Proposed Eagle Creek Housing Development on RE 47, 187 and 188 of Farm 220 Vyf Brakke Fontein, Mossel Bay, Western Cape.

Aquatic Biodiversity Assessment.

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- 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;
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Specialist: Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources)

Date: 9 October 2024

EXECUTIVE SUMMARY

Confluent Environmental was appointed by Sharples Environmental Services to undertake a freshwater assessment for the proposed Eagle Creek residential development on the Remainder of Portion 47 and Portions 187 and 188 of Farm 220 Vyf Brakke Fontein. The development has an Environmental Authorisation (EA) dated 2009, but no water use authorisation was undertaken at the time. This report addresses the freshwater biodiversity assessment required for the submission of a WULA and for fulfilment of the EA conditions. The development involves the subdivision of these farms into 89 residential erven, including the construction of infrastructure such as a stormwater network, a water and sewage reticulation network and access roads (including a bridge crossing the watercourse). The development is essentially split into a western and eastern section. The two sections are connected via a road that is planned to run immediately adjacent to the watercourse. The residential erven will be located outside of the 1:100 year floodline, immediately adjacent to the southern bank of the watercourse. Some infrastructure – or part thereof - (sewage pipeline, stormwater outlets, and road crossing) falls within or immediately adjacent to the 1:100 year floodline of the river.

A perennial stream grading into a channelled valley bottom wetland (**PES – C**; **EIS - Moderate**) runs along the northern boundary of the development. The watercourse is confined by a very steep embankment which is vulnerable to disturbance typically associated with urban developments (e.g. stormwater runoff and erosion, clearing of natural vegetation for lawns which reduces bank stability, establishment of alien invasive plant species etc.). A 15 m buffer is therefore deemed necessary to protect the embankment and the watercourse which flows immediately adjacent to it.

The final SDP was determined following an initial round of consultation between the author of this report and the developer. The initial design (Alternative A) had several erven located within the proposed 15 m buffer. Given the importance of a buffer for protecting the banks, these erven were subsequently removed from the updated layout presented in this report (Alternative B). Apart from the bridge and stormwater outlets, the section of access road connecting the western and eastern parts of the development is the only infrastructure that will remain within the buffer. Given the proximity of the road to the edge of the very steep embankment, infilling along the embankment or an engineered retaining wall will be required which will most likely extend into the banks and bed of the watercourse – possibly requiring a partial diversion of the channel of the watercourse. This activity represents a Medium risk to the watercourse, prompting the need for a WULA. All other activities can be mitigated to a Low risk. A seep wetland is also present in the eastern most extent of RE47 of Farm 220. The SDP has however been modified to avoid this wetland and no impacts to the wetland are anticipated.

Alternative B is recommended subject to a more detailed design to understand and mitigate against the impacts of the access road in the buffer zone.

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1. INTRODUCTION

Confluent Environmental was appointed by Sharples Environmental Services to undertake a freshwater assessment for the proposed Eagle Creek residential development on the Remainder of Portion 47 and Portions 187 and 188 of Farm 220 Vyf Brakke Fontein. The development has an Environmental Authorisation (EA) dated 2009, but no water use authorisation was undertaken at the time. This report addresses the freshwater biodiversity assessment required for the submission of a WULA and for fulfilment of the EA conditions.

1.1 National Environmental Management Act

According to the protocols specified in GN 1540 (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 (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 screening tool classified the site as being of **Very High** aquatic biodiversity due to its location with a river Freshwater Ecosystem Priority Area (FEPA). According to the protocol, prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the sensitivity of the site as indicated by the screening tool:

- Where the information gathered from the site sensitivity verification differs from the screening tool designation of **Very High** aquatic biodiversity sensitivity, and it is found to be of a **Low** sensitivity, an Aquatic Biodiversity Compliance Statement must be submitted.
- Similarly, where the information gathered from the site sensitivity verification differs from the screening tool designation of **Low** aquatic biodiversity sensitivity, and it is found to be of a **Very High** sensitivity, an Aquatic Biodiversity Specialist Assessment must be submitted.

1.2 National Water Act (NWA, 1998)

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, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) aims to protect water resources, through:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

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 a watercourse,
- And a reference to a watercourse includes, where relevant, its bed and banks.

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, a Water Use License (WUL) 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).

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).

1.3 Scope of Work

- To undertake a desktop analysis and site inspection to verify the sensitivity of aquatic biodiversity as **Very High** or **Low**; and
- Compile and Aquatic Biodiversity Compliance Statement or Aquatic Biodiversity Specialist Assessment based on the site verification of the sensitivity of the site; and
- Verify whether the site falls within the regulated area of any watercourses and compile the required DWS Risk Assessment to determine water use authorisation requirements.

2. WATERCOURSE ASSESSMENT METHODS

2.1 Desktop Assessment

A desktop assessment was conducted to contextualize the affected watercourses in terms of 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 wetlands, 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:

- National Freshwater Ecosystem Priority Area (NFEPA) atlas (Nel at al., 2011);
- National Wetland Map 5 and Confidence Map (CSIR, 2018);
- Western Cape Biodiversity Spatial Plan (CapeNature, 2017); and
- DWS hydrological spatial layers.

A site visit was conducted on the 9th of June 2023, with the objective of identifying and classifying the watercourse potentially affected by the development, determining its Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS).

2.2 Classification

The watercourse was classified based on its hydrological and geomorphological characteristics which provides a fundamental understanding of the drivers that characterize the wetlands and therefore assists in the interpretation of impacts to the watercourse. The classification of the watercourse also determines which PES and EIS assessment methodologies can be applied. Wetlands were categorised into discrete hydrogeomorphic units (HGMs) based on their geomorphic characteristics, source of water and pattern of water flow through the wetland. These HGMs were then classified according to Ollis et al. (2013).

2.3 Delineation of Watercourses

2.3.1 Wetlands

The presence of wetlands was verified 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 following soil wetness indicators were used to identify/confirm zones of saturation in any suspected wetland areas:

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

2.3.2 Riparian Zone

The riparian zone was delineated using methods described in DWAF (2005) as well as various desktop methods including the use of topographic maps, historical and current digital satellite imagery, and historical aerial photographs.

2.4 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 PES of the wetland hydrogeomorphic (HGM) units was assessed using the Level 2 WET-Health assessment tool developed by Macfarlane et al. (2007) – see Appendix 1. Data collection involved a desktop review of the extent and intensity of catchment land cover impacts and the onsite identification and recording of observable wetland impacts.

2.5 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 EIS assessment methodology applied to wetlands can be viewed in Appendix 2.

2.6 Sensitivity Mapping

Watercourses on or adjacent to the site were mapped in the field and verified at a desktop level using satellite imagery. A protective buffer zone was applied to watercourses potentially affected by the development. 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 and providing an ecological corridor for movement of riparian and terrestrial biota. 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.

3. LIMITATIONS AND ASSUMPTIONS

- The assessment of the site visit represents a brief temporal snapshot of conditions on the site. Changes in season or short-term changes in climatic conditions may possibly result in the presence of aquatic habitats (e.g. temporary or seasonal wetlands) under significantly wetter conditions that may previously have gone unnoticed. Despite this limitation the sensitivity of aquatic biodiversity on the site was determined with a high level of confidence.
- Assessment of impacts was based on the interpretation of civil engineering designs provided by the applicant. The author of this report is not an expert in engineering and it is possible that impacts may be over- or under-estimated based on this interpretation. It is further acknowledged that some of these designs may not be final or may require update following the outcome of this assessment.

4. DESKTOP SURVEY

The site falls within Primary Catchment K (Kromme) area and in quaternary catchment K10A, which is a coastal catchment. Numerous, mostly non-perennial, rivers drain the catchment area and terminate at the coastline (Figure 1). The catchment areas fall within the South Coastal Belt Level 1 ecoregion (22.2 Level 2 ecoregion), which is characterised by moderately undulating plains with altitude ranging from 0 to 500 m above mean sea level. Mean annual precipitation for the catchment area is between 300 and 700 mm per year and occurs all year-round, with peaks in October to November and March to April. The development area covers three farm portions located just west of the N2 highway in Mossel Bay (Figure 2). A channelled valley bottom wetland is mapped to occur along the northern boundary of the property and key desktop biodiversity attributes of the wetland are listed in Table 1. Channelled valley bottom wetlands associated with this vegetation type are not protected and their ecosystem threat status is Critically Endangered.

Table 1: Wetland characteristics according to the National Biodiversity Assessment (CSIR, 2018).

Feature	Description
Wetland Classification	Channelled Valley Bottom
Bioregion	Albany thicket
Ecosystem Threat Status	Critically Endangered
Ecosystem Protection Status	Not Protected
Desktop Present Ecological State	D/E/F

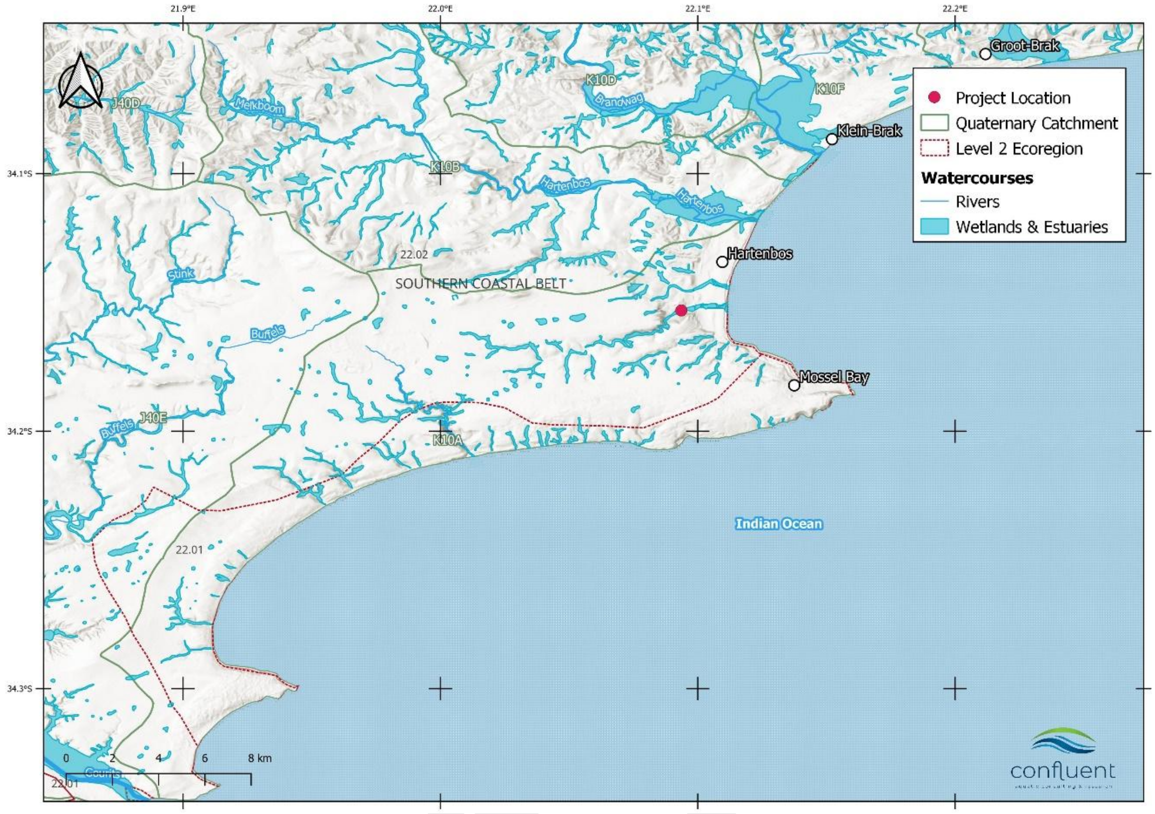

Figure 1: Map illustrating watercourses in relation to the development footprint.

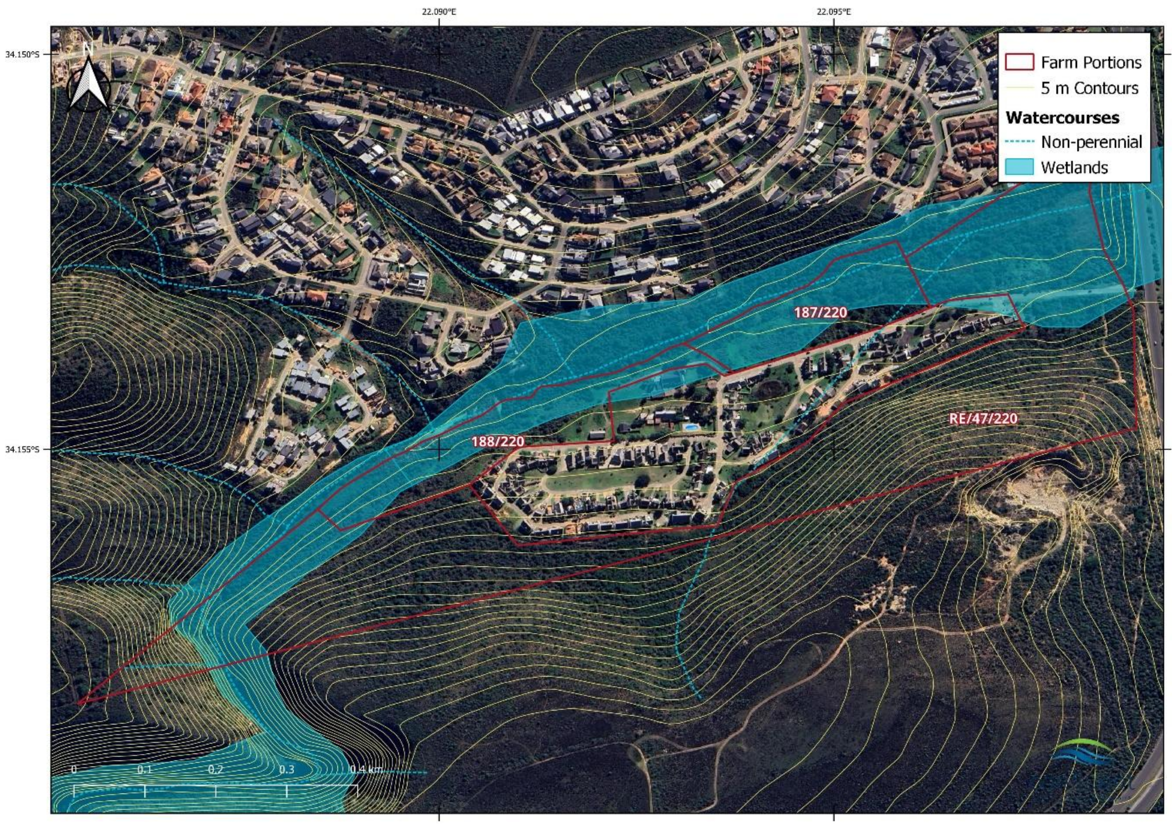

Figure 2: Map indicating channel valley bottom wetland mapped along the northern boundary of all properties.

4.1 National Freshwater Ecosystem Priority Areas (NFEPA)

The properties fall within a sub-quaternary catchment (SQC) that has been designated as a Freshwater Ecosystem Priority Area (FEPA) (Figure 3). River FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.

For river FEPAs the whole sub-quaternary (or quinary) catchment is identified as a FEPA, although the FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and catchment area needs to be managed in a way that maintains the good ecological condition of the river reach.

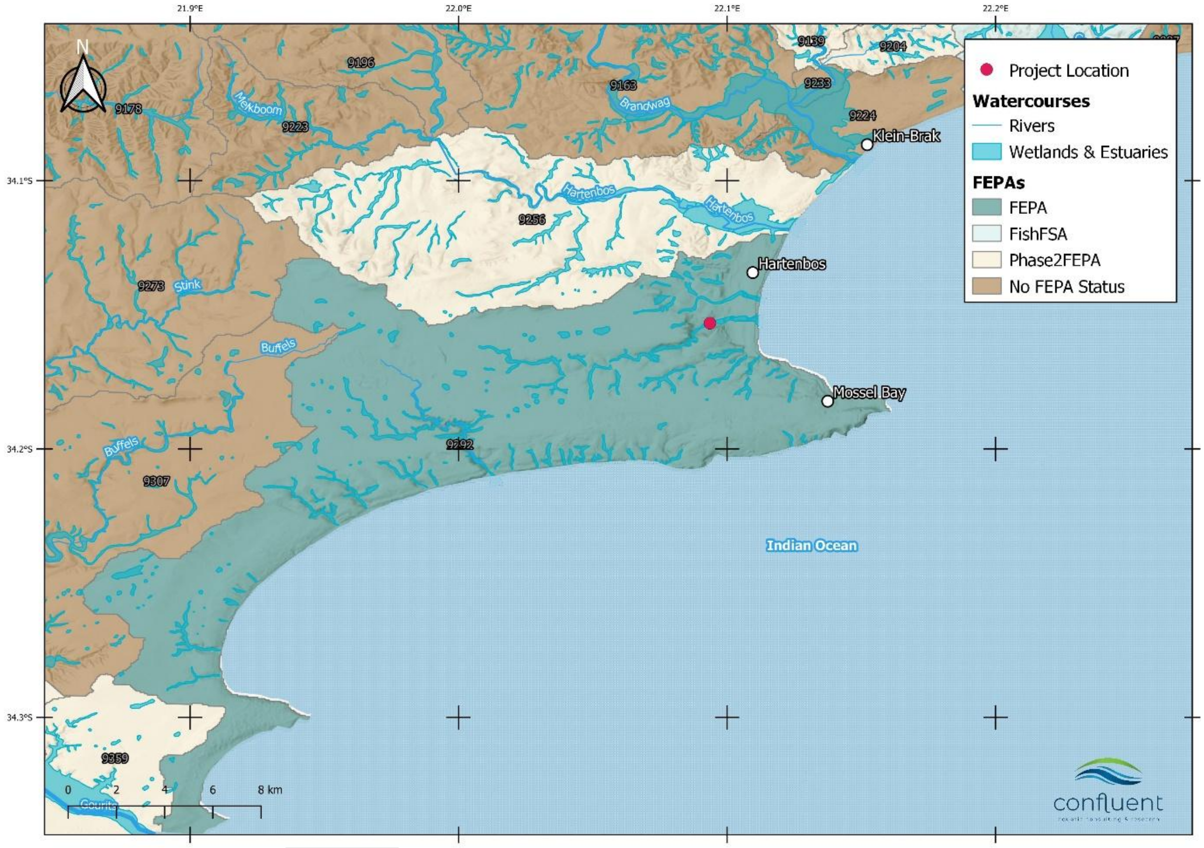

Figure 3: Location of the site relative to FEPAs.

4.2 Western Cape Biodiversity Spatial Plan

The main purpose of a biodiversity spatial plan is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land use and development planning, environmental assessments and authorisations, natural resource management and other multi-sectoral planning processes. The WCBSP plan achieves this by providing a map of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs).

The majority of the wetland is mapped as an aquatic CBA1 (Figure 4) and is therefore considered to be in a relatively natural condition and important for meeting provincial biodiversity targets. Management objectives require minimal, low impact development so that the natural state of the watercourse is maintained (Table 2).

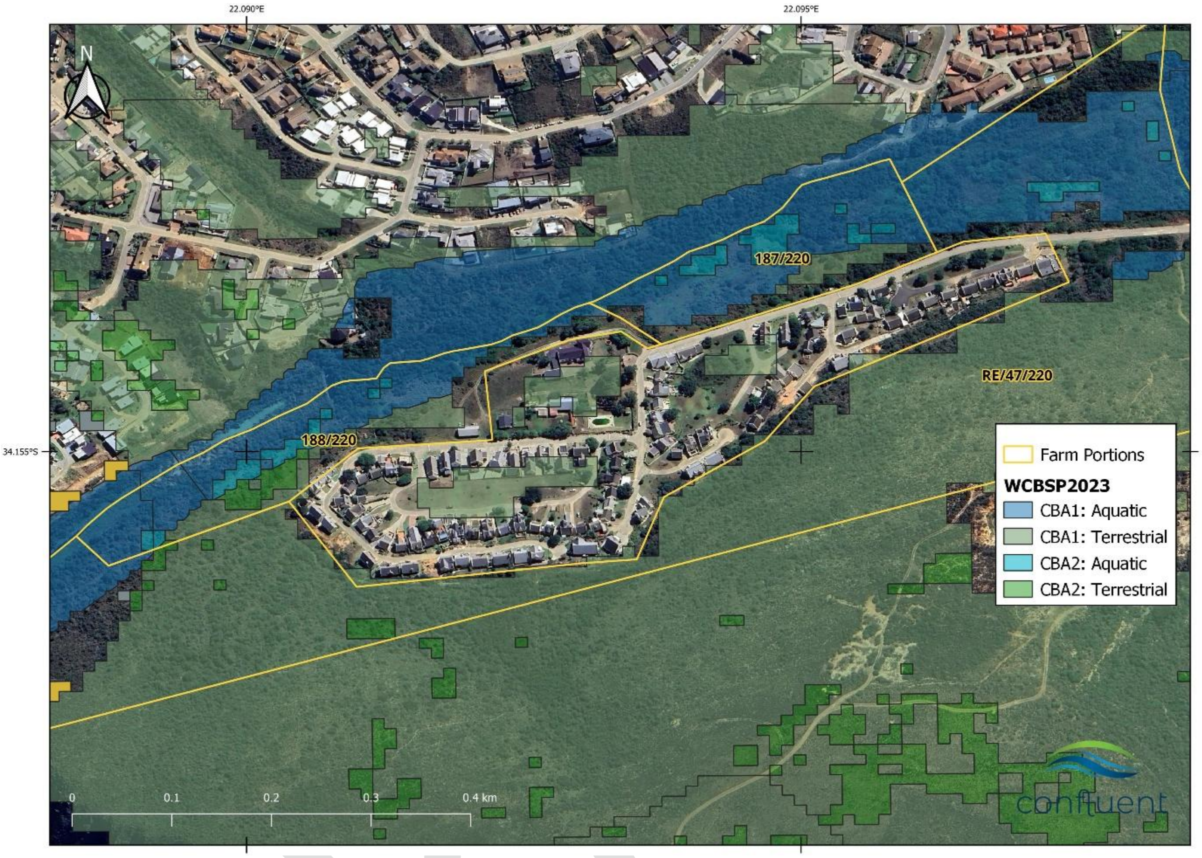

Figure 4: Map indicating property boundaries in relation to the 2023 Western Cape Biodiveristy Spatial Plan.

Table 2: Management objectives for biodiversity spatial planning units mapped within the properties.

Category	Description	Management Objectives
Aquatic 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 habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land-uses are appropriate.

5. WATERCOURSE ASSESSMENT

5.1 Watercourse Classification

5.1.1 Channelled Valley Bottom Wetland

The site visit identified a distinct active river channel, that flows from an instream dam (which is visible in aerial photographs from as far back as 1936) and runs along a valley bottom (representing the macro-channel) approximately 30 - 40 m wide. The active channel of the river is narrow (less than 3 m) and is comprised of mixed cobble and boulder substrate forming riffles and occasional pools (Figure 5). Immediately below the dam and for a stretch of approximately 300 m eastwards, the channel is confined immediately to the south by a very steep embankment (approximately 4 – 5 m high), which also forms the southern extent of the macro-channel). The upper reach of the watercourse immediately below the dam is consistent with a narrow non-perennial river (stream), fringed by a relatively wide riparian zone consisting of thicket species, namely *Olea exasperate*, *Carissa bispinosa* and *Searsia spp.* (Figure 6). There is no wetland vegetation on this embankment and vegetation is characterised by a mixture of indigenous and invasive terrestrial shrubs and trees (Figure 5).

As the channel approaches the N2 highway, the gradient of the southern embankment becomes more gentle, and the river grades into a channelled-valley bottom wetland (Figure 6). The active channel widens and is bordered by wetland habitat, characterised by dense reed beds consisting of *Cyperus textilis, Arundo donnax* and *Phragmites australis*. Analysis of historical imagery indicates that the wetland area immediately south of the active channel was historically cultivated (Figure 7) and at various times in the past was crossed by various road crossings. Construction of the N2 highway resulted in infilling across the watercourse, causing impedance of higher flows, and increased inundation and saturation of the banks adjacent to the channel – enhancing wetland habitat. It also appears as if the eastern most extent of the wetland (where it widens noticeably against the N2 highway) was associated with an area of disturbance (possibly an excavation), which allowed water to extend beyond its natural course (Figure 8). The delineated extent of the riparian zone and wetland is much narrower than mapped by CSIR (2018) and is mapped in Figure 6. There are other indicators of wetland vegetation (reed beds of *A. Donnax*) outside of the delineated area indicated in Figure 6, but these are all associated with stormwater outlets that discharge stormwater from the main access road, overland towards the direction of the wetland and are not considered as natural wetland areas.

Figure 5: Photographs illustrating the narrow active channel of the river (A); steep embankment and riparian thicket vegetation along the valley bottom (B); a patch of Cyperus textilis in the wetland(C); patch of Phragmites australis in the wetland (D); and a view of the wetland as it broadens towards the N2 showing P. australis reed-bed.

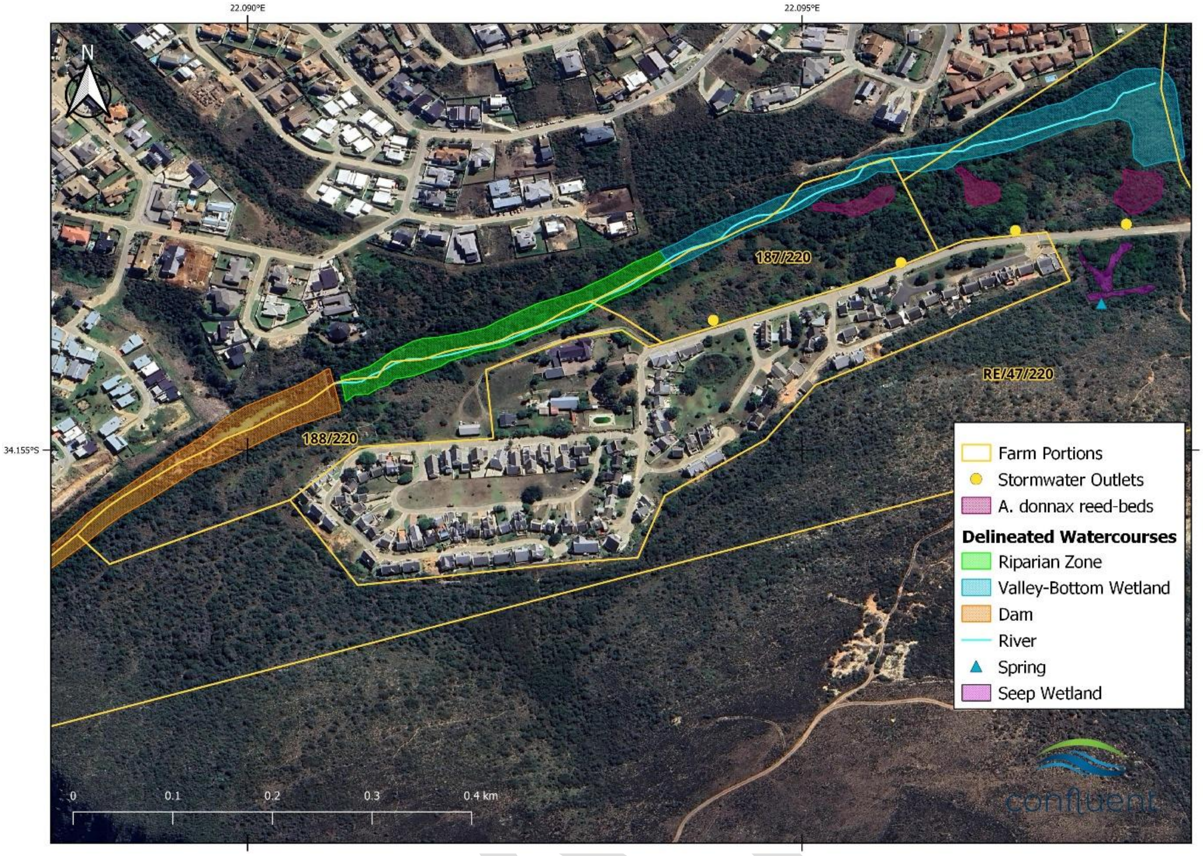

Figure 6: Site-based delineation of the riparian zone and wetland habitat.

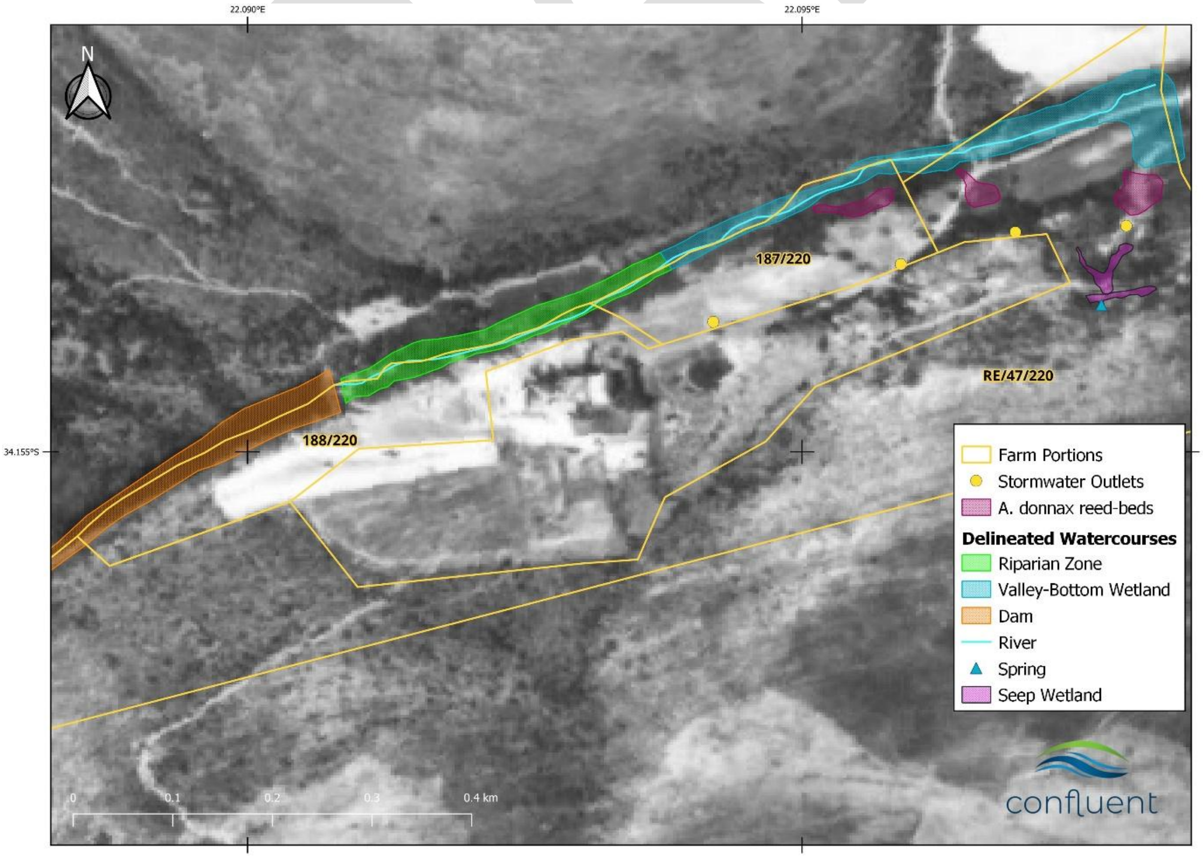

Figure 7: Delineated watercourse features overlaid on a 1963 historical image.

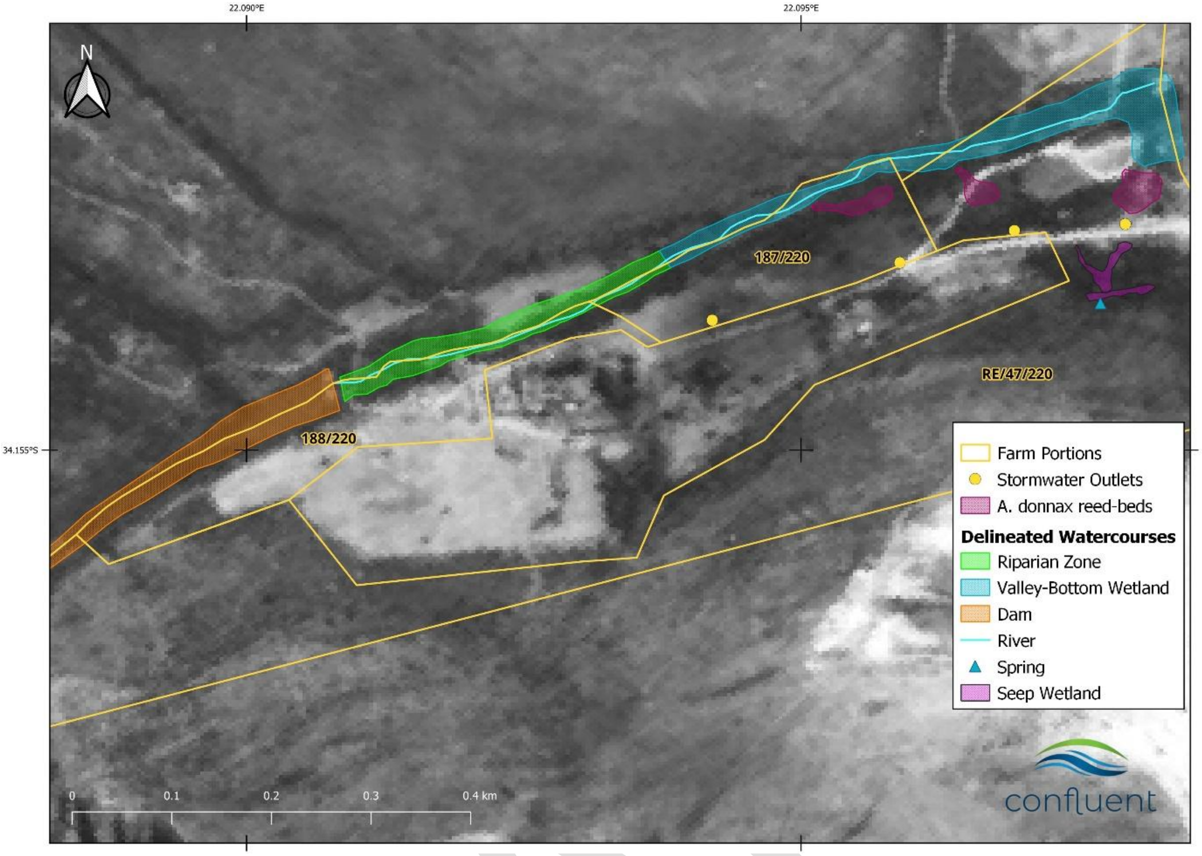

Figure 8: Delineated watercourse features overlaid on a 1974 historical image.

5.1.2 Seep Wetland

A seep wetland was identified on the Remainder of Portion 47 of Farm 220, south of the access road into the development area. The wetland originates from a spring that discharges from the mountain side. The spring has been contained by a berm which creates a small, inundated area that is vegetated by wetland plant species that include *P. australis* and *C. textilis* (Figure 9). Surface and sub-surface water however seeps below the berm and down towards the road, which concentrates flow towards a culvert and ultimately discharges as a narrow stream into the channelled valley bottom wetland below. Some of the surface flow is directed into a stormwater channel running south of the access road. The spring is likely to be permanent and has led to the development of a highly organic saturated soil layer above the road.

Figure 9: Photographs of the seep wetland showing the berm and area of inundation characterised by P. australis (A); surface flow and wetland vegetation (B); saturated organic soil within the wetland area (C) and; a stormwater channel into which some surface flow from the wetland is diverted (D).

5.2 Present Ecological State

5.2.1 Channelled Valley Bottom Wetland

The wetland has experienced several modifications over time. The most serious being the construction of the instream dam along the most upstream section of the development and the N2 highway along the eastern boundary of the development. As mentioned above, the dam is visible in imagery from 1939 and historically would have altered the flow regimes (base flows and flood peaks) and delivery of sediment to downstream habitats. Currently, the surface of the dam is covered in emergent aquatic macrophytes (e.g. *Typha*) indicating that it is relatively shallow (most likely filled with sediment) and that the majority of surface flows are likely to pass directly through the dam. Furthermore, given that no active agriculture is currently being practiced, it is unlikely that abstraction rates from the dam are very high.

Infilling associated with the construction of the N2 highway has impeded flow to an extent and resulted in some inundation and associated increase in the extent of wetland habitat upstream of the road. The watercourse also currently receives stormwater input from the access road into the Vakansieplaas Estate as well as from residential developments to the north. Fringing riparian vegetation is largely natural, although signs of invasion by succulent species (most notably *Hylocereus undatus* – Dragon fruit and *Opuntia engelmannii* – Prickly pear) along the river section and *Arrundo donnax* in the wetland area was observed (Figure 10). There was evidence of dumping (i.e. garden refuse and rubble) all along the length southern steep embankment. Based on the land use of the catchment area (a mixture of agricultural, urban and natural), together with modifications caused by the instream dam and the N2 highway, the PES of the wetland is C (Moderately Modified) (Table 3).

Figure 10: Photographs of the site showing the steep embankment and invasion by Hylocereus undatus and Opuntia engelmannii.

Table 3: Wet Health-2 scores for the unchannelled valley bottom wetland.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.8	2.4	3.2	3.0
PES Score (%)	62%	76%	68%	70%
Ecological Category	**C**	**C**	**C**	**C**
Combined Impact Score	3.2			
Combined PES Score (%)	68%			
Combined Ecological Category	**C**			

5.2.2 Seep Wetland

The main modifications to the seep wetland are due to the berm and road which has disrupted and diverted the natural flow of the wetland down the hillslope, resulting in more concentrated flow through the road culvert and into the stormwater channel. Some less of vegetation has occurred as a result of the historical construction of the access road.

Table 4: Wet Health-2 scores for the seep wetland.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.8	2.4	1.1	3.0
PES Score (%)	43%	76%	89%	70%
Ecological Category	D	C	B	C
Combined Impact Score	3.4			
Combined PES Score (%)	66%			
Combined Ecological Category	C			

5.3 Ecological Importance & Sensitivity

5.3.1 Channelled Valley Bottom Wetland

The watercourse has a good diversity of habitat at a local scale, consisting of narrow riffle, sections, deeper run and pool sections, a wider section of wetland habitat and a good riparian coverage (Table 5). The broader macro-channel, including the associated river, riparian and wetland habitat, therefore provides good refuge at a local scale and also provides a good migration corridor for instream and riparian biota connecting the estuary all the way up to undeveloped mountain areas. Given its perennial characteristics, the stream is sensitive to changes in flow. Assimilative capabilities of the wetland are fairly limited, given the modifications to geomorphology and the relatively small size of the wetland (Table 6). The wetland offers limited direct human benefits, although there is good potential for recreational activities along the entire length of the watercourse (e.g. walking and bird-watching) (Table 7).

Table 5. Ecological Importance and Sensitivity of the channelled valley bottom wetland.

Criteria	Score
Biodiversity Support	
Presence of Red Data species	1
Populations of unique species	1
Migration/feeding/breeding sites	1
Average	**1**
Landscape Scale	
Protection status of wetland	1 – Poorly protected
Protection status of vegetation type	1 – Poorly protected
Regional context of the ecological integrity	1 – Moderately modified from natural
Size and rarity of the wetland types present	2 – Small to medium wetlands.
Diversity of habitat types	2 – River, riparian and wetland vegetation
Average	**1.2**
Sensitivity of Wetland	
Sensitivity to changes in floods	1
Sensitivity to changes in low flows	2
Sensitivity to changes in water quality	2

Average	**1.67**
ECOLOGICAL IMPORTANCE AND SENSITIVITY	**1.67 (Moderate)**

Table 6: Hydro-functional importance of the channelled valley bottom wetland.

Hydro-functional importance			Score
Regulating & supporting benefits	Flood attenuation		2
	Streamflow regulation		2
	Water quality enhancement	Sediment trapping	2
		Phosphate assimilation	2
		Nitrate assimilation	2
		Toxicant assimilation	2
		Erosion control	2
	Carbon storage		2
HYDRO-FUNCTIONAL IMPORTANCE			**2 (Moderate)**

Table 7: Direct human benefit of the channelled valley bottom wetland.

Direct human benefits		Score
Subsistence benefits	Water for human use	0
	Harvestable resources /cultivated foods	0
Cultural benefits	Cultural heritage	0
	Tourism and recreation & education and research	2
DIRECT HUMAN BENEFITS		**0.25 (Low)**

5.3.2 Seep Wetland

Given the small size of the wetland and its limited habitat diversity, the wetland is unlikely to be important for supporting biodiversity and is of low importance at a landscape scale (Table 8). Vegetation structure within the wetland provides limited hydro-functional attributes (Table 9) and apart from some potential for abstractive use, provides no direct human benefits (Table 10).

Table 8. Ecological Importance and Sensitivity of the seep wetland.

Criteria	Score
Biodiversity Support	
Presence of Red Data species	1
Populations of unique species	1
Migration/feeding/breeding sites	1
Average	**1**
Landscape Scale	
Protection status of wetland	1 – Poorly protected
Protection status of vegetation type	1 – Poorly protected
Regional context of the ecological integrity	1 – Moderately modified from natural
Size and rarity of the wetland types present	1 – Small to medium wetlands.
Diversity of habitat types	1 – Limited wetland vegetation
Average	**1**

Sensitivity of Wetland	
Sensitivity to changes in floods	1
Sensitivity to changes in low flows	1
Sensitivity to changes in water quality	1
Average	**1**
ECOLOGICAL IMPORTANCE AND SENSITIVITY	**1 (Low)**

Table 9: Hydro-functional importance of the seep wetland.

Hydro-functional importance			Score
Regulating & supporting benefits	Flood attenuation		1
	Streamflow regulation		1
	Water quality enhancement	Sediment trapping	1
		Phosphate assimilation	1
		Nitrate assimilation	1
		Toxicant assimilation	1
		Erosion control	1
	Carbon storage		1
HYDRO-FUNCTIONAL IMPORTANCE			**1 (Low)**

Table 10: Direct human benefit of the seep wetland.

Direct human benefits		Score
Subsistence benefits	Water for human use	1
	Harvestable resources /cultivated foods	0
Cultural benefits	Cultural heritage	0
	Tourism and recreation & education and research	0
DIRECT HUMAN BENEFITS		**0.25 (Low)**

6. SENSITIVITY MAPPING

Buffer zones are implemented to provide protection to watercourses from anthropogenic activities, which in this case will include increased generation of surface runoff and stormwater associated with hardening of surfaces (e.g. paved roads, driveways, roofs etc.). Buffer zones thus protect watercourses from erosion and also provide habitat for a variety of aquatic, riparian and terrestrial biota. In the case of this development a buffer is considered particularly important, especially given the very steep slope of the embankment (which is poorly vegetated in sections) along the western section of the development and should be considered as a sensitive area. Buffer determination considered the implementation of mitigation measures specified in Section 8 below as well as the catchment characteristics which are summarised as follows:

- It was assumed that mitigation measures (described in Section 8 of the report) will be implemented during the construction and operational phase.
- Mean Annual Precipitation Class: 600 - 800 mm.

- Rainfall Intensity: Zone 4.
- The inherent runoff potential of soil in the catchment area: Low (C soils).
- Average slope of the rivers catchment: >11 %.
- Inherent erosion potential of the catchment soils: Moderate (K factor 0.5 – 0.7).
- The slope of the buffer area: Moderately steep (20 - 40 %).
- Vegetation characteristics: Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands).
- Moderate soil permeability: Shallow (<30cm) well drained soils.
- Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception.

Based on these inputs a 15 m buffer for river and wetland area is recommended (Figure 11).

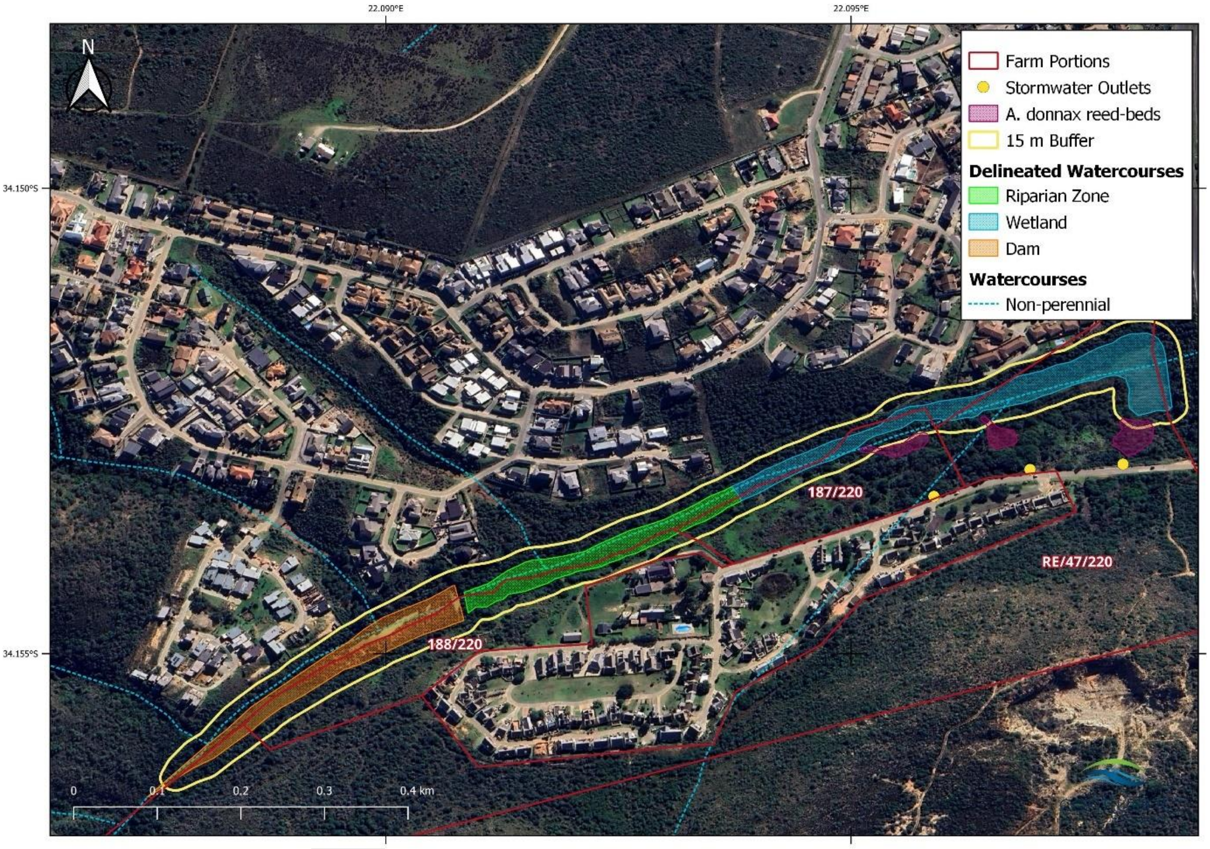

Figure 11: Recommended 15 m buffer for delineated watercourses.

7. PROJECT DESCRIPTION

The development involves the subdivision of these farms into 89 residential erven, including the construction of infrastructure such as a stormwater network, a water and sewage (reticulation network and access roads (including a bridge crossing the watercourse). The development is essentially split into a western and eastern section (Figure 12). The two sections are connected via a road that is planned to run immediately adjacent to the watercourse. The residential erven will be located outside of the 1:100 year floodline, immediately adjacent to the southern bank of the watercourse. Some infrastructure – or part thereof - (sewage pipeline, stormwater outlets, and road crossing) falls within or immediately adjacent to the 1:100 year floodline of the river. The following details are relevant:

- The final SDP was determined following an initial round of consultation between the author of this report and the developer. The initial design (Alternative A) had several erven in the western section over-lapping with the proposed 15 m buffer of the wetland (Figure 13). Given the steepness of the embankment and the importance of a buffer for protecting the banks, these erven were subsequently removed from the updated layout presented in this report (Alternative B). Furthermore, erven that originally overlapped with the seep wetland (Alternative A) were removed from the update layout (Alternative B) (Figure 13).
- An internal gravity sewer system will collect the sewage from the development and deliver it to a proposed new pump station as indicated. From this new pump station, sewage will be pumped to a sewer manhole on the existing municipal system as indicated and gravitate to the Voorbaai pump station.
- Stormwater outlets will consist of gabion basket stilling basin (for energy dissipation) which will overflow onto a reno mattress (for erosion protection) (Figure 14).
- A concrete culvert bridge will be constructed across the watercourse to connect the development to Island View to the north. The bridge will be designed for the 1:50 year flood level. Flow will be directed through four box culverts (3.6 m wide x 3.0 m high) (Figure 15).
- The road connecting the western and eastern sections of the development will run within the buffer, directly adjacent to the watercourse as no alternative option for this access is possible.

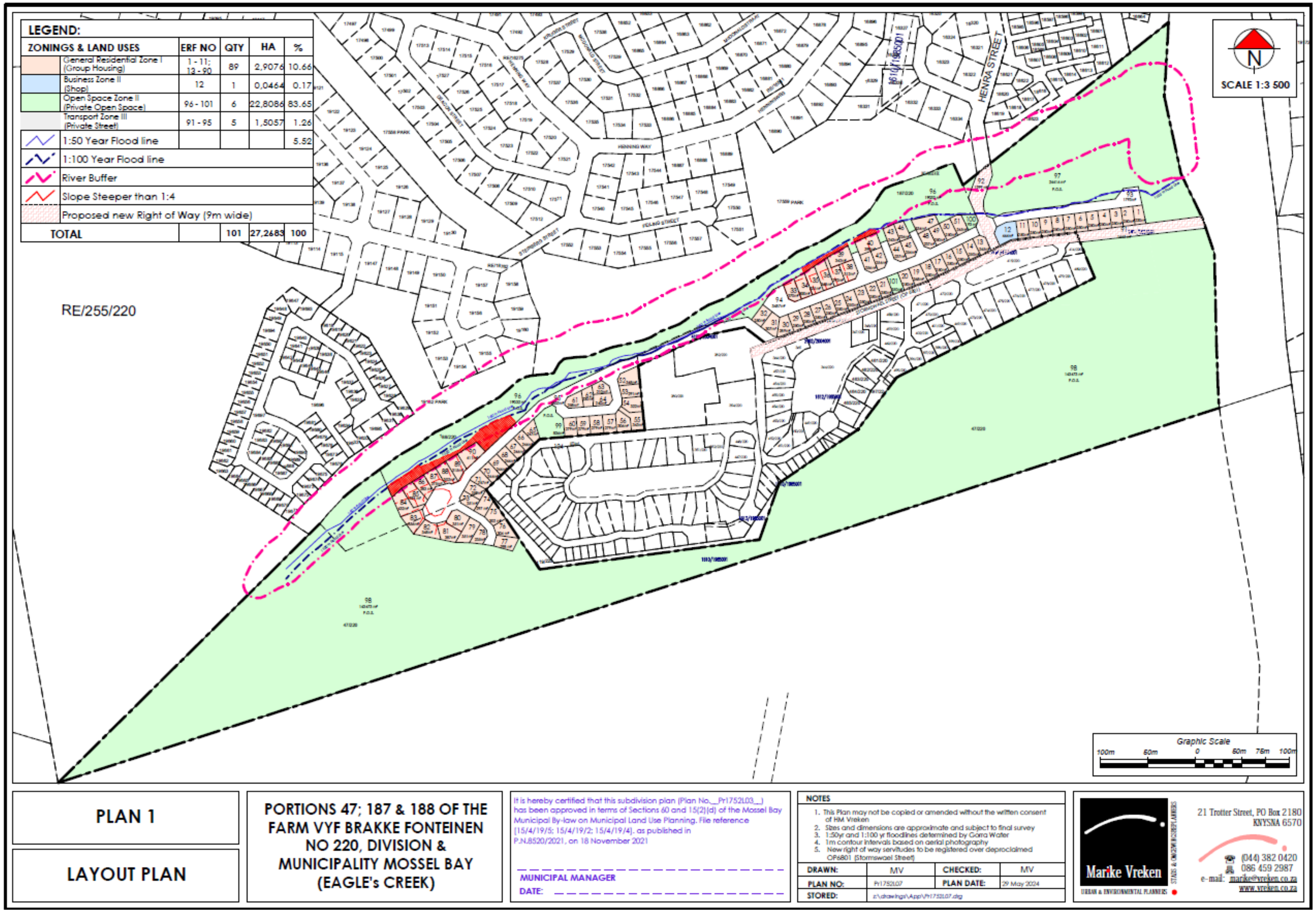

Figure 12: Proposed site development plan (Alternative B).

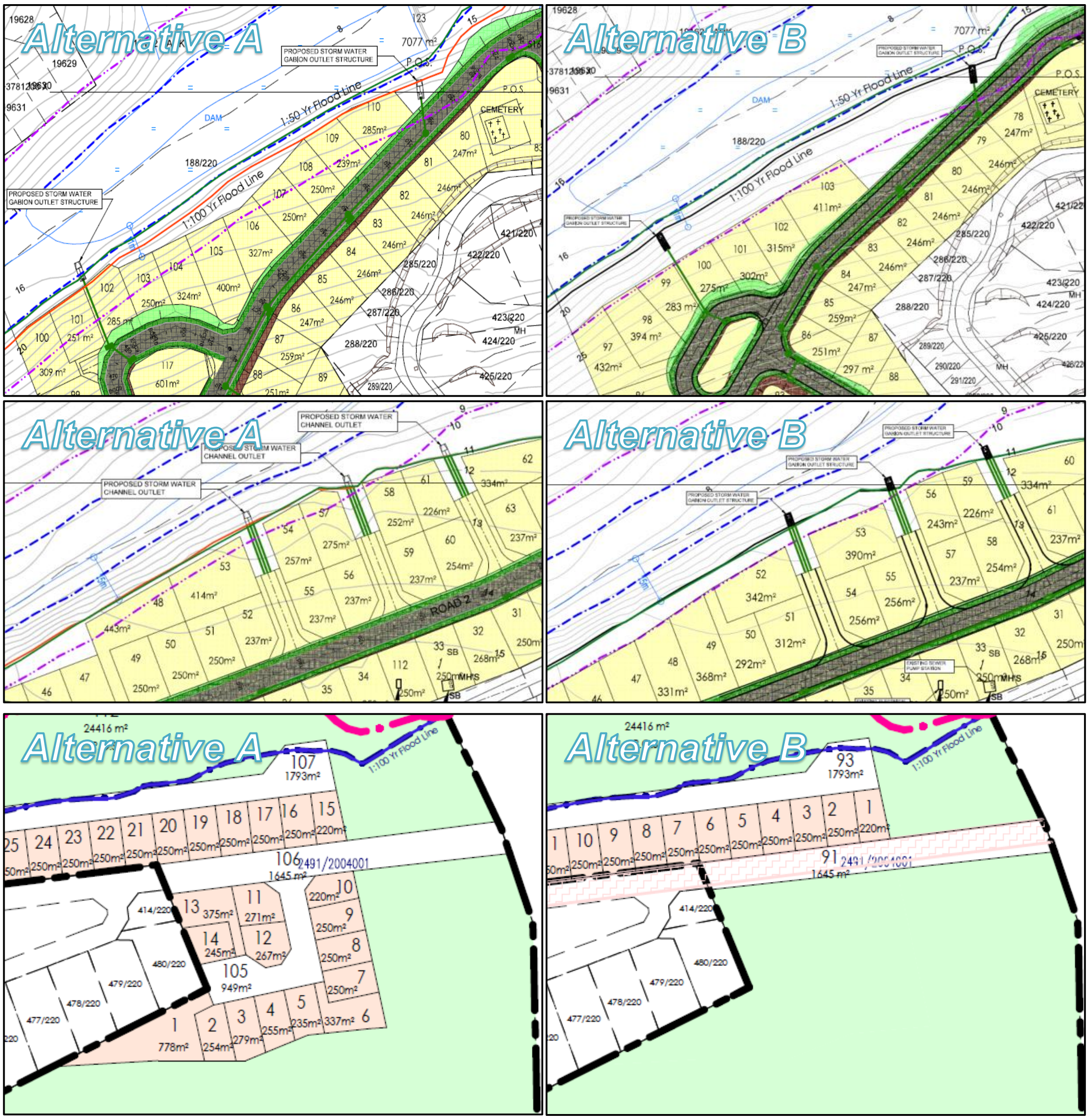

Figure 13: Comparison of Alternative A (left – with erven located in the 15 m buffer – indicated by purple dashed line – and located over seep wetland) and Alternative B (right – erven removed from 15 m buffer – indicated by purple dashed line – and removed from seep wetland).

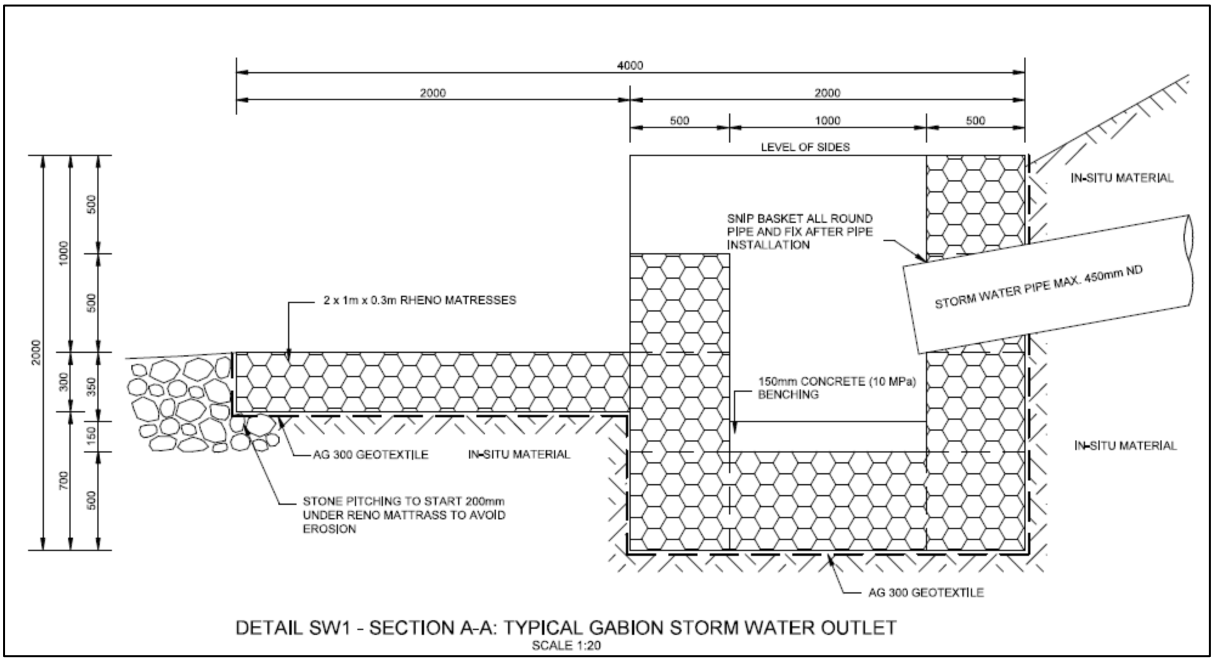

Figure 14: Section drawing of proposed stormwater outlets

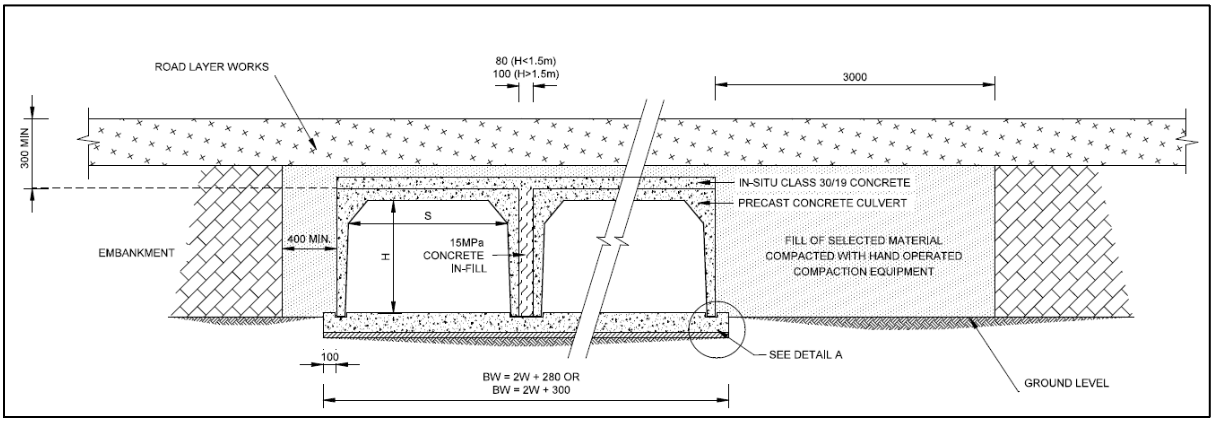

Figure 15: Drawing of proposed concrete culvert bridge

8. IMPACT ASSESSMENT

The alternatives (A and B) described in Section 7 above were assessed as part of the impact assessment.

8.1 Design Phase

Impact 1: Design of road crossing on hydrogeomorphological features of the wetland Poorly designed road crossings impede flow causing inundation and sedimentation of habitat upstream of the road and often erosion and scouring of habitat downstream of the road due to concentrated, high energy flows passing through relatively narrow culverts.				
	Alternative A		**Alternative B**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	High	Moderate	High	Moderate

Duration	Permanent	Permanent	Permanent	Permanent
Extent	Very limited	Very limited	Very limited	Very limited
Probability	Almost certain	Unlikely	Almost certain	Unlikely
Significance	**-78: Moderate**	**-36: Minor**	**-78: Moderate**	**-36: Minor**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- The design will incorporate box culverts which will maximise flows beneath the bridge and are considered more suitable in comparison to circular culverts.
- The culvert invert must be level with the bed of the river to allow free-flow of the river during low base-flow periods and to prevent inundation of habitat upstream of the road.
- No vertical drop-offs below the road crossing. Alternatively, erosion protection must be incorporated into the design of the bridge downstream of the crossing.

Impact 2: Erosion and scouring of instream habitat caused by increased stormwater runoff.

Increase in the area of hardened surfaces will result in increased stormwater inputs into the watercourse. Concentrated high volume and high energy stormwater inputs have the effect of eroding the bed and banks of watercourses, resulting in channel incision and modifications to instream habitat. An adequate stormwater management plan must therefore be developed in the design phase to mitigate these impacts.

	Alternative A		**Alternative B**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	High	Moderate	High	Moderate
Duration	Permanent	Ongoing	Permanent	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Almost certain	Likely	Almost certain	Likely
Significance	**-84: Moderate**	**-60: Minor**	**-84: Moderate**	**-60: Minor**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Stormwater must, as far as is possible, be managed onsite through the implementation of Sustainable Drainage Systems (SuDS) which should include infiltration devices that capture and retain a portion of the runoff and allow it to infiltrate into the soil. Such devices include infiltration trenches, infiltration basins, dry wells, leaching catch basins, porous pavement/blocks, and infiltration islands.
- Runoff from impervious surfaces should be directed towards open areas (e.g. lawns and parks) to increase infiltration and minimise high-level flow into stormwater infrastructure and watercourses.
- Sidewalks should be graded so that runoff drains into open areas (e.g. lawns and parks) rather than toward the street.
- Stormwater leaving the development footprint must not under any circumstances be allowed to be discharged directly onto the steep slopes of the southern embankment (i.e. the steep slopes to the south of the development footprint).

- Stormwater leaving the development footprint must be conveyed/piped to an area of lower elevation and must be discharged through an appropriate energy dissipation structure (e.g. detention basin, reno mattress etc.).
- As stormwater drains discharge directly into the watercourse, inlets to these drains should be labelled with painted or prefabricated messages that warn residents of the environmental hazards of dumping materials into stormwater drains.
- The recommended 15 m buffer must be enforced, with a view to providing some protection to the watercourse.

Impact 3: Modification to instream habitat and channel morphology caused by construction of a section of the access road connecting the western and eastern portion of the development.

A section of the road connecting the western and eastern portion of the development will run through the designated 15 m buffer and will require that section of the bank to be filled or stabilised with concrete or gabion retaining walls. Given the steepness of the banks, fill will most likely extend into the channel of the watercourse, which would require that the channel be diverted further to the north (away from the embankment). Stabilisation of the river-bank using gabions or a concrete retaining wall will result in a hardened surface along that section of the river bank. This results in a localised change in flow hydrodynamics (e.g. deflection of energy, increased flow speed during high flow events) which can result in unanticipated scouring and erosion of the unprotected opposite banks.

	Alternative A		**Alternative B**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very high	Moderate	Very high	Moderate
Duration	Permanent	Permanent	Permanent	Permanent
Extent	Limited	Limited	Limited	Limited
Probability	Almost Certain	Likely	Almost Certain	Likely
Significance	**-90: Moderate**	**-65: Minor**	**-90: Moderate**	**-65: Minor**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- The width of the road must be reduced so that no fill is required along the steep embankment or alternatively, a near vertical gabion wall or concrete retaining wall is recommended over fill as this would minimise the encroachment into the watercourse and could potentially avoid the need for diversion of the channel.

8.2 Construction Phase

Impact 4: Loss of aquatic habitat caused by construction of infrastructure located in the bed and banks of the watercourse

Construction of infrastructure along the watercourse (e.g. bridge crossing, stormwater outlets, stabilisation of embankments etc.) and immediately adjacent to the steep embankment will result in some habitat loss. Alternative A would result in the loss of the seep wetland.

	Alternative A		Alternative B	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	High	Very Low	Low	Very Low
Duration	Permanent	Permanent	Permanent	Permanent
Extent	Limited	Very limited	Very limited	Very limited
Probability	Certain	Certain	Certain	Certain
Significance	**-98: Moderate**	**-91: Moderate**	**-77: Moderate**	**-70: Minor**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Areas where instream construction activities will take place must be confined to clearly demarcated areas so as to prevent unnecessary disturbance of instream and riparian habitat outside of these areas;
- The recommended 15 m buffer must be implemented and demarcated to protect the watercourse from construction activities and to provide a corridor that allows movement of aquatic and riparian biota from the wetland area, upstream to the dam and beyond to more undeveloped areas of the catchment;
- No equipment or materials to be stored or stockpiled within the delineated area of the wetland or riparian zone or within the 15 m buffer.

Impact 5: Sedimentation of instream habitat caused by construction activities within the watercourse

Construction of infrastructure within the bed and banks of the watercourse (e.g. concrete culvert bridge, stormwater outlets etc.) will mobilise soil and sediments which can increased turbidity and smother aquatic habitat.

	Alternative A		Alternative B	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	High	Moderate	Moderate	Moderate
Duration	Brief	Brief	Brief	Brief
Extent	Limited	Limited	Limited	Limited
Probability	Almost certain	Almost certain	Almost certain	Probably
Significance	**-54: Minor**	**-48: Minor**	**-48: Minor**	**-32: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Instream construction activities should as far as possible be scheduled for a period of low probability of rainfall.
- A temporary check dam (using sand bags) must be established upstream of the construction site to create dry working conditions. Water from upstream should be transferred through the construction area by an appropriately sized flexible pipe.

- Temporary straw-bale check dams must be placed across the channel, immediately downstream of instream construction activities as a back-up to trap high levels of sediment in the event of a high rainfall event. Accumulated sediment and the check dams must be removed by hand and as soon as construction is complete.
- All materials (e.g. sandbags) must be removed from the watercourse following completion of the construction activity.
- Exposed, disturbed banks must be reprofiled to natural contours and revegetated (using indigenous grass-seed mix) once construction has been completed.
- Construction phasing (sequencing) must be implemented. Only a portion of the site must therefore be disturbed at any one time according to a planned schedule to complete the needed building in that phase. Other portions of the site must not be cleared and graded until exposed soils from the earlier phase have been stabilized and the construction is nearly completed.

Impact 6: Erosion and Sedimentation During Site Preparation

Vegetation will need to be cleared and the potential for erosion and sedimentation of the river is relatively high given the steep-sided slopes that run down to the river below.

	Alternative A		**Alternative B**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Moderate	Moderate	Moderate	Low
Duration	Short term	Short Term	Short term	Brief
Extent	Limited	Limited	Limited	Limited
Probability	Almost certain	Probably	Almost certain	Probably
Significance	**-54: Minor**	**-36: Minor**	**-54: Minor**	**-28: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Runoff from disturbed areas must be directed through silt traps (silt fences, sandbags etc.) to remove sediment and reduce the sedimentation of the river in the valley below.
- Clearing and grading should occur only where absolutely necessary to build and provide access to structures and infrastructure. Clearing should be done immediately before construction, rather than leaving soils exposed for months or years.
- Construction phasing (sequencing) must be implemented. Only a portion of the site must therefore be disturbed at any one time according to a planned schedule to complete the needed building in that phase. Other portions of the site must not be cleared and graded until exposed soils from the earlier phase have been stabilized and the construction is nearly completed.
- When excavated areas are backfilled the surface must be level with the surrounding land surface, to minimise soil erosion from the areas when the excavation is complete.
- During the excavation of pits, roads, construction sites etc. the removed topsoil should be stored and appropriately protected so that it does not wash into waterbodies, causing sedimentation and nutrient loading. This is then used to backfill the area so that it can be effectively rehabilitated.
- The 15 m buffer must be implemented and demarcated. No construction activities (apart from stormwater outlets and the access road), stockpiles or laydown of construction equipment are permitted in the buffer.

8.3 Operational Phase

Impact 7: Fragmentation of riparian and ecological corridors caused by construction of a road and erven (Alternative A) within the recommended buffer.

Part of the access road linking the eastern and western section of the development will encroach into the recommended buffer which fragments the ecological corridor along the southern bank of the river. Connectivity is however maintained along the northern bank of the river. Alternative includes residential erven within the buffer.

	Alternative A		Alternative B	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Moderate	Moderate	Very low	Very low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Almost certain	Almost certain	Unlikely	Unlikely
Significance	**-66: Minor**	**-66: Minor**	**-30: Negligible**	**-30: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- No mitigation possible. Alternative B is recommended due to lower impact.

Impact 8: Degradation of watercourses as a result of increased edge effects, including water quality changes, litter, erosion, dumping and alien invasion associated with localised increase in the residential population.

The watercourse will be vulnerable to degradation from edge effects associated with increased suburban pressures that include the accumulation of litter, dumping of refuse and garden waste and increased propensity for the invasion of watercourses by alien or weedy vegetation (often associated with household gardens).

	Alternative A		Alternative B	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	High	Moderate	Moderate	Low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Almost Certain	Almost Certain	Probably	Unlikely
Significance	**-78: Moderate**	**-72: Moderate/Minor**	**-48: Minor**	**-33: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- No activities or gardens are permitted to extend into the buffer zone. The buffer should be viewed as a valuable green space, supporting local biodiversity and only low impact recreational activities (e.g. walking, bird-watching etc.) are permitted;

- Numerous exotic invasive species were observed along the river embankments, including *Hylocereus undatus* (Dragon Fruit) and *Opuntia engelmannii* (Prickly Pear). These have the potential to invade and spread throughout the riparian area and must be actively controlled and removed from the site;
- Active revegetation of bare exposed banks with indigenous vegetation is recommended; and
- Strict rules must be implemented and enforced which forbid dumping of waste and garden refuse within the buffer zone.

9. DWS RISK ASSESSMENT MATRIX

Risks of activities associated with the development were determined according to the risk assessment matrix developed as part of GN 4167 of 2023 (Section 21 (c) and (i) water use Risk Assessment Protocol) **- Error! Reference source not found.** The first stage of the risk assessment is the identification of environmental activities, aspects and impacts and essentially mirror those that were identified in the impact assessment (see Section 8). The intensity of impact to receptors and resources (i.e. hydrology, water quality, geomorphology, biota and vegetation) is rated (from 0 to 5, representing negligible and very high impact, respectively), which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. Risks were then quantified based on the anticipated spatial scale, duration and likelihood of occurrence and assumed the full implementation of recommended mitigation measures described in Section 8.

Alternative B removes residential erven from the buffer and represents a significant improvement over the original SDP (Alternative A). Only risks associated with Alternative B were assessed in the risk matrix and can be summarised as follows:

- Apart from the bridge and stormwater outlets, the section of access road connecting the western and eastern parts of the development is the only infrastructure located within the buffer. Given the proximity of the road to the edge of the very steep embankment, infilling along the embankment or an engineered retaining wall will be required and for the reasons described in Impact 3 above, represents a **Medium** risk to the watercourse;
- Construction activities located in the buffer and/or bed and banks of the river are limited to the concrete culvert bridge and stormwater outlets. The use of box culverts for the bridge represents is an acceptable design and is unlikely to result in a significant modification to the flow dynamics;
- The **Low** risk for stormwater outlets is based on the condition that stormwater will not be discharged onto the unprotected steep embankment and that the outlets incorporate energy dissipation and erosion protection as per Figure 14; and
- Implementation of a 15 m buffer together with mitigation measures proposed in Section 7 should provide sufficient protection to the watercourse during the construction phase.

Based on the Medium risk assigned to the construction of the access road a WUL would be required for authorisation of Section 21 (c) and (i) activities.

Table 11: DWS Risk Assessment Matrix for Section 21 (c) and (i) water use activities associated with Alternative B.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					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 (with mitigation)	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
PRE-CONSTRUCTION (DESIGN)	Concrete Culvert Crossing	Impeding flow and sediment delivery	Wetland	C	Moderate	2	0	2	2	2	4	1	5	10	3	30	60%	18	L	High
	Stormwater Discharge	Erosion of the bed and banks	Wetland	C	Moderate	4	2	3	2	2	8	3	5	16	3	48	60%	28.8	L	High
	Construction of Access Road Connecting the Western and Eastern Portion of the Development	Infilling along the banks of the river	Wetland	C	Moderate	3	1	3	2	2	6	1	5	12	3	36	100%	36	M	High
		Fragmentation of riparian and ecological corridors	Wetland	C	Moderate	0	0	0	2	2	4	1	5	10	3	30	60%	18	L	High
CONSTRUCTION	Construction of Infrastructure located along the bed and banks of the watercourse	Loss of Instream Habitat	Wetland	C	Moderate	0	0	1	1	1	2	1	5	8	3	24	100%	24	L	High
		Sedimentation of Instream Habitat	Wetland	C	Moderate	0	2	2	3	3	6	2	2	10	3	30	60%	18	L	High
		Pollution and distrubance of wetland habitat	Wetland	C	Moderate	0	2	1	3	3	6	2	2	10	3	30	60%	18	L	High
	Clearing of vegetation for preparation of the site	Erosion along the banks of the watercourse	Wetland	C	Moderate	0	2	1	1	1	4	1	2	7	3	21	60%	12.6	L	High
OPERATIONAL	Incrreased suburban population and associated activities	Edge effects on watercourse	Wetland	C	Moderate	0	2	0	2	2	4	3	4	11	3	33	60%	19.8	L	High

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10. CONCLUSION

The proposed Eagle Creek development is bordered by a perennial stream and associated channelled valley bottom wetland along its northern boundary. The watercourse is confined by a very steep embankment which is vulnerable to disturbance typically associated with urban developments (e.g. stormwater runoff and erosion, clearing of natural vegetation for lawns which reduced bank stability, establishment of alien invasive plant species etc.). Implementation of an adequate sized buffer is therefore considered important for the long-term protection of the watercourse. In this respect the applicant has altered the original SDP to remove several residential erven from the buffer and represents a significant improvement over the original SDP. The access road connecting the eastern and western portion of the development will however remain in the buffer. Given the close proximity of the road to the edge of the very steep embankment, infilling along the embankment or an engineered retaining wall will be required, which will most likely extend into the banks and bed of the watercourse – possibly requiring a partial diversion of the channel of the watercourse. This activity represents a Medium risk to the watercourse, prompting the need for a WULA. In this respect a more detailed design will be required to understand and mitigate against the impacts associated with this activity.

A seep wetland is also present in the eastern most extent of RE47 of Farm 220. The SDP has however been modified to avoid this wetland and no impacts to the wetland are anticipated.

11. 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.

Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Peterson, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H., Swartz, E. and Smith-Adao, L.B. (2011) Atlas of freshwater ecosystem priority areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission Report No. TT 500/11.

Ollis, D., Snaddon, K., Job, N., & Mbona, N. (2013). Classification system for wetlands and other aquatic ecosystems in South Africa. South African National Biodiversity Institute.

APPENDIX 1: 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.

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 12 below.

Table 12: 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 2: ECOLOGICAL IMPORTANCE AND SENSITIVITY (WETLANDS)

The revised method for the determination of the EIS of a wetland considers the three following ecological aspects (Rountree et al., 2013):

- **Ecological importance and sensitivity**
  - Biodiversity support including rare species and feeding/breeding/migration;
  - Protection status, size and rarity in the landscape context;
  - Sensitivity of the wetland to floods, droughts and water quality fluctuations.
- **Hydro-functional importance**
  - Flood attenuation;
  - Streamflow regulation;
  - Water quality enhance through sediment trapping and nutrient assimilation;
  - Carbon storage
- **Direct human benefits**
  - Water for human use and harvestable resources;
  - Cultivated foods;
  - Cultural heritage;
  - Tourism, recreation, education and research.

Each criterion is scored between 0 and 4, and the average of each subset of scores is used to derive a score for each of the three components listed above. The highest score is used to determine the overall Importance and Sensitivity category of the wetland system.

Table 13: 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: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these floodplains is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

Reference:

Rountree, M.W., Malan, H.L., Weston, B.C. (2013). Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2). Water Research Commission Report No. 1788/1/12.