vegetation type threat status*	Van Deventer *et al.* (2018b)
	KZN Biodiversity Sector Plan: Critical Biodiversity Areas Irreplaceable (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2016)
	KZN Biodiversity Sector Plan: Critical Biodiversity Areas Optimal (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2016)
	KZN Terrestrial KZN Aquatic Systematic Conservation Plan (GIS Coverage	*Provincial conservation planning importance.*	EKZNW (2011)
	KZN Aquatic Systematic Conservation Plan (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2007)

2.1.2. Desktop Mapping

All watercourses within 500m of the project property were mapped at a desktop level in a GIS. The mapping process involved digitization of the wetland and riparian zone boundaries in QGIS by the eyeballing of 2022 Google Earth imagery in conjunction with the use of available 10m contour information of the study area.

2.1.3. Impact Screening / Likelihood of Impact

For the purposes of this assessment, the study area for infield assessment comprised all rivers within 100m and wetlands within 500m of the development footprint that stand to be measurably negatively impacted. The wetlands and rivers likely to be impacted were identified using the 'likelihood of impact' guidelines in Table 2.

Table 2. Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
Definite	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within the footprint** of the proposed development activity and will be impacted by the project; and/or ➢ resources located **within 15m upstream and/or upslope** of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located **within 15m or downslope** of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: ○ **within 15m downstream** of a low-risk development; ○ **within 50m downstream** of a moderate risk development; and/or ○ **within 100m downstream** of a high-risk development e.g. mining, large industrial land uses.
Likely / Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within 32m but greater than 15m upstream, upslope or downslope** of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: ○ **within 32m downstream** of a low-risk development; ○ **within 100m downstream** of a moderate risk development; and/or ○ **within 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to

Likelihood of Impact Rating	Description of Rating Guidelines
	incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: ○ **greater than 32m downstream** of a low-risk development; ○ **greater than 100m downstream** of a moderate risk development; and/or ○ **greater than 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment, and which will not be impacted by the development in any way, shape or form.

2.2. Infield Assessment

2.2.1. Data Collection

A field assessment to delineate and assess the rivers and wetlands within the study area was undertaken on **19-20 January 2021**. Data collection involved the following:

- Systematic soil sampling across all valley lines, valley bottom areas, valley heads, hillslopes and depressions using a clay auger to confirm the presence and extent of wetland and alluvial (riparian) soils according to the guideline: '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas*' (DWAF, 2005). Soil sample points were recorded onsite using a hand-held GPS. Soil sample points were recorded onsite using a hand-held GPS.
- The recording of the dominant plant species and general composition of the wetland and riparian vegetation in the vicinity of the soil sample points based on visual observations. Observations points were recorded onsite using a hand-held GPS.
- The recording of the landscape / terrain position at each sample point based on visual observations. Observations points were recorded onsite using a hand-held GPS.
- The recording of existing river and wetland impacts (such as extent of existing infilling) using a hand-held GPS.

2.2.2. Data Analysis

The methods and tools that were used as part of the baseline wetland ecosystem assessment are summarised in Table 3, below.

Table 3. Summary of methods used in the assessment of the affected rivers and wetlands.

Method/ technique	Reference for methods/ tools used
Wetland and river /riparian delineation	• *'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas'* (DWAF, 2005)
Classification of Aquatic Ecosystems (rivers & wetlands)	• National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013)
Present Ecological State (PES)	• Level 1 WET-Health assessment (Macfarlane *et al.,* 2020) • The IHI (Index of Habitat Integrity), version 2 (Kleynhans, 1996, updated in 2012)
Functional Importance	• Level 2 WET-EcoServices assessment (Kotze *et al*., 2020)
Ecological Importance & Sensitivity (EIS)	• Wetland EIS assessment (Kotze *et al*., 2020) • River EIS assessment (Keynhans, 1999)

2.3. Impact Assessment

2.3.1. Impact Categories

The river impacts were grouped into the following broad impact types:

- **Direct ecosystem modification or destruction / loss impacts** – This impact refers to the direct physical destruction and/or modification of river and wetland communities, habitat and associated biota. Such impacts may be attributed to a range of activities including vegetation / habitat clearing (stripping / grubbing), earthworks (i.e. excavation and infilling) and deep flooding by impoundments.
- **Alteration of hydrological and geomorphological processes** – This impact refers to all the indirect impacts resulting from human activities within the river / wetland or catchment that alter hydrological and geomorphological processes i.e. rates of erosion

and sedimentation. This includes activities that: (i) modify landcover characteristics that alter the quantity and pattern of catchment runoff and sediment inputs e.g. earthworks, surface hardening, plantations, etc.; (ii) activities that regulate, reduce or increase flows e.g. impoundment / dams, abstraction, return flows and decant flows; and activities alter river flow hydraulics e.g. establishment of drains, flow canalisation, flow constrictions and flow diversions.

- **Water pollution impacts** – This impact refers to the alteration of the chemical and biological characteristics of soil and water within rivers and wetlands and the associated ecological impacts. In the context of this impact assessment, water quality is assessed in relation to changes to its fitness for use (e.g. for domestic, recreational or agricultural purposes) and ability to maintain the health of aquatic ecosystems. This impact includes a full spectrum of activities ranging from direct inputs (e.g. spillages / point source discharges) through to diffuse source inputs from landuse activities that affects the quality of water entering watercourses (e.g. hazardous substances handling, storage & transport; urban stormwater management; irrigation return flows and acid mine drainage).
- **Ecological connectivity and edge disturbance impacts** – This impact refers to the alteration of local and regional ecological processes resulting from the transformation of land and disturbance within and/or surrounding a wetland. Key ecological processes of relevance in this regard include ecological connectivity and edge effects edge effects that are impacted by habitat fragmentation, patch size reduction, increased alien invasive plant invasion, noise pollution, vibrations, light pollution, and the occurrence of barriers to propagule and animal movement.

2.3.2. Impact Scenarios

The impact assessment was undertaken for the following mitigation scenarios only:

1. **Realistic Poor Mitigation Scenario**: This scenario involves the implementation of the proposed development plan and designs that are currently proposed with the associated implementation of standard construction and operational phase mitigation measures. In terms of implementation success, this scenario assumes a realistic / likely poor implementation scenario based on the author's experience with such activities.

2. **Realistic Good Mitigation Scenario**: This scenario involves the implementation of the development plan and designs that incorporate all the project planning and design, construction, operational and decommissioning phase mitigation measures recommended by the author. In terms of implementation success, this scenario assumes a realistic best-case scenario for implementation based on the author's experience with such activities.

2.3.3. Impact Significance

Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). A significant impact is defined in the NEMA EIA Regulations 2017 as follows:

> "…an impact that may have a notable effect on one or more aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence."

The impact significance assessment involved the rating and integration of the following aspects of the potential impacts:

- Intensity – defines the severity and importance of the impact to water resources / habitats / species or human populations within defined impact extent.
- Extent – relates to the expected extent of the impact in spatial and population terms.
- Duration – relates to the duration of the impact in time (consideration should be given to reversibility which may reduce the duration of impact).
- Probability – relates to the expected likelihood and frequency of the impact causing event occurring.

A detailed description of the impact assessment method used is included in **Annexure B**.

2.4. DWS Risk Matrix Assessment

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorisation of Section 21(c) and 21(i) water uses, key among which is that only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
- Use of water within the 'regulated area' of a watercourse where the Risk Class is Medium or High.
- Where any other water use as defined in Section 21 of the NWA must be applied for.
- Where storage of water results from Section 21 (c) and/or (i) water use.
- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 c and I water use Risk Assessment Protocol') was applied to the proposed project. The tool uses the following approach to calculating risk:

RISK = CONSEQUENCE X LIKELIHOOD

whereby:

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The key risk stressors associated with each of the four (4) impact groups / types considered were:

1. Direct transformation and modification of habitat – Physical disturbance
2. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities within and outside of the watercourse – Erosive surface runoff, sediment and increased and/or reduced water inputs
3. Water pollution impacts – Chemical, organic and biological pollutants

4. Ecological process and disturbance impacts – Alien invasive plants, noise pollution, dust pollution

For each of the above stressors, risk was assessed qualitatively using the DWS risk matrix tool.

It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty-five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses was used to inform WUL requirements for the proposed development.

3. Study Context

3.1. Drainage Setting

The project site is located at the headlands of an unnamed tributary stream of the uMhlali River in Quaternary Catchment U30E (Figure 2). The confluence of the tributary stream with the uMhlali River is approximately 3.5km downstream of the project site.

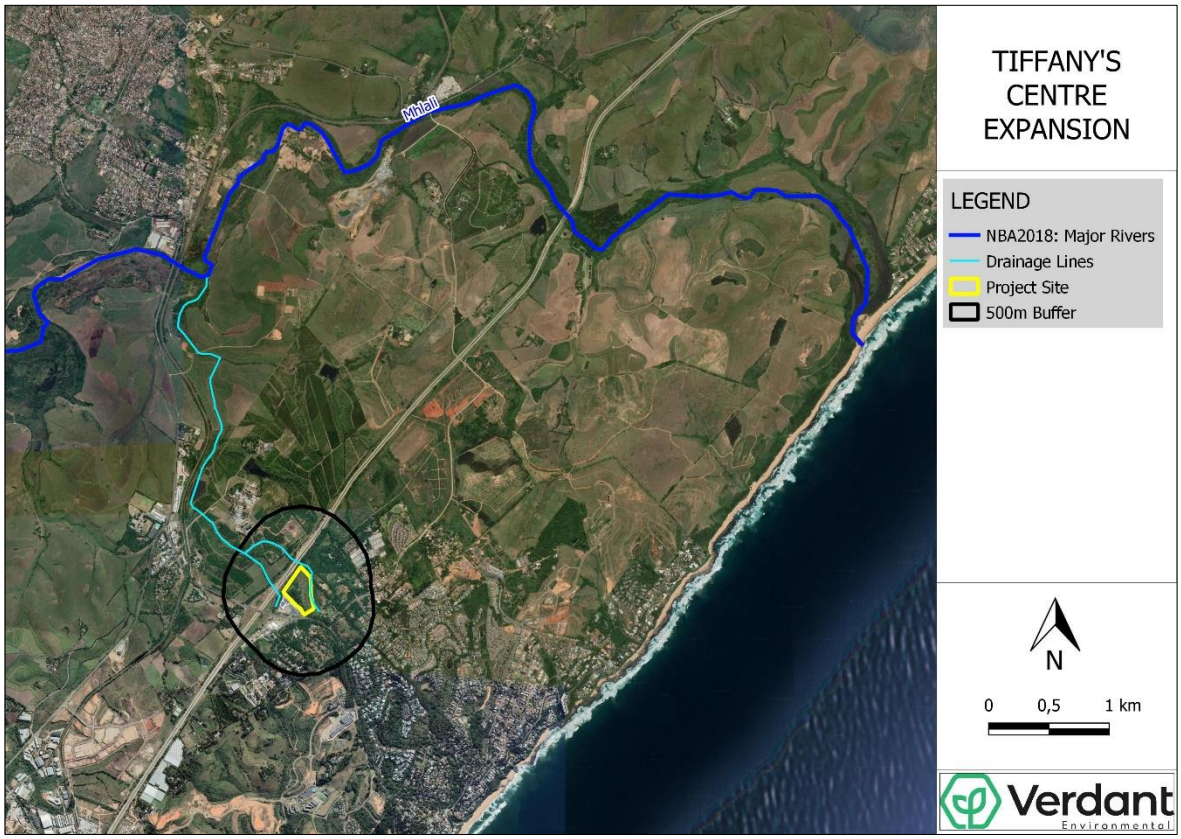

Figure 2. Drainage setting of the study area.

3.2. Bioregional Setting

The project site falls within the Indian Ocean Coastal Belt Biome (or bioregion). In terms of the national and provincial vegetation maps, the entire project area and surrounds falls within the KZN Coastal Belt / KZN Coastal Belt Grassland vegetation type, the primary reference terrestrial vegetation type for the region. In terms of azonal wetland and riparian/riverine vegetation, the local and regional wetlands fall within the Subtropical Freshwater Wetlands Vegetation type and riverine/riparian areas within the Subtropical Alluvial Vegetation type, both of which are the primary reference wetland/alluvial vegetation type for the region. At a national scale, the wetland vegetation falls within the Indian Ocean Coastal Belt Group 2 vegetation type. The KZN Coastal belt and Indian Ocean Coastal Belt Group 2 vegetation types are both considered Critically Endangered as a result of substantial cumulative loss due to cane cultivation and urban

development. The Subtropical Freshwater Wetlands Vegetation type is considered Vulnerable at a provincial scale.

3.3. Wetland Setting

No natural wetlands have been modelled to occur within the project site and within 500m of the site as part of the National Wetland Map version 5 and the National Freshwater Ecosystem Priority Areas (NFEPA) Wetland Inventory (Figure 3). The closest natural wetland modelled for the region is a channelled valley bottom wetland located at the confluence of the unnamed stream with the uMhlali River approximately 3.5km downstream.

From a desktop analysis of aerial photography, there are however numerous degraded but semi-intact wetlands located downstream of the project site along the unnamed tributary.

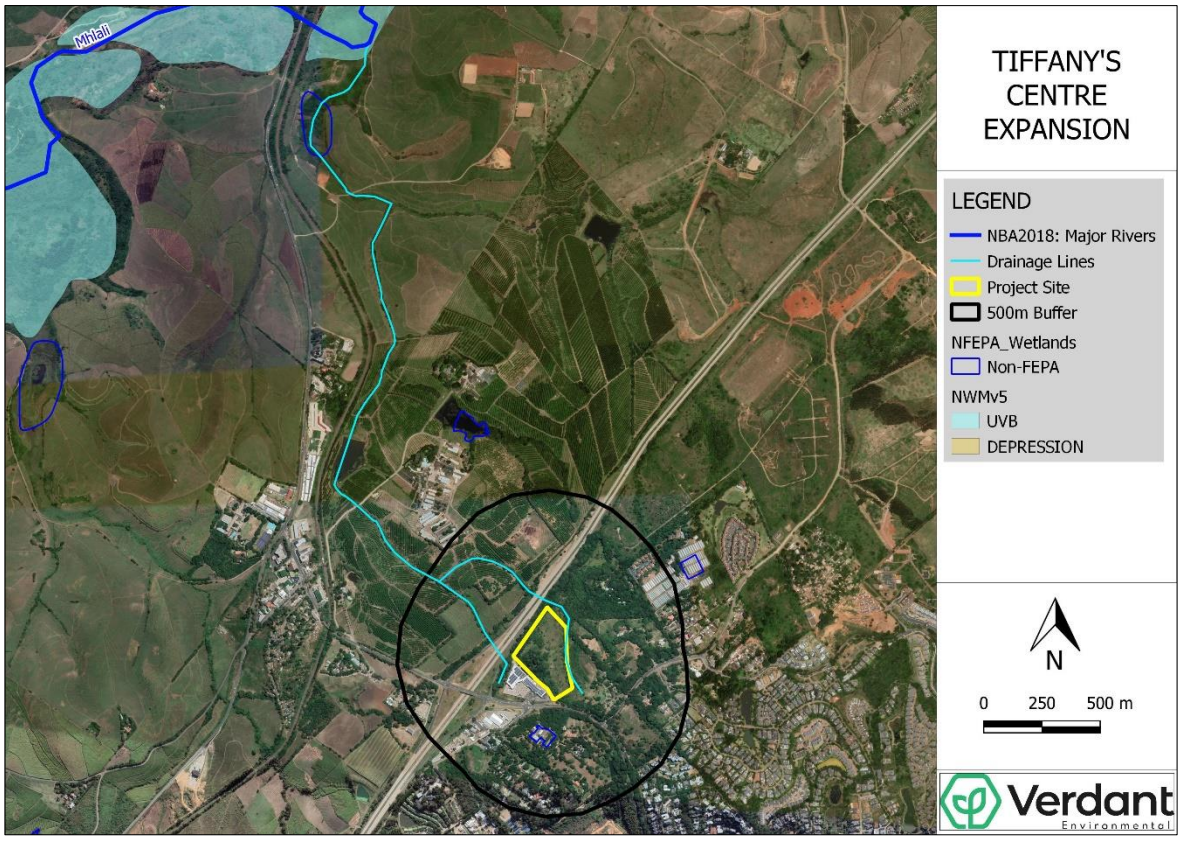

Figure 3. Drainage setting of the study area.

3.4. Conservation Planning Context

3.4.1. National Biodiversity Assessment (NBA) & National Freshwater Priority Areas (NFEPA)

Widespread transformation and degradation of wetland ecosystems has been experienced across the country. These impacts are reflected in the National Biodiversity Assessment (Nel et al., 2011) which showed that of South Africa's 791 wetland ecosystem types, 48% are critically endangered, 12% are endangered, and 5% are vulnerable with only 35% being classified as least threatened. Wetland loss has also been extensive within the KwaDukuza Local Municipality, with wetlands in the study area falling within a critically endangered wetland vegetation group.

In terms of the National Freshwater Priority Areas (NFEPA) project, the lower reaches of the uMhlali River and its sub-catchments are not classified as river priority areas, fish support areas or upstream management (support) areas. Similarly, the onsite wetlands and riparian units are not considered wetland priority areas (wetland FEPAs).

Furthermore, although not classified as wetland FEPAs, the following downstream aquatic and wetland ecosystems should still be considered important:

- channelled valley bottom wetland located at the confluence of the unnamed stream with the uMhlali River.
- uMhlali River.
- uMhlali River estuary.

3.4.2. Provincial Freshwater Ecosystem Conservation Plan

The sub-catchments in which the project area occurs is listed as 'Available' in the provincial freshwater conservation plan but is not considered a conservation priority.

3.4.3. Provincial Terrestrial Ecosystem Conservation Plan

The property and its ecosystems are not listed as CBAs or ESAs in terms of KZN Systematic Conservation Assessment as shown in Figure 4. CBA ecosystems are located south of the project site.

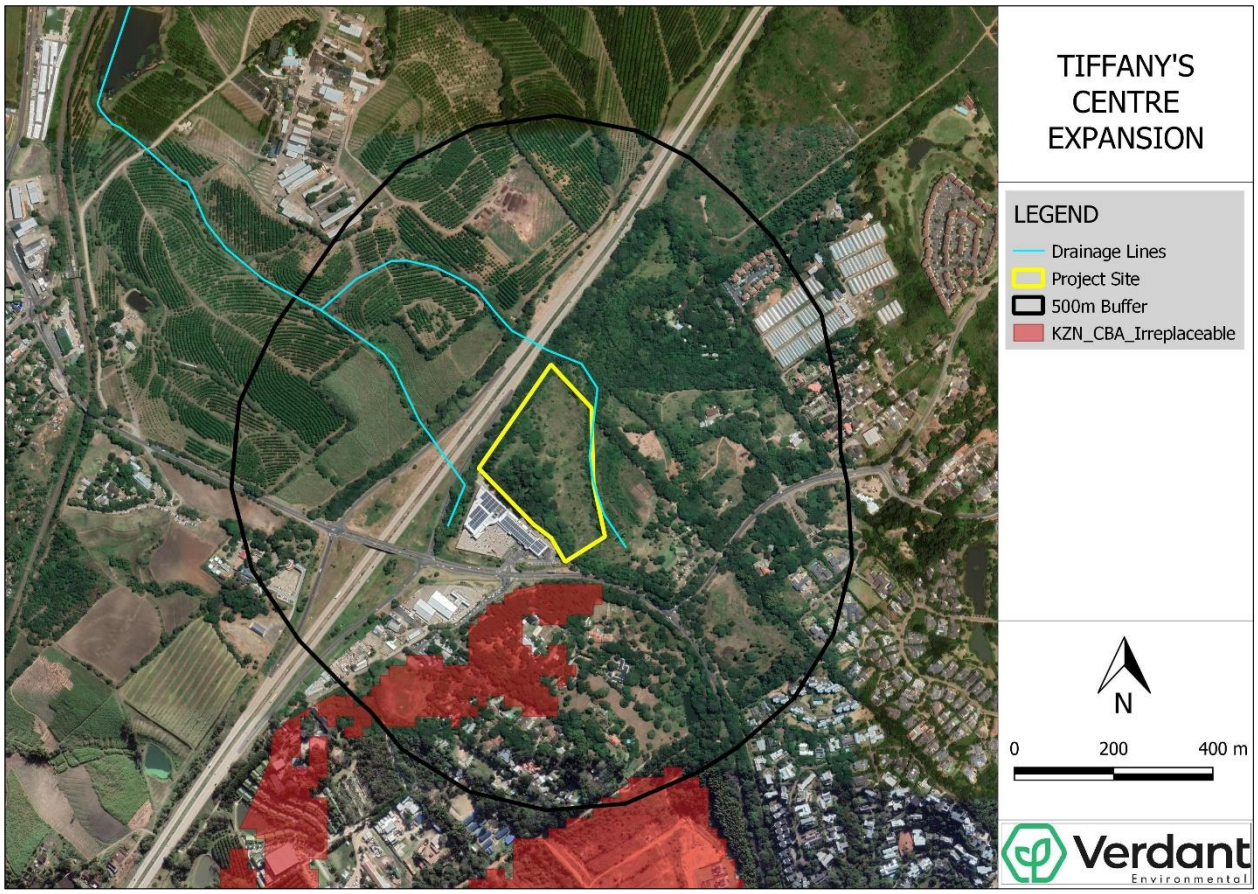

Figure 4: KZN CBAs in relation to the study area.

4. Desktop Watercourse Mapping

4.1. Mapping

All the potential wetlands (natural and artificial) occurring within 500m of the proposed development site and associated activities were mapped and classified in terms of hydrogeomorphic (HGM) types as shown in Figure 5. All the watercourses assessed were seep wetlands.

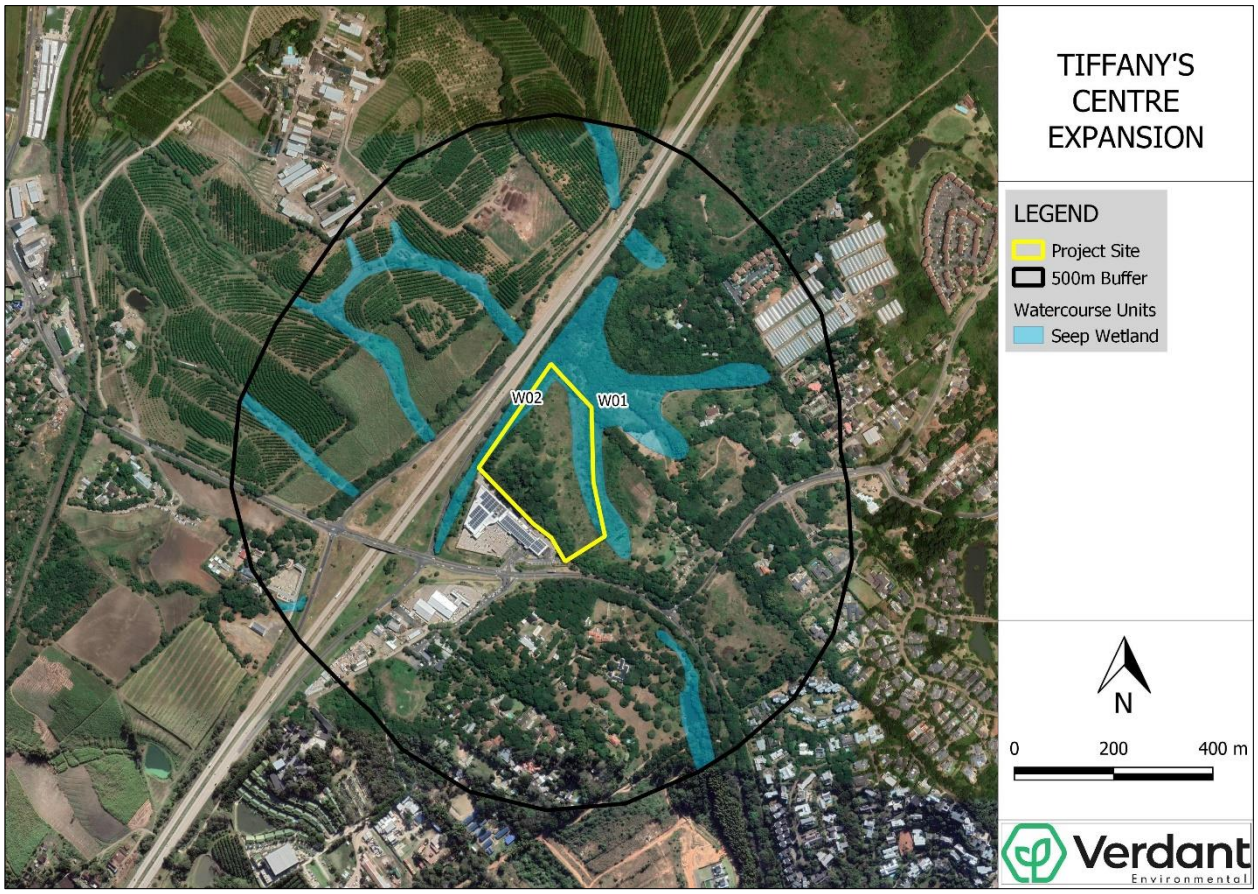

Figure 5: KZN CBAs in relation to the study area.

4.2. Likelihood of Impact

An indication of the 'likelihood of impact' for each of the mapped wetlands within 500m of the project site is depicted visually on the map in Figure 6. Units W01 and W02 are likely to be indirectly impacted and fall within the project property and were taken forward for infield assessment.

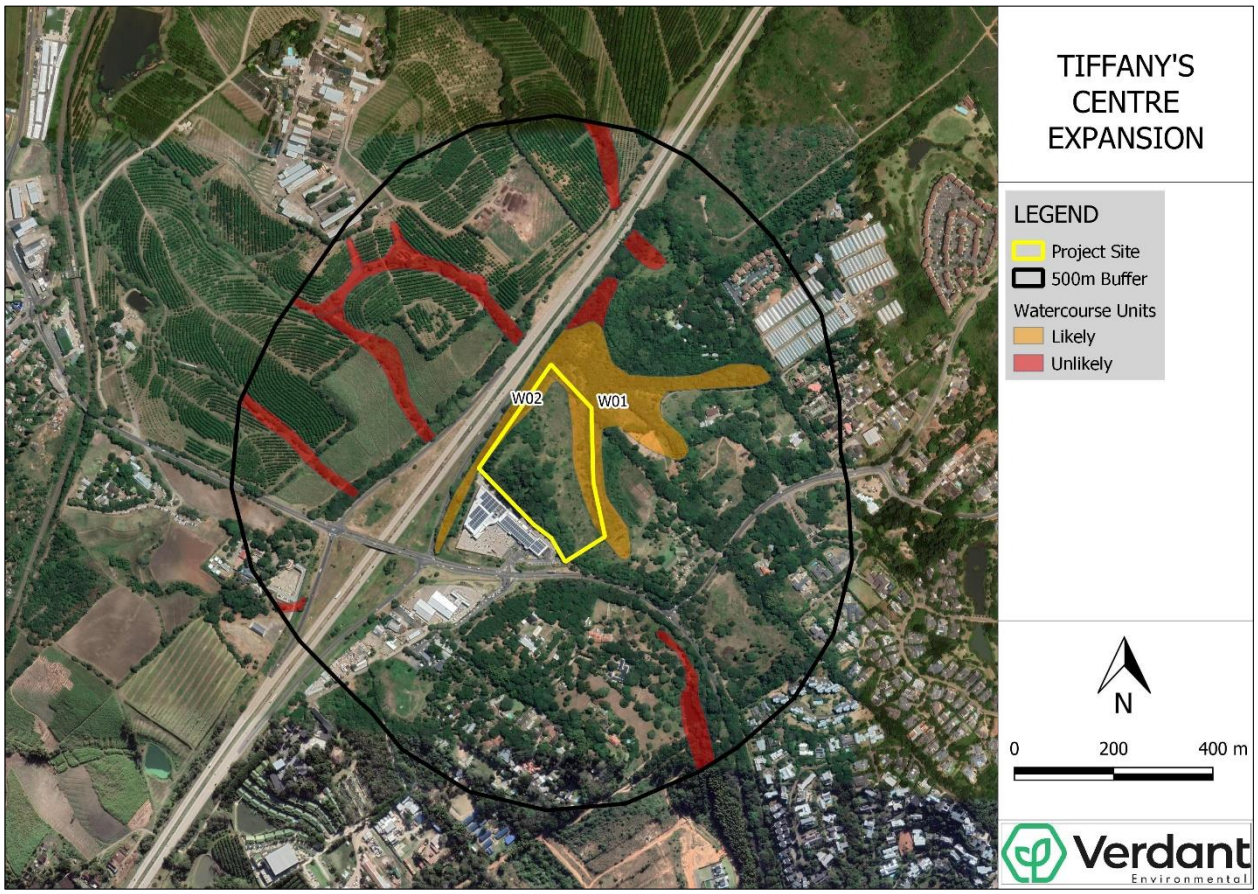

Figure 6: KZN CBAs in relation to the study area.

5. Results and Discussion: Delineation and Classification

Soil and vegetation sampling and conjunction with the recording of the terrain / landform setting confirmed the presence of two seep wetland hydrogeomorphic (HGM) units within the project site that are likely to be impacted by the proposed development. The location and extent of the wetlands units is shown in Figure 7 below.

Wetland Unit W01:

Wetland Unit W01 is a seep wetland located within a concave-shaped valley bottom and valley head landform that runs along the eastern boundary of the project site.

Soil sampling confirmed the presence of both temporarily saturated and seasonally saturated hydric soils within the seep wetland, with the majority of the seep comprising temporary wetland.

The temporary wetland soil profiles sampled comprise dark grey-brown clay loam and loam topsoils (orthic A horizon) overlying dark brown-grey becoming dark grey clay subsoils with clear evidence of low to moderate abundances of distinct orange mottling from depths >30cm deep with the mottles ranging from small to moderate in size. The subsoils had matrix chromas of 2 or less (i.e. 7.5YE3/1 – 7.5YR3/2).

The seasonal soils sampled were located within the lower lying areas and comprise dark grey loamy clay topsoils (orthic A horizon) overlying dark grey subsoils with clear evidence of a high abundance of distinct orange mottling from depths >20cm deep with the mottles ranging from small to moderate in size. The subsoils had matrix chromas of 1 (i.e. 7.5YE3/1 – 7.5YR4/1). In some areas the seasonal soils were sandier in texture and comprise grey loamy sand subsoils with a moderate abundance of moderately sized orange mottles.

The lowest lying areas of the seep has a broad and moderately defined ephemeral channel that is flanked by typical closed and semi-closed woody riparian and wetland vegetation. The woody

vegetation comprises a narrow band / corridor of early successional *Bridelia micrantha* swamp forest with other prominent but less abundant species being *Rauvolfia caffra*, *Ficus sur*, *Ficus trichopoda*, *Syzygium cordatum* in the canopy and *Tabernamontana ventricosa*, *Psychotria capensis*, *Apodytes dimidiata* and *Strelitzia nicolai* in the subcanopy. Fringing riparian and dryland ecotone woody communities were also apparent with prominent species being *B. micrantha*, *Alibizia adianthifolia*, *Acacia sieberiana* var *woodii*, *Clerodendrum glabrum*, *Ficus lutea, Chrysanthimoides monilifera* and some alien invasive species including *Schinus terebinthifolius*, *Melia azedarach* and *Psidium guajauva*.

Upslope of the central woody vegetation communities along the base of the footslopes, secondary hygrophilous grassland was encountered with high abundances of *Hermarthria altissima* and *Cyperus sphaerospermus* and low to moderate abundances of *Imperata cylindrica*, *Leersia hexandra*, *Kyllinga melanospermum*, *Asystasia gangetica*, *Pycreus polystachyos*, *Stenotaphrum secundatum* and *Eriosema* sp.. *Chromolaena odorata* and *Psidium guajava* invasion was apparent at the ecotone between the grassland and woody vegetation.

Wetland Unit W02:

Wetland Units W02 is a seep wetland located within a concave-shaped valley bottom and valley head landform that runs along the northern boundary of the project site.

Soil sampling confirmed the presence of both temporarily saturated and seasonally saturated hydric soils within the seep wetland, with the majority of the seep comprising seasonal wetland.

Soil sampling was not undertaken in the central wet areas associated with the swamp forest and focused on the wetland edges for delineation purposes. Seasonal samples were sampled

The temporary wetland soil profiles sampled comprise dark grey-brown sand and loamy sand topsoils (orthic A horizon) overlying dark grey loamy sand subsoils with clear evidence of low to moderate abundances of small sized, distinct orange mottling from depths >30cm deep. The subsoils had matrix chromas of 2 or less (i.e. 7.5YE3/1 – 7.5YR3/2).

The seasonal soils sampled were located along the lower lying footslopes and comprise dark brown-grey sand and loamy sand topsoils (orthic A horizon) overlying dark grey sandy clay subsoils with clear evidence of moderately abundance, small-sized, distinct orange mottling from depths >20cm deep. The subsoils had matrix chromas of 1 (i.e. 7.5YE3/1 – 7.5YR4/1).

Most of the wetland comprises *Ficus trichopoda – Syzygium cordatum* swamp forest fringed with temporary hygrophilous grassland dominated by *Cyperus sphaerospermus* and *Imperata cylindrica*.

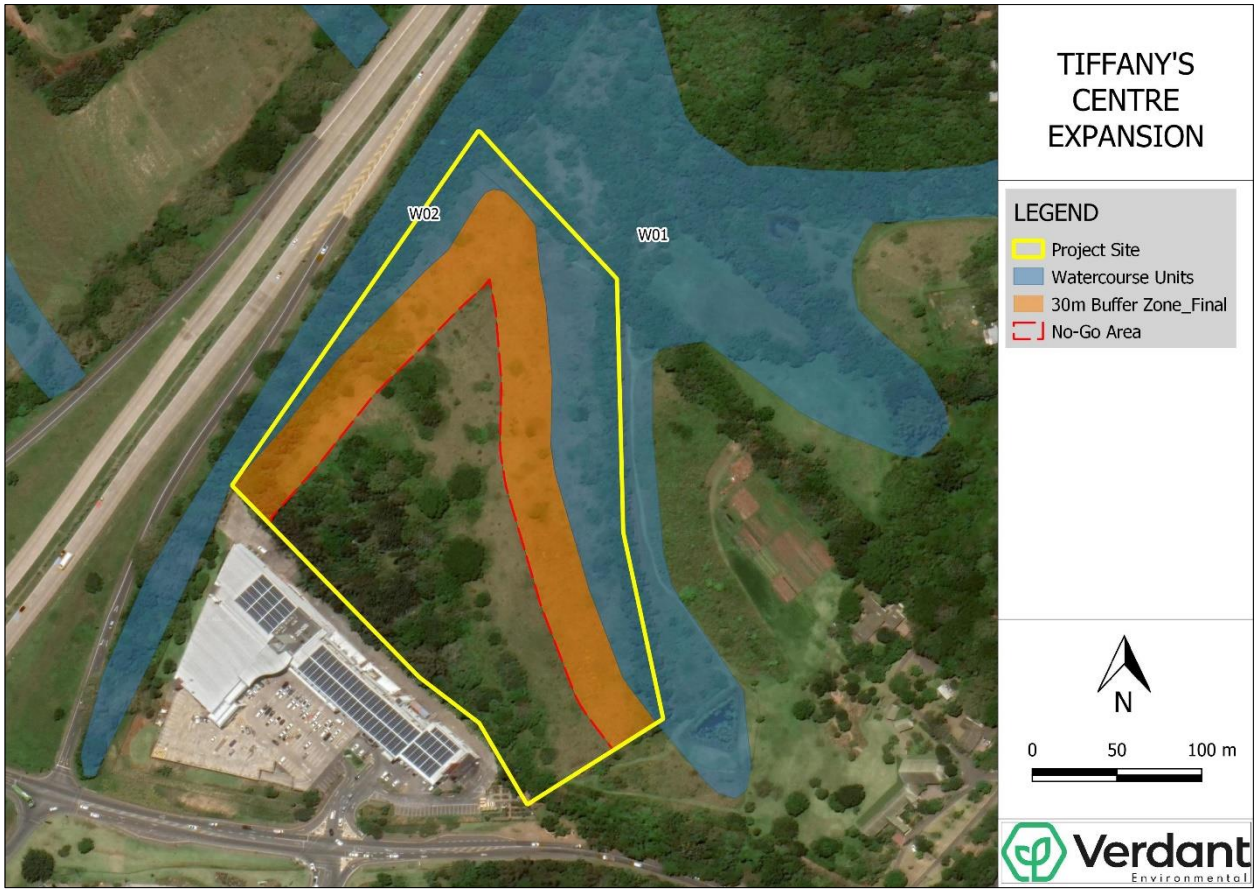

Figure 7. Delineated wetland units with 30m buffer zone.

Figure 8: View of hygrophilius grassland within the lower footslopes fringing the *Bridelia micrantha* woody vegetation in Unit W01.

Figure 9: View of the hygrophilous grassland on the gently sloping lower footslopes that border a corridor of swamp forest within the lowest lying areas in Unit W01.

Figure 10: View of the understorey of the early successional Bridelia micrantha swamp forest in Unit W01.

Figure 11: View of the *Ficus trichopoda* swamp forest and fringing grassland in Unit W02.

6. Results and Discussion: Present Ecological State (PES) Assessment

This section presents and discusses the results of the wetland PES assessment. PES is defined as a measure of the similarity or deviation from a natural or reference state (Macfarlane et al., 2020).

The impact scores were interpreted using the PES categories and descriptions provided in Table 4 below.

Table 4. PES impact categories and descriptions for wetlands.

IMPACT CATEGORY	DESCRIPTION	IMPACT SCORE RANGE
None	No discernible modification or the modification is such that it has no impact on wetland integrity.	0-0.9
Small	Although identifiable, the impact of this modification on wetland integrity is small.	1-1.9
Moderate	The impact of this modification on wetland integrity is clearly identifiable but limited.	2-3.9
Large	The modification has a clearly detrimental impact on wetland integrity. Approximately 50% of wetland integrity has been lost.	4-5.9
Serious	The modification has a clearly adverse effect on this component of habitat integrity. Well in excess of 50% of the wetland integrity has been lost.	6-7.9
Critical	The modification is present in such a way that the ecosystem processes of this component of wetland health are totally / almost totally destroyed.	8-10

Both wetland units were assessed as being moderately modified (PES Class C) as summarised in Table 5 below. The key impacts are as follows:

- Unit W01:

- Catchment impacts of cultivation.
- Direct impacts of the establishment of a dirt road within the hygrophilous grassland.
- Deep flooding and infilling of wetland for the establishment of a dam at the head of the wetland.
- Low levels of central channel erosion.
- Low to moderate densities of alien invasive plant invasion in wetland.

- Unit W02:
  - Catchment hardening impacts and stormwater impacts of existing Tiffany's Centre and N2 highway.
  - Historical direct impacts of the establishment of the adjacent N2 highway.
  - Low levels of central channel erosion.
  - Low to moderate densities of alien invasive plant invasion in wetland.

Table 5: Summary of the impact scores for the wetland units.

Units	Hydrology	Geo-morphology	Water Quality	Vegetation	Overall Impact Score	Habitat PES Class
W01	2.9	2.5	1.0	3.9	**2.6**	**C: Moderate**
W02	3.4	2.6	3.2	3.4	**3.2**	**C: Moderate**

7. Results and Discussion: Ecosystem Services Assessment

This section discusses the results of the wetland ecosystem service assessment. Ecosystem services are broadly defined as the benefits people obtain from ecosystems (Kotze *et al*., 2020). A broader definition is that they are all the aspects of ecosystems utilized (actively or passively)

to produce human well-being (Kotze *et al*., 2020). The ecosystem services scores were interpreted using the categories and descriptions provided in Table 6, below.

Table 6. Ecosystem services importance categories and descriptions.

Score	Supply/Demand/Importance Ratings	Importance Description
0.0 – 0.5	Very Low	Not important
0.6 – 1.0	Low	Low importance
1.1 – 1.5	Moderately-Low	Mild importance
1.6 – 2.4	Moderate	Moderately important
2.5 – 2.9	Moderately-High	Important
3.0 – 3.4	High	Very/highly important
3.5 – 4.0	Very High	Critically important

Wetland Unit W01:

The importance scores and ratings for the ecosystem services provided wetland unit W01 assessed is summarised in Table 7 below.

The wetland unit was assessed as being of moderate importance in terms of biodiversity maintenance. This is due to the presence of moderately degraded but intact swamp forest and hygrophilous grassland ecosystems that are critically endangered nationally.

The rest of the regulating, provisioning and cultural services were all assessed as being of very low to low importance with carbon storage being the most important regulating service. The low importance for the regulating services is a result of the moderately-low supply and low demand. The low supply is driven by the small catchment size of the wetland and the resultant low water interception potential of the wetlands, as well as the temporary wetness of the wetland. The low importance for the provisioning and cultural services is a result of the very low demand for such services and lack of use of the wetlands in the local setting.

Table 7: Summary of the importance scores and ratings for regulating services for Unit W01.

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.1	0.6	0.0	Very Low
	Stream flow regulation	1.0	1.3	0.2	Very Low
	Sediment trapping	1.5	1.0	0.5	Very Low
	Erosion control	1.6	0.9	0.6	Very Low
	Phosphate assimilation	1.3	1.0	0.3	Very Low
	Nitrate assimilation	1.3	1.0	0.3	Very Low
	Toxicant assimilation	1.5	1.0	0.5	Very Low
	Carbon storage	1.4	2.7	1.3	Low
	Biodiversity maintenance	2.0	2.0	1.7	Moderate
PROVISIONING SERVICES	Water for human use	0.6	0.0	0.0	Very Low
	Harvestable resources	2.0	0.0	0.5	Very Low
	Food for livestock	2.0	0.0	0.5	Very Low
	Cultivated foods	2.1	0.0	0.6	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.5	0.0	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

Wetland Unit W02:

The importance scores and ratings for the ecosystem services provided wetland unit W02 assessed is summarised in Table 8 below.

The wetland unit was assessed as being of moderate importance in terms of biodiversity maintenance and carbon storage services. This is due to the presence of moderately degraded

but intact swamp forest and hygrophilous grassland ecosystems that are critically endangered nationally, and the predominance of woody vegetation and seasonally saturated soils where organic matter decomposition rates are diminished relative to dryland ecosystems.

The rest of the regulating, provisioning and cultural services were all assessed as being of very low to low importance with carbon storage being the most important regulating service. The low importance for the regulating services is a result of the moderately-low supply and low demand. The low supply is driven by the small catchment size of the wetland and the resultant low water interception potential of the wetlands. The low importance for the provisioning and cultural services is a result of the very low demand for such services and lack of use of the wetlands in the local setting.

Table 8: Summary of the importance scores and ratings for regulating services for Unit W02.

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.0	0.8	0.0	Very Low
	Stream flow regulation	1.7	1.3	0.8	Low
	Sediment trapping	1.5	1.0	0.5	Very Low
	Erosion control	1.6	1.3	0.8	Very Low
	Phosphate assimilation	1.3	2.0	0.8	Low
	Nitrate assimilation	1.4	2.0	0.9	Low
	Toxicant assimilation	1.5	2.0	1.0	Low
	Carbon storage	2.1	2.7	1.9	Moderate
	Biodiversity maintenance	1.9	2.0	1.7	Moderate
PROVISIONING SERVICES	Water for human use	0.6	0.0	0.0	Very Low
	Harvestable resources	2.5	0.0	1.0	Low
	Food for livestock	1.5	0.0	0.0	Very Low

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
	Cultivated foods	2.1	0.0	0.6	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.5	0.0	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

8. Results and Discussion: Ecological Importance and Sensitivity (EIS) Assessment

This section discusses the results of the Ecological Importance and Sensitivity (EIS) assessment. Ecological Importance (EI) is the expression of the importance of wetlands and rivers in terms of the maintenance of biological diversity and ecological functioning at a local and landscape level (Kotze et al., 2020). Ecological Sensitivity (S) refers to ecosystem fragility or the ability to resist or recover from disturbance (Kotze et al., 2020).

The wetland EIS scores were interpreted using the categories and descriptions provided in Table 9 below.

Table 9. Wetland EIS rating categories.

Score	EIS Rating	Importance Description
0.0 – 0.5	Very Low	Not important
0.6 – 1.0	Low	Low importance
1.1 – 1.5	Moderately-Low	Mild importance
1.6 – 2.4	Moderate	Moderately important
2.5 – 2.9	Moderately-High	Important
3.0 – 3.4	High	Very/highly important
3.5 – 4.0	Very High	Critically important

A summary of the wetland EIS scores and ratings is provided in Table 10. Both wetland units were assessed as being of moderate EIS driven by a the presence of moderately degraded but intact swamp forest and hygrophilous grassland.

Table 10. Summary of EIS scores and overall EIS rating for the wetlands.

Units	Ecological Importance	Sensitivity	EIS Score	EIS Rating
W01	1.7	2.0	1.9	**Moderate**
W02	1.7	2.0	1.9	**Moderate**

9. Recommended Ecological Category (REC)

The recommended ecological category (REC) is the target or desired state of freshwater ecosystems required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES that is driven by the context / setting. The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the watercourse (Kleynhans & Louw, 2007). However, the causes related to a PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs for water resources is shown in Table 11, below.

Table 11. Generic matrix for the determination of REC for water resources.

			EIS			
			Very high	High	Moderate	Low
PES	A	Pristine/Natural	A Maintain	A Maintain	A Maintain	A Maintain
	B	Largely Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good - Fair	B Improve	B/C Improve	C Maintain	C Maintain
	D	Poor	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Very Poor	D Improve	E/F Improve	E/F Maintain	E/F Maintain

Based on the above matrix (Table 11), PES is generally at REC (Table 12). The regional management objective for all watercourses within and downstream of the study area would be to 'maintain PES and functioning. Any direct and indirect negative impacts as a result of the proposed development activities would be undesirable from a water resource management perspective and therefore the management objective must be to ensure that the project impacts are mitigated such that the current supply of ecosystem services remains the same.

Table 12. REC and RMO for the wetland units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
W01	C	Moderate	C	Maintain
W02	C	Moderate	C	Maintain

10. Impact Mitigation and Management Plan

This section outlines the planning and design mitigation measures recommended to avoid and reduce / minimize potentially significant freshwater ecosystem impacts.

'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a

result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on freshwater ecosystems is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected.

10.1. Project Planning and Design Measures

10.1.1. No-Go Areas and Buffer Zone Determination

'Buffer zones' (also termed development "set-backs") are essentially strips of vegetated undeveloped land typically designed to act as a protective barrier between human activities and sensitive habitats such as wetlands, rivers and forests. Research shows that buffer zones are useful at performing a wide range of functions such as sediment trapping and nutrient retention, and in doing so, play an important role in protecting water resources from the adverse impacts that are typically associated with various land-uses and developments. Although there are no legislative requirements regarding the establishment of buffers around water resources in the South African legislation, the application of buffers is aligned with the principles of the National Water Act (1998), which is to provide for the sustaining of water quality and preserving natural aquatic habitats and ecosystem functions.

According to the draft Guidelines for Biodiversity Impact Assessment in KZN (EKZNW, 2011), a standard buffer width of 30m from the outer edge of the delineated wetland areas is recommended in the Province of KZN, often irrespective of site conditions and development/land use type. The guideline document goes on to recommend that the determination of ecological buffers should rather be based on several site-specific factors. A national protocol for buffer determination around rivers, wetlands and estuaries has recently been developed (Macfarlane & Bredin, 2016) and represents emerging best-practice in aquatic buffer zone determination. Using this protocol, the minimum buffer zone width to ensure that adjacent development impacts are minimized was calculated to be 30m. The recommended freshwater ecosystem no-go zone is thus the wetlands and the 30m buffer zone within the project site, as shown in Figure 7, earlier.

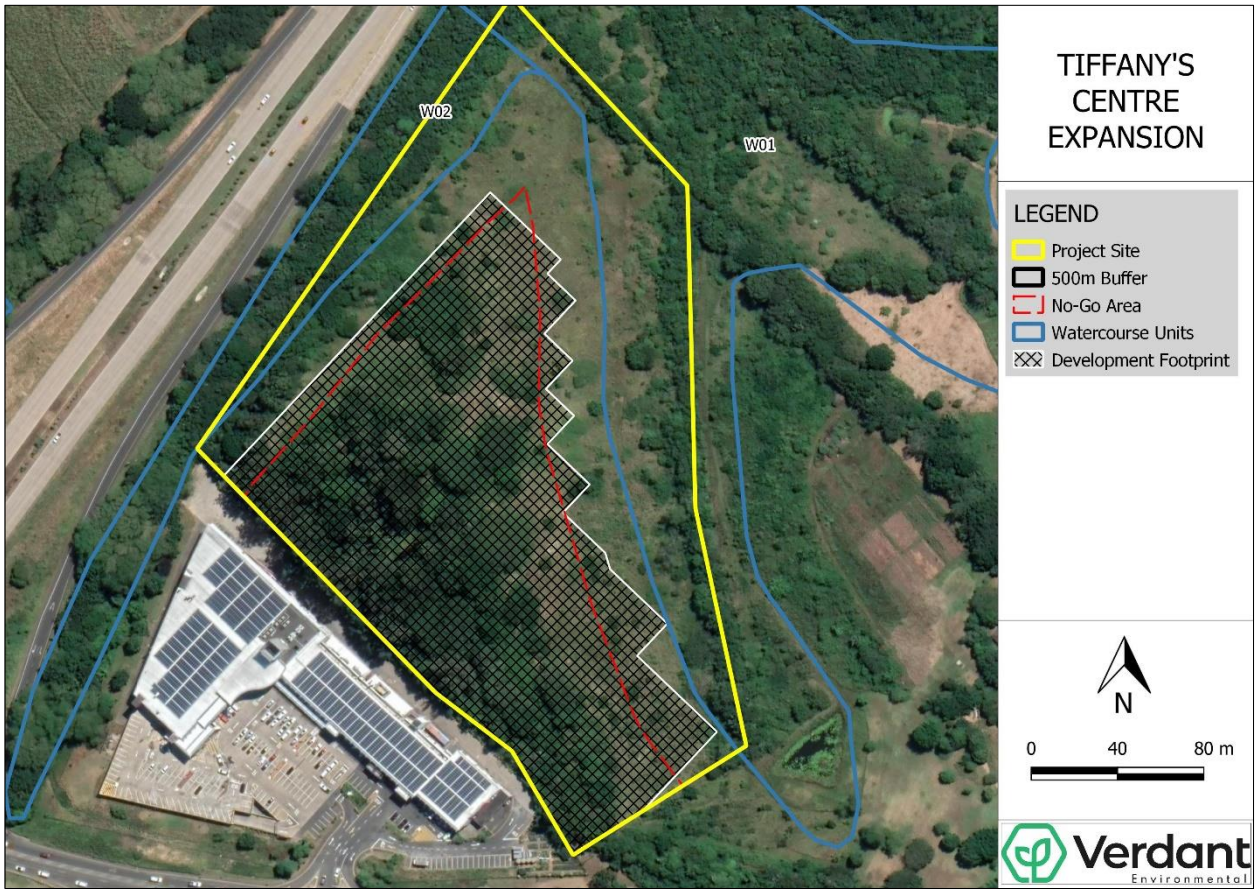

Figure 12. Development footprint in relation to delineated wetland and 30m buffer zone.

10.1.2. Application of the Mitigation Hierarchy

The mitigation hierarchy is a framework to enable environmental considerations to be incorporated meaningfully into the development planning process. This is achieved by chronologically applying four principles in a stepwise manner, namely: 1. Avoid, 2. Minimise, 3. Rehabilitate, and 4. Offset, as outlined in Figure 13. The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology and phasing until the proposed development can best be accommodated without incurring significant negative impacts to the receiving environment.

The protection of water resources (wetlands & rivers/streams) begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the

form of reactive practical actions that minimizes or reduces such impacts. Driver et al. (2011) recommend that the management of freshwater ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging.

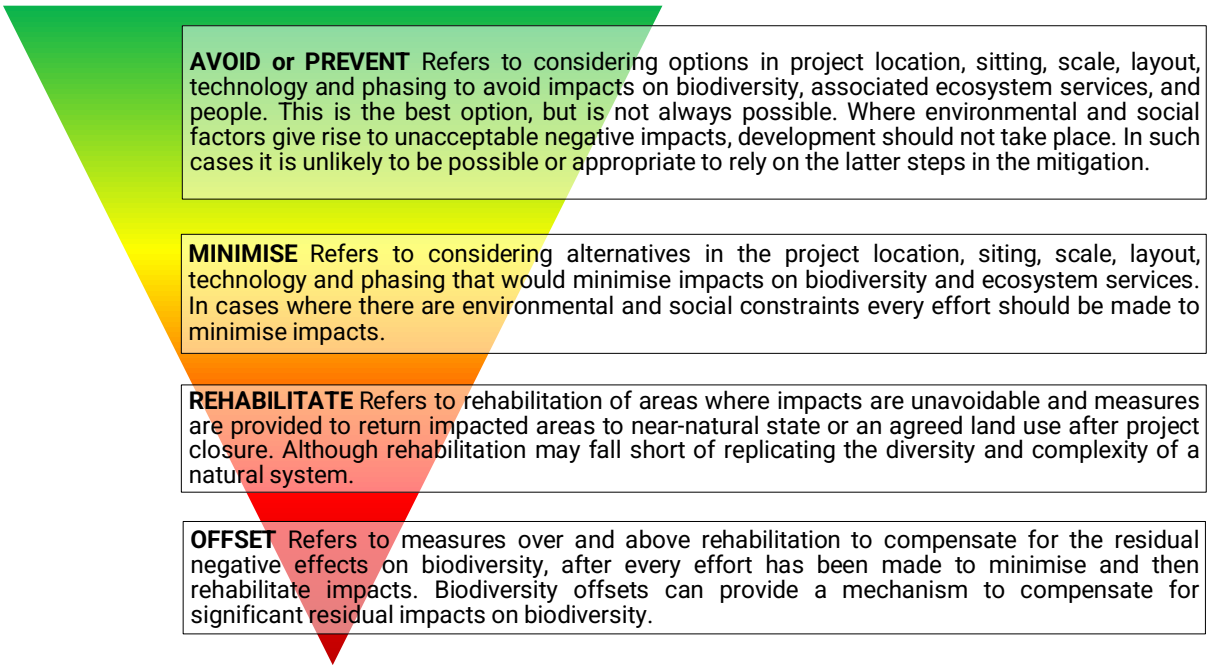

Figure 13. Diagram illustrating the 'mitigation hierarchy' (Eco-Pulse, 2019; DEA et al., 2013).

The draft site development plan shown in Figure 1 (URBIS Architects dated 20/06/2022, Dwg. No.: SK02-01) and the development footprint in Figure 12 shows measurable buffer zone encroachment. It is not best practice to propose encroachment into the recommend freshwater no-go areas without meaningfully considering alternatives that avoid the no-go areas upfront on the planning process. To assist with guiding this process, following planning measures are listed in chronological order of investigation in line with the mitigation hierarchy:

Step 1: Avoidance:

- Adhere to the no-go area and buffer zone recommendations provided in Section 10.1.1 above.

- All stormwater attention facilities and outlets must be located outside of the wetlands and buffer zones.

Step 2: Minimisation:

Where avoidance of direct impacts cannot be achieved for well-substantiated reasons:

- Direct impacts:
  - Encroachment should only occur within the buffer zones and where such encroachment occurs, a minimum 15m buffer zone must still be maintained.
  - Where there is buffer encroachment, such loss of buffer functions should be compensated for through the implementation of additional construction phase and operational stormwater, erosion and sediment management measures.
- Indirect impacts:
  - Implement best practice controls and mitigation measures during the construction phase.
  - Implement best practice stormwater management, pipeline watercourse crossing and road watercourse crossing design and operation.

Step 3: Remediation:

Direct and indirect impacts to watercourses because of planned and approved encroachment / working in watercourses must be rehabilitated.

- Indirect erosion and sedimentation impacts to watercourses during the construction and operational phases must be rehabilitated.
- Any accidental river and wetland encroachment and loss during the construction and operational phases should be rehabilitated.

Step 4: Offset:

Not applicable to this project provided no wetland infilling and loss is proposed that presents a medium / moderate significance impact or higher.

10.1.3. Stormwater Management

When developing a stormwater management plan for the site, it will be critical that due consideration is given to the collection and treatment of stormwater prior to discharge into the natural environment. It is therefore recommended that the stormwater management plan be developed with appropriate ecological input and be developed based on Sustainable Drainage Systems (SUDS). The following best practice stormwater management design measures are recommended based on our understanding of the soils, geology and sensitivity of the site:

- Rainwater harvesting and storage should take place onsite and runoff from roofs should be collected in closed-top tanks or landscaped features for irrigation and non-potable purposes.
- Al stormwater runoff generated by the proposed development during all design storm events (1:1yr – 1:100yr) should be attenuated within the development footprint to pre-development levels prior to discharge to the freshwater environment.
- Where 100% attenuation onsite / within the development platform footprint is not feasible for well substantiated reasons, consideration would be given to the establishment of attenuation structures below the outlets (and within buffer zones) but not within the wetlands.
- As the wetlands are laterally fed by subsurface flows, runoff infiltration onsite must be maximised. Recommended infiltration structures include underground storage tanks, bioretention areas and unlined detention basins, infiltration basins, and grassed swales. Contour infiltration swales will be important.
- In terms of general stormwater conveyance, stormwater runoff generated by developed and hardened surfaces should be directed into, and conveyed by, open, impermeable[1] swales rather than into underground piped systems or concrete V-channels wherever feasible and practical. These features should be well vegetated with appropriate species and stabilised by means of gabion or concrete check walls to prevent erosion and vertical incision. This will provide for some filtration and removal of urban pollutants (e.g. oils and hydrocarbons), provide some attenuation by increasing the time runoff takes to reach low

[1] Feedback from civil engineers indicates that no infiltration will be allowed within/on the platform.

points, and reduce the energy of storm water flows within the stormwater system through increased roughness when compared with pipes and concrete V-drains.

- Many smaller stormwater outlets must be favoured over a few large outlets. This also applies to roads.
- All stormwater discharge must be via formal outlets with headwalls and appropriately designed end-of-pipe energy dissipation and erosion reduction measures. Such outlets must tie into the infiltration structures.
- All outlets must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. In this regard, suitably designed energy dissipation (e.g. stilling basins) and erosion protection structures (Reno-mattresses) will need to be installed at appropriate locations. Pre- and post-discharge velocities at each outlet should be calculated to inform the appropriate design of the energy dissipation and erosion protection measures.
- All outlet erosion protection measures (e.g. Reno-mattresses) must be established to reflect the natural slope of the surface and located at the natural ground-level.
- If subsoil drains are required, the following outlet design recommendations should be adhered to:
    - Level spreaders must be installed at all subsoil drain outlets.
    - The level spreaders must be designed to accommodate the predicted flow velocities and, in this regard, the predicted flow velocities at each outlet must be calculated / estimated.
    - Alternatively, the outlets could feed into the infiltration channels.
- Measures to capture solid waste and debris entrained in stormwater runoff must be incorporated into the design of the system and should include the use of either curb inlet/inlet drain grates and/or debris baskets/bags.
- All stormwater generated by parking areas and/or washing areas must receive basic filtering and treatment onsite prior to discharge into the freshwater environment. Furthermore, all treatment should occur within the development footprint. Recommended filtering interventions include: soap, oil and grease traps (SOGTs), oil-water separators and/or sand filter traps. These structures will require regular maintenance by the site owners / operators. In this regard, a 'first-flush' system should also be investigated.

- In order to function adequately, it is critically important that the onsite stormwater system be regularly maintained over time. Key maintenance will include litter and sediment clearing and the servicing and maintenance of key collection points like catch pits, filtering devices (e.g. SOGTs and oil-water separators), detention tanks etc. Such maintenance should be the responsibility of the mall operator and budgeted for accordingly.

10.1.4. Sewer Pipeline Design Recommendations

- The number of watercourse sewer pipeline crossings must be minimised as far as practically possible and crossings of important systems should be avoided.
- All pipeline crossings must be aligned and designed to minimise the extent of instream, riparian and wetland habitat directly impacted by construction activities. In this regard the pipeline crossings should be aligned at right angles to flow and along existing or planned areas / corridors of disturbance.
- For stream, river and channelled pipeline crossings:
    - The pipeline crossings should be via pipe bridge or attached to / include in the road crossing structures to avoid having to trench the watercourses.
    - Pipe bridges must be designed such that pipes are suspended sufficiently high above the channel bed and above the high-water mark so as not to interfere with natural flow regimes and such that pipes do not act as traps for debris and sediment transported through the channel.
    - Pipe bridge piers should be places on either side of the watercourse for smaller rivers/streams and not to be placed within the channel bed. Piers should be placed with enough distance up the bank (preferably on the top of the upper bank) and not below the water mark/bank full level.
- For wetland crossings:
    - Pipelines should be installed below the natural surface and encased with concrete to limit operational risks. However, where there are opportunities to attach to / include pipelines in the road crossing structures, these must be investigated.
    - The pipelines and associated embedment material must be established below the wetland and preferential seepage area subsurface flow / interflow zone to ensure

that it does not act as barrier or impediment to such flow (in the case of the pipeline) or an alternative flow conduit (in the case of permeable embedment material).

  - Buried pipelines within watercourses will need to be protected to minimise the risk of damage or leakage. This means typically encasing the pipe in concrete or other suitable resistant material.

- All pipeline joins within watercourses must be sealed i.e. welded.
- No sewer manholes or pump stations must be established within wetlands, rivers and riparian zones.
- Pump stations should be located outside of the 1:100 year floodline.
- A minimum 30m buffer zone should be established between wetlands and manholes. If this cannot be adhered to for substantiated technical reasons, a minimum 15m buffer zone must be established between wetlands and manholes and the following additional mitigation measures applied:
  - All sewer manholes occurring within 15m of any watercourses must be sufficiently sealed to ensure that surcharge events do not occur if there is a blockage.
  - For all sewer manholes within 30m but outside of 15m of any watercourse, permanent surcharge containment / emergency storage measures must be installed e.g. earthen bund, concrete box. In addition, these manholes should be raised by 1 metre to improve backup storage capacity if required.
- Ideally manholes should be located outside of the 1:100 year floodline. If this is unavoidable for substituted reasons the manholes must be sufficiently sealed.
- To reduce the risk of surcharging sewer manholes onsite and downstream, a form of gully trap should be installed at or before the connection of the various components of the development with the main line. This gully trap will block foreign objects from entering the main internal line of the site and isolate blockage problems at the source.
- All pump stations should have at least 24 hours emergency storage capacity (freeboard) to ensure that surcharge and overflow events are avoided. This should ensure that the municipal workers have sufficient time to address the issues before the emergency storage facility is full.

10.1.5. Water Pipeline Design Recommendations

- The number of watercourse pipeline crossings must be minimised as far as practically possible, and crossings of important systems should be avoided.
- All pipeline crossings must be aligned and designed to minimise the extent of instream, riparian and wetland habitat directly impacted by construction activities. In this regard the pipeline crossings should be aligned at right angles to flow and along existing or planned areas / corridors of disturbance.
- For stream, river and channelled pipeline crossings:
    - The pipeline crossings should be via pipe bridge or attached to / include in the road crossing structures to avoid having to trench the watercourses.
    - Pipe bridges must be designed such that pipes are suspended sufficiently high above the channel bed and above the high-water mark so as not to interfere with natural flow regimes and such that pipes do not act as traps for debris and sediment transported through the channel.
    - Pipe bridge piers should be places on either side of the watercourse for smaller rivers/streams and not to be placed within the channel bed. Piers should be placed with enough distance up the bank (preferably on the top of the upper bank) and not below the water mark/bank full level.
- For wetland crossings:
    - Pipelines should be installed below the natural surface and encased with concrete to limit operational risks. However, where there are opportunities to attach to / include pipelines in the road crossing structures, these must be investigated.
    - The pipelines and associated embedment material must be established below the wetland and preferential seepage area subsurface flow / interflow zone to ensure that it does not act as barrier or impediment to such flow (in the case of the pipeline) or an alternative flow conduit (in the case of permeable embedment material).
- Buried pipelines within watercourses will need to be protected to minimise the risk of damage or leakage. This means typically encasing the pipe in concrete or other suitable resistant material.

- All pipeline joins within watercourses must be sealed i.e. welded.

10.2. Formal Onsite Wetland Rehabilitation and Management

A formal and detailed wetland rehabilitation plan must be developed for the project. This plan should include but not be limited to the following measures.

- All foreign material deposited / placed within the wetland must be removed and the original wetland surface re-exposed and reshaped.
- Engineered control structures and interventions should be designed by a suitably experienced rehabilitation engineer in conjunction with a wetland ecologist. The objectives of these structures should be to maximise the extent and retention times of the wetland.
- An invasive alien plant control plan must form part of the rehabilitation plan.
- Re-vegetation should be via active planting of desirable obligate wetland plants as sods and plugs to suite the desired wetland hydroperiod.
- A formal and detailed wetland management plan must be developed for the project. An annual budget must be allocated to the management of the wetland in perpetuity.

10.3. Construction Phase

The following mitigation measures must be implemented in conjunction with any generic measures provided in the Environmental Management Programme (EMPr).

10.3.1. Demarcation of 'No-Go' areas and construction corridors

- The no-go area for the construction phase is the final approved wetland buffer zone in line with the approved SDP (i.e 15m). All areas within the buffer zone must be considered no-go areas.
- Prior to the commencement of any construction activities, the 15m wetland buffer zone must be staked out by a surveyor and demarcated using brightly coloured shade cloth.

- Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project.
- The demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- The demarcations are to remain until construction and rehabilitation is complete.

10.3.2. Method Statements for working in watercourses

Method statements for all work within wetlands must be compiled.

10.3.3. Runoff, erosion and sediment control

- Wherever possible, existing vegetation cover on the development site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- Sediment barriers (e.g.: silt fences/sandbags/hay bales) must be installed immediately downstream of active work areas (including soil stockpiles) as necessary to trap any excessive sediments generated during construction.
- All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2m) to break the energy of surface flows.
- Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
- If re-vegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.

- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.
- Regular maintenance of any sediment control dams must be undertaken during the construction / establishment period to ensure that these structures continue to function appropriately.

10.3.4. Hazardous substances / materials management

- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 30m of any watercourse.
- No vehicles transporting concrete, asphalt or any other bituminous product may be washed on site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period following the appropriate SANS codes. The bund wall should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.

- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.

10.3.5. Invasive Alien Plant control

- All alien invasive vegetation that colonise the construction site must be removed, preferably by uprooting. The contactor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for IAPs every two weeks and IAPs removed by hand pulling/uprooting and adequately disposed.
- Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in wetlands by independent testing authority are to be used. The ECO must be consulted in this regard. The herbicide contractor must be certified to apply/utilise the herbicide in question.

10.3.6. Noise, dust and light pollution minimisation

- Temporary noise pollution due to construction works should be minimized by ensuring the proper maintenance of equipment and vehicles and tuning of engines and mufflers as well as employing low noise equipment where possible.
- Water trucks will be required to suppress dust by spraying water on affected areas producing dust. This will likely be required daily in the drier months or during dry periods.
- No lights must be established within the construction area near the watercourses and buffer zones.

10.3.7. Prohibitions related to animals

- The handling and/or killing of any animal species present is strictly prohibited and all staff/personnel must be notified of such incidents.
- Wetland fauna (e.g. snakes, frogs, small mammals) that are encountered during the construction phase must be relocated to other parts of the wetland under the guidance of the EO or ECO.
- Poaching/snaring is strictly prohibited.

10.3.8. General rehabilitation guidelines

- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.
- All land impacted by the proposed development must be rehabilitated by undertaking the following general tasks:
    - All foreign material must be removed from site.
    - Land must be regraded / re-shaped and topsoils must be reinstated.
    - Compacted soils must be adequately ripped/loosened where compacted, as informed by the ECO.
    - Re-vegetation should take place as follows:
        - For any permanently and seasonally saturated areas - via active planting of sods and plugs as advised a wetland ecologist.
        - For temporary and dryland areas - via hydroseeding using an appropriate indigenous seed mix as advised by a qualified ecologist.

10.3.9. Construction phase monitoring measures

- Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EO's (Environmental

Officers) having the required competency skills and experience to ensure that monitoring is undertaken effectively and appropriately.

- A photographic record of the state of the onsite wetlands prior to the commencement of clearing/construction must be kept for reference and rehabilitation monitoring purposes.
- The ECO must undertake bi-monthly compliance monitoring audits. Freshwater ecosystem aspects that must be monitored related to monitoring freshwater ecosystem impacts include:
    - The condition of the demarcation fence.
    - Evidence of any no-go area incursions.
    - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures.
    - Evidence of sedimentary deposits / plumes and elevated rates of sedimentation (i.e. vegetation smothering / burial).
    - Evidence of elevated river / stream turbidity levels.
    - Evidence of gully or bed/bank erosion.
    - Visual assessment of stormwater quality and instream water quality.
    - The condition of waste bins and the presence of litter within the working area.
    - Evidence of solid waste within the no-go areas.
    - Evidence of hazardous materials spills and soil contamination.
    - Presence of alien invasive and weedy vegetation within the working area.
    - Rehabilitation and re-vegetation methods and success.
- Once the construction and rehabilitation has been completed, the ECO should conduct a close out site audit 1 month after the completion of rehabilitation.

10.4. Operational Phase

10.4.1. Maintenance and management

- It is the applicant's responsibility to ensure the proper functioning of infrastructure that is likely to require regular on-going maintenance. This includes the stormwater management infrastructure, road infrastructure, water infrastructure and sewerage infrastructure.

- It is important that the location and extent of the wetlands in the vicinity of project activities be incorporated into all formal maintenance and repair plans for the project.
- In terms of management, alien invasive plant control must be practiced on an on-going basis in line with the requirements of Section 2(2) and Section 3 (2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on their property.

10.4.2. Monitoring

It will be important that long-term monitoring of the potential freshwater ecosystem impacts be undertaken to proactively to identity any environmental issues and impacts that may arise as a result of the operational phase of the project. The following key aspects should be monitored:

- Rehabilitation monitoring - structure stability and effectiveness;
- Erosion and/or sedimentation in the onsite and downstream wetlands;
- Presence of alien invasive plants; and
- Water quality and evidence of pollution.

11. Impact Assessment

This section deals with the assessment of the construction and operational and phase impacts of the project on local freshwater ecosystems.

11.1. Activities and Impacts Assessed

The activities requiring assessment for this study and the associated potential impacts are summarised in Table 13, on the next page.

11.2. Key Assumptions

The following assumptions apply to the impact assessment:

- The realistic good mitigation scenario assumes the following:
    - The site plan as shown in **Annexure A** will be developed and include buffer encroachment.
    - The planning and design measures recommended in Section 10.1 will be adhered to except for the proposed buffer zone encroachment. If any of the recommended mitigation measures provided in Section 10.1 cannot be adhered to, the impact and risk assessments will need to be revised.
    - No sewer and water pipelines will cross wetlands or rivers.

Table 13. Summary of impacts assessed for each of the project activities.

Activities	Impact Group	Impact Description
C1. Construction activities – Catchment slope and wetland buffer zone stripping and grubbing, earthworks within wetland buffers and near to wetlands, hazardous material management, stormwater management, erosion and sediment control, land reshaping and rehabilitation / re-vegetation.	C1-1: Direct ecosystem destruction and modification impacts	• No planned direct impacts to wetlands are proposed. • Accidental disturbance / infilling of wetlands due to poor no-go area demarcation and/or poor environmental management practices.
	C1-2: Indirect hydrological and geomorphological impacts	• Erosion and/or sedimentation of wetlands due to poor stormwater management and erosion and sediment control within the construction area. • Gully erosion and/or channel incision within wetlands with associated reduced saturation levels and alteration of vegetation communities and habitat. • Smothering and burial of vegetation and alteration of hydrological and vegetation characteristics. • Reduced subsurface water inputs as a result of land clearing and compaction within the development footprint that consists of a large proportion of the wetland's catchment that includes the deep recharge zones and interflow zones as defined by Eco-Assist (2022). In addition, the current site plan in Annexure A indicates that substantial buffer encroachment is planned along the eastern boundary of Unit W01.
	C1-3: Water quality impacts	• Pollution of wetlands on the site and possibly also downstream, due to the mishandling of hazardous substances and/or improper maintenance of machinery during construction (e.g. oil and diesel leaks and spills). • Any erosion leading to sedimentation of rivers and wetlands onsite/downstream could also lead to raised water turbidity and suspended solids concentrations, also affecting water quality.
	C1-4: Fragmentation and ecological disturbance impacts	• Increased alien invasive plant invasion. • Reduced wetland patch size and modified wetland/riverine ecological connectivity. • Expanded / more intense edge impacts could occur as a result of buffer zone encroachment, deterioration in vegetation quality

Activities	Impact Group	Impact Description
		and cover and the potential for increased alien invasive plant invasion due to disturbance causing activities near wetlands. • Noise pollution and vibrations associated with earthworks and the use of heavy machinery could affect local wildlife (birds, amphibians and small mammals especially).
O1: Operation of activities – use of platforms as per approved land use type, operation and management of stormwater management system, maintenance and repairs, open space management.	O1-1: Direct ecosystem destruction and modification impacts	• Accidental direct impacts to wetland habitat and vegetation by heavy machinery during repair and maintenance activities.
	O1-2: Indirect hydrological and geomorphological impacts	• Increase in hardened surfaces and stormwater runoff volumes via point source discharges. This could lead to increased flood peaks through wetlands if peak flows are not properly attenuated, and increased velocities of mean and peak flows. Such increased discharges and velocities could result in channel erosion and the widening and deepening of the existing channels within the wetlands with associated impacts to wetland PES and the supply of ecosystem services. • Reduced subsurface water inputs as a result of the hardening and sealing of a large proportion of the wetland's catchment that includes the deep recharge zones and interflow zones as defined by Eco-Assist (2022). This could lead to a reduction in subsurface water inputs and interflows and reduced wetland soil saturation levels. In addition, the current site plan in Annexure A indicates that substantial buffer encroachment is planned along the eastern boundary of Unit W01. • Erosion and/or sedimentation of wetlands due to the accidental rupture of water and/or sewerage pipelines near the wetlands.
	O1-3: Water quality impacts	• Discharge of runoff contaminated by hydrocarbons, oils, detergents and other urban contaminants from the commercial land use. • Sewage pollution due to the accidental rupture of sewerage pipelines near the wetlands.
	O1-4: Fragmentation and ecological disturbance impacts	• Increased alien invasive plant invasion. • Increased wetland fragmentation and reduced ecological connectivity due to reduced wetland buffer zone.

Activities	Impact Group	Impact Description
		• Expanded / more intense edge impacts could occur as a result of wetland buffer zone encroachment, deterioration in vegetation quality and cover and the potential for increased alien invasive plant invasion due to disturbance causing activities near wetlands. • Light pollution ecological impacts. • Noise pollution ecological impacts.

11.3. Impact Significance Assessment

The results of the impact significance assessment are summarised in Table 14 below.

Under the poor mitigation scenario, four (4) impacts were assessed as being of moderate significance, namely:

- C1-2: Erosion and sedimentation of intact wetlands as a result of poor stormwater management and erosion and sediment control during the construction phase. A one class drop in PES and reduced ecosystem services are predicted.
- O1-2: Erosion and sedimentation of intact wetlands as a result of increased runoff volumes and velocities being discharged by the stormwater system, and the alteration of subsurface interflow zones that feeds Unit W01 and reduced water inputs. A one to two class drop in PES and reduced ecosystem services are predicted.
- O1-3: Water quality impacts of the discharge of untreated and unfiltered runoff from the development site. A one class drop in PES and reduced ecosystem services are predicted.
- O1-4: Ecological connectivity and fragmentation impacts of the development of relatively large proportion of the wetland catchment and buffer zone. A one class drop in PES and reduced ecosystem services are predicted.

The rest of the impacts were assessed as being of low to moderately-low significance under a poor mitigation scenario and are acceptable impacts that require duty of care measures.

With the effective and stringent implementation of the mitigation measures recommended in this report, Impacts C1-2, O1-3 and O1-4 can be reduced to low to moderately-low significance. Key mitigation measures include strict measures to establish sediment barriers and traps prior to construction and clearing commencing, and that areas under earthworks and incomplete platforms slope away from the watercourses rather than towards so that runoff is taken westwards to the cut-face and then managed to ensure discharge is even across the slope and low energy.

The significance of Impact O1-2 under the good mitigation scenario remains moderate due to the unavoidable alteration of the subsurface interflow zone that feeds Unit W01 and the encroachment into the buffer zone that negates opportunities to establish infiltration zones across the toe of the platform along the length of the wetland unit. Thus, a section of wetland is likely to experience measurably reduced water inputs and soil saturation rates. The residual moderate impact is not a fatal flaw but likely requires compensation.

To further reduce the significance of Impact O1-2, it is recommended that development be pulled back from the wetland edge and that a minimum 15m buffer be established that can be used as an engineered infiltration zone that can mimic the altered interflow zone. The applicant has confirmed that a minimum 15m buffer will be maintained and the latest SDP reflects this.

Alternatively, onsite wetland rehabilitation may be required to compensate for PES reduction and reduced ecosystem services. A wetland specialist will need to investigate the rehabilitation opportunities.

Table 14. Summary of impact significance assessment ratings for the additional impacts of the revised plan.

Phase	Impacts	Intensity	Extent	Duration	Probability	Reversibility	Irreplaceable Loss of Resources	Significance
'Poor' Mitigation Scenario								
Construction	C1-1: Direct ecosystem destruction and modification impacts	Site	Moderate	Medium-term	Possible	Partly reversible	No loss of resource	**Low**
	C1-2: Indirect hydrological and geomorphological impacts	Local	Moderate	Long-term	Definite	Partly reversible	Significant loss of resources	**Moderate**
	C1-3: Water quality impacts	Local	Moderate	Medium-term	Probable	Reversible	No loss of resource	**Moderately-Low**
	C1-4: Fragmentation and ecological disturbance impacts	Local	Moderate	Medium-term	Definite	Partly reversible	Marginal loss of resource	**Moderately-Low**
Operation	O1-1: Direct ecosystem destruction and modification impacts	Site	Moderate	Long-term	Probable	Partly reversible	No loss of resource	**Low**
	O1-2: Indirect hydrological and geomorphological impacts	Local	Moderate	Long-term	Definite	Barely reversible	Significant loss of resources	**Moderate**
	O1-3: Water quality impacts	Local	Moderate	Long-term	Definite	Partly reversible	Marginal loss of resource	**Moderate**
	O1-4: Fragmentation and ecological disturbance impacts	Local	Moderate	Long-term	Definite	Barely reversible	Marginal loss of resource	**Moderate**
'Good' Mitigation Scenario								
Construction	C1-1: Direct ecosystem destruction and modification impacts	Site	Low	Short-term	Possible	Reversible	No loss of resource	**Low**
	C1-2: Indirect hydrological and geomorphological impacts	Surrounding Area	Moderate	Medium-term	Highly Probable	Partly reversible	Marginal loss of resource	**Moderately-Low**
	C1-3: Water quality impacts	Site	Low	Short-term	Possible	Reversible	No loss of resource	**Low**

Phase	Impacts	Intensity	Extent	Duration	Probability	Reversibility	Irreplaceable Loss of Resources	Significance
	C1-4: Fragmentation and ecological disturbance impacts	Surrounding Area	Moderately-Low	Medium-term	Definite	Partly reversible	Marginal loss of resource	**Low**
Operation	O1-1: Direct ecosystem destruction and modification impacts	Site	Low	Long-term	Possible	Reversible	No loss of resource	**Low**
	O1-2: Indirect hydrological and geomorphological impacts	Local	Moderate	Long-term	Definite	Barely reversible	Significant loss of resources	**Moderate**
	O1-3: Water quality impacts	Surrounding Area	Moderately-Low	Long-term	Probable	Partly reversible	Marginal loss of resource	**Low**
	O1-4: Fragmentation and ecological disturbance impacts	Surrounding Area	Moderate	Long-term	Definite	Partly reversible	Marginal loss of resource	**Moderately-Low**

11.4. Risk Matrix Assessment

It is our understanding that the purpose of the risk matrix tool developed by the DWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) to local and regional water resource quality. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services onsite and/or downstream of activities.

The results of the risk assessment for impacts to wetland ecosystems are shown in Tables 15, on the pages that follows.

The risk of Impacts C1-2, O1-2 and O1-4 were assessed as moderate under a good mitigation scenario due to the following factors:

- A large area of the wetland's catchment will be cleared and transformed.
- The eastern buffer zone to Unit W01 will be substantially reduced.
- The wetlands are predominately subsurface fed systems with a moderate EIS. The proposed development will result in the unavoidable alteration of the subsurface interflow zone that feeds Unit W01 and the encroachment into the buffer zone that negates opportunities to establish infiltration zones across the toe of the platform along the length of the wetland unit. Thus, a section of wetland is likely to experience measurably reduced water inputs and soil saturation rates.

For the rest of the impacts, the risks were assessed as low.

Table 15. Summary of the DWS 'Risk Assessment Matrix' results under a 'good' mitigation scenario.

No.	Phase(s)	Activity	Aspect (Stressor)	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction	Catchment slope and wetland buffer zone stripping and grubbing, earthworks within wetland buffers and near to wetlands, hazardous material management, stormwater management, erosion and sediment control, land reshaping and rehabilitation / re-vegetation.	C1-1: Physical Disturbance	1	1	1	1	**1**	1	2	**4**	3	1	5	1	**10**	**40**	**Low**
			C1-2: Erosive water or eroded sediment	1	1	1	1	**1**	2	2	**5**	3	3	5	2	**13**	**65**	**Moderate**
			C1-3: Pollutants	1	1	1	1	**1**	2	1	**4**	2	2	5	2	**11**	**44**	**Low**

No.	Phase(s)	Activity	Aspect (Stressor)	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
			C1-4: Ecological Disturbances / Nuisances	1	1	1	1	**1**	1	2	**4**	5	2	5	1	**13**	**52**	**Low**
2	Operation	Operation of activities – use of platforms as per approved land use type, operation and management of stormwater management system, maintenance and repairs, open space management.	O1-1: Physical Disturbance	1	1	1	1	**1**	1	2	**4**	2	2	5	1	**10**	**40**	**Low**
			O1-2: Erosive water & eroded sediment	1	1	2	1	**1.25**	2	2	**5.25**	3	3	5	2	**13**	**68.25**	**Moderate**

No.	Phase(s)	Activity	Aspect (Stressor)	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
			O1-3: Pollutants	1	1	1	1	**1**	1	2	**4**	3	2	5	3	**13**	**52**	**Low**
			O1-4: Ecological Disturbances / Nuisances	1	1	1	2	**1.25**	2	2	**5.25**	3	3	5	1	**12**	**63**	**Moderate**

12. Assumptions and Limitations

The following assumptions and limitations apply to this assessment:

- Although all watercourses occurring within 500m of the proposed activities were mapped at a desktop level, field investigations were confined to only those wetlands where an appreciable 'risk of potential impact' was determined.
- The mapping and classification of the watercourse units outside of the study area but occurring within a 500m radius of activities should be considered preliminary and coarse in resolution. These units were not verified in the field.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- Assessment of aquatic ecosystems were not undertaken.
- No sampling and analysis of surface and subsurface water quality was undertaken.
- The assessment of impacts is predictive and was based on the information and site development provided by the client. The 'realistic good mitigation scenario' impact significance and risk ratings and assessment outcomes assumes that all the mitigation measures recommended in Section 10 will be adhered to. However, the realistic good mitigation scenario assumes the development will take place as per the site plan as shown in Annexure A, which includes buffer encroachment.
- No stormwater management designs and plan was provided to the author for consideration. It is recommended at the designs and plan be submitted to the author for review prior to the finalization of this assessment.
- No civil engineering services designs and plan was provided to the author for consideration (with exception of the stormwater management plan). It is recommended at the designs and plan be submitted to the author for review prior to the finalization of this assessment.

13. Conclusion

The proposed development is predicted to result in moderately significant impacts to the local seep wetlands that are in a fair to moderately degraded ecological condition (PES Class C) and have a moderate EIS owing to the wetlands having intact swamp forest and hygrophilous grassland that is critically endangered. Under the poor mitigation scenario, four (4) impacts were assessed as being of moderate significance, namely:

- C1-2: Erosion and sedimentation of intact wetlands as a result of poor stormwater management and erosion and sediment control during the construction phase. A one class drop in PES and reduced ecosystem services are predicted.
- O1-2: Erosion and sedimentation of intact wetlands as a result of increased runoff volumes and velocities being discharged by the stormwater system, and the alteration of subsurface interflow zones that feeds Unit W01 and reduced water inputs. A one to two class drop in PES and reduced ecosystem services are predicted.
- O1-3: Water quality impacts of the discharge of untreated and unfiltered runoff from the development site. A one class drop in PES and reduced ecosystem services are predicted.
- O1-4: Ecological connectivity and fragmentation impacts of the development of relatively large proportion of the wetland catchment and buffer zone. A one class drop in PES and reduced ecosystem services are predicted.

The rest of the impacts were assessed as being of low to moderately-low significance under a poor mitigation scenario and are acceptable impacts that require duty of care measures.

With the effective and stringent implementation of the mitigation measures recommended in this report, Impacts C1-2, O1-3 and O1-4 can be reduced to low to moderately-low significance. Key mitigation measures include strict measures to establish sediment barriers and traps prior to construction and clearing commencing and that areas under earthworks and incomplete platforms slope away from the watercourses rather than towards so that runoff is taken

westwards to the cut-face and then managed to ensure discharge is even across the slope and low energy.

The significance of Impact O1-2 under the good mitigation scenario remains moderate due to the unavoidable alteration of the subsurface interflow zone that feeds Unit W01 and the encroachment into the buffer zone that negates opportunities to establish infiltration zones across the toe of the platform along the length of the wetland unit. Thus, a section of wetland is likely to experience measurably reduced water inputs and soil saturation rates. To further reduce the significance of Impact O1-2, it is recommended that development be pulled back from the wetland edge and that a minimum 15m buffer be established that can be used as an engineered infiltration zone that can mimic the altered interflow zone. The applicant has confirmed that a minimum 15m buffer will be maintained and the latest SDP reflects this.

The residual moderate impact is not a fatal flaw but likely requires compensation depending on the predicted effectiveness of the engineered infiltration zone to mimic the altered interflow zone. Onsite wetland rehabilitation could be an option achieve compensatory gains in wetland ecosystem services and/or habitat.

The application of the DWS risk matrix assessment revealed that the predicted risk of Impacts C1-2, O1-2 and O1-4 were assessed as moderate under a good mitigation scenario due to the following factors:

- A large area of the wetland's catchment will be cleared and transformed.
- The eastern buffer zone to Unit W01 will be substantially reduced.
- The wetlands are predominately subsurface fed systems with a moderate EIS and thus the unavoidable alteration of the subsurface interflow zone that feeds Unit W01 will result in reduced water inputs and soil saturation rates.

For the rest of the impacts, the risks were assessed as low.

14. References

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Annexure A – Site Development Plan

See enclosed PDF.

Annexure B – Impact Assessment Method

For the purposes of this assessment, the assessment of potential impacts was undertaken using the "Impact Assessment Methodology for EIAs" designed by Eco-Pulse Consulting (2020).

The assessment of impact significance is based on the basic risk formula: **Risk = consequence x probability**. However, the calculation of consequence has been modified to assess significance rather than risk. The basic significance formula utilised is:

Impact significance = impact consequence x impact probability, where
Impact consequence = (impact intensity + impact extent) x impact duration

In order to improve the repeatability of the system, concise descriptions have been developed to assist the user in rating extent and intensity criteria (Table A1). These have been specifically tailored for each of the four ultimate consequences considered as part of the significance assessment. An overall statement of impact significance is then obtained by qualitatively assessing the cumulative effect of all impacts on each aspect of the water resource being assessed.

Table A1. Criteria and numerical values for rating environmental impacts to freshwater ecosystems.

Score	Rating	Description
Extent (E) – relates to the expected extent of the impact in spatial and population terms		
10	**National**	***The effects of an impact are experienced over a very large geographic area. Given the extent of impacts, they are likely to be relevant at a national scale.*** ***Water resource management:*** • Water resources are affected across a very extensive geographic area (e.g. spanning a number of water management areas / crossing international boundaries); and / or • Indirect impacts continue to affect water resources far from the development site (e.g. impacts continue to be experienced > 100km downstream).

Score	Rating	Description
		Ecosystem conservation: • The extent of direct impacts results in extensive impacts to water resources relative to the remaining extent (e.g. affecting >100ha wetlands / >10km watercourses); and / or • The extent of direct impacts is high relative to the extent of affected habitat types (e.g. affecting >10% of a remaining ecosystem type); and / or • The proposed development affects large areas (e.g. > 1000 ha) across a broad geographic area and affecting a range of terrestrial habitat types. ***Species conservation:*** • Impacts affect a large proportion of the population of an important species at a national level (e.g. >10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a very large geographic area. ***Direct use values***: • Impacts will affect a society at a national scale (e.g. large number of stakeholders across multiple district municipalities / provinces).
8	**Regional**	***The effects of an impact are experienced over a large geographic area. Given the extent of impacts, they are likely to be relevant at a regional scale.*** ***Water resource management:*** • Water resources are affected across a broad geographic area (e.g. extending across a large number of quaternary catchments); and / or • Indirect impacts continue to affect water resources a considerable distance from the development site (e.g. 10 - 100km downstream). ***Ecosystem conservation:*** • The extent of direct impacts results in large-scale impacts to water resources relative to the remaining extent, (10-100ha wetlands / 2-10km watercourses); and / or • The extent of direct impacts is notable relative to the extent of affected habitat types (e.g. affecting 1 - 10% of a remaining ecosystem type); and / or • The proposed development affects *a large area (100 – 1000ha) and typically extends across a range of terrestrial habitat types.* ***Species conservation:*** • Impacts affect a large proportion of the population of an important species at a regional level (e.g. 1 - 10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a large geographic area. ***Direct use values:*** • Impacts will affect a society at a regional scale (e.g. large number of communities and stakeholders across a number of local municipalities).
5	**Local**	***The effects of an impact are experienced over a limited geographic area. Given the extent of impacts, they are likely to be relevant at a local scale.*** ***Water resource management:***

Score	Rating	Description
		• Water resources are affected within a localised geographic area (e.g. single quaternary catchment); and / or • Indirect impacts continue to affect water resources some distance from the development site (e.g. 1 - 10km downstream). ***Ecosystem conservation:*** • The extent of direct impacts results in localised impacts to water resources relative to the remaining extent, (1 - <10ha wetlands / 200m - <2km watercourses); and / or • The extent of direct impacts is limited relative to the extent of affected habitat types (e.g. affecting <1% of a remaining ecosystem type); and / or • The proposed development affects *a moderately large area (10 – 100ha) but may extend across a wide range of terrestrial habitat types.* ***Species conservation:*** • Impacts affect species populations that are important at a local scale (e.g. < 1% of population affected); and / or • The proposed development will affect a number of important species across a local geographic area. ***Societal impacts***: • Impacts will affect society at a local scale (e.g. a number of communities across a single local municipality).
2	**Surrounding Area**	***The effects of an impact are experienced over a very small area. Given the extent of impacts, they are likely to be relevant at a very localised scale.*** ***Water resource management:*** • Water resources are affected within a small geographic area (e.g. single quinery catchment); and / or • Indirect impacts affect water resources a limited distance downstream of the development site (e.g. <1km downstream). ***Ecosystem conservation:*** • Direct impacts affects a small area proportion of water resources (e.g. 0.1-1ha wetlands / 20 – <200m watercourses); and / or • The proposed development affects a small localised area (1 – 10ha) and is often confined to a very few terrestrial habitat types. ***Species conservation:*** • Impacts affect populations of important species beyond the site level; ***Direct use values:*** • Impacts will affect society at a very local scale (e.g. a number of households within a single community).

Score	Rating	Description
0.5	**Site**	***The effects of an impact are confined to a very small footprint. Given the extent of impacts, they are likely to be relevant at a site scale.*** ***Water resource management:*** • Impacts are largely confined to the development footprint with limited downstream impact (<100m downstream effect). ***Ecosystem conservation:*** • Direct impacts are typically confined to a single water resource or few water resources within a small focal area (typically <0.1ha wetlands / 20m watercourses); and / or • The proposed development affects a small area (<1ha) and is typically confined to very few terrestrial habitat types. ***Species conservation:*** • Impacts are very localised and are unlikely to affect important species beyond the site level; ***Direct use values:*** • Impacts will affect society at a very local scale (single or few households within a single local community)
Intensity (I) – defines the severity and importance of the impact to water resources / habitats / species or human populations within defined impact extent		
10	**High**	***Water resource management:*** • Loss of regulating and supporting services critical to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss will compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Loss of largely intact critically endangered habitat; and / or • Loss of habitat associated with validated FEPA Rivers & wetlands; and / or • Loss of particularly unique / especially important special habitat features. ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of critically endangered species; and / or • Loss of or seriously compromises viable landscape-level corridors and longitudinal connectivity (e.g. dams on free-flowing rivers) ***Direct use values:*** • Loss of human life; and / or • Marked deterioration in human health; and / or • Loss of ecosystem services that are critical to support / protect livelihoods of dependant vulnerable communities; and / or

Score	Rating	Description
7	**Moderately-High**	***Water resource management:*** • Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs) ; and / or • Loss is very likely to compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Serious modification (2 or more classes) of critically endangered habitat; and / or • Loss of largely intact endangered habitat types; and / or • Loss of moderately modified critically endangered habitat types (and with reasonable rehabilitation potential) ; and / or • Loss of habitat that has special habitat attributes (e.g. high habitat diversity / species richness). ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of endangered species; and / or • Loss of regionally important species populations (e.g. at municipal scale). ***Direct use values:*** • Loss of human livelihoods; and / or • Some deterioration in human health; and / or • Loss of ecosystem services that are important (highly valued but not critical to) supporting / protecting vulnerable communities. Alternative options / resources are not available to meet community needs without incurring significant costs.
4	**Moderate**	***Water resource management:*** • Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss could compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Moderate modification (1 classes) of critically endangered habitat / serious modification (2 classes) of endangered habitat; and / or • Loss of largely intact vulnerable habitat types; and / or • Loss of moderately modified endangered habitat types (and with reasonable rehabilitation potential). ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of vulnerable / endemic / specially protected species; and / or • Loss of or seriously compromises viable corridors that are locally important for species movement. ***Direct use values:*** • Notable impact on human livelihoods; and / or • Moderate reduction in the availability of ecosystem services that are important for supporting / protecting vulnerable communities; and / or

Score	Rating	Description
		• Loss of ecosystem services that are moderately valued by local communities. Alternative options / resources are available but limited.
2	**Moderately-Low**	***Water resource management:*** • Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss is unlikely to compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Moderate modification (1 classes) of endangered habitat / serious modification (2 classes) of vulnerable habitat; and / or • Loss of largely intact least-threatened habitat types; and / or • Loss of moderately modified vulnerable habitat types (and with reasonable rehabilitation potential). ***Species conservation:*** • Reduction in populations of vulnerable / endemic / specially protected species (without compromising viability of locally occurring populations); and / or • Loss of populations of locally important species. ***Direct use values:*** • Limited but identifiable impact on human livelihoods; and / or • Moderate reduction in the availability of ecosystem services with a noticeable but limited impact to livelihoods.
0	**Low**	***Water resource management:*** • Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss will not compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Loss of highly degraded threatened vegetation types (and with low rehabilitation potential) ; and / or • Moderate modification (1 classes) of vulnerable habitat; and / or • Loss of moderately modified least threatened habitat types. ***Species conservation:*** • Limited impact to any locally important species populations. ***Direct use values:*** • None / very limited impact on human livelihoods; and / or • None / limited reduction in the availability of ecosystem services with very limited impact to livelihoods.
Duration (D) – relates to the duration of the impact in time (consideration should be given to reversibility which may reduce the duration of impact)		
1	**Permanent**	The impact will continue indefinitely (>30 years) and is essentially regarded as irreversible.

Score	Rating	Description
0.95	**Long-term**	The impact and its effects will continue over the long-term (10 - 30 years).
0.85	**Medium-term**	The impact and its effects will persist for a number of years (1 – 10).
0.75	**Short-term**	The impact and its effects will persist for a number of months after the impact has occurred (2 -12 months) but is unlikely to persist for more than a year.
0.5	**Immediate**	The impact and its effects will cease within days or weeks after the impact has occurred (0 – 2 months).
Probability (P) – relates to the expected likelihood and frequency of the impact causing event occurring		
1	**Definite**	More than 80% likelihood of occurrence. The impact is typically recorded under similar conditions and settings.
0.95	**Highly Probable**	The impact has a 50-80% chance of occurring and thus expected to occur. The impact is known to occur regularly in similar conditions and settings.
0.8	**Probable**	The impact has a 20-50% chance of occurring and thus is quite likely to occur. The impact is known to occur quite frequently in similar conditions and settings (less than once in 10 years).
0.6	**Possible**	The impact has a 5-20% chance of occurring. This impact could occur and is known to occur irregularly under the similar conditions and settings (less than once in 20 years).
0.4	**Unlikely**	The possibility of the impact occurring is low with less than 5% chance of occurring. The impact has little chance of materialising (less than once in 50 years).

Table A2. Additional impact significance criteria assessed as required by NEMA that were integrated into the significance score and rating.

Score	Rating	Description
Reversibility - This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
4	**Irreversible**	The impact is irreversible and no mitigation measures exist.
3	**Barely reversible**	The impact is unlikely to be reversed even with intense mitigation measures.
2	**Partly reversible**	The impact is partly reversible but more intense mitigation measures are required.
1	**Completely reversible**	The impact is reversible with implementation of minor mitigation measures.
Irreplaceable Loss of Resources - This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
4	**Complete loss of resources**	The impact is result in a complete loss of resources.
3	**Significant loss of resources**	The impact will result in significant loss of resources.
2	**Marginal loss of resource**	The impact will result in marginal loss of resources.
1	**No loss of resource**	The impact will not result in the loss of any resources.

Table A3. Impact significance categories and definitions.

Impact Significance	Impact Significance Score Range	Definition
High	**14.5 - 20**	**Totally unacceptable** and fatally flawed from an environmental perspective. The proposed activity should only be approved under very special circumstances (i.e. national priorities with large societal benefit). If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderately High	**12 – 14.4**	**Generally unacceptable** and should ideally be avoided. The potential impact will affect a decision regarding the proposed activity and require that the need and desirability for the project be clearly substantiated to justify the associated ecological risks. If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms
Moderate	**8.5 – 11.9**	**Potentially unacceptable** and should ideally be reduced to lower significance levels. The potential impact should influence the decision regarding the proposed activity and requires a clear and substantiated need and desirability for the project to justify the risks. If authorised, offsets should be considered to compensate for residual impacts.
Moderately Low	**4.5 - 8.4**	**Acceptable** with low to moderate risks. The potential impact may not have any meaningful influence on the decision regarding the proposed activity.
Low	**0 – 4.4**	**Acceptable**. The potential impact is very small or insignificant and should not have any meaningful influence on the decision regarding the proposed activity.

Thank you. If you have any questions, please contact us via the contact details below.

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