Aquatic Biodiversity Impact Assessment

Proposed construction of Plett Lagoon residential estate on Erf 6503, Plettenberg Bay, Western Cape

Prepared for Cape EAPrac (Pty) Ltd by Dr. Jackie Dabrowski

Confluent Environmental (Pty) Ltd

Compiled in July 2023
Revised in March 2024 for amended Site Development Plan
Revised in May 2024 for proposed fence around wetland area
Revised in July 2024 for inclusion of sewage package plant

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DECLARATION OF CONSULTANTS INDEPENDANCE

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;

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• All the particulars furnished by me in this document are true and correct.

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1. INTRODUCTION

Confluent Environmental Pty (Ltd) were appointed by Cape EAPrac to provide aquatic specialist inputs to the proposed residential development known as Plett Lagoon Estate on RE/6503 (Figure 1). The property is approximately 19 hectares in extent and is in the town of Plettenberg Bay between the Keurbooms Estuary to the east and the Plettenberg Bay Primary School to the west. Site access is via Beacon Way on the southwestern corner of the property. The eastern portion of the site is below the 5 m.a.m.s.l. contour which places it in the Estuarine Functional Zone of the Keurbooms Estuary Figure 1.

Figure 1. Proposed site of a housing development known as Plett Lagoon Estate on RE/6503, Plettenberg Bay.

1.1 The Proposed Development

The Site Development Plan (SDP) which was originally assessed for this report in July 2023 is presented in Figure 4. The original Site Development Plan proposed at Plett Lagoon Estate had split-zoning as follows:

- Residential Zone 1: 2.27 ha
- Residential Zone 2: 4.06 ha
- Open Space Zone 2: 0.37 ha
- Open Space Zone 3: 10.57 ha (includes wetland area)
- Transport Zone (Streets): 1.83 ha

Housing and amenities will consist of:

- Single Residential: 42-50 Erven
- Group Housing: 41 Units

Following identification and delineation of the wetland on site, the Site Development Plan was scaled back to exclude the wetland with the result that 10.5 hectares (almost 60%) of the site will be zoned as public open space and managed as a nature conservation area by the development's body corporate (Figure 4).

1.1.1 Updated Site Development Plan March 2024

The SDP was updated following feedback received from the Bitou Municipality. The development footprint remained the same, but the density of residential erven reduced to 50 residential plots in total. For ease of comparison a snapshot of the original SDP is compared to the updated SDP in Figure 2.

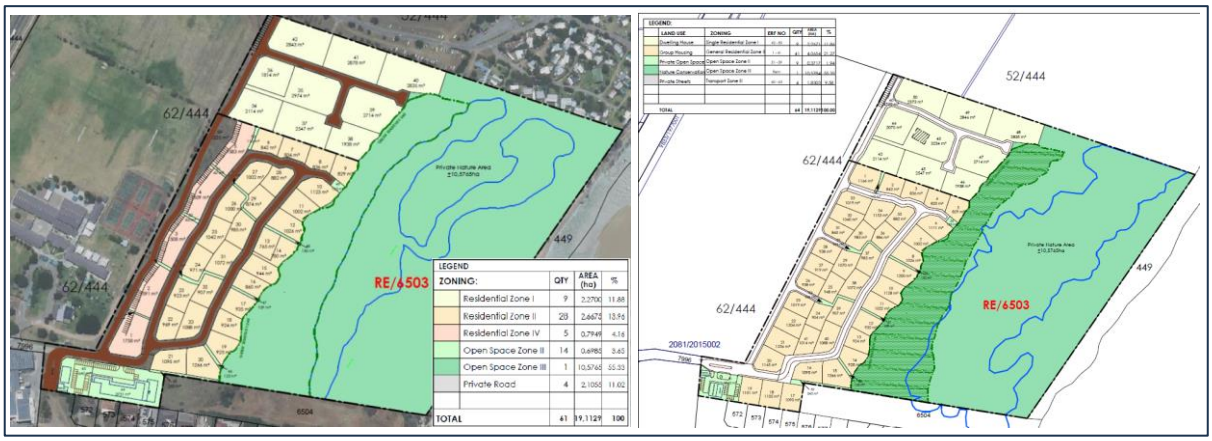

Figure 2. Original Site Development Plan assessed for the report (left, July 2023), followed by the updated SDP reviewed in the updated report (right, March 2024).

Differences that were identified in the revised SDP are as follows:

- One less internal road in the residential area. This was reduced from three parallel roads to two in the revised SDP.
- The original layout had 75 erven and the new layout has 50 erven (9 Zone 1 and 41 Zone 2).

From the perspective of Aquatic Biodiversity the footprint of development is the same, and the revised SDP has still been planned to fully accommodate the wetland buffer determined in this report. While the reduction in erven hasn't reduced the footprint, it will reduce human traffic at the site which should slightly reduce the impact to the wetland in terms of foot traffic accessing the area which is a slight positive impact. The approach to stormwater management has remined the same and is described in the following section.

There are no additional negative impacts anticipated from the revised SDP and therefore the remainder of the report remains unchanged.

1.1.2 Proposal to Fence Wetland Area

The original Site Development Plan included a security fence around the proposed development area only (yellow line in Figure 3). This was a recommendation of the first and second versions of this report with the aim to maintain connectivity between the wetland and

adjacent Keurbooms Estuary predominantly for the movement of wildlife. This mitigation measure was recommended to avoid the impact of fragmentation. Subsequently, the developer has proposed an additional security fence due to concerns about security in the wetland area, and to secure this area for future residents of the estate. In addition the presence of vagrants sleeping in the wetland area was linked to a fire that occurred historically on the site.

Two alternative fence routes have been proposed along the estuary, and two routes are also being considered to secure the housing area. All proposed alternative fencelines follow existing jeep tracks to minimise the requirement for vegetation clearance and allow for easy access and maintenance. Estuary alternative 1 traverses the buffer and part of the wetland area, while alternative 2 encroaches into less actual wetland area. The original development fenceline followed the transition line between transformed grassland and more natural thicket vegetation on the upper slope along essentially flat ground. The alternative development fenceline follows the base of the slope along an existing pathway and intersects areas of the buffer. As the proposed alternatives all interact with the wetland and estuary to some extent, their respective impacts must be assessed and mitigation measures proposed, if feasible, to minimise these impacts. This is addressed further in the impact assessment which also considered mitigation measures recommended by the faunal specialist (Biodiversity Africa, April 2024).

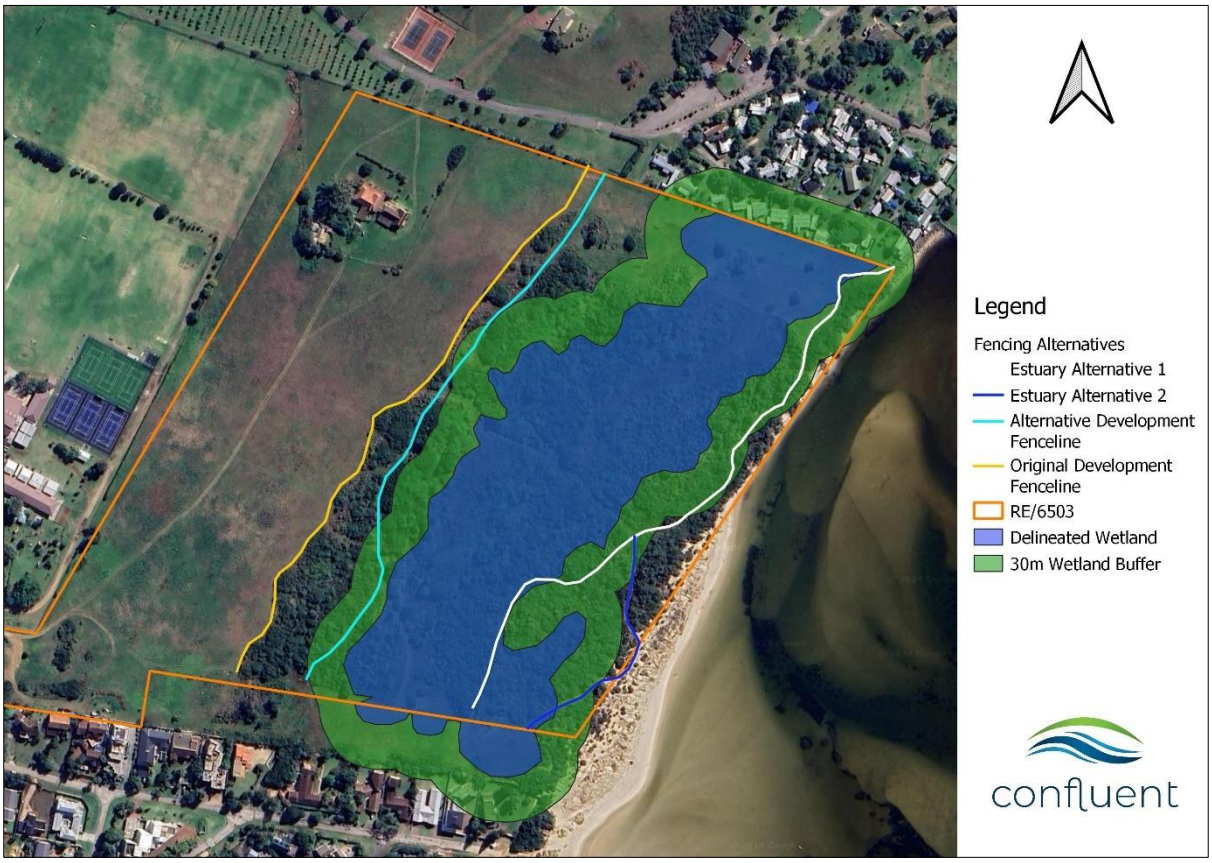

Figure 3. RE/6503 showing proposed fenceline alternatives in relation to delineated wetland and buffer areas.

1.1.3 Stormwater Management

Aspects of the development that may influence the wetland and Keurbooms estuary include the management of stormwater and wastewater from the site. Vita Engineers provided a Civil Engineering Services Report (June 2023) for the site which states the following:

<u>Stormwater Management</u>

- The pre-development site drains from the higher lying western boundary to the lower lying eastern boundary.
- The site is underlain by aeolian sands several metres thick with high permeability, therefore promoting the infiltration of surface water runoff from the site.
- A network of swales along roads has been proposed as the main SuDS-based attenuation feature. The swales aim to attenuate peak flows to pre-development runoff rates and to treat stormwater runoff by percolation through sands.
- Channels with flow velocities > 1m/s will be lined and protected with open pavers, while unlined channels with lower flow velocities will be vegetated.

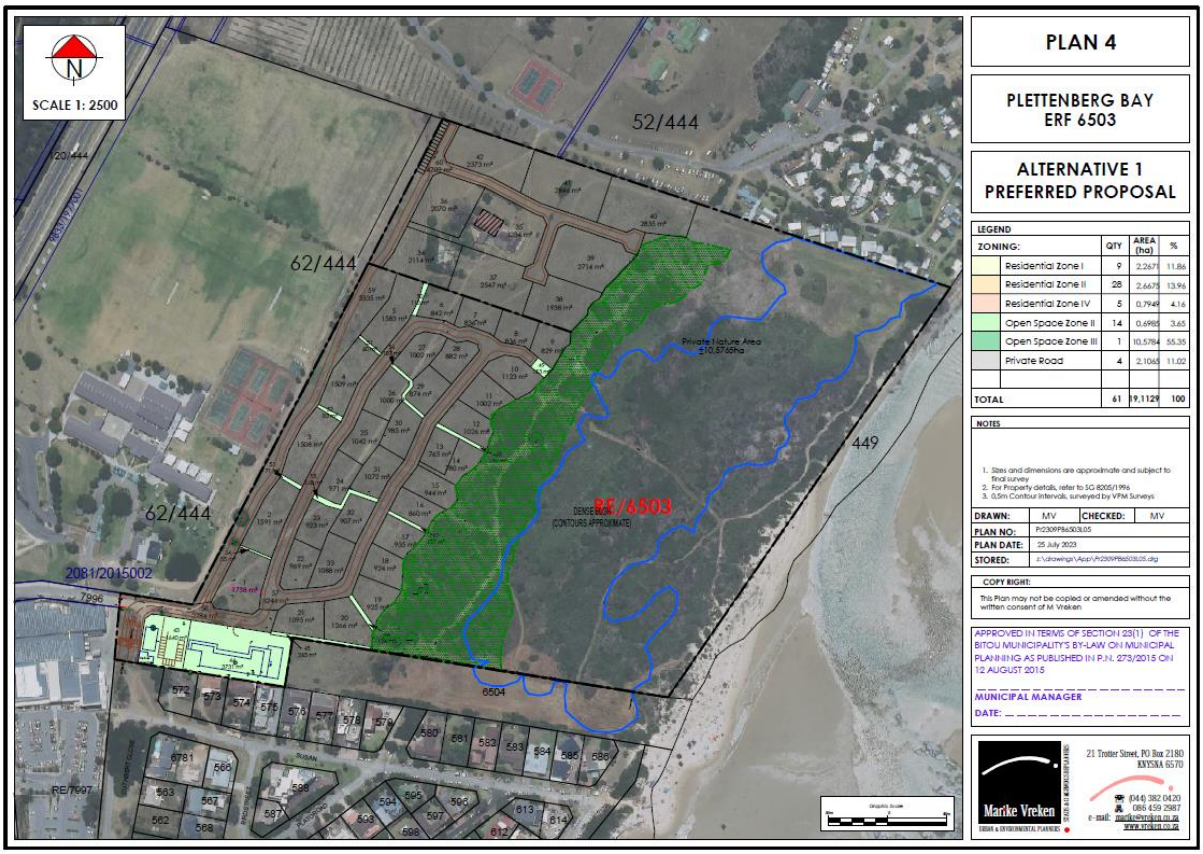

Figure 4. Proposed Site Development Plan for RE/6503, Plettenberg Bay.

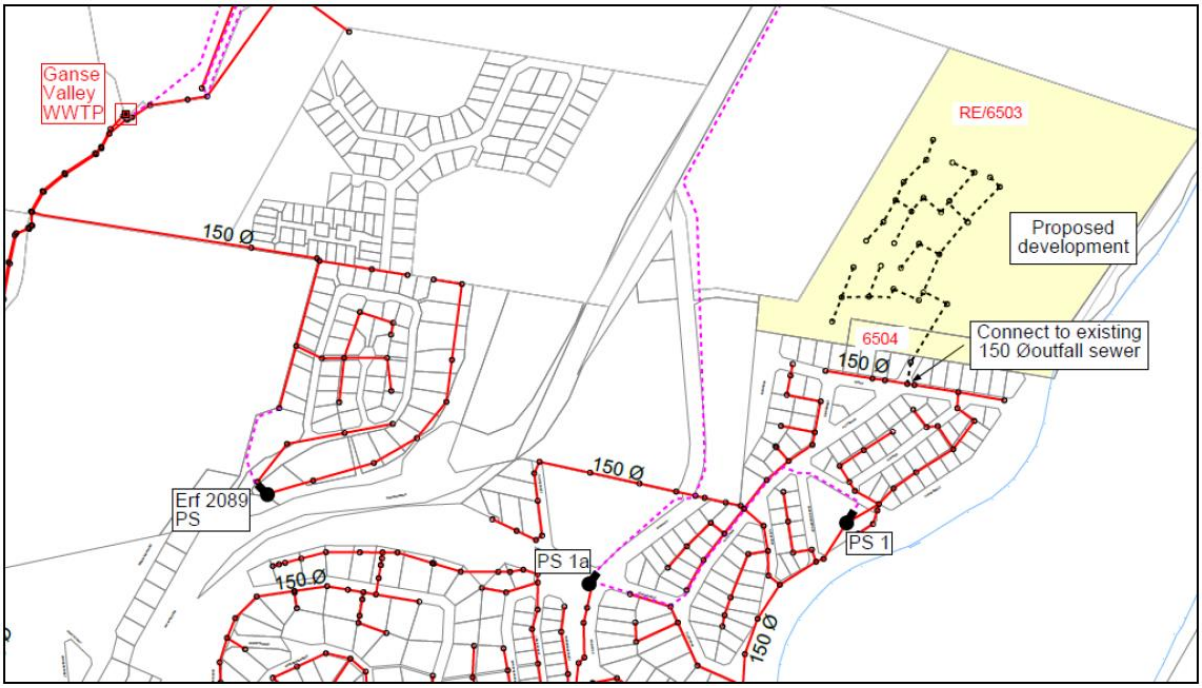

Figure 5. External sewer masterplan extracted from GLS Consulting (Feb, 2023).

Sanitation

The Bitou Municipality confirmed that there is currently insufficient capacity to accommodate this development's sewages through the existing municipal infrastructure. The municipality have agreed to allow installation of a sewage package plant for the development until their wastewater treatment works has been upgraded and can accommodate sewage from the site.

The proposed package plant is an Alveo Water Membrane Bioreactor Wastewater Treatment Plant with the following description:

"The proposed packaged wastewater treatment plant is a membrane bioreactor (MBR). MBR technology combines microfiltration with bio-digestion to reap the benefits of combined physical separation and biological removal. The dependency of effluent quality on influent quality is partially removed with an MBR system and thus MBR systems consistently provide quality effluent water. Furthermore, the minimal transfer of suspended solids through the MBR system allows the concentration of active bacteria to increase as much as four (4) times that possible in a CAS plant. This ensures that superior bio-digestion occurs with the use of an MBR at a fraction of the area required when using CAS alone.

The containerised WWTP will be constructed in one 12m container which will house the following:

- 3mm fine screen
- Anoxic tank mixer
- Aerobic section diffuser disks and pipework
- MBR membranes
- Blowers for aeration and membrane scouring

- Permeate pumps to remove water from the MBR chamber.
- UV disinfection
- CIP tank and skid to clean membranes periodically.
- All electrical MSS, cabling and instrumentation required for a fully functional plant
- Generator.

The treatment plant footprint will be 20m x 6m and the location of the plant is near the entrance to the estate in the south-west corner (Figure 6). The rising main sewer line runs along the eastern edge of the development parallel to the edge of the wetland buffer and includes a pump station towards the northern section of the development which is indicated in Figure 6. It is proposed to irrigate the treated wastewater across open areas of the estate on a regular (likely daily) basis. It is envisaged that the Bitou Municipality will eventually upgrade their wastewater treatment works and then the estate will 'switch over' to this system, rendering the package plant obsolete. But until then, the treated effluent would need to be irrigated across the site.

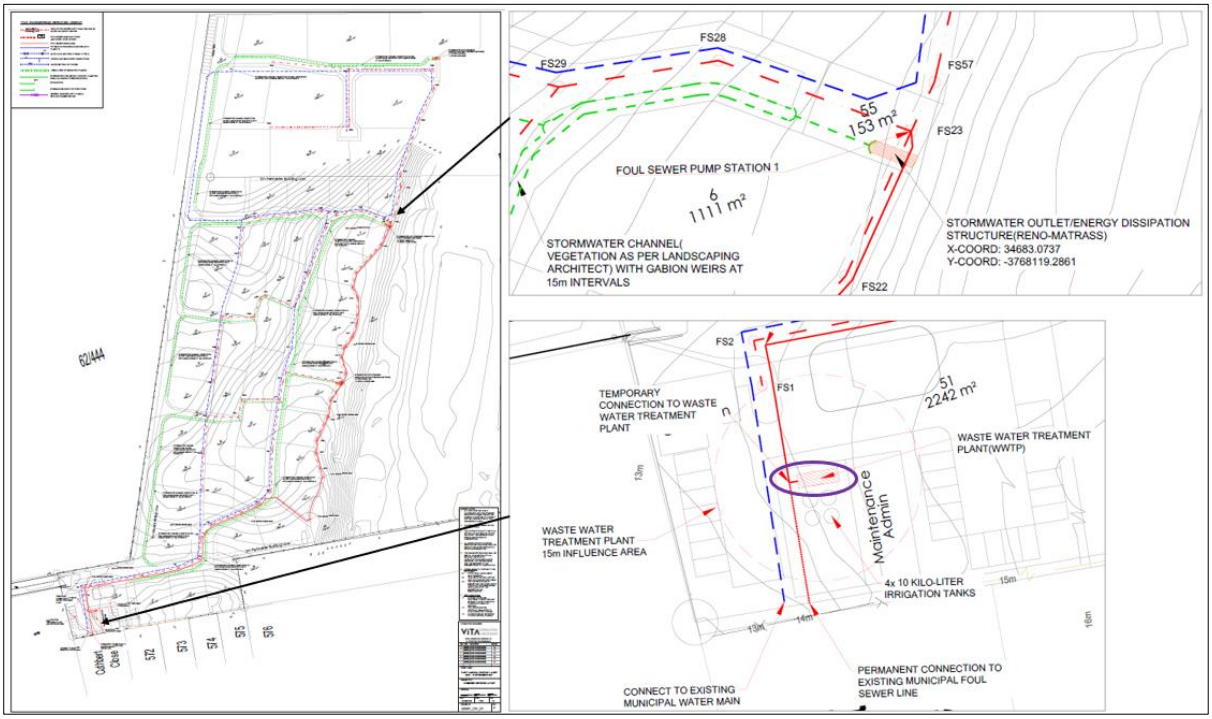

Figure 6. Extract of stormwater and sewage reticulation from Appendix E, Pg. 65 of the Engineering Services Report (Vita Consulting Engineers, July 2024). Enlarged sections highlight the location of a sewer pump station and the sewage package plant (encircled).

1.2 DFFE Screening Tool Results

According to the Department of Environment, Forestry and Fisheries (DFFE) screening tool, aquatic biodiversity at the site has a **Very High** sensitivity (Figure 7). The sensitivity features identified are:

- Critical Biodiversity Area 1 – Aquatic
- Keurbooms Estuary
- FEPA Sub-catchment

- Wetlands (Estuary)

As both an estuary and freshwater wetland are located at the site, the scope of work for this report is guided by the legislative requirements of the National Environmental Management Act (NEMA) and the National Water Act (NWA; Act No 36 of 1998).

Figure 7. Results of the DFFE Screening Tool which indicate Very High Sensitivity of the Aquatic Biodiversity theme.

1.3 Scope of work

According to the protocols specified in GN 320 (Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity) of the National Environmental Management Act (NEMA; Act No. 107 of 1998), 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 objectives of this assessment included the following:

- To undertake a Site Sensitivity Verification for aquatic biodiversity using desktop analysis and a site inspection. Sensitivity will be verified as either **Very High** or **Low**; and,
- Compile an Aquatic Biodiversity Compliance Statement or Aquatic Biodiversity Specialist Assessment based on the sensitivity verification for the site. This includes assessment of the following:

Interrogation of available desktop resources including:

- DWS spatial layers (1:50 000 rivers)
- National Freshwater Ecosystem Priority Areas (NFEPA) spatial layers (Nel *et al.,* 2011)
- National Wetland Map 5 and Confidence Map (CSIR, 2018)
- Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

Conduct a site visit to determine the site sensitivity:

- Identification and classification of watercourses within and adjacent to the site according to methods detailed by Ollis *et al*. (2013);
- Determine the watercourse Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) using an appropriate method (if watercourses are present).
- Delineate wetland / riparian areas following methods prescribed by DWAF (2015).
- Determine an appropriate buffer for wetland areas using the site-specific buffer tool developed by Macfarlane and Bredin (2016).

This report will also meet the requirements for a Water Use License Application (WULA) which will be required given installation and connection to sewage pipelines will be necessary within the regulated area of a wetland (defined as 500 m from a wetland). The relevant water uses will be:

Section 21 c) impeding or diverting the flow of water in a watercourse;

Section 21 i) altering the bed, banks, course or characteristics of a watercourse;

Section 21 e) engaging in a controlled activity identified as such in sections 37(1) or declared under section 38(1), and;

Section 21 g) disposing of waste in a manner which may detrimentally impact on a water resource.

1.4 Assumptions and Exclusions

The site visit was undertaken on 21 May 2023 which is considered Winter. 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 along with rainfall during the site visit meant that wetland features were quite evident and easily identified. In fact, this May was considered the 6th wettest May on record since the late 1800s (*pers. comm*. J. Crowther, local dairy farmer).

2. CATCHMENT CONTEXT

2.1 Catchment features

The development site is located at the lower extent of quaternary catchments K60E and K60G which drain the Keurbooms River to the east and the Piesang River to the west respectively. The property is located adjacent to the Keurbooms River. Rainfall is relatively high by South

African standards with a Mean Annual Precipitation of 647 mm which can fall with a Very High intensity. Coupled with the High erodibility of soils in the area, erosion of soils and stormwater management are factors which must always be carefully considered when planning a development (Table 1 & Figure 8).

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

Feature	Description
Quaternary catchment	K60E & K60G
Mean Annual Runoff	101 mm
Mean Annual Precipitation	647 mm (weather station No. 0014633W)
Inherent erosion potential of soils (K-factor)	0.56, High
Rainfall intensity	Very High
Ecoregion Level II	20.02, Southeastern coastal belt
Geomorphological Zone	Floodplain / Estuary
NFEPA area	Sub-quaternary reach 9188, Fish FEPA
Mapped Vegetation Type	FFg5: Garden Route Shale Fynbos (Endangered; FFh9) and Goukamma Dune Thicket (Least Concern; AT36)
Soils	Soils with limited pedological development
Conservation	Critical Biodiversity Area 1 and 2 (Terrestrial & Aquatic; WCBSP, 2017)

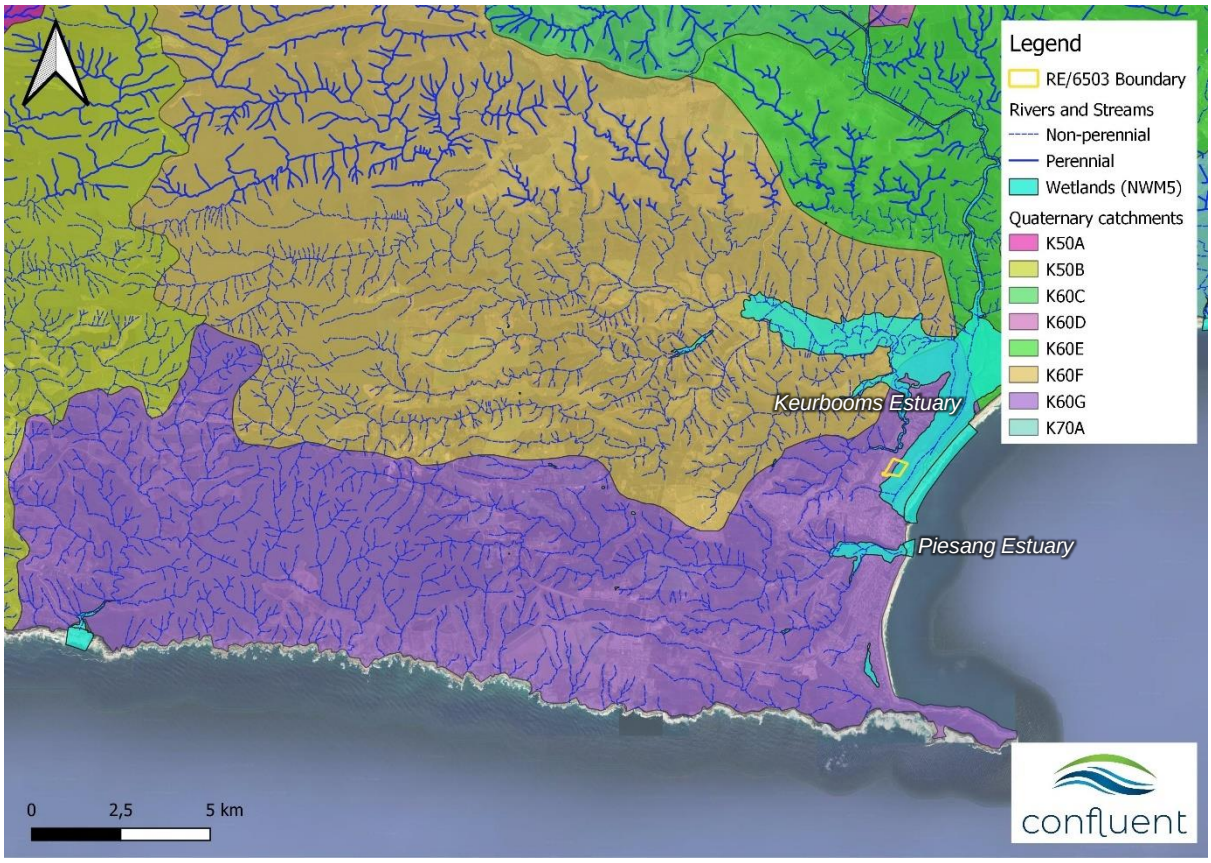

Figure 8. Location of the property at the boundary of quaternary catchments K60E and K60G.

Rainfall occurs year-round with seasonal peaks in spring and autumn (Figure 9).

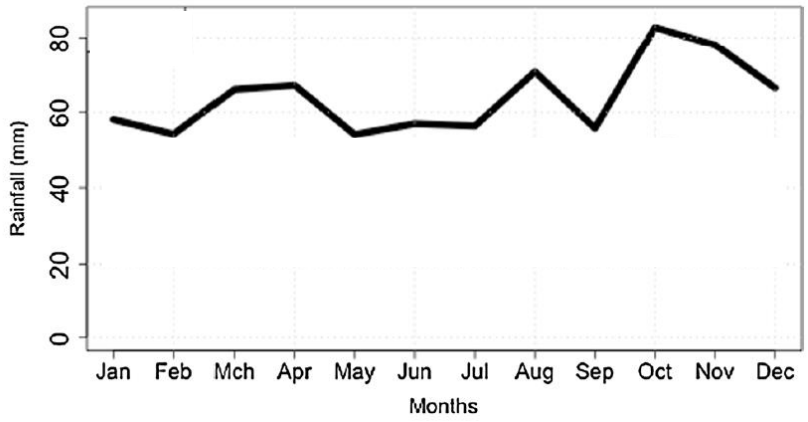

Figure 9. Area-averaged monthly rainfall for the coastal Southern Cape indicating peaks in Mar-Apr, Aug, and Oct. Data averaged between 1979 and 2011 (Engelbrecht *et al*., 2015).

The project area is located 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.

2.2 Vegetation

The mapped vegetation type on the western half of the property Garden Route Shale Fynbos which is categorised as Endangerd (FFh9; NVM, 2018), while the eastern half of the property is Goukamma Dune Thicket which is classed as Least Concern (AT36; Figure 10). Vegetation in the Keurbooms Estuary is mapped as non-terrestrial, which is correct as most of the vegetation is considered aquatic.

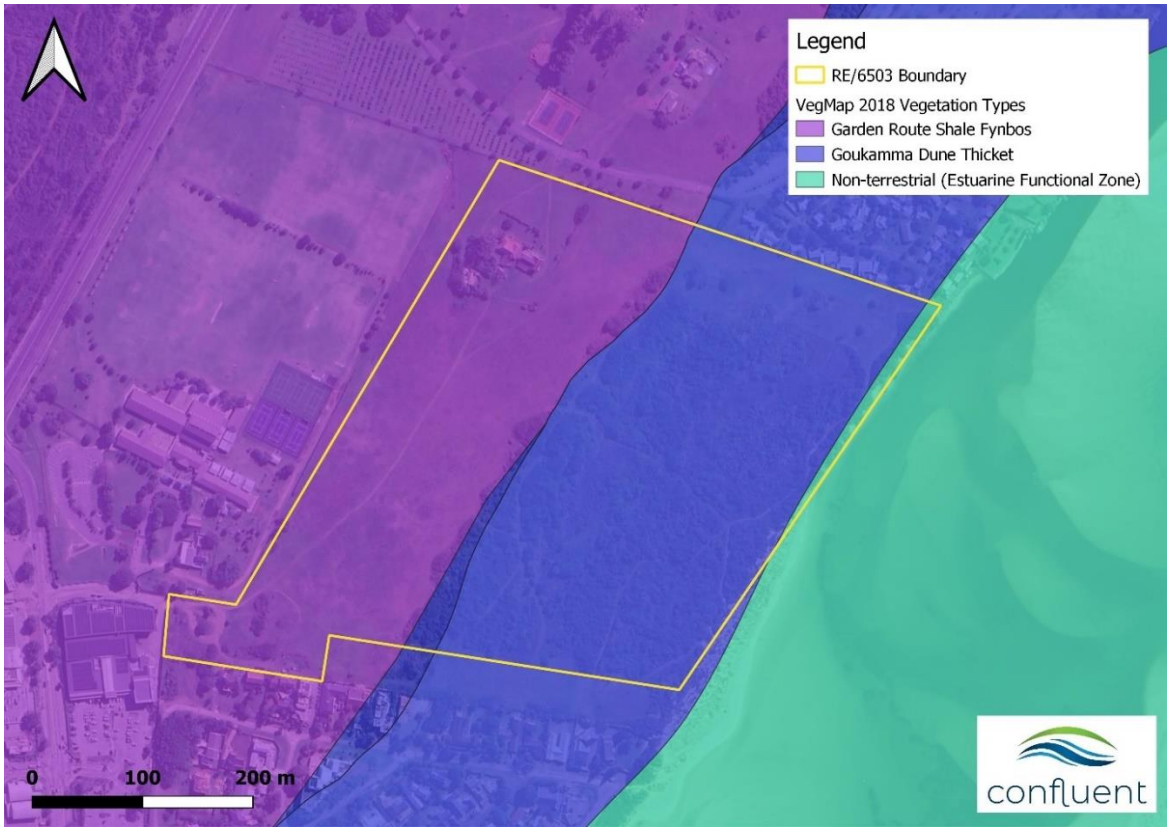

Figure 10. Mapped vegetation at the site according to VegMap (2018).

2.3 Conservation and catchment management

2.3.1 WCBSP

The Western Cape Biodiversity Spatial Plan (WCBSP; 2017) indicates the western half of the site as a Critical Biodiversity Area 2, which corresponds with the higher-lying area (Figure 11). The eastern half of the site and Keurbooms Estuary are mapped as a Critical Biodiversity Area 1, mostly consisting of Aquatic habitat. The definition and management objectives of each of these classes are described in Table 2.

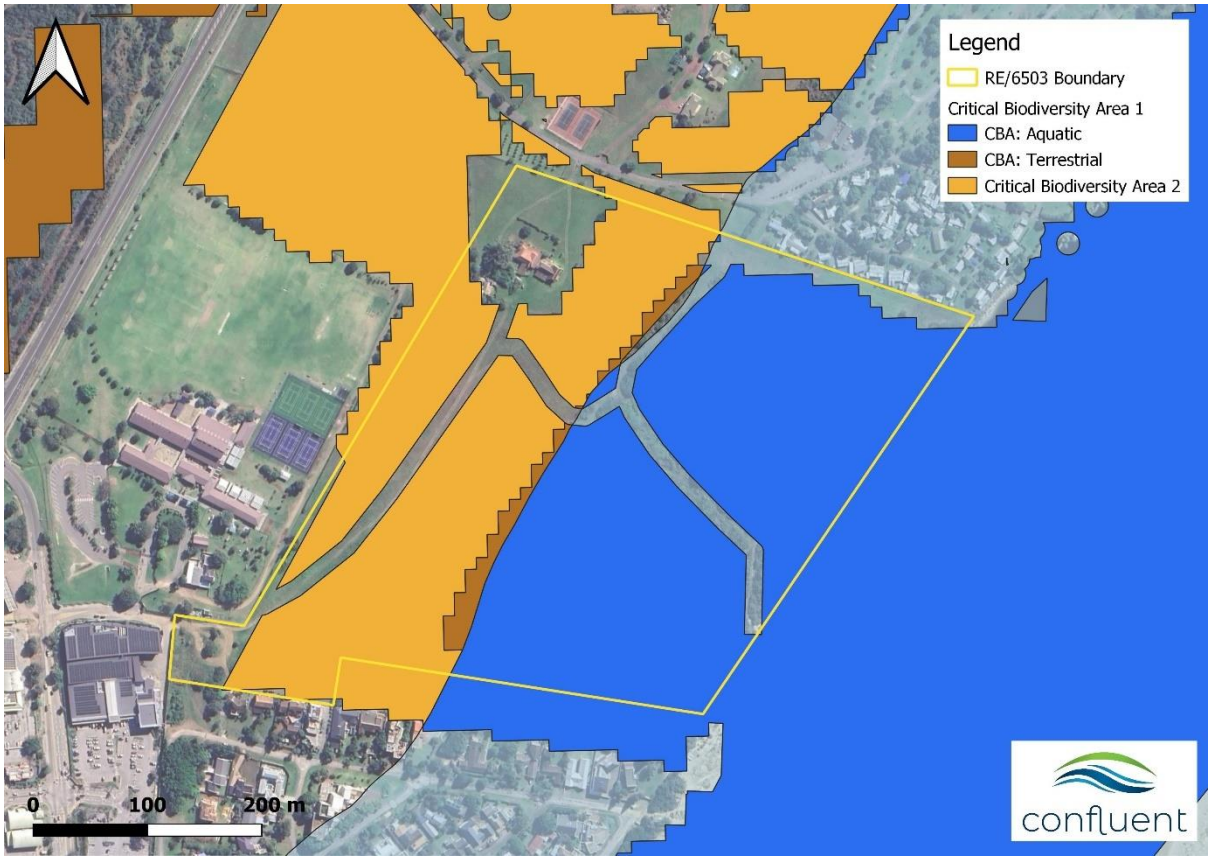

Figure 11. Mapped conservation features of the Western Cape Biodiversity Spatial Plan (2017).

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

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.

2.3.2 NFEPA

According to the National Freshwater Ecosystem Priority Atlas (NFEPA; Nel *et al*., 2011) the sub-quaternary reach (SQR 9188) is classified as a FishFEPA, which is a Fish Support Area.

Fish Support Areas were identified in river systems in a good ecological state (PES A or B) and that have been identified as FEPAs (Freshwater Ecosystem Priority Areas). These rivers contribute to national biodiversity goals and support sustainable use of water resources. Fish Support Areas also include sub-quaternary catchments that are important for the migration of threatened or near threatened species.

This is due to the presence of Endangered or Critically Endangered fish in the quinary catchment of the Keurbooms River. Fish recorded in the system include the extremely range restricted *Pseudobarbus* sp. nov. 'Keurbooms' (previously *Pseudobarbus tenuis*), *Pseudobarbus afer* (Endangered, Eastern Cape Redfin), and *Sandelia capensis* (Data Deficient, Cape Kurper).

Generally, *Pseudobarbus tenuis* occurs in the headwater streams while *Psuedobarbus afer* occurs in the forested peat-stained water. The main threat to these fishes is through the introduction of predatory alien fish species of bass and trout. Impacts related to forestry and agriculture are also known to affect populations.

2.3.3 Strategic Water Source Area

Aquatic biodiversity within the site has been identified as Very High. One of the reasons is that the site falls within the Outeniqua Strategic Water Source Area for surface water (SWSA-sw). SWSAs are defined as areas of land that supply a disproportionate (ie. 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.

2.4 Mapped Watercourses

The only mapped aquatic feature proximal to the site is the Keurbooms Estuary which is indicated as the area below the 5 m.a.m.s.l. contour (Figure 1 and Figure 12). The 0.5 m contours are shown for this area as they provide a more detailed picture of the micro-topography.

2.4.1 Keurbooms-Bitou Estuary

The estuary feeds what is known as the Keurbooms Lagoon. The Present Ecological State of the estuary is classified as A/B, and the same category is applicable for the Recommended

Ecological Category. The estuary has a high conservation value, supporting one of only three known populations of the iconic Knysna Seahorse occurring in *Zostera* (segrass) beds. In terms of management objectives, the Keurbooms-Bitou Estuarine Management Plan (K-BEMP) states that formal protection mechanisms to obtain conservation status for land parcels within or spanning the EFZ must be investigated. In terms of land-use and infrastructure, the following relevant guidelines are provided in the K-BEMP:

- Planning should allow for the maintenance of a riparian zone along the length of the estuary where sensitive habitats (e.g. wetlands, supratidal saltmarsh and indigenous vegetation) occur. The implementation of the CML, CPZ, floodlines and inclusion of Critical Biodiversity Areas within all planning schemes should allow for this.

- Development and land use in the catchment and estuarine area should not lower water quality or interfere with normal hydrodynamic or sedimentary processes and cycles;

These management guidelines will be considered in view of the proposed development of the Plett Lagoon Estate.

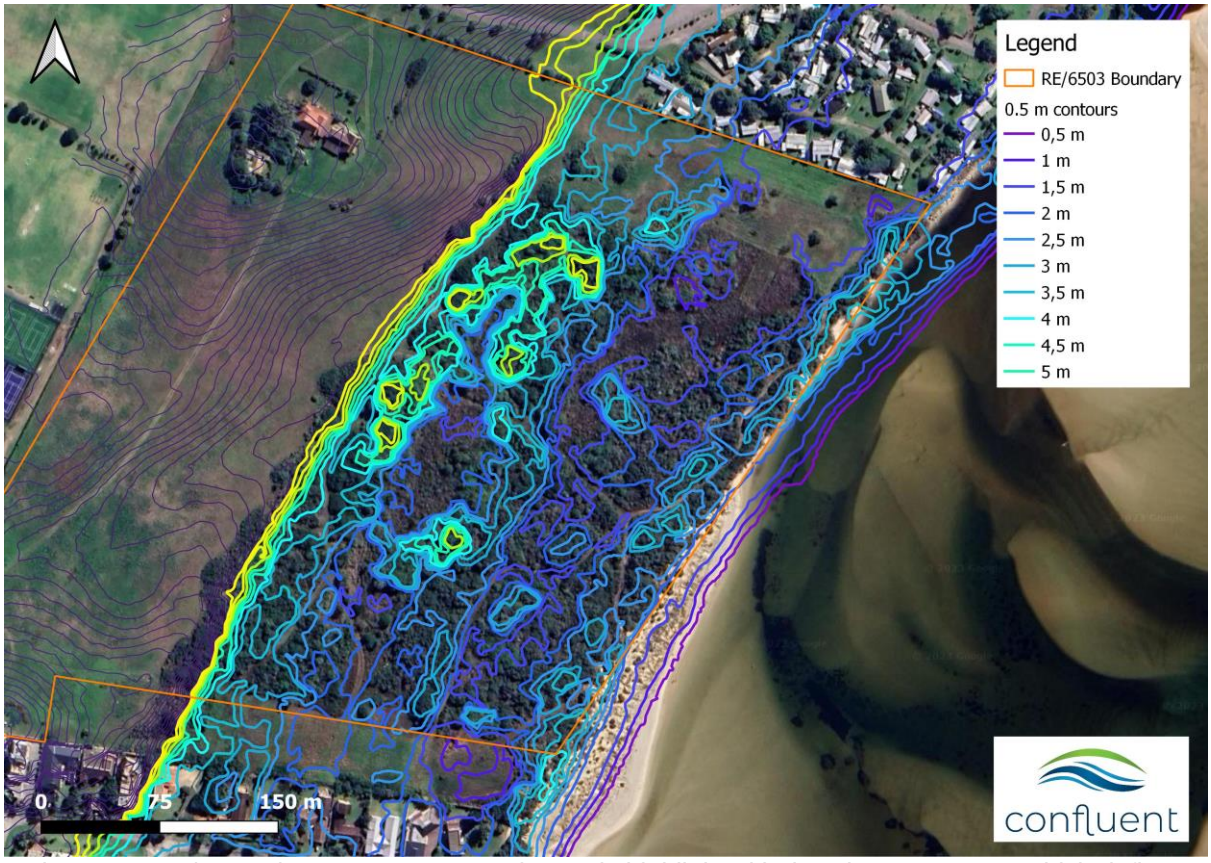

Figure 12. RE/6503 site contours at 0.5m intervals highlighted below the 5m contour which defines the Estuarine Functional Zone (EFZ).

2.5 Historical assessment

Historical aerial and satellite photos were examined of the site over a period of approximately 8 decades (Figure 13).In the earliest photo from 1936, very little development had occurred either on the property itself or in the neighbouring properties. The difference between the more grassy, open vegetation to the west of the site, compared to the more densely vegetated eastern portion is evident throughout the site's history. Dense vegetation along the lagoon no

the neighbouring properties was cleared for construction of housing developments around the 1970s. The residence located on RE/6503 in the northern corner was evident as a small settlement in 1936 and has always been the site of a residence to the present day. Footpaths through the wetland were evident from 2011, although they were probably present for a while before then, but overgrown.

Figure 13. Historical photos showing the approximate property boundary for a period of 86 years (CD:NGI & Google Earth imagery).

3. SITE ASSESSMENT

3.1 Site Visit

The site was visited on 21 May 2023. Above average rainfall had been experienced in the Garden Route in May and it rained periodically during the site assessment. An extensive area of 5.2 km was walked to assess aquatic features where accessible (Figure 14).

Figure 14. GPS track of route walked during the site assessment on 21 May 2023.

3.2 Wetland Delineation

Wetlands were delineated using a combination of hydrophilic plant species, soils with redoximorphic features (e.g. mottling and/or gleying; Figure 15), and topographical location (Figure 16).

A wide variety of wetland plant species were observed throughout the wetland area. These were dominated by freshwater species but included a few species typically located in the supratidal zone of estuaries. Species considered to be obligate as well as facultative wetland plants were recorded (Table 3).

Table 3. Wetland plant species identified in the depression on RE/6503.

Common name	*Species name*
Fluitjiesriet	*Phragmites australis*
Vleibiesie / knobby club-rush	*Ficinia nodosa*
Impepho / fume everlasting	*Helichrysum cymosum*
Arum lily	*Zantedeschia aethiopica*
White carpet	*Falkia repens*
Brak rush	*Juncus krausii*
Oak waxberry	*Morella quercifolia*
Cogon grass	*Imperata cylindrica*
Manyspike flatsedge	*Cyperus polystachyus*
Slender knotweed	*Persicaria decipiens*
Water pimpernel	*Samolus porosus*
Black bog-rush	*Schoenus nigricans*
Brook weed	*Samolus valerandi*

Hydric soils display indicators which are predominantly formed by the accumulation or loss of iron, manganese, sulfur or carbon under permanent or periodic saturated and anaerobic conditions. Sandy soils such as those on the RE/6503 seldom show the same degree of mottling and gleying as saturated or seasonally saturated soils with a higher clay content. Nonetheless, soils from multiple points showed degrees of mottling and gleying in permanent and seasonal zones of the wetland, and standing water was often present from 30 cm depth (Figure 15).

Figure 15. Wetland soil indicators observed at the site.

Wetland vegetation and soil auger results observations were combined with the fine-scale site topography to delineate the depression wetland as indicated in Figure 16. The wetland is mostly located below the 2.5 m to 3 m.a.m.s.l. contours at the site.

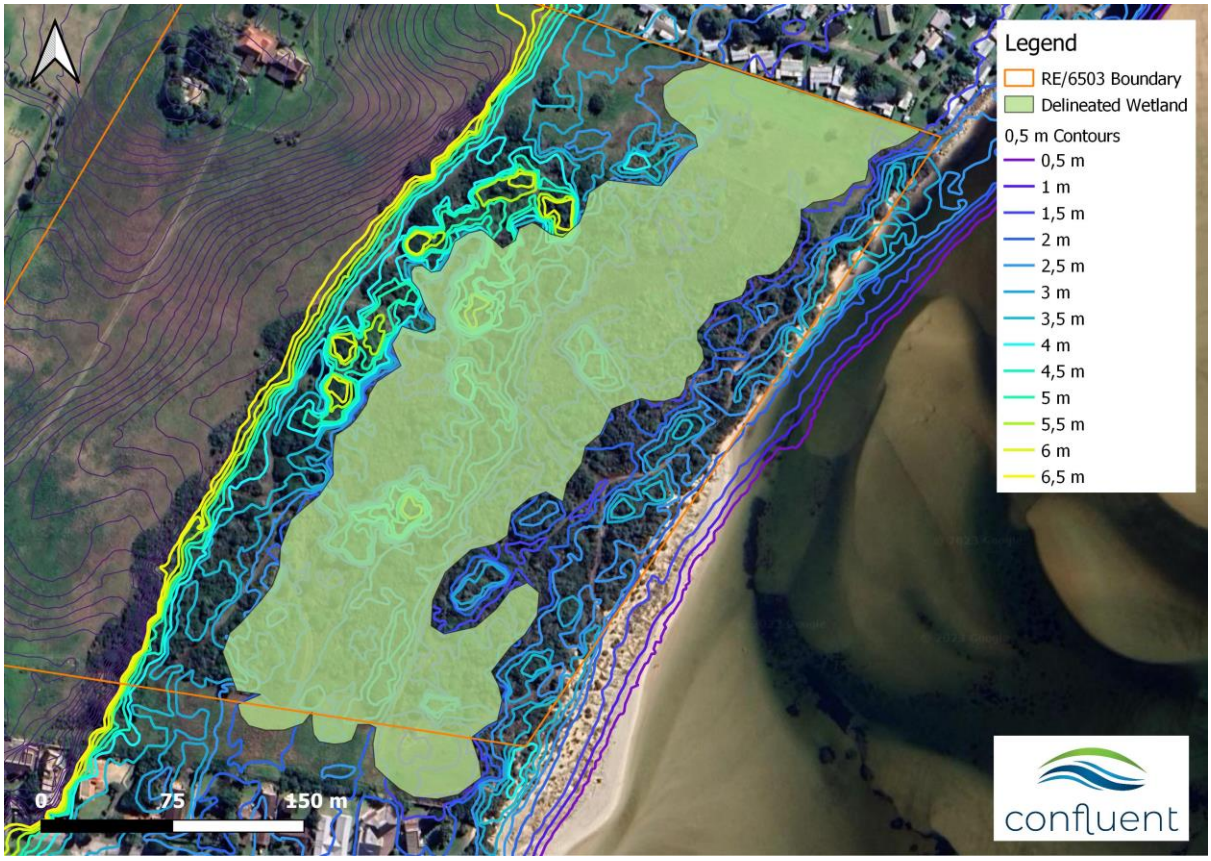

Figure 16. Wetland delineation based on soil, vegetation, and topography of the site.

3.3 Wetland Classification

The interdunal water-filled depression is classified as a depression wetland (Ollis *et al*., 2013; Figure 17). No channelled flow into or out of the depression is present and the wetland is inward draining (endorheic).

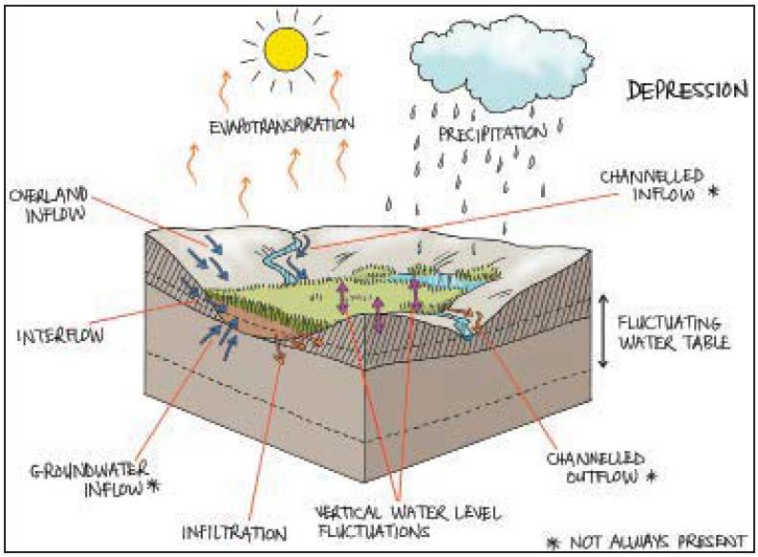

Figure 17. Conceptual illustration of the interdunal depression wetland (from Ollis *et al*., 2013).

Figure 18. Photos of various wetland and estuarine features on RE/6503.

3.4 Wetland Buffer

Buffers are located where the land meets a delineated watercourse, and refer to the zone where these two habitats interface. Buffer areas are linear zones adjacent to watercourses managed with the intention of protecting water resources from diffuse pollution associated with adjacent land uses. In addition, they provide habitat for wildlife within, and act as corridors for movement, feeding and breeding through fragmented landscapes. In this case the buffer performs an important function for the maintenance of conectivity between the lagoon and the wetland. It buffers not only the lagoon from the development, but also the wetland from the

development. The width of the aquatic impact buffer zone was determined to be **30 m** through use of the site-based wetland buffer tool developed by Macfarlane & Bredin (2017).

Figure 19. Delineated wetlands and 30 m wetland buffer in relation to the remainder of the site.

4. ECO-CLASSIFICATION

4.1 Present Ecological State (PES)

The PES of the wetland was determined using the updated WET-Health Version 2 method described by Macfarlane *et al.* (2020). Methods for the assessment are provided in Appendix 1. The result of the assessment was an overall **PES of A, Natural,** although the score was close to the boundary with B, Largely Natural. Minor impacts have occurred which have slightly reduced the state of the wetland from its natural reference condition (Figure 20). These are summarised as follows:

- Natural wetland and thicket vegetation has been invaded in isolated areas by alien invasive plants.
- An area of approximately 0.7 ha of wetland vegetation to the north is mowed on a regular basis. There are areas of alien invasion within the mowed area.
- Existing roads and walking paths are established through the wetland and surrounding area. These are maintained by vegetation trimming and are infrequently travelled by vehicle.

Most impacts affect vegetation which is reflected in the score of B, Largely Natural, determined in the PES assessment. Minimal impacts were observed to affect the wetland's hydrology water quality or geomorphology.

Table 4. Summarised Present Ecological State determined for the depression wetland using WET-Health.

Final (adjusted) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1,2	0,3	1,2	1,9
PES Score (%)	91%	97%	90%	81%
Ecological Category	**A**	**A**	**A**	**B**
Trajectory of change	↓	↓	→	→
Confidence (revised results)	High	High	Medium	High
Combined Impact Score	1,1			
Combined PES Score (%)	91%			
Combined Ecological Category	**A**			
Hectare Equivalents	5,2 Ha			

Figure 20. Photos of various impacts affecting vegetation of the wetland.

4.2 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) was determined using methods provided in Appendix 2 which was developed by Rountree *et al*. (2013). The EIS of the wetland was determined to be '**Very High'** (Table 5). The definition of wetlands in this category is as follows:

"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."

An important aspect of this wetland type's sensitivity is that it is inward draining (endorheic) and therefore any water, sediment or material inputs cannot be 'flushed out' of the system.

Table 5. Summarised Ecological Importance and Sensitivity of East and West Wetland.

Ecological importance and sensitivity	Score 0-4	Confidence 1-5	Motivation
Biodiversity support	**3.6**		
Presence of Red Data species	3	3	None observed in wetland, but Plett lagoon is home to Knysna seahorses and the wetland plays a supportive role.
Populations of unique species	4	3	Diverse and abundant population of wetland plants creating unique habitat which usually supports unique vertebrate and invertebrate species.
Migration/feeding/breeding sites	4	4	Habitat for amphibians, reptiles, small mammals, birds etc. Good connectivity between the wetland and lagoon.
Landscape scale	**3.4**		
Protection status of wetland	3	4	Identified as CBA1 on WCBSP and ownership is private (not public open space).
Protection status of vegetation type	3	4	Located at ecotone between disturbed fynbos (mapped CR) and thicket / wetland / estuarine vegetation (LC).
Regional context of the ecological integrity	4	4	In good condition for peri-urban wetland but will be increasingly pressured if proposed development go ahead.
Size and rarity of the wetland types present	4	4	Moderate to large size and one of the last remaining interdunal depression wetlands along the Keurbooms Lagoon.
Diversity of habitat types	3	4	Areas of seasonal, temporary and permanent wetland interspersed with thicket 'islands'. Relatively diverse habitats.
Sensitivity of the wetland	**3**		
Sensitivity to changes in floods	3	3	Erosion of slopes to the west would result in sediment deposition and vegetation smothering in the wetland. Thicket areas would be inundated leading to vegetation transition.
Sensitivity to changes in low flows	2	3	Loss of permanent wetland vegetation, but water levels already fluctuate to an extent.

Sensitivity to changes in water quality	4	4	High nutrients can transform vegetation to a greater dominance by reeds such as *Typha capensis* and *Phragmites australis*.
Hydrofunctional Importance	**2**	**3**	
Direct human benefits	**1.8**	**3**	
ECOLOGICAL IMPORTANCE AND SENSITIVITY	**3.6**	**VERY HIGH**	

5. LEGISLATIVE IMPLICATIONS

5.1 Site Sensitivity Verification

The Site Sensitivity in terms of Aquatic Biodiversity for Option C is **confirmed as Very High** as indicated by the DFFE Screening Tool because significant wetland habitat is present on the site.

5.2 Water Use Authorisation

The presence of a wetland on the property means that the construction and operation of the proposed housing development would be taking place in the Regulated Area of a Watercourse as defined in GN4167 of the National Water Act. For wetlands this is defined as the area within a 500m radius of the wetland. The installation of sewage package plant with the intention of irrigating wastewater for the development is an activity which is currently excluded from the General Authorisation, meaning it would be necessary to apply for a Water Use License.

A specialist impact assessment for all phases of the proposed development will be compiled in order to meet the requirements for both the NEMA and the NWA.

6. IMPACT ASSESSMENT

Methods used for the impact assessment are provided in Appendix 3. The impact assessment follows the mitigation hierarchy of avoidance, minimisation of impacts, restoration of damaged ecosystems and offsets for residual damage, prioritised in that order.

6.1 Design and Layout Phase

6.1.1 Stormwater management

The stormwater management plan compiled by Vita Consulting Engineers proposes SuDS-type design features for the management of stormwater which are fully supported. The report acknowledges the high erodibility of soils on the site. Being downslope of the proposed development the wetland is vulnerable to localised smothering by transported sediment from eroded slopes, and being inward draining, this material would eventually form terrestrialised islands with different vegetation, most likely being colonised by alien plant species. Avoidance of erosion is therefore the primary aim of managing stormwater on the site. The following additional mitigation measures are recommended to further reduce impacts:

- Wherever possible driveways and parking areas must use open paver / permeable paving systems such as grass blocks or sudpave-type products. These should not be underlain with G7 due to its low permeability. This will utilise the highly permeable nature of soils at the site to reduce runoff to roads in > 1:5 year rainfall events.

- Stormwater outlets leading towards the wetland will need to ensure water does not form concentrated flow paths downslope and is attenuated and drained on the upper slope area. Following discussions with the engineer and engineering specialist at BOCMA it was considered likely that soil permeability at the site will be sufficient to facilitate local draining to groundwater if small detention ponds are included at the end of outlets. This will avoid the need for constructed outlets directing stormwater into the wetland.
- Detention ponds for stormwater management must be located on the *inside* of the fenced residential area so they can be monitored for erosion and maintained clear of aliens and free of litter.

6.1.2 Original Fenceline

Note This was the original recommendation regarding the design and layout of the fenceline prior to the proposed additional fencing along the estuary.

As the wetland area is the last remaining area of significant wetland and natural vegetation remaining along the western shoreline of the Keurbooms Lagoon, it is important to protect the function as an ecological corridor. Wildlife currently move between the wetland and lagoon area, and an important function of the wetland is the provision of shelter and habitat for feeding, breeding and movement. Fences can seriously restrict the movement of wildlife and at worst can contribute to mortalities (Figure 21). The following mitigation measures are recommended:

- The fenceline should enclose the residential area only, and not the wetland area. The final location is yet to be determined but should minimise the disturbance of natural vegetation on the slope as far as possible. This is very important for the ongoing stability of the slope which is protected by established vegetation.
- Install code-operated pedestrian gates along the fenceline aligned to existing pathways and roads to allow joggers and walkers access to the wetland and lagoon.
- Use alternative security measures to monitor the wetland such as guarding or cctv cameras.
- It is assumed that typical Clearvu-type fencing would be preferred, however this seriously restricts the movement of any animals. Install larger grid sections along the base of the fenceline in a few sections, to allow smaller-bodied vertebrates to move in and out of the residential area.
- Do not use any electric strands along the base of the fenceline.

Figure 21. Dead tortoise wedged in a diamond mesh fenceline in an estuarine area, Sedgefield.

6.1.3 Additional and Alternative Fencelines

The alternative residential area fenceline and two alternative options along the estuary are compared in terms of their impacts from a design and layout perspective. The reason for the original recommendations for fencing were to maintain the open link between the wetland and estuary for the purpose of wildlife movement. However, the alternative fenceline along the wetland edge is due to concerns about security and fire risk management.

1. *Original versus Alternative fenceline (residential area)*

Throughout comparisons of fenceline alternatives reference is made to Figure 22 and Figure 23. Benefits of the original fenceline (yellow line) were that it completely avoided the buffer and wetland area, minimised vegetation disturbance, and did not intersect any of the more natural habitat associated with the wetland and buffer area (Figure 22). The original fence resulted in zero direct impacts to the wetland or buffer, from an aesthetic perspective the developer would prefer to place the fence at the bottom of the slope along an existing pathway, which would reduce vegetation disturbance compared to areas outside of paths, but would fragment an area of about 1.3 ha of more natural vegetation from the adjacent wetland area and encroach into the buffer, quite close to the wetland in places.

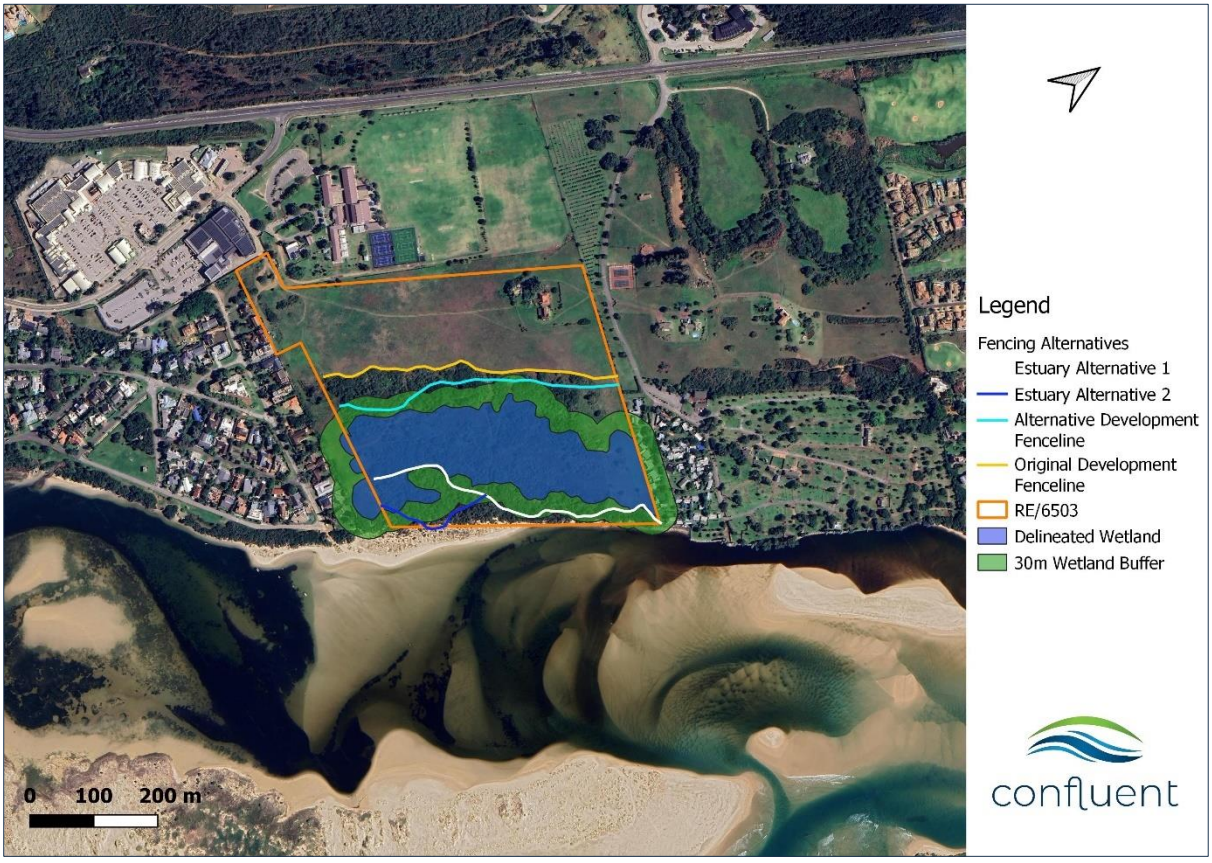

Figure 22. Rotated view of RE/6503 showing the alternative fenceline options in relation to the surrounding area and delineated wetland features.

Figure 23. Photos of existing a proposed aspects of the alternative fenceline options.

2. *Estuary Fenceline Alternative 1 Versus Alternative 2*

Alternative 1 and 2 along the estuary follow the same path until the south-eastern area where they split with Alternative 1 following a pathway that crosses the buffer and approximately 134 m of wetland. This is compared to Alternative 2 which crosses less of the buffer and wetland with approximately 30 m through the wetland near to the estuary. Alternative 1 leaves more of the habitat open on the estuary side (about 1.5 ha open to the estuary) while Alternative 2 intersects more habitat from the estuary (0.5 ha open to the estuary) but crosses through more actual wetland habitat. The area of wetland intersected by Alternative 1 has a large diversity of wetland plant species, very high saturation levels and standing water at times (See Figure 23A, E and F). The installation and maintenance of the fence for Alternative 1 could have

potentially higher impacts on the wetland than for Alternative 2 because it crosses an extensive area of wetland with high water levels.

6.1.4 Preferred Fencing Options

An impact assessment comparing the fencing alternatives in the residential area and along the estuary is presented in Table 6. This impact assessment is compiled under the assumption that all recommended design mitigation measures as recommended in this, and the terrestrial faunal assessment are adhered to (the residual negative impact). All the mitigation measures in the faunal assessment are agreed with except for the width between the vertical struts. The standard width is 11 cm for palisade fencing. The width of Sensitive Species 8 (a species highlighted as possibly present in the faunal report) is 14-21 cm. Insurance companies stipulate that their cover is limited to burglar bars with a maximum width of 12 cm. Therefore, if the width between the palisade fencing can be specified as **12 cm** it will create slightly more room for animal movement. The faunal report recommends periodic gaps measuring **40 cm high and 21 cm wide aligned with animal paths**. This fencing system is considered reasonably permeable for most species likely to be present at the site.

Table 6. Comparison of impacts for fencing options for the residential area and the eastern extent along the estuary. Ratings assume full implementation of mitigation measures for the design and layout phase.

IMPACT: Habitat fragmentation and restricted wildlife movement through wetland / estuary habitat				
	Residential Area		Estuary Fenceline	
	Original Fenceline	**Alternative Fenceline**	**Alternative 1**	**Alternative 2**
Duration	Permanent	Permanent	Permanent	Permanent
Extent	Very Limited	Limited	Local	Local
Intensity	Low	Moderate	High	Moderate
Probability	Likely	Almost Certain	Almost Certain	Almost Certain
Confidence	High	High	High	High
Reversibility	High	Medium	Medium	Medium
Resource Irreplaceability	Medium	Medium	High	High
Significance	Minor - Negative	Moderate - Negative	Moderate - Negative	Moderate Negative

The ***preferred alternative for the residential area is the Original Fenceline*** because the impact is Minor compared to the Alternative which is Moderate. Along the estuary fence line the **preferred option is Alternative 2** because the construction *and maintenance* impacts are likely to be much lower in terms of water quality and habitat disturbance than for Alternative 1. This benefit only slightly outweighs the benefit of greater open habitat along the estuary for Alternative 1. This is reflected in the same Moderate Negative significance for each of the fence lines proposed in the wetland / buffer area.

6.2 Construction Phase Impact Assessment

An Environmental Control Officer (ECO) must be appointed for the duration of the construction phase with a high frequency of site visits (scheduled and unscheduled) during earth-moving and fence installation phases.

6.2.1 Pre-construction Wetland Rehabilitation

The wetland is in a very good ecological state, apart from a few impacts which are discussed in the PES section. It is recommended that prior to commencement of construction, these impacts be dealt with to improve the wetland's condition and ensure that best practice management of the wetland commences early on. Mitigation of existing impacts will result in a positive outcome if all mitigation measures are implemented (Table 7).

Table 7. Construction phase: pre-construction wetland rehabilitation.

Project phase	**Construction**			
Impact	**Pre-construction wetland rehabilitation**			
Description of impact	**Habitat degradation by alien vegetation and through mowing**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**• Control alien vegetation in isolated stands where it occurs. No herbicide to be used in the wetland. Large trees must be fully ring-barked, while smaller plants can be hand-pulled or removed using a tree popper. Shrubs of bramble and Lantana must be cut back with clippers until the stump is visible, which must then be removed. • All vegetation biomass must be removed from the wetland and disposed of at a green waste dump. No vegetation must be dumped in the wetland. • Follow up alien must be conducted every 6 months following initial clearing to ensure emergent seedlings are consistently removed. • Cease mowing the northern area of the wetland barring one path that can be maintained for access to the lagoon and a strip large enough for a single vehicle along the boundary fenceline.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Positive	
Duration	Medium term	Impact will last between 5 and 10 years	Brief	Impact will not last longer than 1 year
Extent	Limited	Limited to the site and its immediate surroundings	Very limited	Limited to specific isolated parts of the site
Intensity	Very low	Natural and/ or social functions and/ or processes are slightly altered	Very high	Natural and/ or social functions and/ or processes are majorly altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Likely	The impact may occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Minor - positive**	
Comment on significance				
Cumulative impacts				

6.2.2 Unnecessary Disturbance to Sensitive Areas

The wetland and buffer are no-go zones for any workers, equipment, vehicles, or materials for the duration of the development. As the slope is sensitive to erosion and disturbance of vegetation, it is recommended that termporary fencing be established along the edge of the slope identifying it as a No-go area. Sensitive areas must be established using temporary

fencing and signage before commencement of construction and all personnel involved in the project must be briefed about no-go areas. Impacts are likely to be a negligible negative if all mitigation measures are fully implemented (Table 8).

Table 8. Construction phase: Unnecessary disturbance to sensitive areas.

Project phase	**Construction**			
Impact	**Disturbance to wetland and buffer areas**			
Description of impact	**Vehicles, workers and materials active in wetland and buffer areas**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**• Pre-construction, temporary fencing must be erected along No-Go areas with the top of the slope leading to the wetland indicated as the sensitive feature. • Signage indicating No-go areas must be placed on fencing. • All contractors must attend a site induction and be briefed that vehicles, workers, equipment and materials may not encroach into No-Go areas around wetlands. • Consider the termination of contracts or fines for encroachment into the no-go area.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Short term	Impact will last between 1 and 5 years	Immediate	Impact will self-remedy immediately
Extent	Limited	Limited to the site and its immediate surroundings	Very limited	Limited to specific isolated parts of the site
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Very low	Natural and/ or social functions and/ or processes are slightly altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	High	The resource is irreparably damaged and is not represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance	The impact of unnecessarily increasing the footprint of disturbance by entering no-go areas can be mitigated to a large extent by full implementation of these mitigation measures.			
Cumulative impacts	Not applicable			

6.2.3 Stormwater Runoff During Construction

Effective management of stormwater during construction can have a significant impact on the state of the wetland and buffer in the long term. Management interventions need to consider proactive and reactive measures to mitigate the impacts of stormwater runoff as the site topography evolves during the construction phase. Mitigation measures are recommended, and if fully monitored and implemented the impacts could be minimised to a negligible negative level (Table 9).

Table 9. Construction phase: stormwater runoff from the site

Project phase	**Construction**			
Impact	**Stormwater runoff from the site**			
Description of impact	**Sedimentation in the wetland and creation of preferential flow paths**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• The objective of stormwater managmeent during the construction phase is to eliminate the risk as far as possible of discharging sediment-laden water downslope into the wetland. • Daily and weekly site meetings must consider forecasted rainfall to avoid working during such periods, and to plan accordingly for predicted high rainfall events. Work on the site must cease altogether during rainfall. • The site office must have a store of materials suitable for rapid response to erosion control such as shade-cloth (silt-fencing), haybales (check-dams), wooden droppers, hessian fabric, and fencing wire. • All material stores should be kept on flat areas and bunded to prevent material loss during rainfall. • When construction commences in the residential area, create a compacted, low soil berm along the permiter of the site approximatly 400 mm high to retain stormwater on site and reduce runoff to surrounding areas. • Monitor the site during / following periods of rainfall, and install haybale check dams at points where runoff collects and could overtop / breach the soil berm. • Following rainfall, any water that must be pumped out of pools in excavated areas must not be directed to the wetland. The soil berm system or a temporary haybale check dam can be constructed to contain water until it seeps into the ground or slowly disperses through the haybales which act as a filter.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Medium term	Impact will last between 5 and 10 years	Brief	Impact will not last longer than 1 year
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance	Risk reduction is dependent on proactive and reactive mitigation measures as contruction progresses across the site.			
Cumulative impacts	Not applicable			

6.2.4 Construction Phase: Installation of Fences

This section has been updated to include the construction phase for any of the proposed fencing alternatives as the impacts should be fairly similar with similar mitigation measures. It is more likely that differences between the fencing options will be apparent in the operational phase. In many instances, the construction of fencelines in residential estates can have a significant impact on the natural environment. Fencelines can cross watercourses and migration corridors, and their construction can involve significant earth-moving and vegetation clearance. This is not considered necessary for the development, and measures to mitigate impacts associated with an anticipated fenceline are provided in Table 10.

Table 10. Construction phase: Installation of fenceline

Project phase	**Construction**			
Impact	**Greater than necessary footprint for fenceline installation**			
Description of impact	**Loss of vegetation, habitat disturbance, water pollution and harm to animals**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**• Access points for delivery of material are only from the northern side along drier parts of the wetland where the area has been mowed and disturbed already. No Access is permitted by vehicle along the southern edge because this has high sensitivity wetland vegetation and is very wet. • The fenceline may not be installed during the breeding season from September to February. This is to avoid disturbance or harm to dispersing wildlife which are more active and vulnerable at this time. • The limit of disturbance along the fenceline area is 2 m on one side of the fencline which should be already transformed by the jeep track. • Fencelines can be installed with the help of a small machine such as a bobcat, but should otherwise be installed by hand. No excavators or larger machines are permitted to drive along the fenceline. • Vegetation obstructing work on the fenceline should be cut or trimmed, and not uprooted, unless in the direct path of the fenceline. • Disturbed soil along the fenceline should be revetated with low growing indigenous grass already found at the site. Stenotaphrum secondatum (buffalo grass) is recommended in wetland areas. This can create a relatively open area along the fenceline which can be monitored or patrolled on foot. • Any concrete mixing for posts must be contained in a wheelbarrow or small vehicle (e.g. Kubota), and is not permitted on the ground, especially in the wetland or buffer areas. • Excess concrete must be removed from the site and disposed of. No waste materials, dirty water, or concrete may be left in the wetland area. This must be monitored closely by the ECO with incidents immediately reported to DEA&DP and/or BOCMA. • Absolutely no washing of tools in water in the wetland. • No water from the wetland may be used to mix concrete. • Any vegetation cleared for installation of the fence must be removed from the site, or lightly scattered. It cannot be piled up along the fence as in Fig. 22 which creates further barriers and smothers vegetation.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Medium term	Impact will last between 5 and 10 years	Short term	Impact will last between 1 and 5 years
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Minor - negative**	
Comment on significance				
Cumulative impacts				

6.3 Operational Phase Impact Assessment

6.3.1 Stormwater Management

Stormwater detention areas must be monitored on a routine basis and *ad hoc* following rainfall to check for erosion or overflows. Even a single severe event can result in creation of an erosion gully, depositing sediment in the wetland and destabilising the slope. This impact should be avoided at all costs. Mitigation measures have been recommended in Table 11

which should reduce the risk to a negligible negative level. However, it is emphasised that monitoring is required to ensure that despite all the SuDS-type interventions aimed at attenuating stormwater and other flows emanating from the site, proactive stormwater management and erosion-control must be implemented.

Table 11. Operational Phase: Stormwater management

Project phase	**Operation**			
Impact	**Damage caused by stormwater runoff**			
Description of impact	**Slope erosion and sedimentation of the wetland**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• The site should be assessed by an aquatic specialist 6 months following conclusion of construction to confirm that stormwater management infrastructure is functional and not causing any impacts to the wetland. • Stormwater management infrastructure such as swales, drains and culverts must be routinely monitored and maintained to ensure they are free of blockages and functional. This includes a regular inspection of all stormwater outflows to identify any emerging erosion issues, and keep the structures clear of excessive siltation and litter. • Where erosion is occurring, immediately identify and control the origin of the flow path, and protect the site of erosion by replacing soil with soil from the site, and stabilising with indigenous vegetation found on the site. Where more serious interventions are required spot installations of gabions may be suitable for stabilisation provided they are not in the wetland buffer or in the wetland itself (an amendment to the WUL may be required). As far as possible, flows must be attenuated, and the source of erosion controlled upslope within the residential area. • Eroded areas of the steep banks must be refilled with topsoil (from the site), reseeded with indigenous vegetation, covered with a light mulch and protected with soil saver mats. The use of silt fencing can be extended to problem areas to provide further protection.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Medium term	Impact will last between 5 and 10 years	Brief	Impact will not last longer than 1 year
Extent	Local	Extending across the site and to nearby settlements	Very limited	Limited to specific isolated parts of the site
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Likely	The impact may occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance				
Cumulative impacts	Not applicable			

6.3.2 Operational Phase: Alien Vegetation

Every effort must be made to ensure the area disturbed during construction is kept free of alien vegetation. This includes not only the residential area, but the wetland and buffer too. Follow up alien vegetation control must take place on a routine basis bi-annually in perpetuity. Provided the recommended mitigation measures are followed the impacts are predicted to be a Negligible Positive (Table 12).

Table 12. Operational Phase Impact: Alien vegetation establishment

Project phase	**Operation**			
Impact	**Alien vegetation establishment**			
Description of impact	**Establishment of aliens in disturbed areas post-construction resulting in habitat degradation**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**• Follow up inspection and control of alien vegetation in the residential development and the wetland on a 6-monthly basis. • No herbicides to be used in the wetland or wetland buffer. Sprays and / or cut-stump treatments may be used in the residential areas. • Ensure bare areas of vegetation are replanted with indigenous vegetation that occurs naturally on the site. • Under no circumstances may removed alien plants be discarded in the wetland. The HOA must inform the landscaping / gardening team that no dumping of vegetation or discarding of waste material may happen in the wetland or buffer area.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Positive	
Duration	Medium term	Impact will last between 5 and 10 years	Brief	Impact will not last longer than 1 year
Extent	Local	Extending across the site and to nearby settlements	Very limited	Limited to specific isolated parts of the site
Intensity	Moderate	Natural and/ or social functions and/ or processes are moderately altered	Very low	Natural and/ or social functions and/ or processes are slightly altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Negligible - positive**	
Comment on significance				
Cumulative impacts	Not applicable			

6.3.3 Operational phase: Landscaping, Fire-breaks and Pathways Maintenance

Landscaping along the edge of the built estate, fire-breaks cut along the property boundary, and pathways in the open space area all contribute to fragmentation of the wetland and associated thicket vegetation (Figure 24). While this has all occurred historically, the lack of significant development and fencing across the site created less fragmented conditions than the future scenario anticipated with development of the estate. Therefore, the management of this area should be reconsidered.

Given the high ecological importance of the wetland it should be managed for conservation outcomes. This means that disturbance and fragmentation of sensitive wetland habitat by mowing teams must be kept to a minimum. Fire is currently considered a risk and has occurred previously on the site. However, this is reportedly associated with vagrants on the site, the presence of which will be deterred by the fenceline proposed to protect the estate. Along with the frequently high moisture levels in the wetland, thicket vegetation, and reduced security risk, the fire risk should be reduced (although **comment on this should be obtained from the Southern Cape Fire Protection Agency,** of which the landowners are already members).

Provided the mitigation measures are implemented as listed in Table 13 the impacts should be a Negligible positive because the wetland will be less impacted by fragmentation than at present.

Figure 24. Photos supplied by landowner showing current approach to cutting firebreaks (cut by the Southern Cape Fire Protection Agency) looking East along the boundary fenceline (left) and a fire-fighting access road into the open space around the wetland (right).

Table 13. Operational phase: Landscaping, fire-breaks and recreational pathways maintenance.

Project phase	**Operation**			
Impact	**Landscaping, fire-breaks and recreational pathways maintenance**			
Description of impact	**Inappropriate mowing, planting or trimming of vegetation leading to habitat degradation**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**• The north-eastern boundary fire-break should be maintained at 20m wide as a defensible zone for adjacent housing. Mowing with weedeaters can continue along the 20m strip. IF it is thought that reed growth (Phragmites) beyond the 20 m fire-break poses a serious fire risk (agreed to in writing by SCFPA), then reeds may be cut by hand to 1m high for an additional 20 m with no soil disturbance by vehicles or machinery permitted. Reeds (no other vegetation) must be cut during winter to avoid disturbance to breeding birds, and removed from the wetland area to avoid smothering vegetation. • The south-western boundary between RE/6503 and neighbouring Erf 6504 can be maintained with a 5m firebreak which provides vehicle access along the fenceline. The wetland area along this section should not be trimmed lower than 1m however. This is to prevent disturbance to the eggs of aquatic biota which are often deposited in the base of stems and leaves close to the water. As there are no houses in the adjacent Erf 6504 the fire risk is reduced, and in any event the entire Erf 6504 is maintained with very low cut vegetation. Should this situation change (ie. houses built), then the SCFPA should be consulted on best practice adjustments in consultation with an aquatic specialist. • Currently at least two road-width pathways are maintained by mowing through the wetland/open space which provide access for fire-fighting. Comment on the necessity of vehicle access should be provided by the SCFPA as it would be preferable to maintain narrower paths at a width of 3 m to allow walking / jogging / small vehicle access only (e.g. kabota). Whether maintaned as roads or pathways, maintenance must include the removal of alien vegetation (previously discussed), trimming of pathways using hand-held weedeaters and no disturbance to indigenous plant roots or soil is permitted. • Use simple markers along the designated edge of paths and fire-breaks to ensure landscaping teams do not encroach further than the designated edge. • No herbicides can be used to maintain pathways or fire-breaks in the wetland area or buffer. • The existing footprint of any mowed or cleared pathways may not be enlarged. • No new pathways may be created in addition to those already existing in the open space area. • Do not plant any exotic plants that do not occur naturally at the site in any area of the wetland or buffer. ie. under no circumstances may kikuyu grass be planted in any part of the wetland or buffer. • No vehicles (tractors pulling mowers) may be used to cut vegetation in any part of the wetland, for firebreaks or pathways. • No fire-break may be cut along the new fenceline proposed adjacent to the estuary. • Ensure gardening / landscaping team / homeowners do not dump green waste into the open space area as this will smother indigenous plants and encourage the spread of alien and exotic plant species.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Positive	
Duration	Short term	Impact will last between 1 and 5 years	Brief	Impact will not last longer than 1 year
Extent	Limited	Limited to the site and its immediate surroundings	Very limited	Limited to specific isolated parts of the site
Intensity	Moderate	Natural and/ or social functions and/ or processes are moderately altered	Very low	Natural and/ or social functions and/ or processes are slightly altered
Probability	Certain / definite	There are sound scientific reasons to expect that the impact will definitely	Unlikely	Has not happened yet but could happen once in the lifetime of the
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Minor - negative**		**Negligible - positive**	
Comment on significance				
Cumulative impacts	No applicable.			

6.3.4 Operational phase: Leaking, Blocked or Overflowing Sewerage Infrastructure

While significant efforts have been made to ensure sewage pump stations and infrastructure are well planned, positioned and maintained within the development, experience has shown

that even well-intentioned developments can have periodic problems with leaking, blocked or overflowing sewerage pipes or pump stations. Maintenance and regular inspections are key to ensuring that any issues are detected and dealt with early. Mitigation measures are provided in sTable 14.

sTable 14. Operational phase impact: leaking, blocked or overflowing sewerage infrastructure.

Project phase	**Operation**			
Impact	**Leaking, blocked or overflowing sewerage infrastructure**			
Description of impact	**Pollution and eutrophication of the wetland leading to habitat degradation and impacts to biota**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**• All sewerage infrastructure must be well maintained and kept free of obscuring vegetation. Manholes, sewerlines, and the pump stations must be accessible, easily observed, and routinely inspected for leaks or blockages. • Emergency response measures to sewage spillages should be maintained on site, including lime to treat sewage and sand bags to contain spill and limit their dispersal. An emergency response protocol must be established by management of the HOA. • Residents should be provided with information of what can / cannot be flushed into toilets. This knowledge is often assumed, but is frequently over-estimated. Even educated people treat a toilet like a rubbish bin. • Ensure sufficient backup power systems are available for the operation of pump stations during load shedding and at peak times (e.g. December).**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Short term	Impact will last between 1 and 5 years	Brief	Impact will not last longer than 1 year
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Very low	Natural and/ or social functions and/ or processes are slightly altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance				
Cumulative impacts	Not applicable			

6.3.5 Operational Phase: Irrigation With Treated Wastewater Causing Eutrophication

According to the engineering services report, all the treated effluent will be used for irrigation, with dedicated irrigation storage tanks installed near the package plant (4 x 10 kilo-litre). The volumes to be irrigated will be up to 40 m^3 per day, which would be at full capacity / development of the estate. Until the estate has been fully developed, irrigation of treated effluent is likely to be fairly achievable given low occupancy and extensive open space. But as the occupancy rates increase and open space decreases there will be increased pressure to irrigate over smaller areas. In either event, the quality of treated water to be irrigated (aim to comply with DWS General Limits) is still considered high in nutrients compared to natural waters, and therefore poses a risk of eutrophication (nutrient enrichment) to the wetland.

This can be mitigated to an extent through monitoring of water quality in two wells. The wells must be installed and baseline water quality determined prior to commencement of the construction phase. However, success of this mitigation is reliant on a proactive response to monitoring results, and possible increases in nutrient levels. Provided mitigation measures provided in Table 15

Table 15. Operational phase impact: Irrigation with treated wastewater resulting in eutrophication of the wetland.

Project phase	**Operation**			
Impact	**Irrigation with treated wastewater daily resulting in eutrophication of the wetland**			
Description of impact	**Seepage of treated wastewater into the wetland could result in eutrophication**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• Under NO circumstances can treated wastewater be discharged to the stormwater system, as this leads directly to the wetland which has a unique water chemistry that supports a diverse assemblage of fauna and flora. • Install 2 groundwater spikes / wells at 10m depth to monitor ground water on the upland area (within the estate) near the wetland buffer. These should be located at least 200 m apart and provide easy access during the construction and operational phase. They should not be located in any area of significant natural vegetation, and should rather be sited in grassy areas. • Collect a water sample from each monitoring point on a monthly basis during the construction and operational phase and submit to a registered laboratory for the analysis of parameters indicated by DWS general limits. • Water chemistry results should not vary by more than 10% of background values as established prior to the development. Therefore, the spikes should be installed for monitoring prior to the commencement of construction, and water sampling to establish the baseline should be undertaken for 3 months. • If water chemistry deviates signficantly from background levels and begins to indicate eutrophication (nutrient enrichment; e.g. elevated levels for > 3 months), then an alternative solution to the irrigation of water must be provided. This could involve discharging to clay-lined ponds, or irrigating on the neighbouring school's sportsfields. Proactive steps to mitigate eutrophication must be taken from the first month that elevated levels are noted, so that if elevated levels persist, a solution is fully actionable by the 3rd month. • Water samples must be submitted to the Bitou Municipality, BOCMA and be reviewed by an aquatic ecologist on a quarterly basis for the first two years of operation of the estate.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Long term	Impact will last between 10 and 15 years	Short term	Impact will last between 1 and 5 years
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	Medium	Determination is based on common sense and general knowledge
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Minor - negative**	
Comment on significance	Mitigation will reduce the intensity and timeframe of the impact as a response to water quality monitoring will include finding alternative sites for disposal of water or improvement of water treatment.			
Cumulative impacts				

7. CONCLUSIONS

The proposed residential development known as Plett Lagoon Estate initially included housing which extended into the wetland area. Since biodiversity specialist inputs have been provided, the proposed development has been significantly reduced to a revised SDP (July 2023) and updated Site Development Plan (March 2024) which exclude any development from the wetland and buffer area entirely.

An update to the original SDP proposed that a security fence be installed along the estuarine edge of the development. Various options were assessed and compared, and if all mitigation measures are implemented the impact would be a Moderate Negative in terms of habitat fragmentation. The No Go option would always be preferable when considering habitat fragmentation and fencing, however, residents would not feel secure without the presence of the fence and a fire risk would be posed by vagrants sleeping in the wetland bush. Therefore, the mitigation measures aimed at deterring criminals but maintaining wildlife movement through fencing should be fully adhered to should the fence line be approved. Fenceline Alternative 2 along the estuary is preferred.

Mitigation measures proposed to manage both stormwater and sewage on site have been carefully considered in the report provided by Vita Consulting Engineers. The SuDS-type interventions proposed in this report provide confidence that stormwater can be effectively managed on site, with minimal risk to the wetland's habitat and water quality. A few additional mitigation measures in terms of the design and layout of stormwater outflows were recommended in this report.

The wetland was classified as a depression with a PES of A (Natural) and an EIS of 'Very High'. As the last remaining natural wetland habitat on the western bank of Keurbooms Lagoon, the wetland has great significance. A wetland buffer of 30 m was recommended and not only protects the wetland from the residential development upslope, but provides a level of connectivity between the terrestrial and wetland areas with the lagoon. The impact assessment determined most of the construction and operational phase impacts to be a Negligible negative with some impacts being a negligible positive.

Development of the Plett Lagoon Estate is supported provided the residential areas are planned outside of the wetland and buffer area, and the wetland is conserved, well maintained and remains a functional component of the Keurbooms Estuary.

8. APPENDICES

8.1 Present Ecological State Methods

The wetland area was assessed using the Level 2 WET-Health assessment tool developed by Macfarlane *et al*. (2020). The tool aims to assess the integrity of a wetland which is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. The reference condition is inferred from conceptual models of the selected hydrogeomorphic wetland type. The method combines an assessment of hydrological, geomorphological, water quality and vegetation health four modules.

Data collection involved a desktop review of the extent and intensity of catchment land use impacts and was undertaken using historical and recent aerial imagery of the site (Chief Directorate: National Geo-spatial Information and satellites). Fieldwork onsite involved the identification and recording of observable impacts to the wetland at the site of relevant activities as well as at reference points upstream and downstream of the activities, and in the catchment area of the wetland. The magnitude of observed impacts to the hydrological, geomorphological and vegetation components of the wetland were calculated and combined as per the tool to provide a measure of the overall wetland condition of the wetland. Resultant scores were then used to assign the wetland into one of six PES categories as shown in Table 16.

Table 16. Wetland Present Ecological State categories and impact descriptions.

Ecological Category	Description	PES Score
A	Unmodified, natural.	90-100%
B	Largely natural with few modifications / in good health. A small change in natural habitats and biota may have taken place but the ecosystem functions are still predominantly unchanged.	80-89%
C	Moderately modified / fair condition. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79%
D	Largely modified / poor condition. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59%
E	Seriously modified / very poor condition. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39%
F	Critically modified / totally transformed. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota.	0-19%

8.2 Ecological Importance and Sensitivity Methods

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 enhancement 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 17).

Table 17.Ecological importance and sensitivity categories for wetlands. 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

8.3 Impact Assessment Methods

Criteria are ascribed for each predicted impact. These include the intensity (size or degree scale), which also includes the type of impact, being either a positive or negative impact; the duration (temporal scale); and the extent (spatial scale), as well as the probability (likelihood). The methodology is quantitative, whereby professional judgement is used to identify a rating for each criterion based on a seven-point scale (Table 18) and the significance is auto-generated using a spreadsheet through application of the calculations.

For each predicted impact, certain criteria are applied to establish the likely **significance** of the impact, firstly in the case of no mitigation being applied and then with the most effective mitigation measure(s) in place.

These criteria include the **intensity** *(*size or degree scale), which also includes the **nature** of impact, being either a positive or negative impact; the **duration** (temporal scale); and the **extent** (spatial scale). These numerical ratings are used in an equation whereby the **consequence** of the impact can be calculated. Consequence is calculated as follows:

Consequence = type x (intensity + duration + extent)

To calculate the significance of an impact, the **probability** (or likelihood) of that impact occurring is applied to the consequence.

Significance = consequence x probability

Depending on the numerical result, the impact would fall into a significance category as negligible, minor, moderate or major, and the type would be either positive or negative (as below).

Significance:	negative	positive
Negligible	Negligible - negative	Negligible - positive
Minor	Minor - negative	Minor - positive
Moderate	Moderate - negative	Moderate - positive
Major	Major - negative	Major - positive

Table 18. Assessment criteria for the evaluation of impacts

Criteria	Numeric Rating	Category	Description
Duration	**1**	**Immediate**	Impact will self-remedy immediately
	2	**Brief**	Impact will not last longer than 1 year
	3	**Short term**	Impact will last between 1 and 5 years
	4	**Medium term**	Impact will last between 5 and 10 years
	5	**Long term**	Impact will last between 10 and 15 years
	6	**On-going**	Impact will last between 15 and 20 years
	7	**Permanent**	Impact may be permanent, or in excess of 20 years
Extent	**1**	**Very limited**	Limited to specific isolated parts of the site
	2	**Limited**	Limited to the site and its immediate surroundings
	3	**Local**	Extending across the site and to nearby settlements
	4	**Municipal area**	Impacts felt at a municipal level
	5	**Regional**	Impacts felt at a regional level
	6	**National**	Impacts felt at a national level
	7	**International**	Impacts felt at an international level
Intensity	**1**	**Negligible**	Natural and/ or social functions and/ or processes are negligibly altered
	2	**Very low**	Natural and/ or social functions and/ or processes are slightly altered
	3	**Low**	Natural and/ or social functions and/ or processes are somewhat altered
	4	**Moderate**	Natural and/ or social functions and/ or processes are moderately altered
	5	**High**	Natural and/ or social functions and/ or processes are notably altered
	6	**Very high**	Natural and/ or social functions and/ or processes are majorly altered

Criteria	Numeric Rating	Category	Description
	7	**Extremely high**	Natural and/ or social functions and/ or processes are severely altered
Probability	1	**Highly unlikely / None**	Expected never to happen
	2	**Rare / improbable**	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
	3	**Unlikely**	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
	4	**Probable**	Has occurred here or elsewhere and could therefore occur
	5	**Likely**	The impact may occur
	6	**Almost certain / Highly probable**	It is most likely that the impact will occur
	7	**Certain / Definite**	There are sound scientific reasons to expect that the impact will definitely occur

When assessing impacts, broader considerations are also considered. These include the level of confidence in the assessment rating; the reversibility of the impact; and the irreplaceability of the resource as set out in (Table 19, Table 20, & Table 21), respectively.

Table 19. Definition of confidence ratings.

Category	Description
Low	Judgement is based on intuition
Medium	Determination is based on common sense and general knowledge
High	Substantive supportive data exists to verify the assessment

Table 20. Definition of reversibility ratings.

Category	Description
Low	The affected environment will not be able to recover from the impact - permanently modified
Medium	The affected environment will only recover from the impact with significant intervention
High	The affected environmental will be able to recover from the impact

Table 21. Definition of irreplaceability ratings.

Category	Description
Low	The resource is not damaged irreparably or is not scarce
Medium	The resource is damaged irreparably but is represented elsewhere

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