24G and Future Development for the George Municipality Water Depot on Erf RE/464, George, Western Cape.

Aquatic Biodiversity Site Sensitivity Verification and Impact Assessment.

Prepared For: Cape EAPrac Environmental Consultants

Author: Mr. F de Ridder (MSc)
Confluent Environmental Pty (Ltd)
7 St. Johns Street,
Dormehls Drift,
George, 6529

SACNASP: Candidate Natural Scientist. (Aquatic Science – 166398)

Reviewer: Dr. J.M. Dabrowski (Pr. Sci. Nat. Water Resources - 114084

Date: 03 March 2026

Version: Draft Final

confluent

EXECUTIVE SUMMARY

Confluent Environmental Pty (Ltd) was appointed by Cape EAPrac Environmental Consultants to provide aquatic specialist inputs for the retrospective assessment of unauthorised vegetation clearing and proposed developments for the George Municipality Water Depot on RE/Erf 464 in George, Western Cape. The site is approximately 1.8 km south of George's town centre, between P.W. Botha Boulevard to the north and Ring Road to the south. The closest perennial river, the Swart River, is located 4.3 km northeast of the site.

The Department of Forestry, Fisheries, and the Environment (DFFE) Screening Tool classified the area as having 'Very High' aquatic biodiversity sensitivity due to its location within a Strategic Water Source Area (SWSA) and the presence of a Critical Biodiversity Area (CBA1). A site visit conducted in October 2024 confirmed the presence of two non-perennial streams and one perennial stream within the development area, along with an associated channelled valley bottom (CVB) wetland. Unauthorised vegetation clearance and dumping activities have impacted sensitive features, including the removal of possibly sensitive vegetation and the degradation of aquatic ecosystems.

The proposed site development plan includes new offices for additional operational personnel, new mechanical and electrical storerooms and test facilities, as well as the expansion of the fleet and service of fleet facilities. The report identified key risks, including increased erosion, sedimentation, and contamination of water resources. However, with strict adherence to mitigation measures—such as buffer zone implementation, rehabilitation of degraded areas, and stormwater management—impacts on aquatic biodiversity can be minimized to negligible or minor levels.

The assessment emphasises the critical need to address current impacts prior to further development and ensure compliance with environmental regulations to maintain or enhance the ecological integrity of the site.

DECLARATION OF SPECIALIST INDEPENDENCE

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;
- I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;
- This document and all information contained herein is and will remain the intellectual property of Confluent Environmental. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.
- All the particulars furnished by me in this document are true and correct.

Specialist: Mr. Franco de Ridder (MSc., Candidate Natural Scientist. Aquatic Science – 166398)

Date: March 2026

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Aquatic Biodiversity	The variety of plant and animal life in water ecosystems, relevant to the study due to the site's proximity to potential water bodies.
Desktop Review	Preliminary assessment based on existing data and information, conducted prior to on-site investigations.
Erosion Control Methods	Techniques employed to prevent or minimize soil erosion, such as haybale check dams or silt fencing, crucial in areas with high inherent erosion potential.
Freshwater Ecosystem Priority Area (FEPA)	Designated areas of high importance for freshwater ecosystem conservation, identified as a sensitivity feature in the DFFE screening tool.
Site Assessment	Comprehensive evaluation of the proposed development site, including the identification of wetlands, watercourses, and soil characteristics.
Sensitivity	The degree to which a particular area or ecosystem is susceptible to disturbance or impact, crucial in determining potential environmental consequences.
Terrestrial Critical Biodiversity Area (CBA1)	A designation indicating the significance of the area's biodiversity on land.
Topography	The physical features of the land surface, considered for its potential influence on drainage and ecological features.
Wetland	An area where water covers the soil, or is present either at or near the surface, contributing to biodiversity and ecological significance.
Western Cape Biodiversity Spatial Plan (WCBSP)	A plan indicating categorized areas based on their ecological importance in the Western Cape region.

ABBREVIATIONS

CBA:	Critical Biodiversity Area
CD:NGI:	Chief Directorate: National Geo-spatial Information
DFFE:	Department of Environment, Forestry and Fisheries
DWAF:	Department of Water Affairs and Forestry
DWS:	Department of Water & Sanitation
EIS:	Ecological Importance and Sensitivity
ESA:	Ecological Support Area
FEPA:	Freshwater Ecosystem Priority Area
GA:	General Authorisation
GPS:	Global Positioning System
NEMA:	National Environmental Management Act
NFEPA:	National Freshwater Ecosystem Priority Areas
NWA:	National Water Act
NWM5:	National Wetland Map 5
SACNASP:	South African Council for Natural Scientific Professions
WCBSP:	Western Cape Biodiversity Spatial Plan
WUL:	Water Use License

1. INTRODUCTION

Confluent Environmental Pty (Ltd) was appointed by Cape EAPrac Environmental Consultants to provide aquatic specialist inputs for a retrospective assessment of activities relating to unauthorised vegetation clearing and the further proposed development of the George Municipality Water Depot on a portion of the remainder of Erf RE/464, George, Western Cape, further referred to as the “development area”.

The municipality initiated clearance of vegetation to facilitate the expansion of the George Municipality Water Depot without obtaining the required environmental authorisation. To rectify this, the municipality now seeks to apply for environmental authorisation through a section 24G application under the National Environmental Management Act (NEMA). This application aims to obtain retrospective authorisation for the vegetation clearance and the continued expansion of the water depot, ensuring compliance with environmental regulations.

The development area is located in the industrial area of George adjacent to P.W. Botha Boulevard towards the north and adjacent to Ring Road towards the south. The development area is approximately 1.8 km south of George’s town centre. Several non-perennial drainage lines and associated channelled valley bottom wetlands are mapped to run through the property (Figure 1). The scope of work for this report is guided by the legislative requirements of the National Environmental Management Act (NEMA) as well as the National Water Act (NWA).

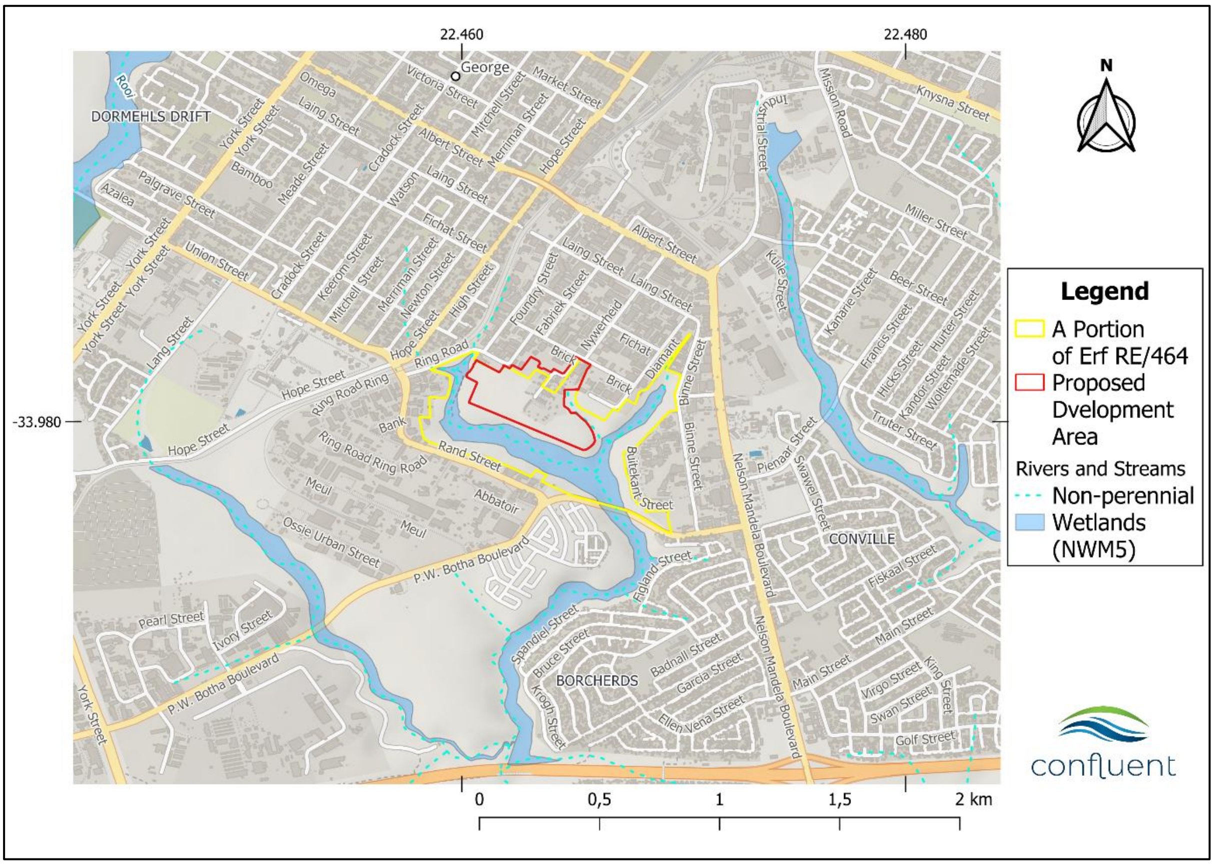

Figure 1. Location Erf RE/464, George, Western Cape.

1.1 Key Legislative Requirements

1.1.1 National Environmental Management Act

According to the protocols specified in GN 4167 (Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when Applying for Environmental Authorisation), assessment and reporting requirements for aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of:

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

The Department of Environment, Forestry and Fisheries (DFFE) screening tool classified the site as being of **Very High** aquatic biodiversity (Figure 2) for the following reasons:

- An aquatic Critical Biodiversity Area (CBA1) is mapped along one or more of the property boundaries; and
- The entire development area falls within the Outeniqua Strategic Water Source area (SWSA (SW) _Outeniqua).
- Wetlands_Eastern Fynbos-Renosterveld Bioregion (Valley-bottom) associated with the Skaapkop River.

According to the protocol, a site sensitivity verification must be undertaken to confirm the sensitivity of the site as indicated by the screening tool.

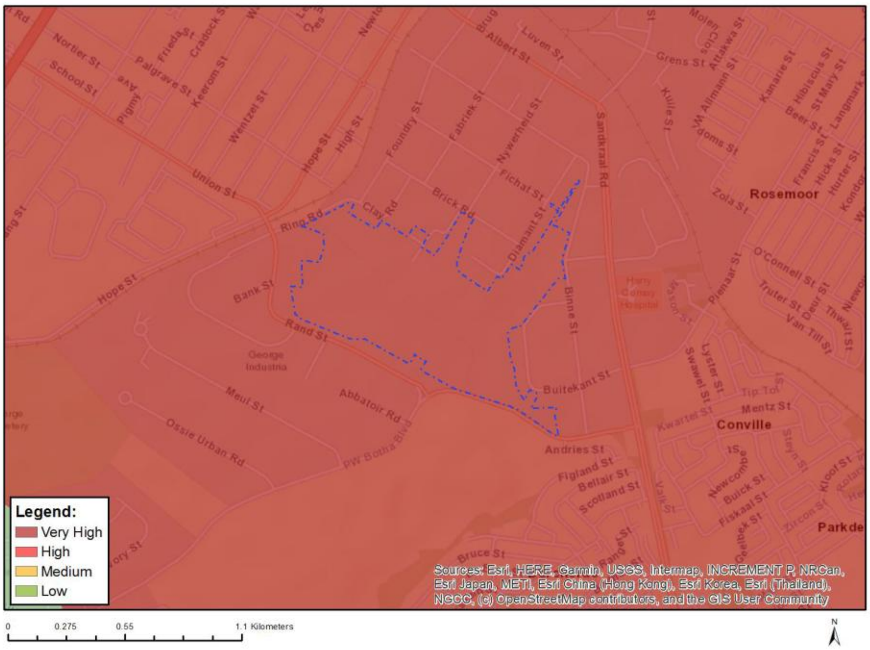

Figure 2: Results of the DFFE Screening Tool which indicate Very High Sensitivity for the Aquatic Biodiversity theme for the 24G area and further developments for the George Municipality Water Depot.

1.1.2 National Water Act

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, or aquifers.

A watercourse means:

- 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 watercourse, and

For the purposes of this assessment, a wetland area is defined according to the NWA (Act No. 36 of 1998):

"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".

Wetlands must therefore have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, an authorization (Water Use License or General Authorisation) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or
c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

According to Section 21 (c) and (i) of the NWA, any water use activities that do occur within the regulated area of a watercourse must be assessed using the DWS Risk Assessment Matrix (GN4167) to determine the impact of construction and operational activities on the flow, water quality, habitat and biotic characteristics of the watercourse. Low-Risk activities require a General Authorisation (GA), while Medium or High-Risk activities require a Water Use License (WUL).

1.2 Assumptions and Exclusions

A site visit was conducted in October 2024 which is considered Spring. It is possible that sensitive features such as rare or unique biota (e.g. amphibians), plants or habitat were not observed during the site visit, but are influenced by season, time of day, flow level or vegetation cover. However, recent good rainfall would have meant that any wetland features would have been quite evident and easy to identify.

1.3 Unauthorised Clearing and Proposed Development

1.3.1 Unauthorised Clearing of Vegetation

The unauthorised clearing of vegetation included an area of approximately 18152 m^2, for the expansion of the George Municipality Water Depot (Purple polygon, Figure 3). An additional area of approximately 19262 m^2 was cleared to establish a dumping site (orange polygon, Figure 3). The clearing and associated development activities took place in close proximity to mapped channelled valley-bottom (CVB) wetlands and non-perennial rivers that flow through the property.

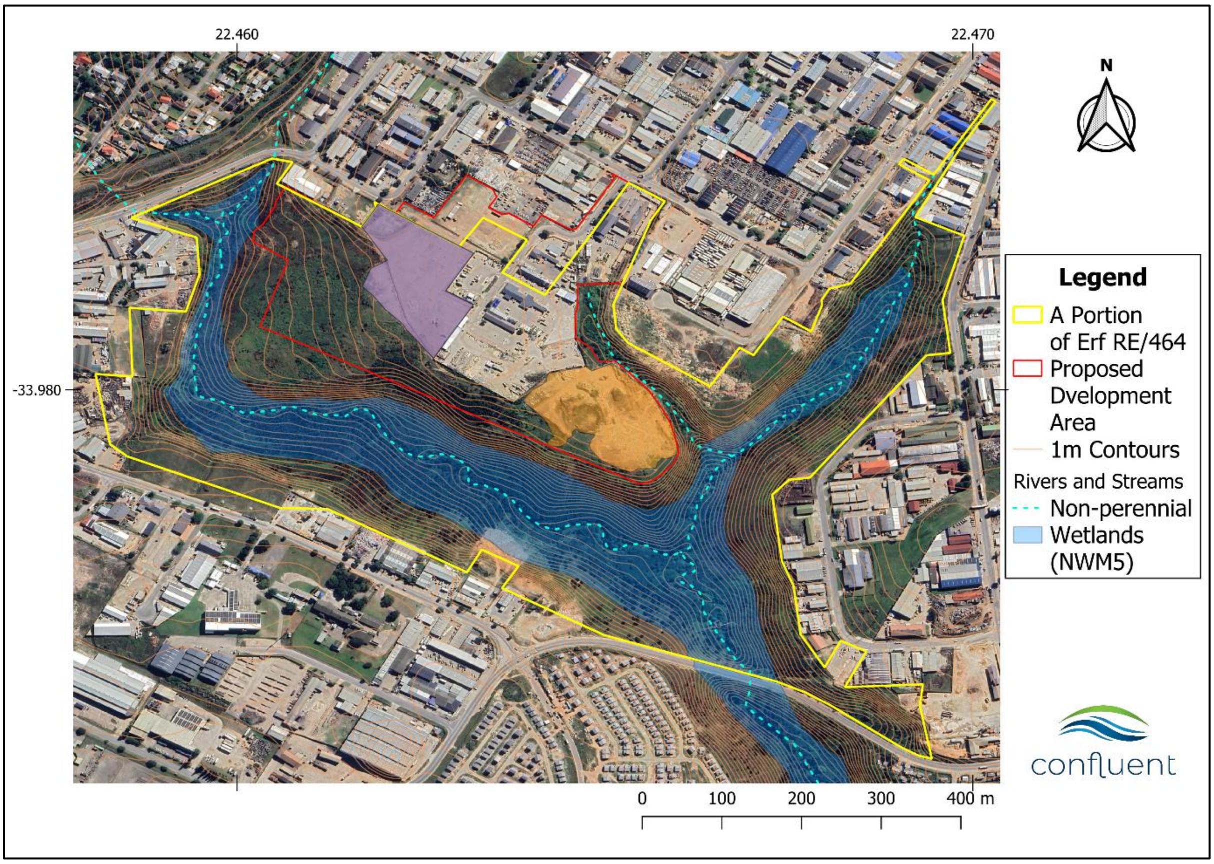

Figure 3: Map showing the unauthorised clearing of indigenous vegetation as well as the proposed development area on a portion of RE/Erf 464 in relation to mapped watercourses.

As part of the Section 24G application, the site development plan includes several ongoing developments aimed at enhancing the operational capacity of the George Municipality Water Depot. Key ongoing developments include:

- New office building (Building 6, Figure 4).
- New Water Depot (Building 7, Figure 4).
- A 5200 m^3 stormwater storage and detention pond (Figure 4):
  - Attenuation ponds serve as flood protection and flood alleviation mechanisms by slowing down the high flow rate during rainfall periods.
  - According to the stormwater management report, the storage and detention pond has been adequately sized such that the post-development peak flow run-off will remain unchanged relative to the pre-development peak flow.

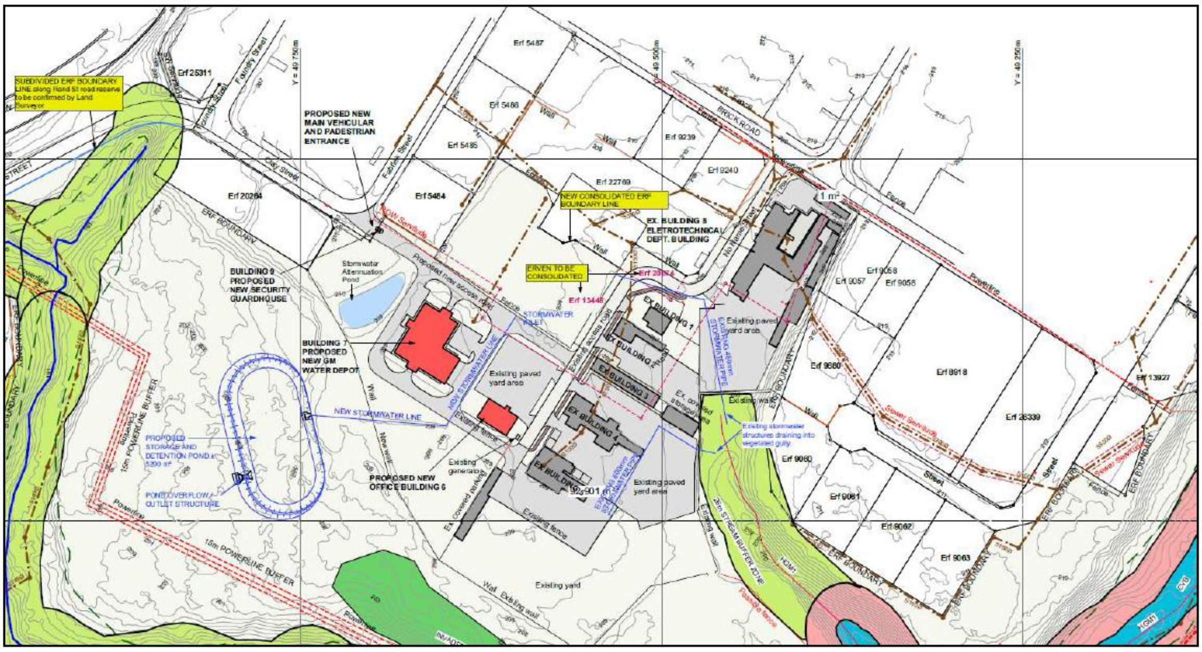

Figure 4: Site development plan showing the proposed new buildings in red and the proposed stormwater storage and detention pond.

2. APPROACH

2.1 Desktop Assessment

A desktop assessment was conducted to contextualize affected watercourses in terms their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment:

- DWS spatial layers;
- National Freshwater Ecosystem Priority Areas (NFEPA) spatial layers (Nel et al., 2011);
- National Wetland Map 5 and Confidence Map (CSIR, 2018) – the latest national wetland inventory map for South Africa;
- Western Cape Biodiversity and Spatial Plan (WCBSP) for George (CapeNature, 2017).

2.2 Watercourse Classification

Classification of watercourses is important as this determines the PES and EIS assessment methodologies that can be applied. Furthermore, classification of the watercourse provides a fundamental understanding of the hydrological and geomorphic drivers that characterise the watercourse and therefore assists in the interpretation of impacts to the watercourse. A site visit was undertaken, during which time the following activities were undertaken:

- Identification and classification of watercourses within the footprint of the site according to methods detailed in Ollis et al. (2013);
- Soil augering to confirm the presence of soil indicators (DWAF, 2005) that may indicate the presence of a wetland (if applicable); and
- Identification of hydrophilic plant species that may indicate the presence of wetland plant species (if applicable).

The boundary of a wetland was delineated in accordance with DWAF (2005) guidelines which considers the following four specific indicators:

- The Terrain Unit Indicator: Identifies those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- The Soil Wetness Indicator: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation (i.e. mottling and gleying within 50 cm of the soil surface); and
- The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

The boundary of a wetland was determined by identifying the presence or absence of the combination of indicators mentioned above at selected points in the field. The location of soil augering points used to assess soil wetness were marked on a hand-held GPS and saturation zones were classified according to the soil wetness indicators as follows:

- Temporary Zone (TZ): Short periods of saturation (less than three months per annum) characterised by few high chroma mottles and minimal grey matrix (< 10 %).
- Seasonal Zone (SZ): Significant periods of wetness (at least three months per annum) characterised by many low chroma mottles and a grey matrix.
- Permanent Zone (PZ): Wetness all year round characterised by a prominent grey matrix and few to no high chroma mottles.

2.3 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The following methods were used to assess the Present Ecological State (PES) of watercourses:

- Rivers and streams: Index of Habitat Integrity (IHI) – see Appendix 1.
- Wetlands: WET Health v 2.0 – see Appendix 2.

2.4 Ecological Importance and Sensitivity

The ecological importance of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al. 1988; Milner 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity. The Ecological Importance and Sensitivity (EIS) of affected watercourses was assessed using the following methods:

- Rivers and streams: DWS EIS method - see Appendix 3.
- Wetlands: WET-Ecoservices v 2.0 – see Appendix 4.

2.5 Buffer Determination

A protective buffer zone was applied to watercourses potentially affected by development activities. Buffer zones are defined as a strip of land with a use, function or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources from adverse negative impacts. Appropriate buffers were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). These guidelines estimate required buffer zone widths based on a combination of input parameters which include, *inter alia*, the nature of the activity and associated impacts, basic climatic and soil conditions and the implementation of appropriate mitigation measures.

2.6 Impact Assessment

Development activities typically impact on the following important drivers of aquatic ecosystems:

- *Hydrology:* Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes and base flows and modifications to general flow characteristics, including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river etc.);
- *Geomorphology:* This refers to the alteration of hydrological and geomorphological processes and drivers, and associated impacts to aquatic habitat and ecosystem goods and services primarily driven by changes to the sediment regime of the aquatic ecosystem and its broader catchment;
- *Modification of water quality:* This refers to the alteration or deterioration in the physical, chemical and biological characteristics of water within streams, rivers and wetlands, and associated impacts to aquatic habitat and ecosystem goods and services (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication etc.);
- *Fragmentation:* Loss of lateral and/or longitudinal ecological connectivity due to structures crossing or bordering watercourses (e.g. road or pipeline crossing a wetland);
- *Modification of aquatic habitat:* This refers to the physical disturbance of in-stream and riparian aquatic habitat and associated ecosystem goods and services including the loss or degradation of all or part of any unique or important features associated with or

within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.)*;* and

- *Aquatic biodiversity:* Impacts on community composition (numbers and density of species) and integrity (condition, viability, predator prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site.

Modifications to these drivers ultimately influence the PES and EIS of a watercourse. Accordingly, impacts to the watercourse were described and assessed based on their potential to modify each of the above-mentioned drivers of aquatic ecosystem health, using the PES and EIS of the watercourse as a baseline against which to assess impacts. The impact assessment methodology is described in the appendix to this report (Appendix 5).

3. CATCHMENT CONTEXT

3.1 Catchment Features

The property is located in the quaternary catchment K30C in the upper reaches of the Skaapkop River catchment (Figure 5) and within the Southeastern Coastal Belt (Ecoregion Level 2:20.02). The terrain is described as closed hills of moderate and high relief and moderately undulating plains. Altitude ranges between 0 – 1 300 m.a.m.s.l. Rainfall occurs year-round with seasonal peaks in spring and autumn (Figure 6).

As the rainfall intensity and the inherent erosion potential of soils in the area are classified as Very High, erosion of soils and stormwater management are factors that must be carefully considered when developing in this area, especially considering the large amounts of stormwater associated with urban developments and the steepness of the slopes leading down to watercourses (Table 1, Figure 5 and Figure 7).

Table 1. Summary of relevant catchment features for the proposed development area.

Feature	Description
Quaternary catchment	K30C
Mean Annual Runoff	124.85 mm
Mean Annual Precipitation	817.00 mm
Inherent erosion potential of soils (K-factor)	0.74, Very High
Rainfall intensity	Very High
Ecoregion Level II	20.02, Southeastern coastal belt
Geomorphological Zone	None
NFEPA area	Sub-quaternary reach 9144, no FEPA.
Mapped Vegetation Type	FFg 5: Garden Route Granite Fynbos (CR: Critically Endangered)
Conservation	CBA1, CBA2, ESA2; WCBSP (2017).

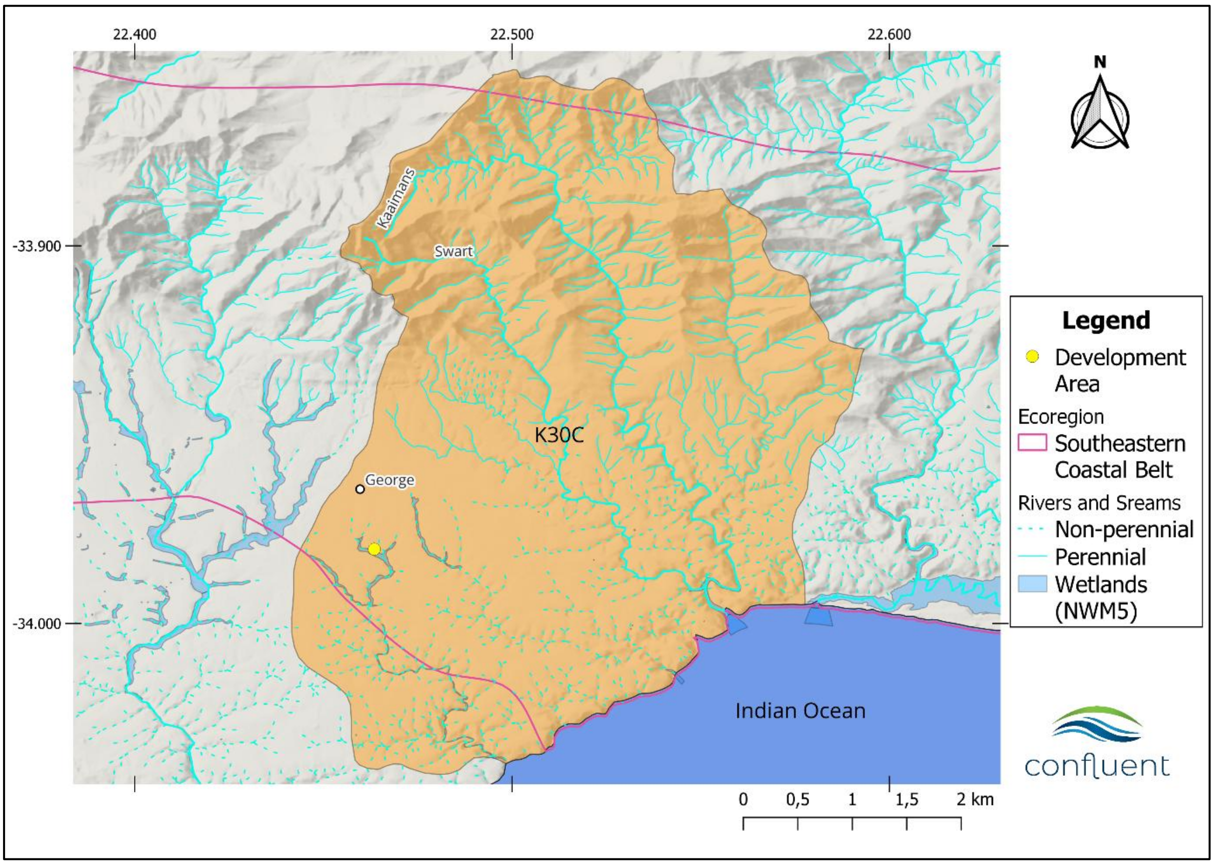

Figure 5. Development area in the quaternary catchment K30C.

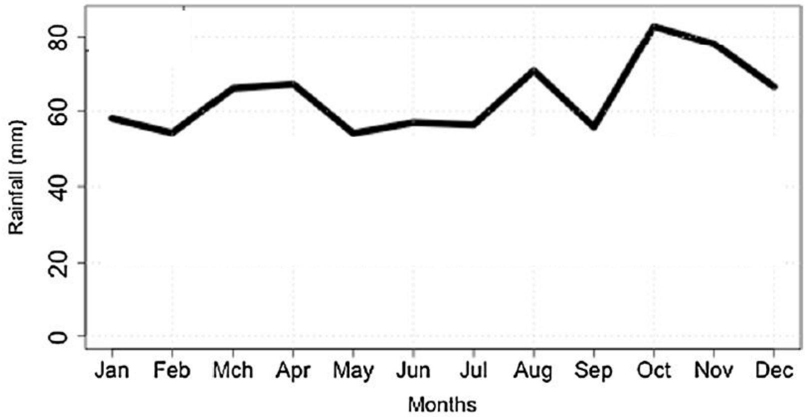

Figure 6. Area-averaged monthly rainfall for the coastal Southern Cape indicating peaks in Mar-Apr, Aug, and Oct. Data averaged between 1979 and 2011 (Engelbrecht et al., 2015).

3.2 Mapped Watercourses

The mapped watercourses alongside and within the proposed development area include three non-perennial streams and associated wetland habitat (with two of the streams) - Figure 7). To easily refer back to the watercourses along and within the proposed development area, the watercourses will be referred to as hydrogeomorphic units (HGM) in combination with a number:

- The first non-perennial stream is a tributary of the Skaapkop River (hereafter referred to as the Skaapkop River), and flows in an easterly direction 35 to 100 m southwest of the proposed development area. A wetland is mapped to extend along the whole length of the stream (Figure 7).
- HGM1 – The second non-perennial stream originates from within the development area and flows in a south-easterly direction immediately north of the dump site. (Figure 7).
- HGM2 – The third non-perennial stream flows along the most easterly section of the development area, originating approximately 504 m northeast of the dump site. This stream is associated with a channelled valley-bottom wetland (Figure 7).

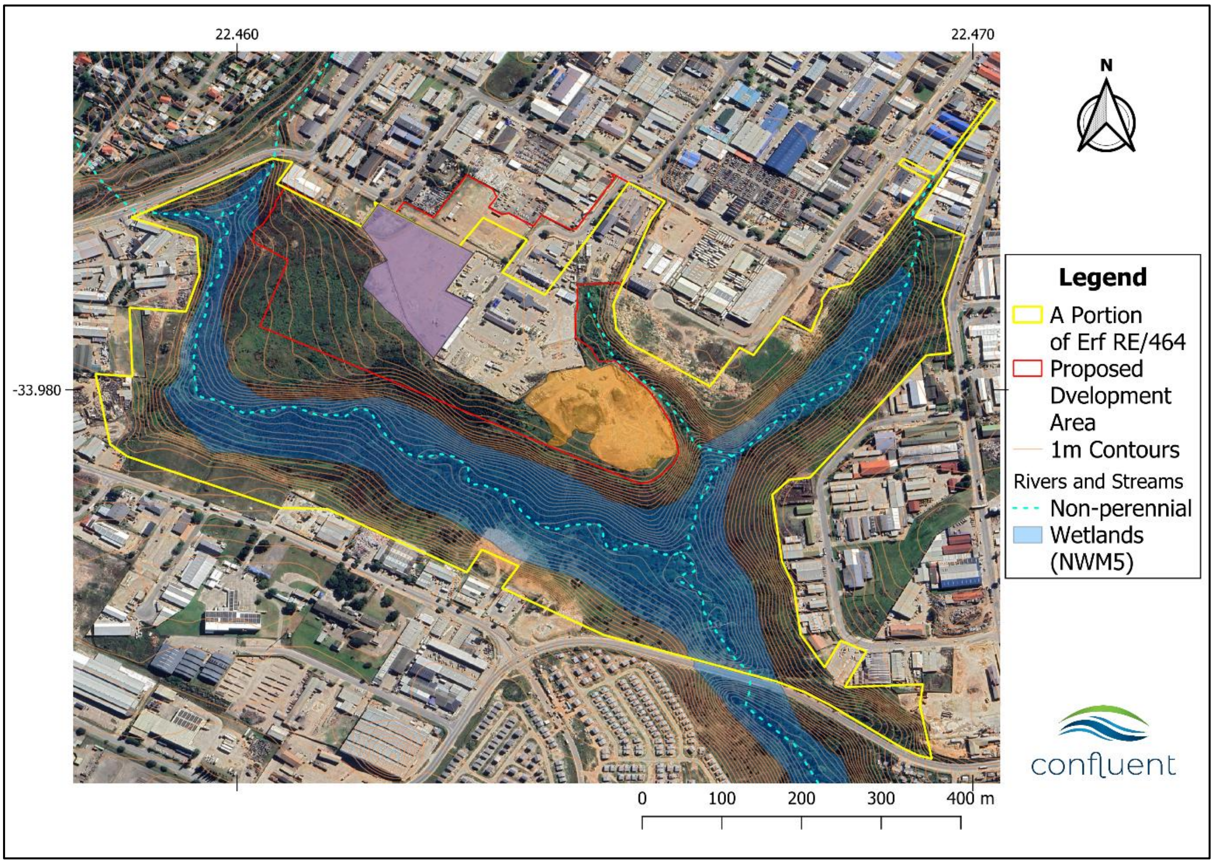

Figure 7: The proposed development area in relation to mapped watercourses.

3.3 Vegetation

The mapped vegetation type at the site is Garden Route Granite Fynbos (FFg 5: Critically Endangered). Garden Route Granite Fynbos has a narrow distribution with high rates of habitat loss in the past 28 years (1990-2018), mostly as a result of cultivation, pine plantations and urban development, placing the ecosystem type at risk of collapse as only about 1% is conserved in the Garden Route National Park (Mucina *et al.,* 2006).

3.4 Conservation and Catchment Management

3.4.1 Western Cape Biodiversity Spatial Plan

The Western Cape Biodiversity Spatial Plan (WCBSP; 2017) indicated the following categorised areas on the property itself and surrounding areas:

- An aquatic Critical Biodiversity Area 1 (CBA1) mapped in association with two of the non-perennial rivers,
- A terrestrial Critical Biodiversity Area 2 (CBA2) mapped on the slopes leading to the non-perennial streams and
- An Ecological Support Area 2 (ESA 2) mapped on the slopes on the outer edges leading to the non-perennial streams, west of the development area.

The main reasons for the categorisation of the area are that the area falls within the following:

- Water source protection- Kaaimans
- Watercourse protection- South Eastern Coastal Belt (Figure 8).

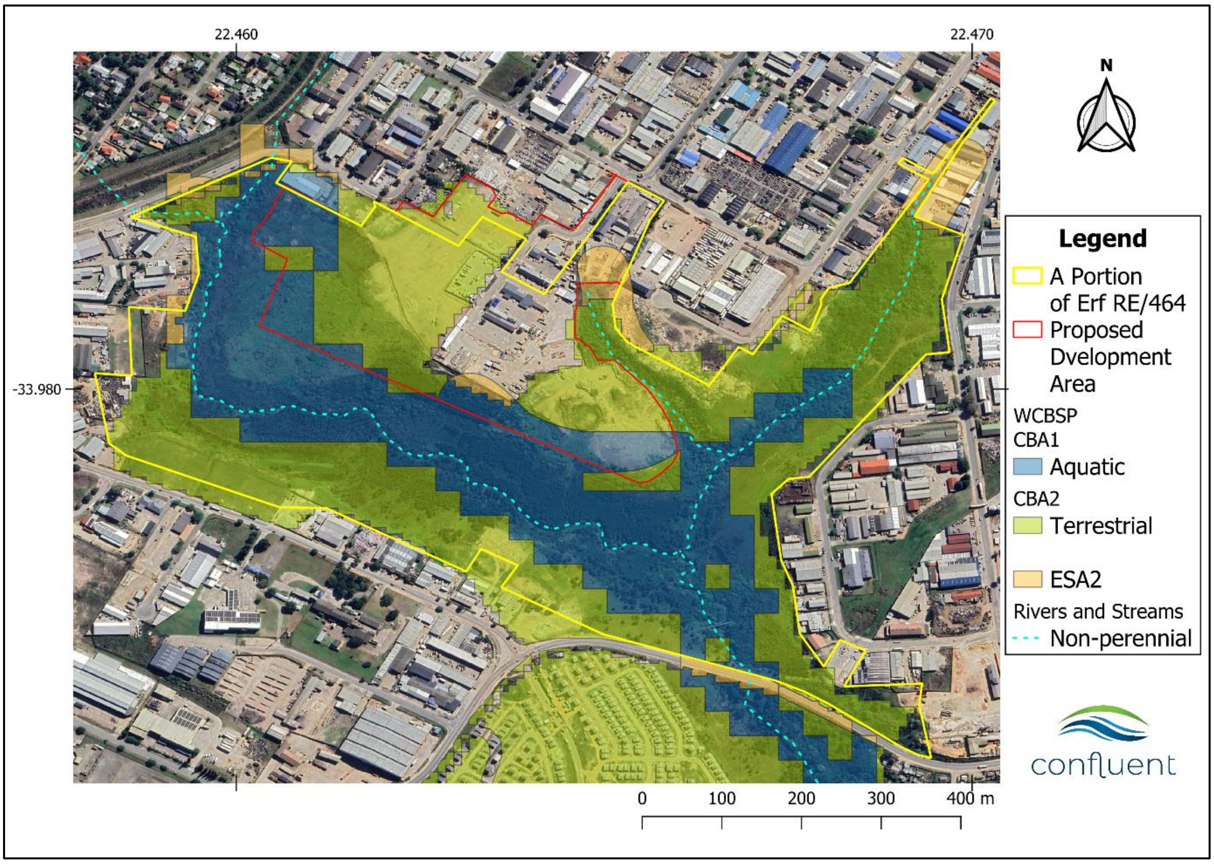

Figure 8. The proposed development area to mapped conservation features of the Western Cape Biodiversity Spatial Plan (2017).

Necessary actions in relation to the WCBSP are to ensure that development on the site does not result in negative impacts on the ecological structure and function of watercourses adjacent to and on to the site (Table 2).

Table 2. Definitions and objectives for conservation categories identified in the Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

WCBSP Category	Definition	Management Objective
Critical Biodiversity Area 1 (CBA1)	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.
Critical Biodiversity Area 2 (CBA2)	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.
Ecological Support Area 2 (ESA2)	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Restore and/or manage to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement.

2.3.3 Strategic Water Source Area

The proposed development site is the Outeniqua Strategic Water Source Area for surface water (SWSA-sw). SWSAs are defined as areas of land that supply a disproportionate (i.e. Relatively large) quantity of mean annual runoff in relation to their size and are therefore considered nationally relevant (Le Maitre *et al.*, 2018). A key objective in the management of SWSAs is to ensure the quantity and quality of water within and flowing from SWSAs is protected from developments that cause unacceptable and irreparable impacts.

Development of roads, parking areas and other impervious surfaces, along with wetland draining or infilling has the potential to change quantities of water in watercourses by intercepting, increasing, reducing or diverting flows from their normal path. Water quality can be impacted by flow-related alterations, particularly increased flows as this usually results in altered sediment transport causing scouring, sedimentation and increased turbidity due to suspended sediments. Especially during the construction phase. The operational phase of urban developments increases the risk of toxic hydrocarbons and other road-based pollutants as well as sewage from leaking or blocked drains or pump stations impacting on water quality.

3.5 Historical Assessment

The proposed development area has been disturbed throughout the past 82 years (1939 to 2021), by various activities, including dumping, invasion by invasive plant species and vegetation clearing (Figure 9):

- In 1939 most to all of the development area was in a natural state including the surrounding area south of the development area (red outline). However, two footpaths were present crossing the Skaapkop River (most probably an unchanneled valley bottom (UVB) wetland at that time, as a channel was not present in a part of the Skaapkop River at the time). Furthermore, dumping of some kind was taking place just north of the development area that was encroaching into the development area (Figure 9).

- In the year leading up to 1989, extensive industrial development took place in the areas surrounding the development area with all of the watercourses invaded by alien vegetation (most probably black wattle, *Acacia mearnsii*). P.W. Botha Boulevard and Ring Rd. were also constructed in the years leading up to 1989 both crossing the Skaapkop River via bridges (Figure 9).
- The most notable change in 2003 was the addition of buildings within the property boundary (yellow outline). In the years leading to 2006, dumping started in the same area as the present dump site (Figure 9 arrow).
- In the years leading to 2016 the alien vegetation within the watercourse was cleared, exposing a more prominent channel in all the watercourse in and adjacent to the proposed development site. In 2017 the dump site extended to the edge of HGM1 (Figure 9).
- In the years leading up to 2021, the southern part of the dump site had revegetated (most likely Kikuyu grass), however, the dump site extended into HGM1. Heavy erosion of the southern slope, leading down to the Skaapkop River, southwest of the dump site can also be observed in 2021. It should also be noted that the cleared area pertaining to the 24G is also observed in 2021 (Figure 9 arrow). Channel incision can also be observed between 2017 and 2021.

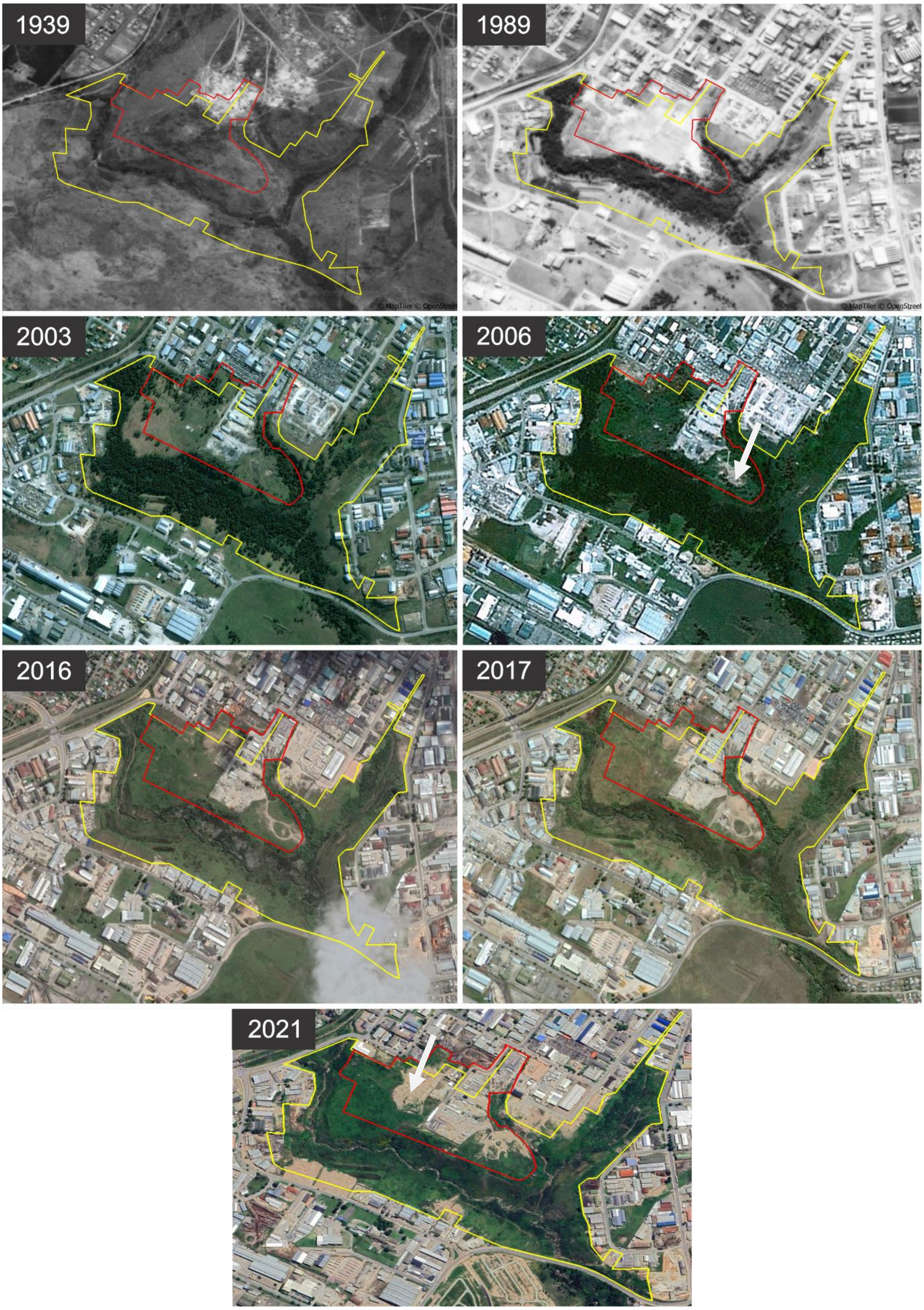

Figure 9. Historical photos showing the development area on Erf RE 464 through notable changes between 1939 and 2021 (CD:NGI & Google Earth imagery).

4. SITE ASSESSMENT

The site visit was conducted on the 4th of October, at the time of the site visit the weather was clear and the site was transversed by foot (Figure 10). The site is relatively flat becoming steeper towards the watercourses adjacent to the development area. The soil on the site is loamy clay, however, most of the soil shows clear signs of disturbance associated with dumping and excavations. The vegetation on the site was mostly dominated by invasives including but not limited to: Kikuyu grass (*Cenchrus clandestinus*), Black wattle (*Acacia mearnsii*), Bugweed (*Solanum mauritianum*) and Castor Bean (*Ricinus communis*) (Figure 11: B). There was evidence of black wattle being cleared however, the stumps do not appear to have been poisoned to limit regrowth.

It was apparent that the site has been historically disturbed for a number of years as indicated by the dominance of invasive plants on the site as well as the large amount of solid waste that had been dumped across the site (Figure 11: A).

Five small depression wetlands were observed in the northwestern section of the site, however, these are considered as artificial and of no aquatic ecological importance as they are associated with excavated patches of dumped soil and other waste. These depression wetlands are dominated by invasive *Arundo donax* (Figure 11: C).

No watercourses were observed within the area already cleared for the expansion of the Water Depot (i.e. related to the 24G). The dump site is actively being used for dumping of building material and road construction rubble, consisting mostly of excavated soil and rocks, fill material (e.g. G5 stone), tar, bricks, paving, and concrete (Figure 11: D). The dump site slopes steeply down towards HGM1 which is located immediately adjacent to the toe of the fill.

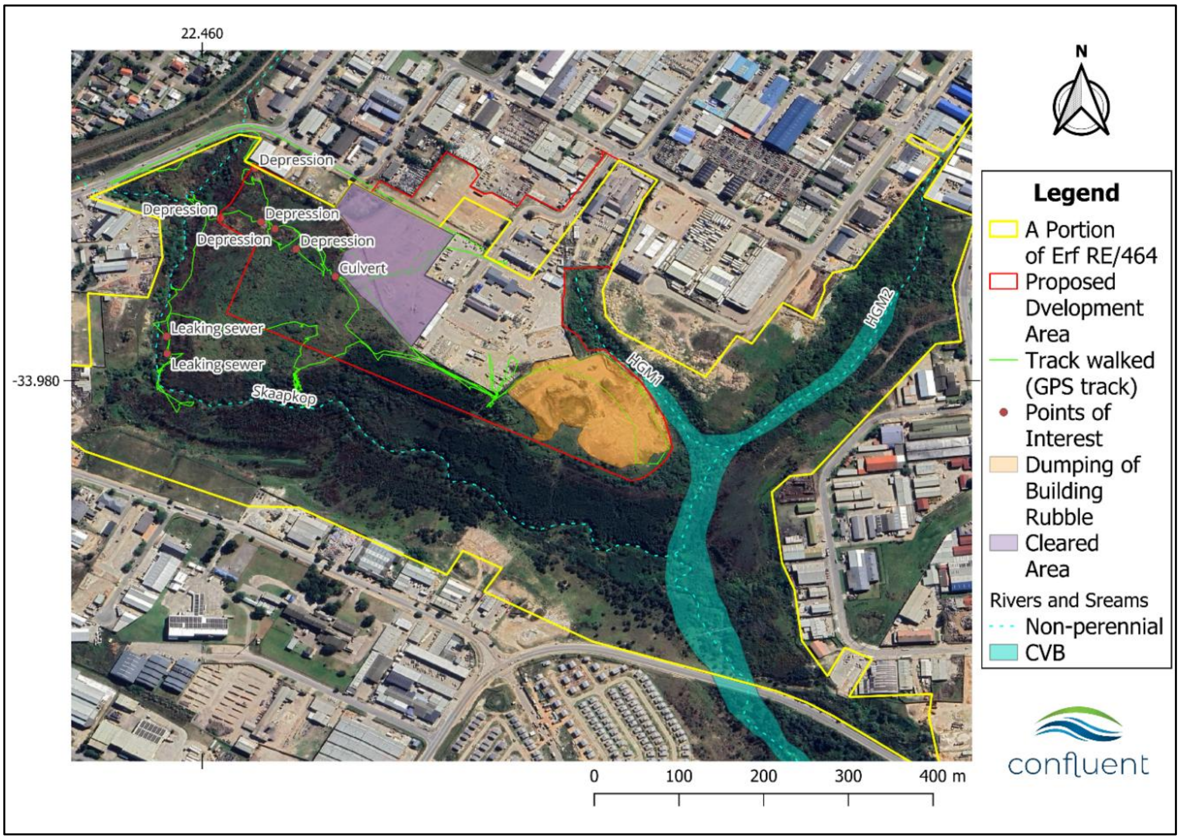

Figure 10: GPS track walked in relation to the proposed development area.

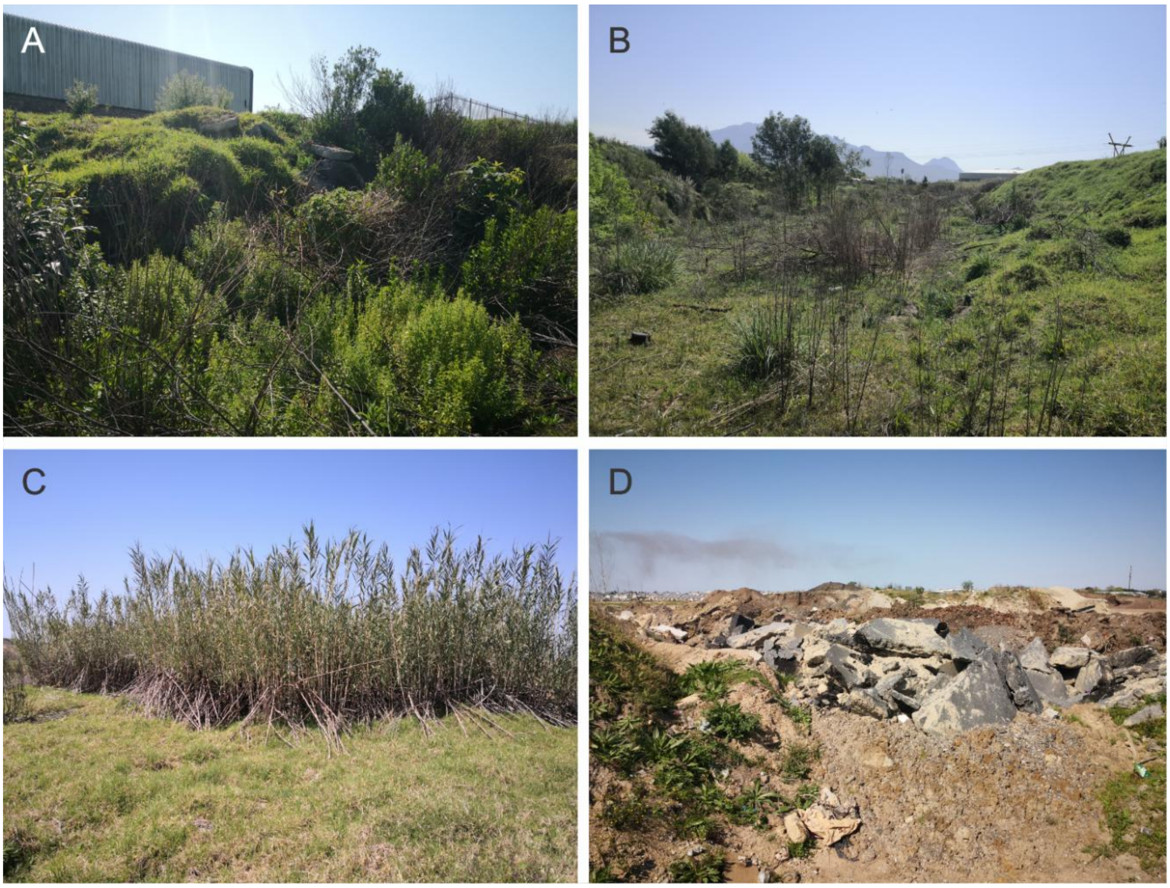

Figure 11: A – Revegetated dumped rubble, B – General vegetation on site, C – Arundo donax within one of the artificial depression wetlands, D – Dumped rubble on the edge of the slope leading down to HGM1.

4.1 Classification of the Watercourse

The mapped wetland associated with the upper reach of the Skaapkop River was not confirmed on site. The Skaapkop River is classified as a perennial stream characterised by a heavily incised channel, clear bed and banks, and continuous water flow (Figure 13). The Skaapkop River has been heavily impacted by sewage, solid waste pollution, and erosion of the channel caused by high stormwater inputs. At the time of the site visit evidence was observed that sewage had been spilling into the river from two manholes (located approximately 10 m east of the Skaapkop River), and were not only polluting the river but also eroding the banks of the river (Figure 12: A and B).

HGM1 is a small non-perennial stream that grades into a small, channelled valley-bottom wetland. The stream is characterised by a distinct channel, prominent bed, and banks with intermittent flow following rainfall events (Figure 13). The valley bottom adjacent to the channel is primarily dominated by Kikuyu grass and Bugweed as well as *Nidorella ivifolia, Arundo donax,* and *Cortaderia selloana* with erosion evident along the banks (Figure 12: D). At the time of the site visit there was visible evidence of building rubble falling down the steep slope into the active channel of HGM1 (Figure 12: C).

HGM2 is a small non-perennial stream (similar to HGM1) that grades into a small channelled valley-bottom wetland (Figure 13). The vegetation along HMG2 includes, but is not limited to; Kikuyu grass, Black wattle, Bugweed, *Nidorella ivifolia, Arundo donax* and *Cortaderia selloana* (Figure 12: E and F).

Figure 12: A – Leaking sewer infrastructure 10 m 10 m east of the Skaapkop River, B – Skaapkop River with eroding banks on the West, C – General vegetation present at HGM1 with the channel of HGM1 filled with building rubble, D – CVB at the lower reach of HGM1, E – CBV at the confluence of HGM1 and HGM2 looking in a north-westerly direction, F – CBV at the confluence of HGM2 and the Skaapkop River looking in a southern direction.

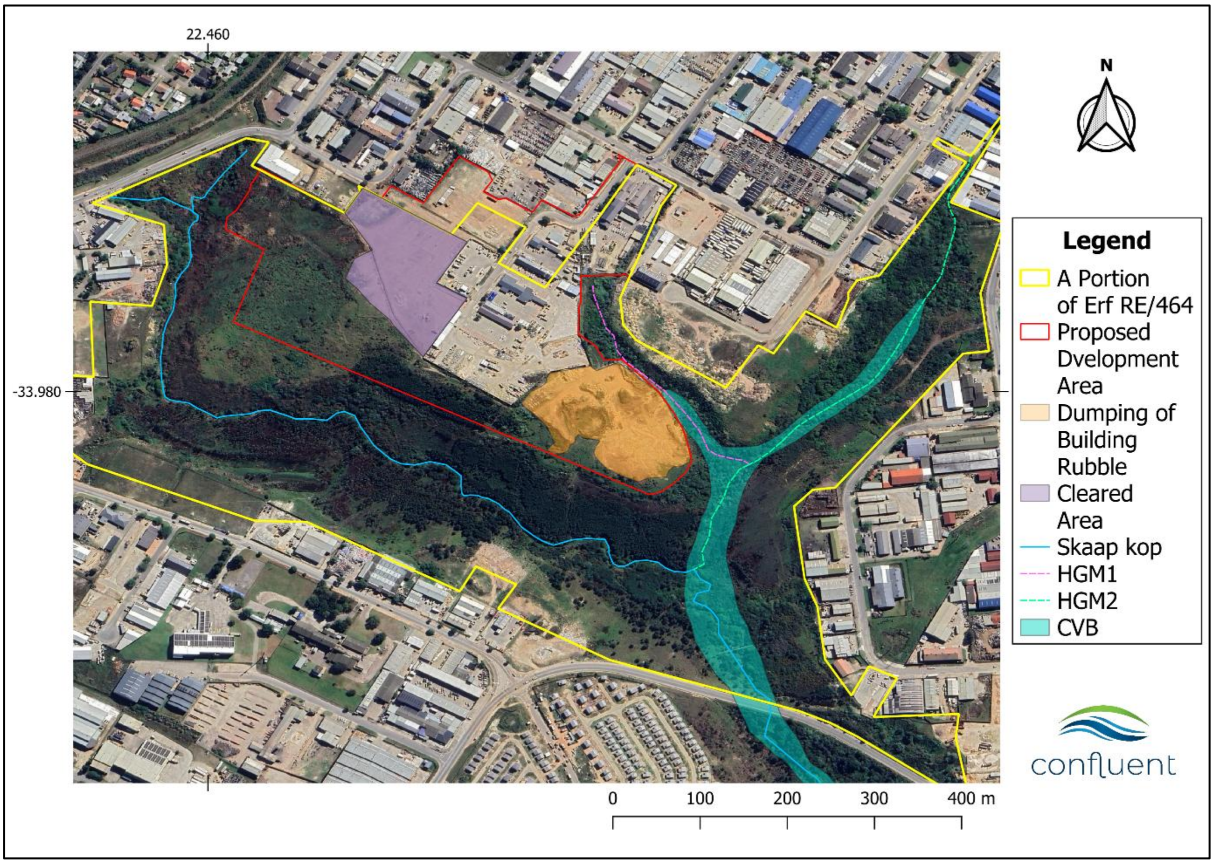

Figure 13: Proposed development area in relation to classified watercourses.

4.2 Present Ecological State (PES)

4.2.1 Skaapkop River

The assessment is applicable for the stream reach along the development area site (approximately 920 m in length). The results of the IHI indicate that the PES of the watercourse is considered to be a **Class D (Largely Modified)** implying that the assessed section of Skaapkop River has been impacted to a large extent by the surrounding industrial development that has led to loss of biota and basic ecosystem functions (Table 3). The PES assessment also emphasises that the development must strive to take place in a manner that will have the least amount of impact on the Skaapkop River so that the ecological condition of the river is maintained or improved.

Table 3. Scores determined for the Index of Habitat Integrity pre-construction phase.

Habitat Modification	Score	Notes
INSTREAM HABITAT		
Water Abstraction	0	none
Flow	10	Increased stormwater flows from roads and industrial areas.
Bed	18	Sedimentation is present due to the erosion on the southern bank as well as form erosion caused by leaking sewer infrastructure.
Channel	15	Channel erosion due to stormwater inputs in incising the channel a lot. The channel is also piped for a road crossing upstream, northwest of the development areas.
Physico-chemistry	20	The physico-chemistry is altered by runoff from the surrounding industrial developments, runoff from Ring Rd. and leaking sewer infrastructure.

Habitat Modification	Score	Notes
Inundation	0	none
Alien Macrophytes	0	none
Introduced Aquatic Fauna	0	none
Rubbish Dumping	10	A moderate amount of solid waste associated with the industrial developments on both sides of the Skaapkop River is present.
	D – Largely modified (47)	
RIPARIAN HABITAT		
Vegetation Removal	10	Some area of vegetation is removed either as a result of eroding soil or anthropogenic activities.
Exotic Vegetation	17	A large amount of invasive vegetation is present along the bank, mostly black wattle
Bank Erosion	10	Erosion on the southern bank as well as from erosion caused by leaking sewer infrastructure
Channel Modification	14	Channel erosion due to stormwater inputs as well as erosion caused by leaking sewer infrastructure.
Water Abstraction	0	none
Inundation	0	none
Flow Modification	7	Increased stormwater flows from roads and industrial areas.
Physico-Chemistry	15	The physico-chemistry is altered by runoff from the surrounding industrial developments, runoff from Ring Rd. and leaking sewer infrastructure.
	D – Largely modified (42)	

4.2.2 CVB Wetland

The most significant impacts affecting the wetland are related to altered hydrology, geomorphology, water quality and vegetation caused by impacts associated with adjacent industrial developments as well as by the complete absence of any natural areas within the catchment of the wetland. The urbanised areas in the upper reaches of the wetland's catchment change the natural flow patterns of the water through stormwater management systems, resulting in changes in the water volumes that reach the wetland and the availability of water for the wetland. The water quality of the wetland is affected primarily by industrial stormwater runoff which can include pollutants such as oils, fuels, paint, pesticides, fertilisers, and domestic waste (including plastic) as well as the direct input of untreated sewage due to broken sewer infrastructure. The combined PES score obtained with the WET-Health Level 1B Assessment tool is a D. The score indicates that the wetland is in a largely modified ecological state and attention to mitigation measures to decrease the intensity of any future impacts should be taken to maintain or improve the PES of the wetland. A summary of the WET-Health Level 1A Assessment tool is presented in Table 4.

Table 4: Summary of the WET-Health Level 1A Assessment tool.

Final (adjusted) Scores				
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	5,4	2.8	3.3	6.0
PES Score (%)	45,9 %	71,5 %	66,9 %	40,0 %
Ecological Category	**D**	**C**	**C**	**E**
Trajectory of change	-	-	-	
Confidence (revised results)	Medium	Not rated	Not rated	Not rated
Combined Impact Score	4.5			
Combined PES Score (%)	55 %			
Combined Ecological Category	**D**			

4.3 Ecological Importance

4.3.1 Skaapkop River

The ecological importance and sensitivity determined by using the DWAF (1999) Ecological Importance & Sensitivity assessment method for river ecosystems, is **Low** for the Skaapkop River stream (Table 5). The location of the Skaapkop River contributes to the low ecological importance and sensitivity, as the area surrounding the stream is disturbed for close to the whole extent of the stream. Thus, regardless of the connectivity of the stream little to no biota will make use of it for migration. However, the non-perennial stream still serves as a refuge for some biota, especially for birds.

Table 5: Ecological Importance score for the Skaapkop River.

Determinant	Score
Presence of Rare & Endangered Species	**1** – Low probability of rare or endangered taxa.
Populations of Unique Species	**1 –** Low probability of unique species.
Intolerant Biota	**2** – Low proportion of biota is expected to be dependent on flowing water for the completion of their life cycle.
Species/Taxon Richness	**1** - Moderate diversity of fauna and flora expected on a local scale.
Diversity of Habitat Types or Features	**1** – Very low habitat diversity with no importance at any scale.
Refuge value of habitat types	**2** – Important at a local scale.
Sensitivity of habitat to flow changes	**1**– Small perennial stream – rarely sensitive to flow changes as the stream is heavily impacted.
Sensitivity to flow related water quality changes	**1** – Small perennial stream – low assimilative capacity and sensitivity to changes in water quality as the stream is heavily impacted.
Migration route for instream and riparian biota	**1** – offers connectivity to a large extent. However, the location of the Skaapkop River within an industrial area decreases the likelihood that it will be used for migration by any biota.
Protection Status	**2** – Aquatic CBA– important at a provincial scale.
EIS Score	**1 (Low Importance and Sensitivity)**

4.3.2 CVB Wetland

The ecological importance of a wetland is related to the ecosystem services the wetland provides. The wetland is large and has the potential and capacity to provide significant ecosystem services. Modifications to the hydrology and geomorphology (particularly the sever channel incision) of the wetland have however compromised the ability of the wetland to provide these services and, as a result, the wetland has a **Low** regulating and supporting services score, a **Very Low** provision services score and **Very Low** cultural services (Table 6). Although the wetland has an overall very low ecological importance score, it can be noted from the graph (Figure 14) that the wetland still plays a role in stream flow regulation and phosphate and nitrate assimilation.

Table 6: Ecological Importance score for the CVB wetland.

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,3	0,0	0,0	Very Low
	Stream flow regulation	2,3	0,0	0,8	Low
	Sediment trapping	1,5	0,0	0,0	Very Low
	Erosion control	1,4	1,9	0,9	Low
	Phosphate assimilation	1,4	0,0	0,0	Very Low
	Nitrate assimilation	1,3	0,0	0,0	Very Low
	Toxicant assimilation	1,3	0,0	0,0	Very Low
	Carbon storage	1,3	2,7	1,1	Low
	Biodiversity maintenance	2,0	4,0	2,5	Moderately High
PROVISIONING SERVICES	Water for human use	0,0	0,3	0,0	Very Low
	Harvestable resources	1,5	0,0	0,0	Very Low
	Food for livestock	1,5	0,3	0,2	Very Low
	Cultivated foods	2,1	0,0	0,6	Very Low
CULTURAL SERVICES	Tourism and Recreation	1,3	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	3,0	0,0	1,5	Moderately Low

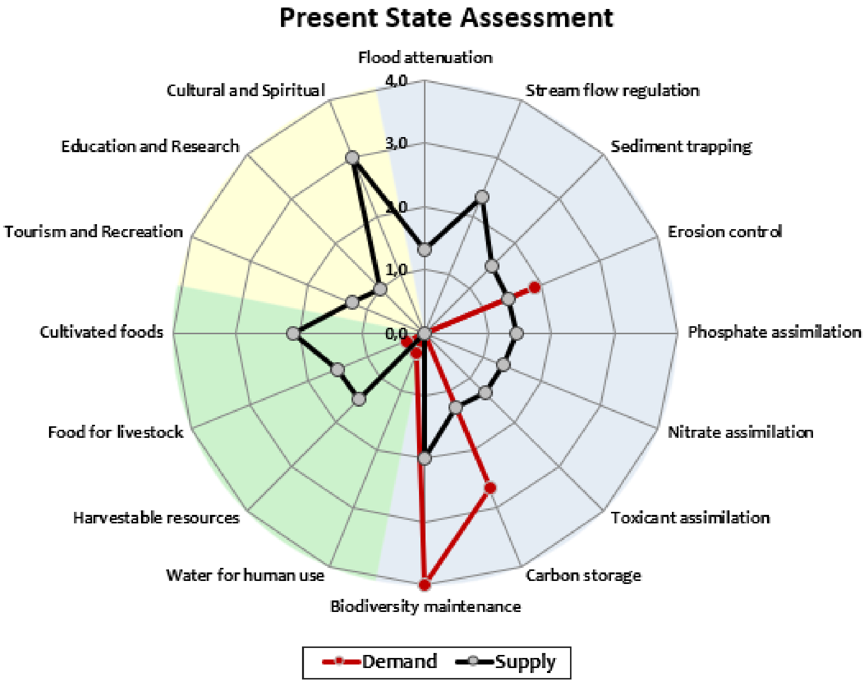

Figure 14: Graph indicating the supply and demand of ecosystem services assessed.

5. BUFFER DETERMINATION

Buffer zones have been defined as a strip of land with a use, function, or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources them from adverse negative impacts. Buffers for watercourses within the development area were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). Buffer determination considered the implementation of mitigation measures specified in the impact assessment below and was determined based on the following catchment and buffer characteristics:

- Skaapkop River, HGM1 and HGM2.
  - River type: Upper foothills
  - Present Ecological State: D
  - Mean Annual Precipitation Class: 801-1000 mm.
  - Rainfall Intensity: Zone 4.
  - Stream order: Second order
  - Perenniality: Perennial system (3-9 months)
  - The inherent runoff potential of soil in the catchment area is moderate to high (B/C soils).

Based on these inputs the buffer for the non-perennial drainage line is set to 26 m (Figure 15).

- CVB wetland:
  - Wetland type: CVB
  - Present Ecological State: D
  - Mean Annual Precipitation Class: 801-1000 mm.
  - Rainfall Intensity: Zone 4.
  - Average slope of the wetland's catchment is 3-5 %.

- Inherent erosion potential of the catchment soils is high (K factor > 0.7).
- The slope of the buffer area is moderately steep (20.1 - 40%).
- Interception characteristics of the vegetation in the buffer is considered to be Good: Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands).

Based on these inputs the buffer for the CVB wetland is set to 22 m (Figure 15).

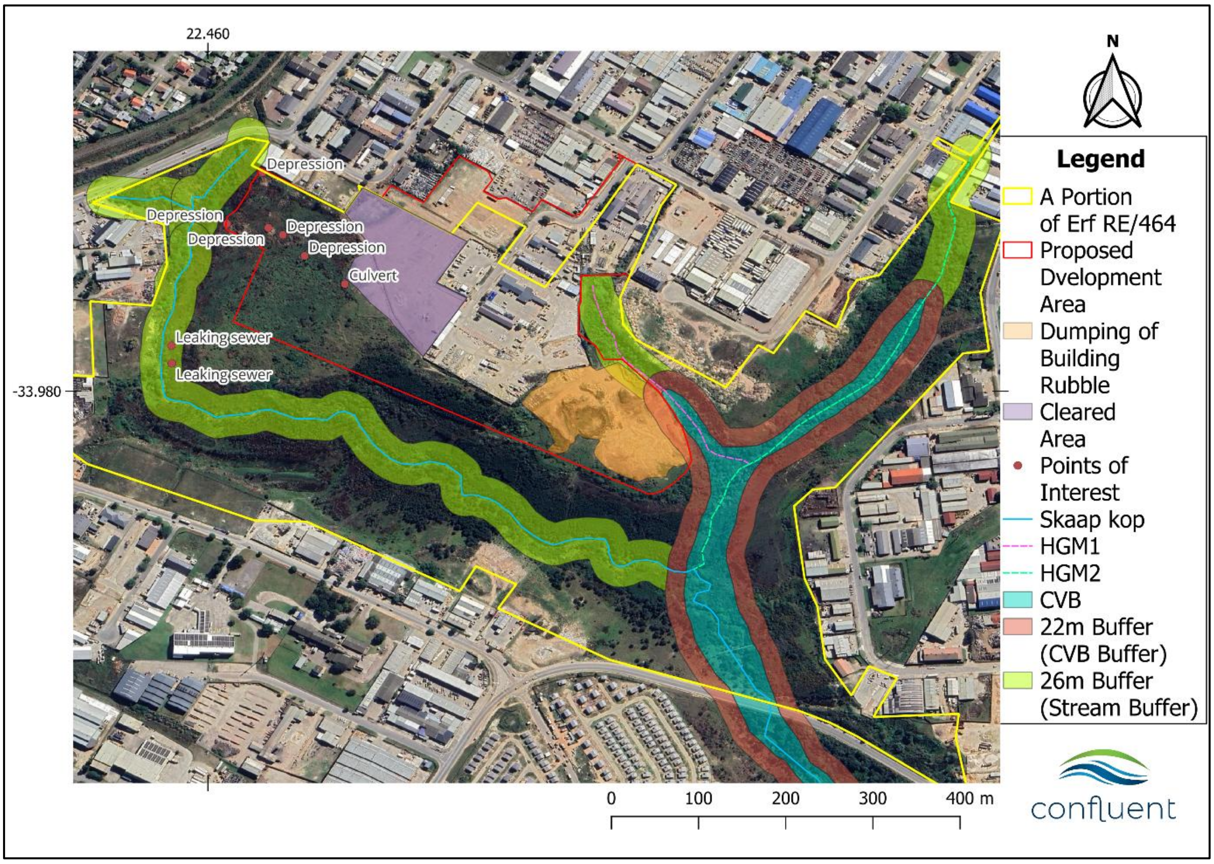

Figure 15: Map showing buffers associated with watercourses.

6. SITE SENSITIVITY VERIFICATION

The existing unauthorised activities have already affected watercourses on the property (specifically the dump site adjacent to HGM1) and given the current impacts on the Skaapkop River in particular (i.e. chemical pollution, solid waste dumping, and erosion), there is a possibility that the proposed future development will also affect watercourses on the property. This, together with the fact that the property is located in the Outeniqua SWSA, confirms the sensitivity of aquatic biodiversity as **Very High**. Thus, an aquatic biodiversity impact assessment has been compiled to address the potential impacts of the proposed development.

7. AQUATIC BIODIVERSITY IMPACT ASSESSMENT

Each of the impacts expected to occur during the current, construction and operational phase has been assessed in terms of their significance. The main impacts associated with the clearing and proposed future development are as follows:

- Decrease in water and habitat quality as a result of an increase in building and road construction rubble ending up in the section of the CVB associated with HGM1.
- Increased chances of erosion as a result of the clearing of vegetation and dumping at the edge of the slope of the section of the CVB associated with HGM1, resulting in sedimentation of the section of the CVB.
- Pollution and erosion associated with leaking sewer infrastructure into the Skaapkop River.
- Increased chances of erosion as a result of the clearing of vegetation, resulting in sedimentation in surrounding watercourses.
- Increasing the amount of stormwater as a result of an increase in hardened surfaces, altering the flow rate and volume of the non-perennial drainage line if stormwater is not managed.

7.1 Current Impacts

Impact 1: Decrease in water quality and habitat quality in HGM1 as a result of erosion and deposition of solid waste from the waste dump.

Deposition of solid waste into HGM1 as a result of dumping of building rubble along the steep slope of the dump, not only decreases water quality but also compromises the ecological integrity of these hydrological features. In addition the steep unvegetated slopes, combined with the high intensity rainfall poses an erosion risk and leads to increased sediment deposition in the watercourse. The cumulative effects of sedimentation, chemical pollution, and habitat degradation could have long-term consequences for biodiversity, water usability, and downstream ecosystem services.

	Current site development plan	
	Without Mitigation	**With Mitigation**
Intensity	Very high	Very low
Duration	Ongoing	Short term
Extent	Local	Very limited
Probability	Certain	Unlikely
Significance	**-105: Moderate**	**-18: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- A 22-meter buffer for the CVB and a 26-meter buffer for HGM1 must be established and demarcated as a no-go zone for dumping, construction activities, or vehicle access (Figure 15).
- Remove all rubble from the HGM1 valley bottom by hand and make sure not to disturb the slope or vegetation further. Ensure rubble is disposed of at an authorised landfill site.
- Rehabilitate the portion of the dump falling within the buffer zone by vegetating the top and the steep slopes of the dump and removing alien plants following an authorised alien management plan.
- Install silt fences or sediment traps along the toe of the dump to reduce the amount of sediment and waste material from entering the watercourses while the slope is revegetating.
- Install a barrier along the edge of the buffer zone (on top of the dump) to prevent vehicle access and dumping in the buffer zone.
- The slope of the dump must be routinely inspected for erosion. Any signs of erosion must be rehabilitated immediately.

7.2 Construction Phase Impacts

Impact 1: Increase of erosion due to clearance of vegetation during the construction phase.

As vegetation is being cleared for construction more soil surface is exposed, which will increase the likelihood of erosion and sediment being deposited into receiving watercourses by surface runoff during heavy rainfall events.

	Current site development plan	
	Without Mitigation	**With Mitigation**
Intensity	Very high	Very low
Duration	Short Term	Brief
Extent	Very limited	Very limited
Probability	Certain	Unlikely
Significance	**-70: Minor**	**-15: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Install silt fences or sediment barriers around the perimeter of the construction site to trap sediment-laden runoff and prevent it from entering the estuary.
- Implement phased construction to minimise the area of exposed soil at any given time and reduce the potential for erosion.
- Do not clear vegetation outside the development area.
- The laydown areas must be constructed on flat surfaces with a minimum distance of 20 m from the buffer.
- All stockpiles must be covered at the end of the day using geotextile fabric, plastic sheeting, or other suitable materials where practical. The primary purpose of covering stockpiles is to prevent erosion and subsequent sedimentation of nearby watercourses.
- Install temporary drainage controls such as swales or berms to manage runoff where necessary.
- All materials used during construction must follow the best practice guidelines set out for each product.
- Check weather reports ahead and prepare the site when rainfall is predicted. Discontinue any on the site during rainfall.
- Construct check dams or sediment basins for flooded construction areas to be drained into if need be, to trap sediment, and facilitate sediment settlement before runoff reaches the non-perennial drainage line.

Figure 16: Examples of silt fences (left) and coir logs (right) used to trap sediment mobilised from steep slopes.

Impact 2: Contamination of watercourses by solid waste and chemical pollutants caused by construction activities.

Construction activities may increase the risk of pollutants, such as oils, fuels, sediments (e.g. G7 and cement) and solid waste (e.g. plastic, building rubble etc.), entering watercourses, thereby degrading water quality and habitat quality.

	Current site development plan	
	Without Mitigation	**With Mitigation**
Intensity	High	Very low
Duration	Short Term	Brief
Extent	Very limited	Very limited
Probability	Almost certain	Unlikely
Significance	**-54: Minor**	**-15: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Maintain buffer areas around HGM1, HGM2, CVB and the Skaapkop River. Buffers will remove sediment, organic matter, and other pollutants (nutrients, toxins and pathogens) from sheet flow and wastewater before they reach water bodies.
- All materials used during construction must follow the best practice guidelines set out for each product, to ensure that the least amount of pollutants enters the watercourses.
- Implement a preventative maintenance system to ensure that work vehicles are maintained in an acceptable condition. This would involve routinely checking vehicles for leaks before construction begins; and not allowing vehicles with significant leaks to operate or be repaired within the construction site. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction site
- Ensure that the site is clean of any package material, food containers, plastic bottles or any other solid waste products. An integrated waste management system must be followed during construction (e.g. recycling). All waste must be placed in skips on-site and around the construction sites and regularly removed from site.
- Place generators in drip trays during use to ensure that no fuel leakages seep into the soil.
- Sanitary facilities should be provided for all construction personnel during the construction phase, placed outside the regulatory buffer zone, and serviced regularly.
- Hazardous chemicals and stockpiles must be stored on bunded surfaces with runoff control measures in place.

- All hazardous storage containers and storage areas must meet relevant SABS standards to prevent leakage and contamination of surface and groundwater.
- Any spills must be promptly cleaned up and appropriately treated.

7.3 Operational Phase Impacts

Impact 1: Degradation and erosion of aquatic habitat/watercourses due to increased stormwater discharge from the development.

The stormwater management plan includes the following key Sustainable Drainage Systems (SUDs):

1. Run-off from roofs will attenuated by installing rainwater harvesting tanks. These tanks will collect rainwater from roofs and gutters for re-use on lawns and gardens. Overflow from the tanks will be piped to a 5200 m^3 stormwater attenuation pond.
2. Road cross sections will be designed against the general site slope. This approach helps prevent uncontrolled stormwater discharge and increases the time of concentration.
3. A 5200 m^3 attenuation pond will be constructed to collect surface run-off for infiltration and evaporation.
4. Runoff will be drained to vegetated areas with erosion protection for infiltration and evapotranspiration.

Based on these interventions post-development runoff is not expected to exceed pre-development runoff, which adequately mitigates against this potential impact.

	Current site development plan	
	Without Mitigation	**With Mitigation**
Intensity	Moderate	Low
Duration	Ongoing	Ongoing
Extent	Limited	Very limited
Probability	Unlikely	Unlikely
Significance	**-36: Minor**	**-30: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Maintain good vegetation cover around all development areas where possible.
- Maintain all buffers around the watercourses.
- Control of alien invasive plant species must be carried out within buffer areas to encourage recolonisation by indigenous vegetation and improve the structural integrity of the buffer.

Impact 2: Contamination of the watercourses by solid waste and chemical pollutants caused by operational activities.

Operational activities may increase the risk of pollutants, such as oils, fuels, paint, pesticides, fertilisers and domestic waste, including plastic, entering the upper reaches of the non-perennial drainage line (HGM 1), thereby decreasing the water quality. These contaminants will also contaminate the wetland (HGM 5) downstream of the development site.

	Current site development plan	
	Without Mitigation	**With Mitigation**
Intensity	High	Moderate
Duration	Ongoing	Ongoing
Extent	limited	Very limited
Probability	Certain	Unlikely
Significance	**-91: Moderate**	**-30: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Maintain buffer areas around all watercourses. Buffers will remove sediment, organic matter, and other pollutants (nutrients, toxins and pathogens) from sheet flow and wastewater before they reach water bodies.
- A waste management plan must be developed and implemented and solid waste must be removed from the buffer areas (minimum once a month).
- Place generators in drip trays during use to ensure that no fuel leakages seep into the soil.
- Plumbing must be inspected and any sewerage leaks must be repaired as soon as possible (minimum once every four months).
- All hazardous storage containers and storage areas must meet relevant SABS standards to prevent leakage and contamination of surface and groundwater (if any).
- Any spills must be promptly cleaned up and appropriately treated.

8. DWS RISK ASSESSMENT

The development occurs within the regulated area of a wetland, a perennial stream and two non-perennial drainage lines. With the location of the Skaapkop River south of the development area corner and the wetland and the two non-perennial streams towards the east within the proposed development area of the development (i.e. within 500 m of a wetland and 100 m of a river) as required, the DWS risk assessment matrix (Based on DWS 2023 publication: Section 21 (c) and (i) water use Risk Assessment Protocol) was implemented to assess risks associated with the construction and operational phase impacts. The first stage of the risk assessment is the identification of environmental activities, aspects, and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change.

Risks for the current, construction and operational phase (Table 7) were assessed **assuming full implementation of recommended mitigation measures**, including refraining from constructing within any buffers of sensitive aquatic areas. The impacts that will be affecting the wetland and non-perennial drainage line include the following:

Current:

- Decrease in water quality as a result of an increase in building rubble ending up in the section of the CVB associated with HGM1.
- Increased chances of erosion as a result of the clearing of vegetation and dumping at the edge of the slope of the section of the CVB associated with HGM1, resulting in sedimentation of the section of the CVB.

- A decrease in water quality and an increase in sedimentation of the Skaapkop River, associated with the poorly maintained sewer infrastructure leaking into the Skaapkop River.

Construction:

- Increase of erosion due to clearance of vegetation during the construction phase.

Operational:

- Degradation and erosion of aquatic habitat/watercourses due to increased stormwater discharge from the development.

The proposed development was assessed to be of **Low** risk (Table 7) and a General Authorisation is therefore applicable.

Table 7: Current, Construction and Operational phase risk matrix completed by Mr. Franco de Ridder (SACNASP registration number 166398). Severity scores assume full implementation of mitigation measures).

Phase	Activity	Impact	Potentially affected watercourses: Name/s	PES	Ecological Importance	Intensity of Impact on Resource Quality – Abiotic Habitat (Drivers): Hydrology	Water Quality	Geomorph	Biota (Responses): Vegetation	Fauna	Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating (without mitigation)	Confidence level
PRE-CONSTRUCTION (DESIGN)	Dumping	Decrease in water quality.	CVB associated with HGM1	D	Low	1	1	1	1	1	2	1	2	5	2	10	20,00%	2	L	High
		Increased chances of erosion.	CVB associated with HGM1	D	Low	2	1	1	1	1	4	1	2	7	2	14	20,00%	2,8	L	High
	Leaking sewer infrastructure	Decrease in water quality and an increase in sedimentation	Skaapkop River	D	Low	2	1	1	1	1	4	3	2	9	2	18	20,00%	3,6	L	High
CONSTRUCTION	Construction activities.	Increase of erosion due to clearance of vegetation during the construction phase.	CVB, HGM1, HGM2 and the Skaapkop River	D	Low	1	1	1	0	0	2	1	2	5	2	10	20,00%	2	L	High
		Contamination of watercourse by solid waste and chemical pollutants.	CVB, HGM1, HGM2 and the Skaapkop River	D	Low	1	1	1	1	1	2	1	2	5	2	10	40,00%	4	L	High
OPERATIONAL	Increased stormwater discharge from the development.	Degradation and erosion of aquatic habitat/watercourses	CVB, HGM1, HGM2 and the Skaapkop River	D	Low	2	2	2	1	1	4	3	4	11	2	22	40,00%	8,8	L	High
	Operational activities	Contamination of the watercourses by solid waste and chemical pollutants	CVB, HGM1, HGM2 and the Skaapkop River	D	Low	1	2	0	1	1	4	3	5	12	2	24	40,00%	9,6	L	High

9. CONCLUSION

Unauthorised vegetation clearance, poor waste management, and leaking sewer infrastructure have degraded the site and the implementation of robust mitigation measures, including the establishment of buffer zones, protection and rehabilitation of the impacted areas, and strict stormwater and waste management, is critical to improving the present ecological state of watercourses and ensuring sustainable development. In particular, the dumping site towards the east of the assessed area is impacting on HGM1 and parts of the CVB wetland. Recommended rehabilitation measures as stipulated in Section 7.1 must be implemented as part of any retrospective authorisation for the development of the Water Depot.

Assuming that prescribed mitigation measures are implemented, the future planned development is acceptable from the perspective of impacts to aquatic biodiversity.

10. REFERENCES

CapeNature (2017). 2017 WCBSP Mossel Bay [Vector] 2017. Available from the Biodiversity GIS website, downloaded on 26 March 2019.

Council for Scientific and Industrial Research (CSIR). (2018). National Wetland Map 5 and Confidence Map [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 30 September 2020.

Department of Water Affairs and Forestry (DWAF) (2005). Final Draft: A Practical Field Procedure for Identification and Delineation of Wetlands and Riparian Areas.

Grootjans, A., Adema, E. B., Bekker, R. M., & Lammerts, E. J. (2004). Why Young Coastal Dune Slacks Sustain a High Biodiversity. In M. L. Martínez, & N. P. Psuty, Coastal Dunes Ecology and Conservation (pp. 85-101). Berlin: Springer-Verlag

Le Maitre, D.C., Walsdorff, A., Cape, L., Seyler, H., Audouin, M, Smith-Adao, L., Nel, J.A., Holland, M. and Witthüser. K. (2018). Strategic Water Source Areas: Management Framework and Implementation Guidelines for Planners and Managers. WRC Report No. TT 754/2/18, Water Research Commission, Pretoria.

Macfarlane, D. and Bredin, I. (2017). Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Part 1: Technical Manual. WRC Report No. TT/715/1/17. Water Research Commission, Pretoria, South Africa.

Marker, M. E., & Holmes, P. J. (2002). The distribution and environmental implications of coversand. South African Journal of Geology, 135-146.

Mucina, L., Adams, J. B., Knevel, I. C., Rutherford, M. C., Powrie, L. W., Bolton, J. J., van der Merwe, J. H., Anderson, R. J., Bornman, T. G., le Roux, A., Janssen, J. A. (2006). Fynbos Biome. In L. Mucina, & M. C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland 19 (pp. 660-690). Pretoria: South African National Biodiversity Institute.

Rebelo, A. G., Boucher, C., Helme, N., Mucina, L., & Rutherford, M. C. (2006). Fynbos Biome. In L. Mucina, & M. C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland 19 (pp. 53-220). Pretoria: South African National Biodiversity Institute.

Pye, K., & Tsoar, H. (2009). Aeolian Sand. Berlin: Typesetting and Production.

Rebelo, A. G., Boucher, C., Helme, N., Mucina, L., & Rutherford, M. C. (2006). Fynbos Biome. In L. Mucina, & M. C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland 19 (pp. 53-220). Pretoria: South African National Biodiversity Institute.

APPENDIX 1: INDEX OF HABITAT INTEGRITY

Index of Habitat Integrity (IHI; Kleynhans, 1996). The IHI was regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and, therefore, produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively – Table 8) based on their degree of modification, along with a confidence rating based on the level of confidence in the score.

Weighting scores are used to assess the extent of modification for each criterion (*x*):

$$Weighted\ Score = \frac{IHI_x}{25} \times Weight_x$$

Where;

- IHI = rating score for the criteria (Table 8);
- 25 = maximum possible score for a criterion; and
- Weight = Weighting score for the criteria (Table 9).

Table 8: Descriptive classes for the assessment of habitat modifications (Kleynhans, 1996)

Impact Class	Description	Score
None	No discernible impact, or the modification is located in a way that has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not affected.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Table 9: Criteria and weights used for the assessment of instream and riparian zone habitat integrity

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**		**100**

The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified – Table 10).

Table 10: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 – 19

<u>Reference:</u>

Kleynhans, C.J. (1996). A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo system, South Africa) Journal of Aquatic Ecosystem Health 5:41-54 1996.

APPENDIX 2: WET-HEALTH VERSION 2.0

WET-Health 2.0 is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider 'deviation' from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition. Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced/ by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components is illustrated schematically in Figure 1 below and forms the basis of the modular-based approach adopted in WET-Health Version 2.

Desktop and field data were captured in GIS software and used to populate the Level 1 WET-Health tool (Macfarlane et al., 2020) which was used to derive the PES of the wetland HGM units. The magnitude of observed impacts on the hydrological, geomorphological, water quality and vegetation components of the wetland were calculated and combined as per the tool to provide a measure of the overall condition of the wetland on a scale from 1-10. Resultant scores were then used to assign the wetland into one of six PES categories as shown in Table 11 below.

Table 11: Wetland Present Ecological State (PES) categories and impact descriptions.

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

<u>Reference:</u>

Macfarlane, D.M., Ollis, D.J. and Kotze, D.C. (2020). WET-Health (Version 2.0). *A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems*. WRC Report No. TT 820/20. Water Research Commission, Pretoria, South Africa.

APPENDIX 3: ECOLOGICAL IMPORTANCE & SENSITIVITY (RIVERS)

The ecological importance and sensitivity (EIS) of the watercourse was assessed using a method developed by Kleynhans (1999). In summary, several biological and aquatic habitat determinants are assigned a score ranging from 1 (low importance or sensitivity) to 4 (high importance or sensitivity). These determinants include the following:

- **Biodiversity support:**
  - Presence of Red Data species;
  - Presence of unique instream and riparian biota;
  - Use of the ecosystem for migration, breeding or feeding.
- **Importance in the larger landscape:**
  - Protection status of the watercourse;
  - Protection status of the vegetation type;
  - Regional context regarding ecological integrity;
  - Size and rarity of the wetland types present;
  - Diversity of habitat types within the wetland.
- **Sensitivity of the watercourse:**
  - Sensitivity of watercourse to changes in flooding regime;
  - Sensitivity of watercourse to changes in low flow regime, and
  - Sensitivity to water quality changes.

The median value of the scores for all determinants is used to assign an EIS category according to Table 12.

Table 12: Ecological importance and sensitivity categories. Interpretation of average scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high: Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and <=4	A
High: Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.	>2 and <=3	B
Moderate: Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use	>1 and <=2	C
Low/marginal: Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and <=1	D

Reference:

Kleynhans, C.J. (1999). Resource Directed Measures for Protection of Water Resources: River Ecosystems. R7: Assessment of Ecological Importance and Sensitivity.

APPENDIX 4: WET-ECOSERVICES

Ecosystem services in were assessed using WET-EcoServices Version 2 (Kotze, Macfarlane and Edwards, 2021). 16 different ecosystem services were evaluated and included:

- Flood attenuation
- Streamflow regulation
- Sediment trapping
- Phosphate assimilation
- Nitrate assimilation
- Toxicant assimilation
- Erosion control
- Carbon storage
- Biodiversity maintenance
- Provision of water for human use
- Provision of harvestable resources
- Food for livestock
- Provision of cultivated foods
- Cultural and spiritual experience
- Tourism and recreation
- Education and research

WET-EcoServices provides a set of indicators (e.g. slope of the wetland) rated on a five-point scale of 0 to 4 that reflect the supply/capability of a wetland for each of the 16 different ecosystem services listed above. An Excel™ based spreadsheet tool has been developed to conduct the assessment. For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

Reference:

Kotze, D.C., Macfarlane, D.M., Edwards, R.J., and Madikizela, B. (2020). WET-EcoServices Version 2: A revised ecosystem services assessment technique, and its application to selected wetland and riparian areas. Water SA, 46(4), 679-688.

APPENDIX 5: IMPACT ASSESSMENT METHODOLOGY

Individual impacts for the construction and operational phase were identified and rated according to criteria which include their intensity, duration and extent. The ratings were then used to calculate the consequence of the impact which can be either negative or positive as follows:

Consequence = *type x (intensity + duration + extent)*

Where type is either negative (i.e. -1) or positive (i.e. 1). The significance of the impact was then calculated by applying the probability of occurrence to the consequence as follows:

Significance = *consequence x probability*

The criteria and their associated ratings are shown in Table 13.

Table 13: Categorical descriptions for impacts and their associated ratings

Rating	Intensity	Duration	Extent	Probability
1	Negligible	Immediate	Very limited	Highly unlikely
2	Very low	Brief	Limited	Rare
3	Low	Short term	Local	Unlikely
4	Moderate	Medium term	Municipal area	Probably
5	High	Long term	Regional	Likely
6	Very high	Ongoing	National	Almost certain
7	Extremely high	Permanent	International	Certain

Categories assigned to the calculated significance ratings are presented in Table 14.

Table 14: Value ranges for significance ratings, where (-) indicates a negative impact and (+) indicates a positive impact

Significance Rating	Range	
Major (-)	-147	-109
Moderate (-)	-108	-73
Minor (-)	-72	-36
Negligible (-)	-35	-1
Neutral	0	0
Negligible (+)	1	35
Minor (+)	36	72
Moderate (+)	73	108
Major (+)	109	147

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium or high (Table 15).

Table 15: Definition of reversibility, irreplaceability and confidence ratings.

Rating	Reversibility	Irreplaceability	Confidence
Low	Permanent modification, no recovery possible.	No irreparable damage and the resource isn't scarce.	Judgement based on intuition.
Medium	Recovery possible with significant intervention.	Irreparable damage but is represented elsewhere.	Based on common sense and general knowledge
High	Recovery likely.	Irreparable damage and is not represented elsewhere.	Substantial data supports the assessment