Upstream Consulting
Aquatic specialist services
- Cell: 072 444 8243
- Email: debbie@upstreamconsulting.co.za
- Address: 25 Blommekloof Street, George, 6530

www.upstreamconsulting.co.za

AQUATIC BIODIVERSITY IMPACT ASSESSMENT

for the proposed

MIXED-USE DEVELOPMENT ON PTN 7 & PTN 8 OF FARM 432 KRANSHOEK, NEAR PLETTENBERG BAY

VERSION 3

DATE: 4 June 2024

PREPARED FOR:

Sharples Environmental Services cc
102 Merriman Street
George
6529

PREPARED BY:

Debbie Fordham
Upstream Consulting
25 Blommekloof St, George, 6529
debbie@upstreamconsulting.co.za

Executive Summary

Introduction

Debbie Fordham of Upstream Consulting has been appointed by Sharples Environmental Services cc, to undertake an aquatic biodiversity impact assessment for the proposed mixed use housing development on Portion 7 and Portion 8 of Farm Kranshoek 432, near Plettenberg Bay. The proposed development has a mixed-use component incorporating a residential, recreational and retail component. The land is currently vacant, previously used for agricultural purposes, but borders the urban area and earmarked for development. According to the Screening Tool Report, the site has areas of “Very High” aquatic sensitivity due to the following features: ESA 1 Aquatic habitat, FEPA Sub catchment, and SWSA_sw, and required further aquatic specialist assessment.

Desktop findings

The study area is located within the DWS Quaternary Catchment K60G and falls within the Coastal Gouritz Water Management Area. It is located on the raised coastal platform which, at the coast, rises steeply from sea level to elevations > 100 m. The rivers are deeply incised into this coastal platform, their catchment areas being relatively small. The topography of the site is fairly flat, sloping gently towards the east, and the catchment drains directly south towards the Indian Ocean. The latest wetland and river maps of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) do not show any natural aquatic habitats within the area. There are also no FEPA watercourses identified by the NFEPA project. The Outeniqua Strategic Water Source Area for surface water is located to the west of the site, but the proposed development does not fall within any SWSAs. The Western Cape Biodiversity Spatial Plan (WCBSP) identifies an ESA 1 watercourse within Portion 8, and an ESA 2 river/wetland within Portion 7, of Kranshoek Farm 432.

Site assessment

The initial site verification assessment confirmed the Very High sensitivity rating due to the presence of watercourses on the properties. Two wetlands were identified and delineated on Portion 8, and one degraded seep was delineated on Portion 7, of Kranshoek Farm 432. These systems were assessed in detail as HGM1, HGM2, and HGM3, for potential impacts from development.

The HGM1 and HGM2 watercourses are discontinuous valley bottom wetland systems which flow through Portion 8 of Kranshoek 432. These wetlands are largely seasonal, with a narrow permanent zone, and temporary zones located laterally along the shallow valley side. Water inputs are derived from rainfall, and lateral and longitudinal seepage. The HGM2 wetland joins the HGM1 system on Portion 8 of Kranshoek 432. HGM2 flows through the urban area and has been subjected to significant habitat loss and modification.

The reach of the HGM1 wetland on Portions 8 & 9 of Kranshoek 432 is relatively undisturbed and in good ecological condition. Despite some alien invasive tree infestation, the reach is geomorphologically stable and well-vegetated with relatively high species diversity. The

wetland supplies important regulatory and supporting ecosystem services such as flood attenuation, sediment trapping, biodiversity maintenance, and pollutant assimilation. However, towards the eastern property boundary the wetland becomes increasingly degraded and ultimately transformed by the construction of a road and dam downstream. Additionally, the water is severely contaminated by raw effluent when it leaves the property through the road pipe culvert. Therefore, while there are portions of HGM1 of high ecological value, the wetland becomes critically modified to the east. The significant habitat loss and high level of water contamination results in an overall 'D' (poor) Present Ecological State (PES) score. It is recommended that the management objective for these wetlands be to improve the systems though alien plant removal and halting pollution.

HGM3 is a severely modified seep wetland which originates on Portion 7 of Kranshoek 432. Under natural conditions, the seep would flow in a diffuse manner towards the southeast and be vegetated with short sedges and fynbos plants. However, there is presently very little wetland habitat remaining on the property. The upper reach assessed obtained a poor ecological health score (PES= D). The habitat has been transformed for grazing and the wetland has been artificially drained and then dammed. The hydrology and geomorphology have been irreversibly changed. Downstream the wetland remains intact but the source zone on the property is transformed. The remaining wetland should be retained to regulate stormwater flows from the site, but overall, the seep has Low ecological importance and functionality.

Recommended buffers

A 42m aquatic buffer was recommended from the edge of the wetland habitat on Portion 8 of Kranshoek 432 (HGM1 and HGM2), while a 15m buffer should be applied from the remaining aquatic habitat on Portion 7 of Kranshoek 432 (HGM3). Additionally, road and sewage infrastructure should not be placed within the wetlands or buffer zones.

Impact prediction

Two alternative project layouts were provided for assessment of their impact upon aquatic biodiversity, namely the Preferred Alternative (the December 2023 site layout plan) and Alternative A (the September 2023 site layout plan). The development layouts are similar, and both allow for the conservation of wetland habitat (except on Portion 9), but Alternative A includes a sports field in the area earmarked for open space in the Preferred Layout. The direct and indirect impacts associated with the project were assessed as:

- Impact 1: disturbance to aquatic habitat and biota
- Impact 2: Increased surface water runoff and stormwater flow patterns on form and function during the construction and into the operational phase, i.e. changes to the hydrological regime
- Impact 3: Changes to hydrological regime that could also lead to sedimentation and erosion, which could also occur in the operational phase
- Impact 4: Potential impact on localised surface water quality

The most significant risks to aquatic biodiversity from the project are associated with sewage leakages, poor stormwater management, and increased alien plant encroachment. These impacts must be prevented with the compilation of a wetland rehabilitation and management programme (attached to the EMPr with buffer map and detailing management actions and responsible persons) and a site-specific stormwater management plan.

Impact significance assessment

The impacts were determined to be Low- Medium and negative in nature. The difference between the two layouts is slight, with the previous layout showing a sports field in the northern section. but housing in the mid-section being slightly farther set back. Both alternatives have the same risk level from sewage pollution as the services layouts are not yet available for assessment. Therefore, the potential impacts for both layouts are the same, but the Preferred Alternative has a lower risk of impacting the northern wetland habitat as there is no sports facility. There are no new impacts associated with the No Go Alternative. However, the reach of wetland on Portion 8 is not being actively managed and will continue to deteriorate in health without intervention.

The cumulative impact of the project upon aquatic biodiversity is of medium significance. Alien invasive trees removal, improved wastewater management, and adherence to a buffer area will protect aquatic habitat from the majority of potential impacts. Improved management of the open spaces as part of the development could improve aquatic habitats that are currently unmanaged and degraded.

Conclusion

There are no fatal flaws associated with the project, provided all the mitigation measures are adopted. The mitigation of impacts must focus on preventing water pollution, maintaining aquatic habitat integrity, and managing the runoff generated by the development and introducing it responsibly into the receiving environment.

Specialist Assessment Protocol Index

Report reference to Table 1 - Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity

2. Aquatic Biodiversity Specialist Assessment	
2.1. The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP), with expertise in the field of aquatic sciences.	Debbie Fordham SACNASP Registration number 119102 (Ecology)
2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.	Section 1- Introduction 1.1 –Location & 1.2 – Project description
2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:	
2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including;	Section 6 – Affected Environment Section 7 - Results
(a) aquatic ecosystem types; and (b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	Section 6.1 – The Drainage Network Section 7.1 – Identified habitat
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	Very High 1.4 -Screening tool results Section 6.5 – Conservation context Section 6.4 - SAIIAE
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	Section 6 – Affected Environment ESA habitat
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:	Section 7. Delineated aquatic habitat Section 6 & 7 – Affected Environment & Results
(a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and (b) the historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain	Section 6.1 – Drainage network Section 7.1 – Identified aquatic habitat Section 6.7 –Historic land use

habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	Section 7 – Results
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions:	
2.5.1. is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Refer to Section 9 – Impact assessment and tables
2.5.2. is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?	
2.5.3. how will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:	Section 8 – Identified Impacts
(a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); (b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub-catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water uses and related activities change;	Section 8.2 –Flow pattern changes 8.3 - Erosion and Sedimentation Section 8.1 – Loss of aquatic habitat Section 8.4 Water Quality impacts
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include:	Section 9 – Impact Significance Assessment
(a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system); (b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river); (c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); (d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); (e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and	Refer to Section 9 – Impact assessment and tables Section 8 – Identified Impacts Section 9 Impact Assessment

(f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);	
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially:	Low Impact (after mitigation) Section 9 – Impact Significance Assessment
(a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	Section 8 – discussion of identified impacts
2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 8 and Impact Table of Section 9
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: (a) size of the estuary; (b) availability of sediment; (c) wave action in the mouth; (d) protection of the mouth; (e) beach slope; (f) volume of mean annual runoff; and (g) extent of saline intrusion (especially relevant to permanently open systems).	Not applicable
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Appendix 2 – Specialist curriculum vitae
2.7.2. a signed statement of independence by the specialist;	Below Declaration of Independence –Page vi
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	4.2 – Site assessment Section 4 – Approach and methodology Section 5 - Assumptions
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Section 4 – Approach and methodology

Declaration of Independence

SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of the Environmental Impact Assessment Regulations and the National Environmental Management Act (Act 107 of 1998), any subsequent amendments and any relevant National and / or Provincial Policies related to biodiversity assessments. This also includes the minim requirements as stipulated in the National Water Act (Act 36 of 1998), as amended in Water Use Licence Application and Appeals Regulations, 2017 Government Notice R267 in Government Gazette 40713 dated 24 March 2017, which includes the minimum requirements for an Aquatic Biodiversity Report.

Report prepared by: Debbie Fordham (Ecology 119102)

Expertise / Field of Study: Internationally certified Professional Wetland Scientist and registered SACNASP ecologist, with 10 years of working experience, specialising in aquatic ecology. Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape. She is a member of scientific organisations such as the Society of Wetland Scientists (SWS), the South African Wetland Society (SAWS), and the Southern African Association of Geomorphologists (SAAG).

I, **Debbie Fordham** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs Fisheries and Forestry and or Department of Water and Sanitation.

Signed:… .... Date:… 4 June 2024………

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Debbie Fordham of Upstream Consulting has been appointed by Sharples Environmental Services cc, to undertake an aquatic biodiversity impact assessment for the proposed mixed use housing development on Portion 7 and Portion 8 of Farm Kranshoek 432, near Plettenberg Bay. The site falls within an area identified as having "Very High" aquatic sensitivity by the National Web based Environmental Screening Tool. The proposal therefore requires an aquatic specialist study to inform the NEMA environmental authorisation process. This document is the third version of the assessment due to the addition of alternative layouts.

1.1 Location

Kranshoek is a residential township located west of the town of Plettenberg Bay in the Bitou Municipal Area. It is to the south of Robberg Road which connects the western parts of Plettenberg Bay to the N2 further west of Kranshoek, and north of the Indian Ocean coast. Kranshoek Farm Portions 7 & 8 consist of largely vacant, old agricultural land bordering the eastern side of the current urban area.

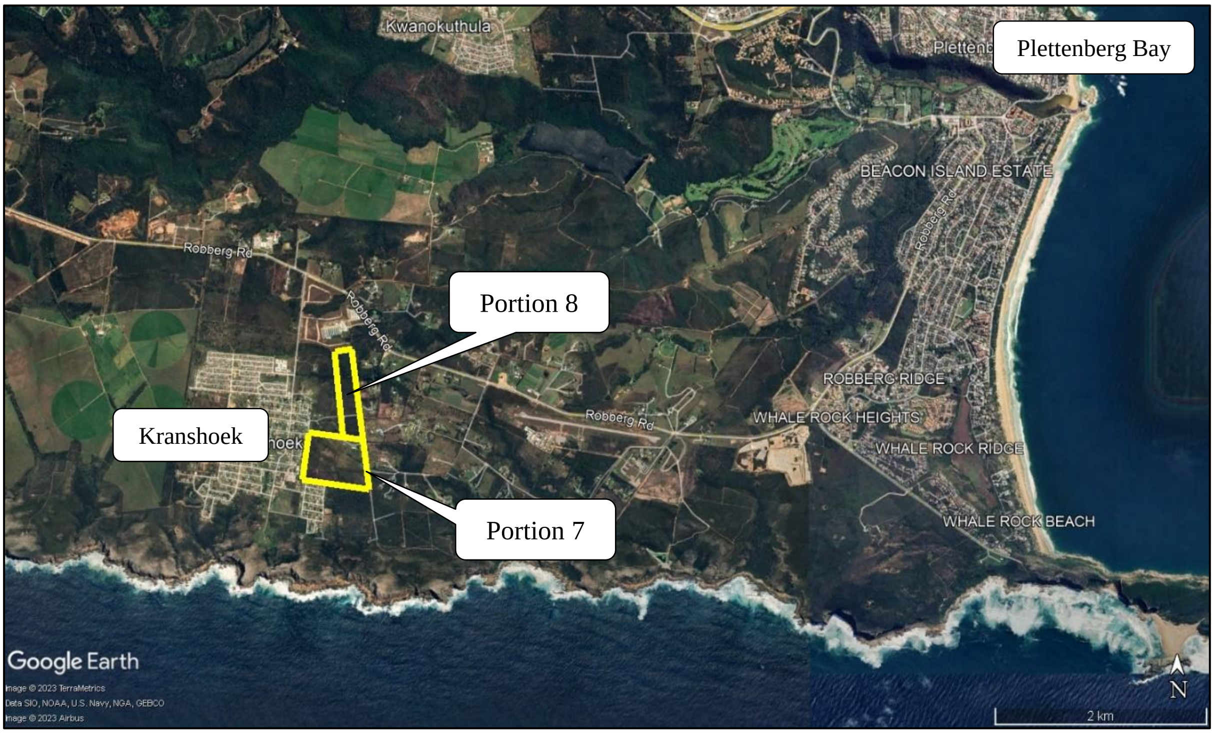

Figure 1: Google satellite map showing the location of Portions 7 & 8 of Kranshoek 432 in relation to Kranshoek town and Plettenberg Bay

1.2 PROJECT DESCRIPTION

The proposed development has a mixed-use component incorporating a residential, recreational and retail component.

In October 2023 an aquatic report was compiled (Version 2) which assessed two layout alternatives provided by the client. These layouts, developed by MetroPlan, were referred to in the report as Alternative A (site development layout dated 28/09/2023) and Alternative B (the preliminary site layout dated 23/05//2023). There were slight differences between these two development layout plans. Alternative A had less hard infrastructure situated within the aquatic habitat and buffer zone than Alternative B. Therefore, the report (Version 2) determined that Alternative A posed a slightly lower threat to aquatic habitat and was concluded to be the preferred development layout from an aquatic biodiversity impact perspective. Figure 2 below shows the proposed Alternative A layout (Drawing No 23010_Kra_12_Revision2) and Figure 3 shows the initial development layout assessed as Alternative B, from the October 2023 (Version 2) aquatic specialist report.

Since then, a new site development layout plan has been provided for assessment as a development alternative (MetroPlan, dated 05/12/2023) The new layout required assessment and therefore the previous aquatic impact assessment report has been amended to include it. This report (Version 3), therefore includes the assessment of the new development layout, referred to as ‘The Preferred Alternative – Layout Revision 9’, which is depicted in Drawing No 23010_PLE_12_Revision 9 (Figure 4).

To date, no civil service designs, layouts or reports have been provided. The details of the sewer and water reticulation system is unknown. This is noteworthy as this assessment must then assume that there may be such infrastructure constructed within the watercourses and associated buffer zones, which significantly increases the potential impact of development. Additionally, the stormwater management plan layout only covered Portion 8 of Kranshoek 432, and was based on the Alternative A plan, not the new layout.

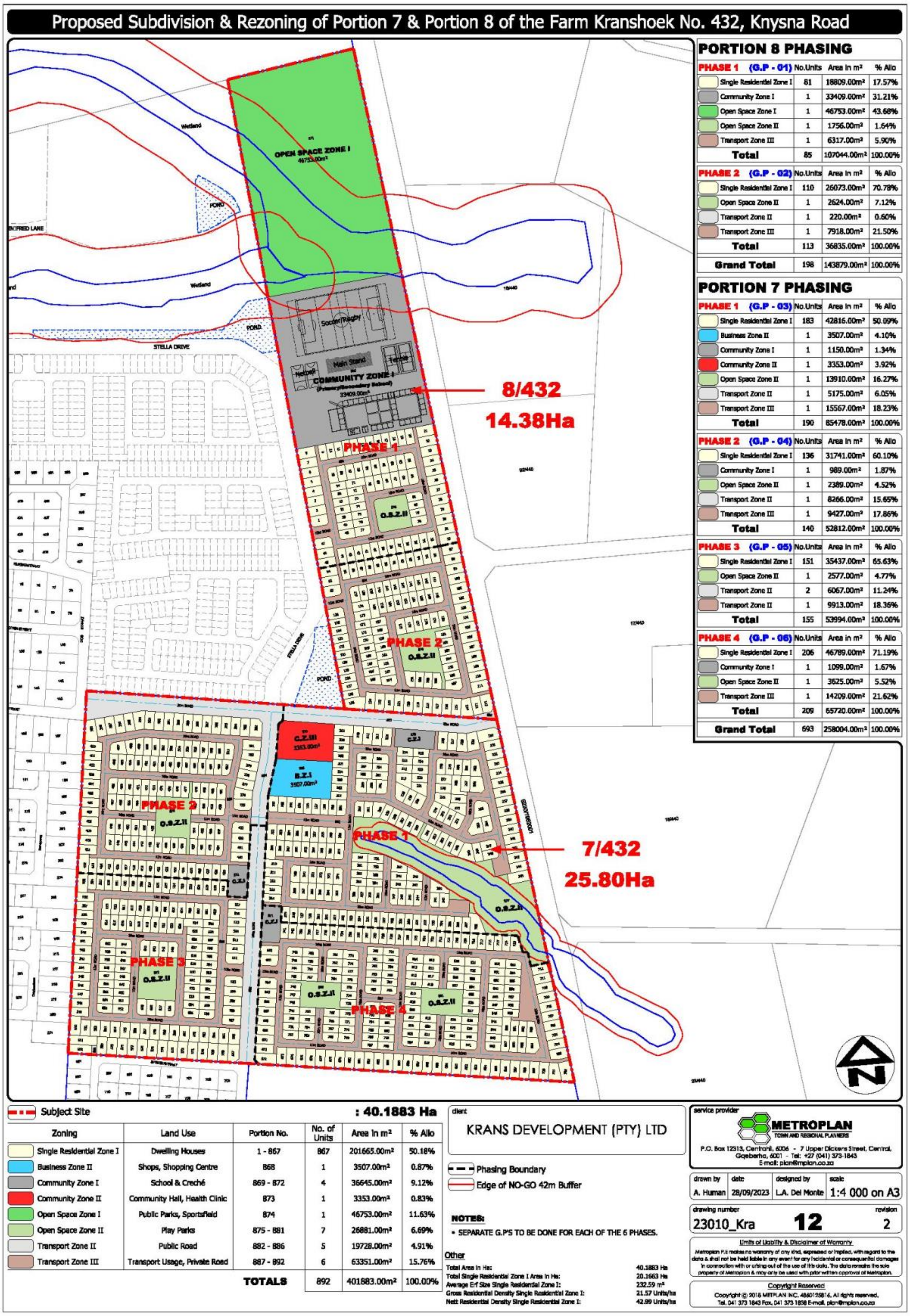

Figure 2: Alternative A layout for the proposed development (by MetroPlan, dated 28/09/2023)

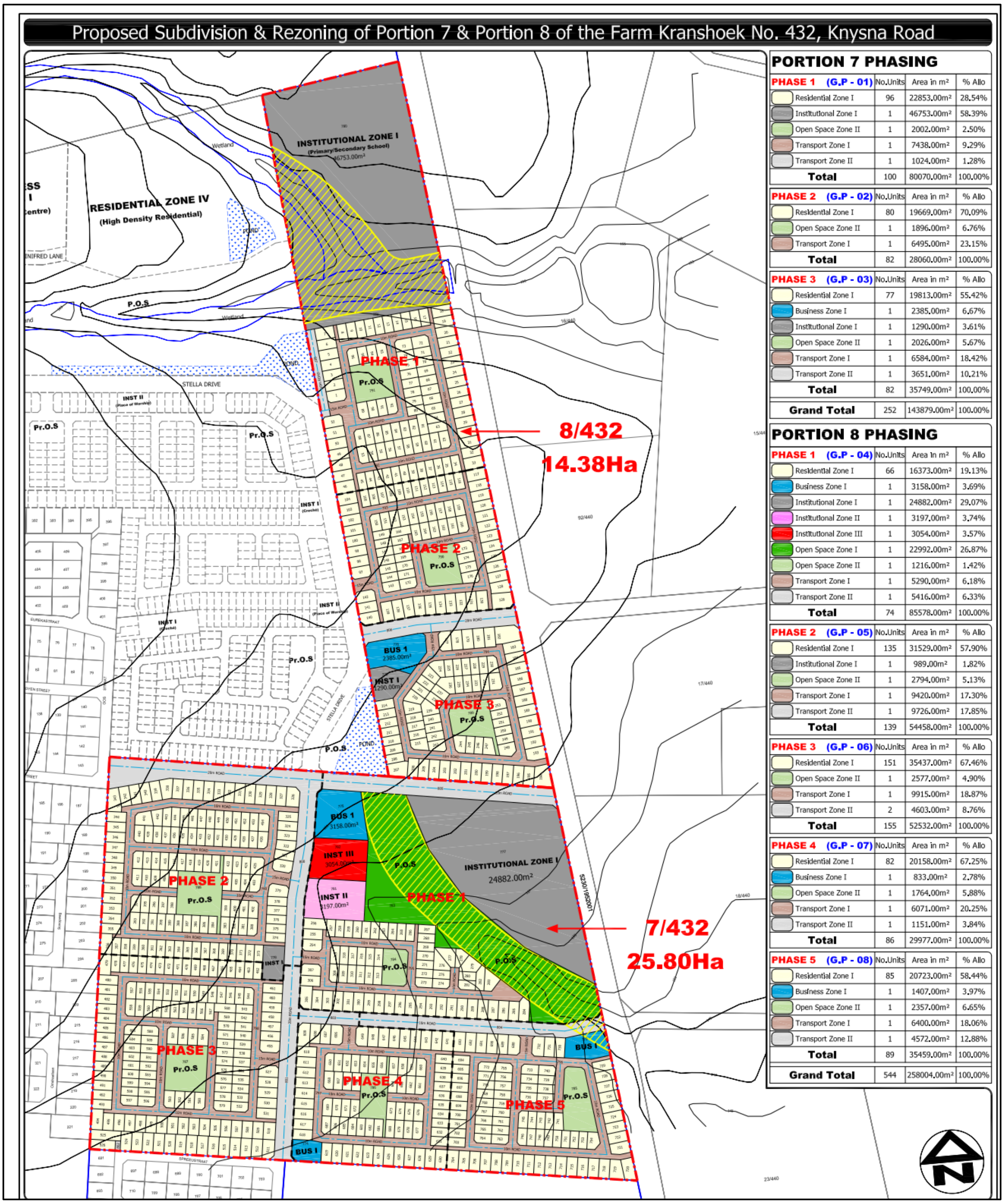

Figure 3: Alternative B layout for the proposed development (by MetroPlan, dated 23/05//2023)

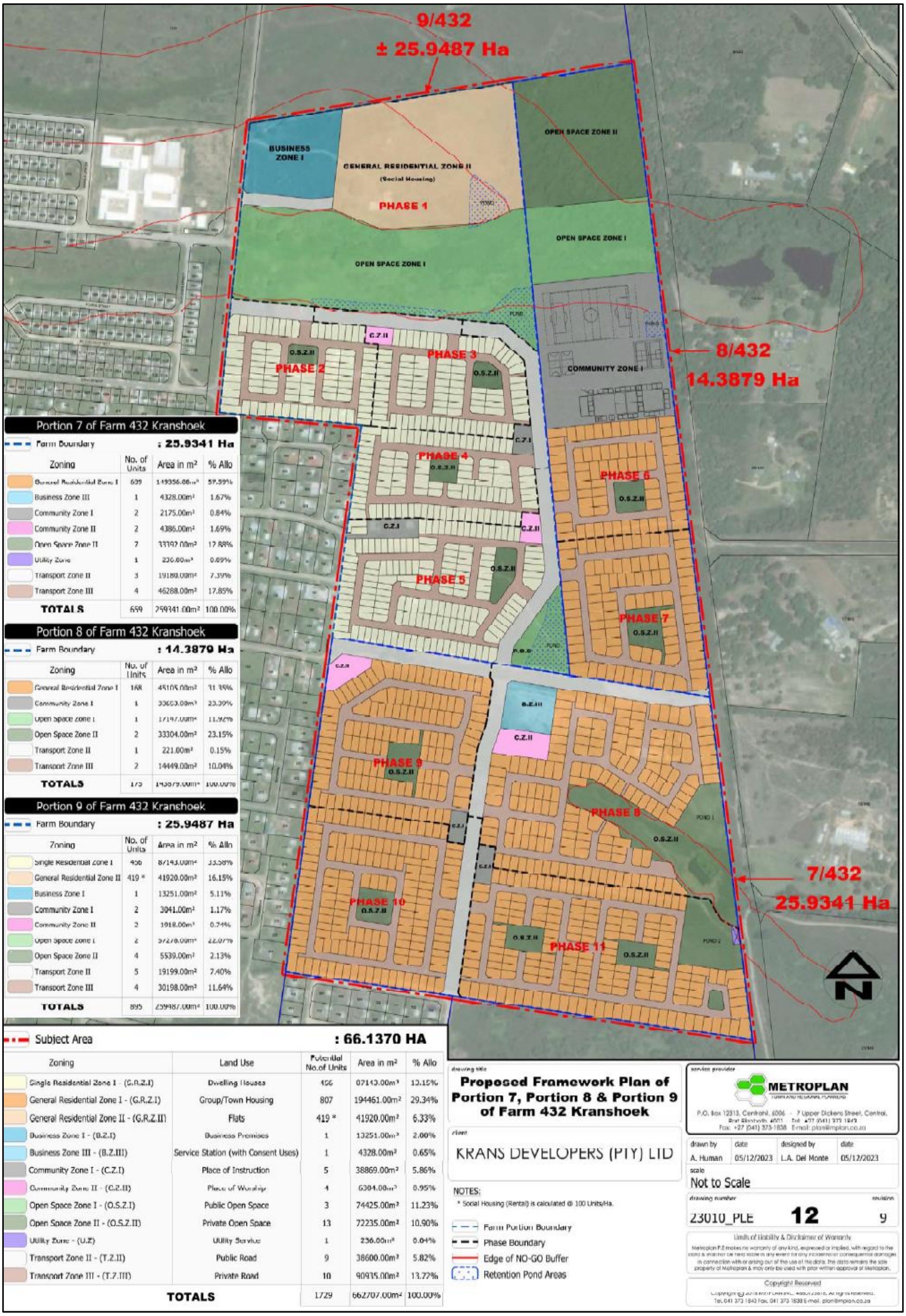

Figure 4: 'The Preferred Alternative – Layout Revision 9', which is Drawing No 23010_PLE_12_Revision 9 (MetroPlan, 05/12/2023)

1.3 SCREENING TOOL RESULTS

The National Web based Environmental Screening Tool was utilised for this proposal in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, to screen the proposed site for any environmental sensitivity. The Screening Tool identifies related exclusions and/ or specific requirements including specialist studies applicable to the proposed site. The Screening Tool allows for the generating of a Screening Report referred to in Regulation 16 (1) (v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation. Requirements for the assessment and reporting of impacts of development on aquatic biodiversity are set out in the 'Protocol for the assessment and reporting of environmental impacts on aquatic biodiversity published in Government Notice No. 648, Government Gazette 45421, on the 10 of May 2020.

According to the Screening Report, the site has areas of “Very High” aquatic sensitivity and requires the assessment and reporting of impacts on Aquatic Biodiversity (Figure 4). The sensitive features identified were ESA 1 Aquatic habitat, FEPA Sub catchment, and SWSA_sw.

The site verification assessment was undertaken and is attached as a Site Verification Report in Appendix 3. The Very High aquatic biodiversity sensitivity rating for parts of the site was confirmed. Therefore, the Aquatic Biodiversity Impact Assessment report was required and has been compiled in accordance with the latest NEMA Minimum Requirements and Protocol for Specialist Aquatic Biodiversity Impact Assessment (10 May 2020).

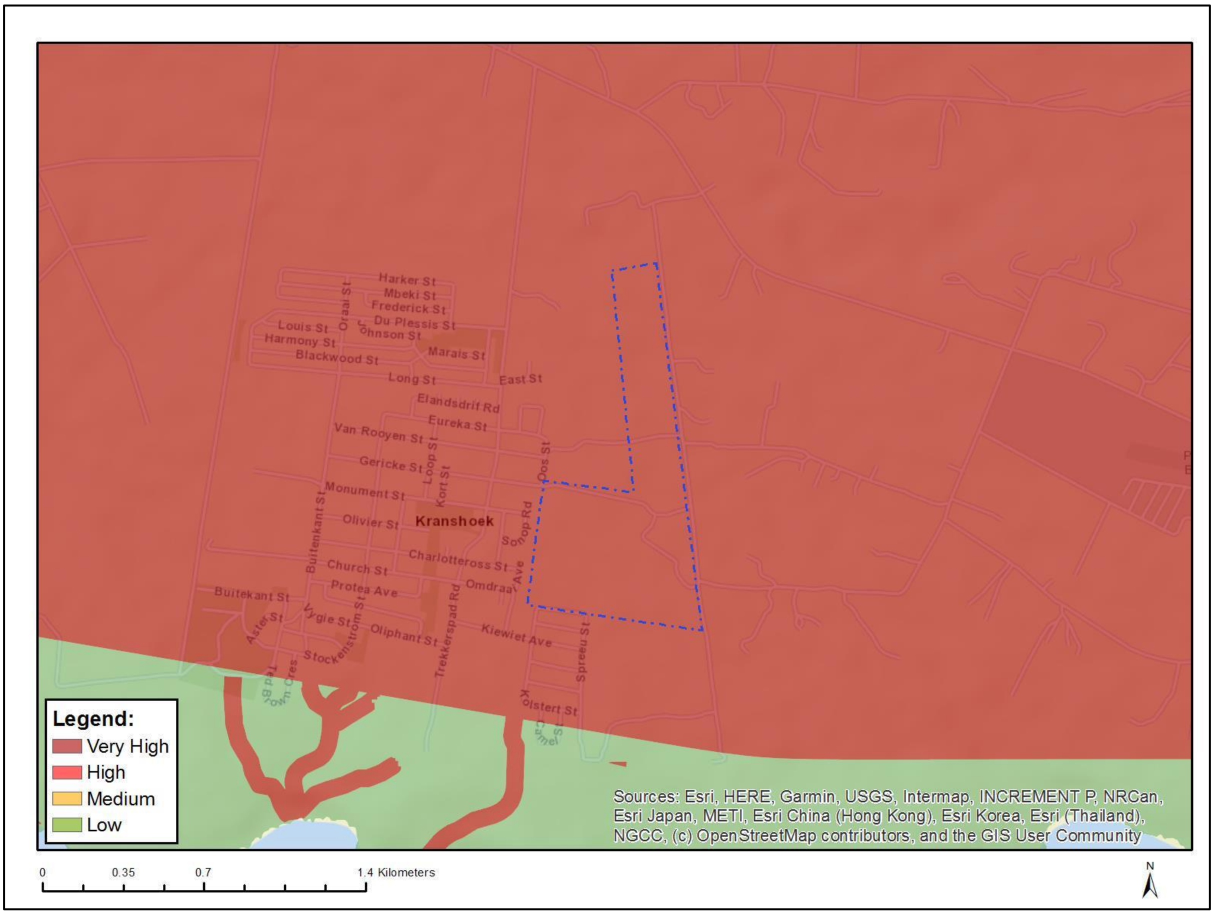

Figure 5: Aquatic biodiversity sensitivity map of the study area from the DFFE Screening Tool

2 RELEVANT LEGISLATION

The protection of water resources is essential for sustainable development and therefore many policies and plans have been developed, and legislation promulgated, to protect these sensitive ecosystems. The proposed project must abide by the relevant legislative requirements. Table 1 below shows an outline of the environmental legislation relevant to the project.

Table 1: Relevant environmental legislation

Legislation	Relevance
South African Constitution 108 of 1996	The constitution includes the right to have the environment protected
National Environmental Management Act 107 of 1998	Outlines principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state. Chapter 1(4r) states that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. Section 24 of NEMA requires

	that the potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation, must be investigated and assessed prior to implementation, and reported to the authority.
Environmental Impact Assessment (EIA) Regulations	The 2014 regulations have been promulgated in terms of Chapter 5 of NEMA and were amended on 7 April 2017 in Government Notice No. R. 326. In addition, listing notices (GN 324-327) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	The proposed project requires water use authorisation in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998, and this must be secured prior to the commencement of activities. Chapter 4 of the National Water Act addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use of water.
Conservation of Agricultural Resources Act (Act 43 of 1983)	The Conservation of Agricultural Resources Act (CARA) is to provide for the conservation of the natural agricultural resources by the maintenance of production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.
National Environmental Management: Biodiversity Act No. 10 of 2004	This is to provide for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits.

3 TERMS OF REFERENCE

- Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information (including but not limited to the South African Inventory of Inland Aquatic Ecosystems (SAIIAE), vegetation, CBAs, Threatened ecosystems, any Red data book information, NFEPA data, broader catchment drainage and protected areas).
- Desktop delineation and illustration of all watercourses within and surrounding the study area utilising available site-specific data such as aerial photography, contour data and water resource data.
- Prepare a map demarcating the respective watercourses or wetland/s, within the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence while classifying the hydrogeomorphic type of the respective water courses / wetlands in relation to present land-use and their current state. The maps depicting demarcated waterbodies will be delineated to a scale of 1:10 000, following the methodology described by the DWS.
- A risk/screening assessment of the identified aquatic ecosystems to determine which ones will be impacted upon and therefore require ground truthing and detailed assessment.

- Ground truthing, identification, delineation and mapping of the aquatic ecosystems in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*.
- Classification of the identified aquatic ecosystems in accordance with the, 'National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis *et al.* 2013) and WET-Ecoservices (Kotze et al. 2009).
- Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland and riparian habitats.
- Identification, prediction and description of potential impacts on aquatic habitat during the construction and operational phases of the project. Impacts are described in terms of their extent, intensity, and duration. The other aspects that must be included in the evaluation are probability, reversibility, irreplaceability, mitigation potential, and confidence in the evaluation.
- All direct, indirect, and cumulative impacts for each alternative will be rated with and without mitigation to determine the significance of the impacts.
- Recommend actions that should be taken to avoid impacts on aquatic habitat, in alignment with the mitigation hierarchy, and any measures necessary to restore disturbed areas or ecological processes.
- Rehabilitation guidelines for disturbed areas associated with the proposed project and monitoring.

4 APPROACH AND METHODS

This study followed the approaches of several national guidelines with regards to wetland/ riparian assessment. See Appendix 1. The following approach to the aquatic habitat assessment is undertaken:

4.1 DESKTOP ASSESSMENT METHODS

The contextualization of the study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information (i.e. existing data for coastal management lines, NFEPA identified rivers and wetlands, critical biodiversity areas (WBSP 2017), estuaries, vegetation units, ecosystem threat status, catchment boundaries, geology, land uses, etc.) in a Geographical Information System (GIS). A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Assessment of 2018 (Van Deventer *et al.* 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourses and the coastal dynamic. The conservation planning information aids in the determination of the level of importance and sensitivity, management objectives, and the significance of potential impacts.

Following this, desktop delineation and illustration of all watercourses within the study area was undertaken utilising available site-specific data such as aerial photography, contour data and water resource data. Digitization and mapping were undertaken using QGIS 3.28 GIS software. These results, as well as professional experience, allowed for the identification of sensitive habitat that could potentially be impacted by the project and therefore required ground truthing and detailed assessment.

4.2 Baseline Assessment Methods

A site assessment was conducted on the 9th of July 2023 to confirm desktop findings, gather additional information, and define the boundaries of the aquatic habitat. General observations were made with regards to the vegetation, fauna and current impacts. The identified aquatic ecosystems were classified in accordance with the, '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009). Information generated from a previous assessment for development of the neighbouring farm portion in 2017 was also utilised.

Infield delineation was undertaken with a hand-held GPS (Figure 5), for mapping of any potentially affected aquatic ecosystems, in alignment with standard field-based procedures in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*. The delineation is based upon observations of the landscape setting, topography, vegetation and soil characteristics (using a hand held soil auger for wetland soils).

Figure 6: Map showing the GPS tracks and waypoints associated with the site assessment

Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats was undertaken utilising:

- Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
- DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS

Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitat was undertaken utilising:

- The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 2 WET-Health assessment tool Version 2 (Macfarlane et al. 2020), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation.
- The WET-Ecoservices tool (Kotze et al., 2020) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing).

4.3 Impact Assessment Methods

The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined. Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring. Unknown parameters are given the highest score as significance scoring follows the Precautionary Principle.

The methodology to determine the significance ratings of the potential environmental impacts and risks associated with the alternatives was provided by Sharples Environmental Services cc as well as the impact table template for completion by the specialist.

Cumulative impacts affect the significance ranking of an impact because the impact is taken in consideration of both onsite and offsite sources. For example, pollution making its way into a river from a development may be within acceptable national standards. Activities in the surrounding area may also create pollution which does not exceed these standards. However, if both onsite and offsite pollution activities take place simultaneously, the total pollution level may exceed the standards. For this reason, it is important to consider impacts in terms of their cumulative nature.

4.4 MITIGATION AND MONITORING

Actions are thereafter recommended to prevent and mitigate the identified impacts on aquatic habitat, in alignment with the mitigation hierarchy, as well as any measures necessary to restore disturbed areas or ecological processes. No-Go Areas will be determined, and any necessary monitoring protocol will be developed.

5 ASSUMPTIONS AND LIMITATIONS

- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this can miss certain ecological information due to seasonality, thus limiting accuracy and confidence.
- The civil services infrastructure layouts and designs were not provided for assessment. It is therefore assumed that there may be infrastructure such as sewage pipeline crossings, pump stations, stormwater outlets, etc. in or near the watercourses.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of aquatic ecosystems, it is important to note that the current extent and classification is reported on here.
- All soil/vegetation/terrain sampling points were recorded using a Garmin Montana Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed activities, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota (e.g. fish, invertebrates, microphytes, etc.) was undertaken, and not deemed necessary.
- The vegetation information provided is based on observation not formal vegetation plots. As such species documented in this report should be considered as a list of dominant and/or indicator wetland/riparian species. Refer to the terrestrial specialist reports for further details on site vegetation.
- The scope of work did not include water quality sampling and the water quality characteristics were inferred from the biophysical characteristics of the area and catchment land uses.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor’s working knowledge and experience with similar projects. The degree of confidence is considered high.

6 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The desktop/ screening study was informed by the available datasets relevant to water resources, as well as historic and the latest aerial imagery, to develop an understanding of the fluvial processes of the study area. A significant amount of the latest spatial data has been provided through the products of the 2018 National Biodiversity Assessment (NBA). The NBA is the primary tool for monitoring and reporting on the state of biodiversity in South Africa. It is used to inform policies, strategies and actions in a range of sectors for managing and conserving biodiversity more effectively. The desktop study was followed by the detailed site assessment. The general biophysical characteristics of the study area are described below.

6.1 BIOPHYSICAL CHARACTERISTICS

Kranshoek receives rain throughout the year with most rain occurring in late Winter and Spring. Annual rainfall amounts to 1030 mm ranging between 64 mm and 92 mm per month. The mean annual temperature is 16.5˚C. Day temperatures peak at 24.1˚C in February and minimum temperatures recede to 8.7˚C in July.

The site is fairly flat, sloping slightly towards the east. It is located on the raised coastal platform which, at the coast, rises steeply from sea level to elevations > 100 m. The rivers are deeply incised into this coastal platform, their catchment areas being relatively small.

The site overlies quartzitic sandstones of the Nardouw Subgroup and Peninsula Formation of the upper Table Mountain Group of the Cape Supergroup (Figure 6). The Nardouw Subgroup is similar to the Peninsula Formation, but on small lithological differences it is subdivided into the Goudini, Skurweberg and Rietvlei Formations. The rocks of this Subgroup generally weather to a more brownish colour than those of the Peninsula Formation, whilst there are also more shale lenses. According to Mucina and Rutherford (2006) the area consists of acidic lithosol soils that are derived from the sandstone geology.

According to the latest national vegetation map produced as part of the National Biodiversity Assessment 2018, the study site is located in a typical fynbos environment on the Southern Cape coastal plain. The main vegetation type found in the area is classified as South Outeniqua Sandstone Fynbos (Figure 7). The fynbos is described as fragmented, with ecological corridors remaining mainly along the road reserves and main watercourses. Extensive alien infestation was also noted.

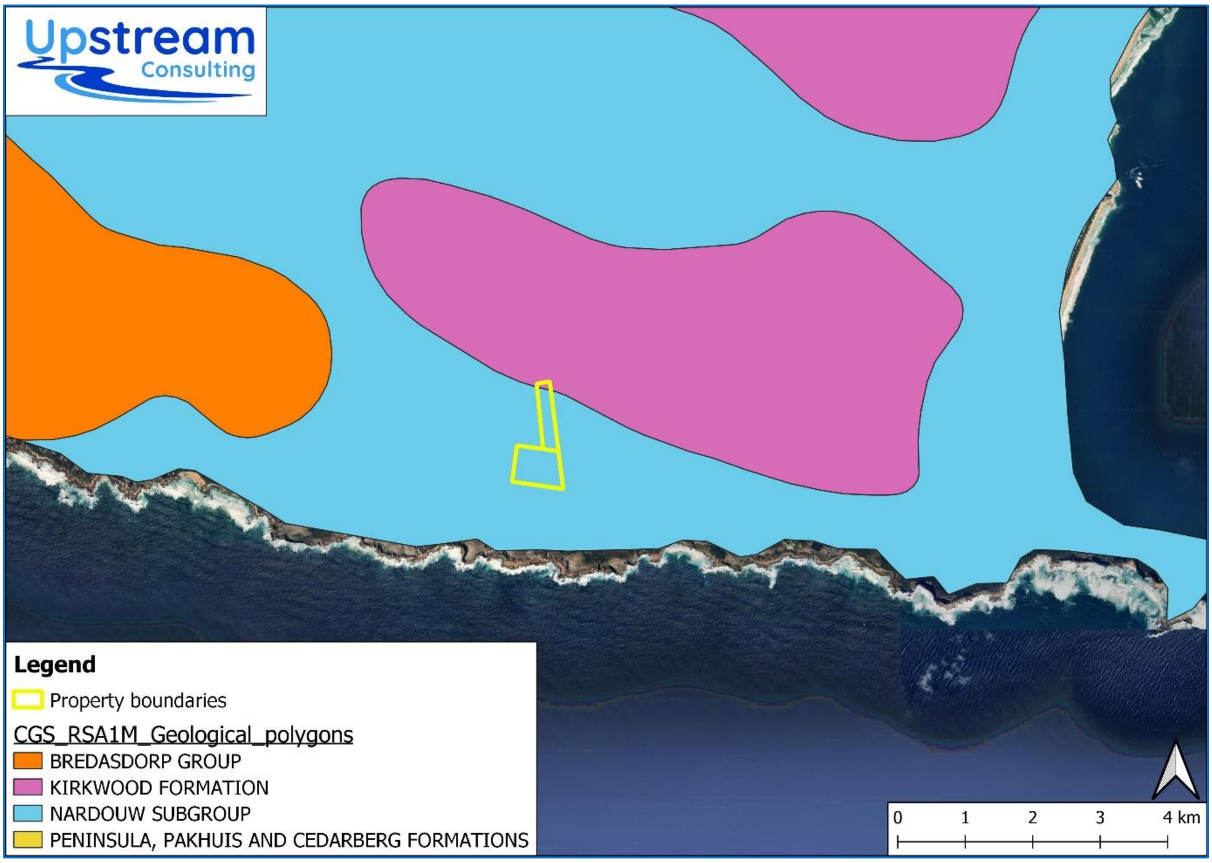

Figure 7: 1: 1 000 000 SA Geological Map of the study area

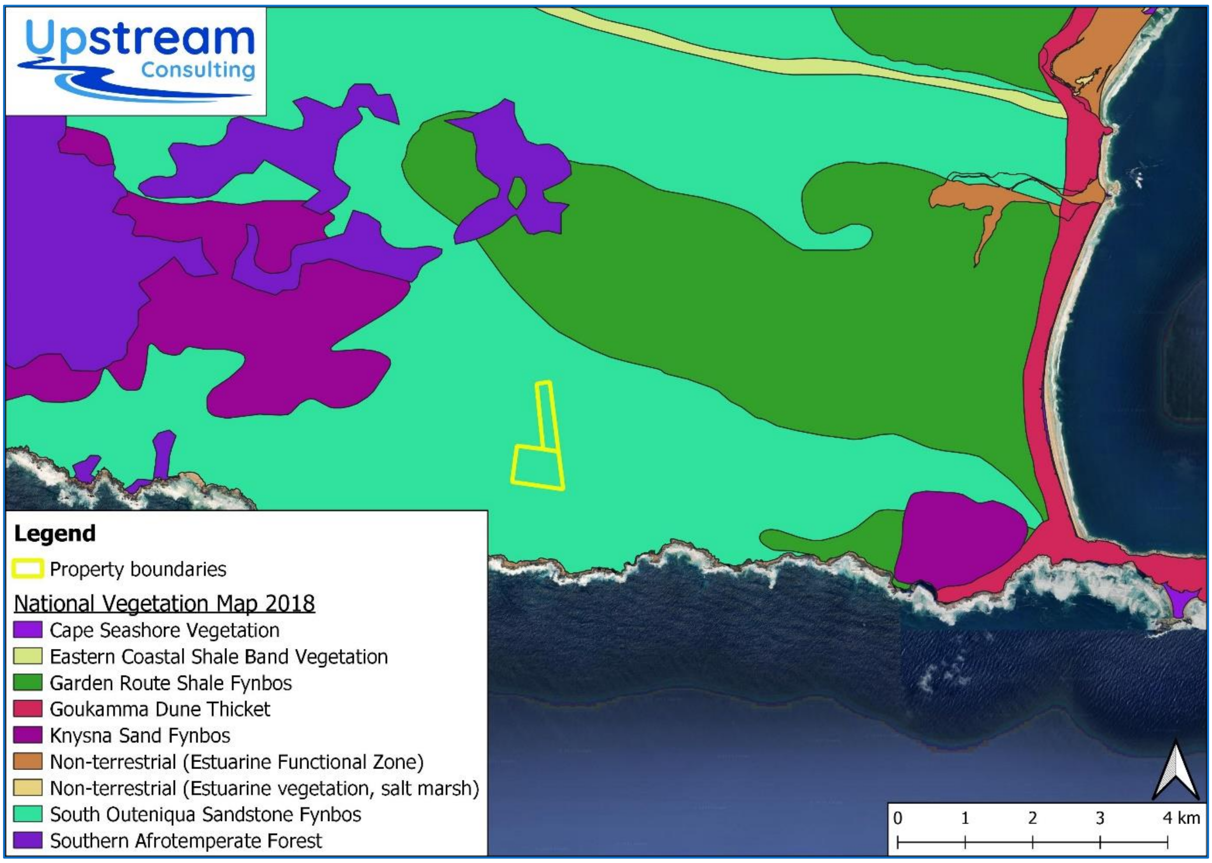

Figure 8: South African Vegetation Map 2018

6.2 DRAINAGE NETWORK

The site falls within the Southern Coastal Belt Ecoregion which is described by Kleynhans *et al.* (2005) as an area of hills and mountains with moderate to high relief and surrounding plains varying in altitude from sea level to 700 MASL. The area is situated on the flat coastal platform with small, deeply incised rivers towards the ocean.

The site is located within the DWS Quaternary Catchment K60G and falls within the Coastal Gouritz Water Management Area (Figure 8). The largest river in this catchment is the Piesang River which flows in an easternly direction to Plettenberg Bay. However, the site's small catchment drains directly south towards the Indian Ocean.

The Outeniqua Strategic Water Source Area for surface water is located to the west of the site (Figure 8). A Strategic Water Source Areas (SWSA) is where the water that is supplied is considered to be of national importance for water security. Surface water SWSAs are found in areas with high rainfall and produce most of the runoff. Groundwater SWSAs have high groundwater recharge and are located where the groundwater forms a nationally important resource. There are 22 national-level SWSAs for surface water (SWSA-sw) and 37 for groundwater (SWSA-gw). The SWSA-sw in South Africa, Lesotho and Swaziland occupy 10% of the land area and generate 50% of the mean annual runoff.

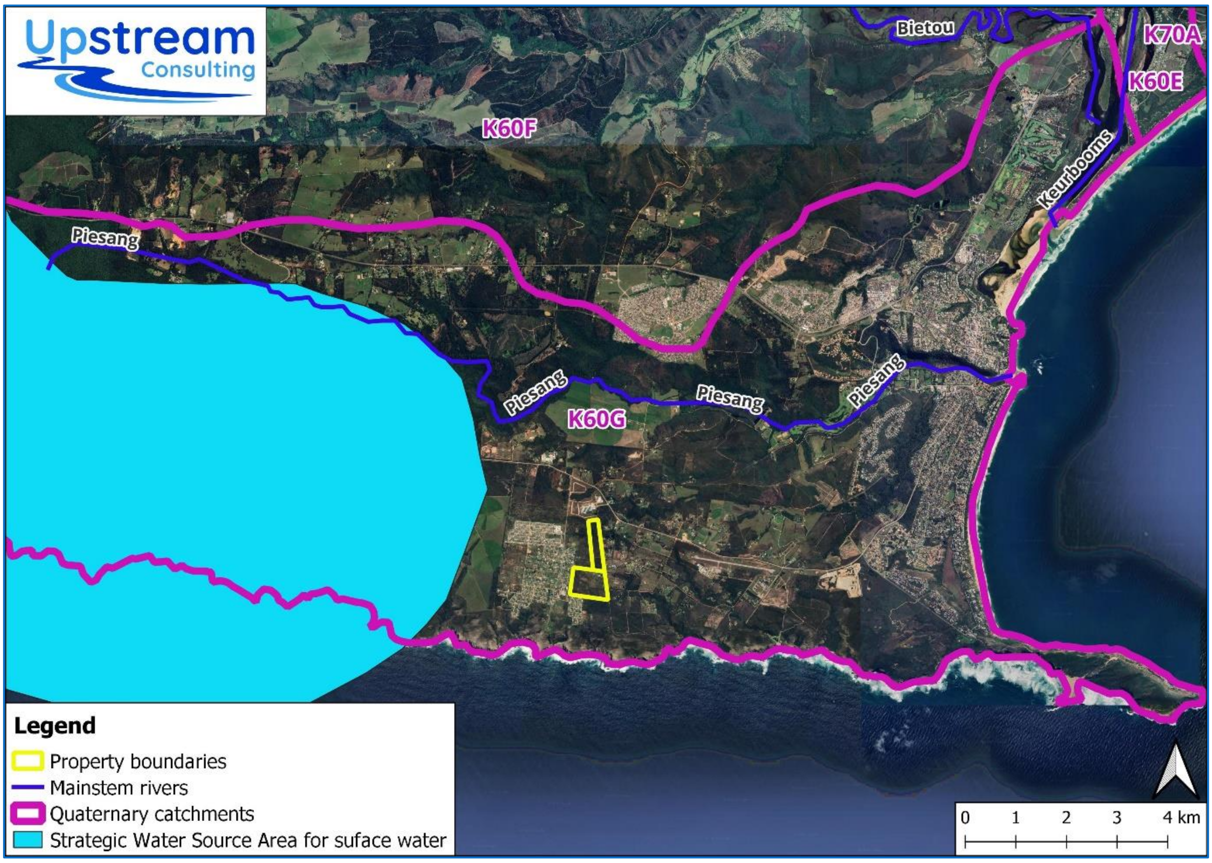

Figure 9: Map of the property in relation to quaternary catchment K60G and SWSAs

6.3 South African Inventory of Inland Aquatic Ecosystems

A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the 2018 National Biodiversity Assessment (Van Deventer *et al.* 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands, such as the National Wetland Map 5 and NBA 2018 Rivers Map.

The National Wetland Map 5 (NWM5) includes inland wetlands and estuaries, associated with river line data and many other data sets. The NWM5 shows no natural wetland ecosystems identified within the study area. The NBA 2018 Rivers Map is a GIS layer which summarises the river condition, river ecosystem types, flagship and free-flowing river information (Van Deventer *et al.* 2019). The NBA 2018 Rivers data only identifies the perennial Piesang River flowing north of the area towards Plettenberg Bay. There are also no FEPA watercourses identified by the NFEPA project.

The non-perennial systems depicted in Figure 9 are from the 1:500000 cadastral rivers data. This shows tow non-perennial drainage lines within the study area.

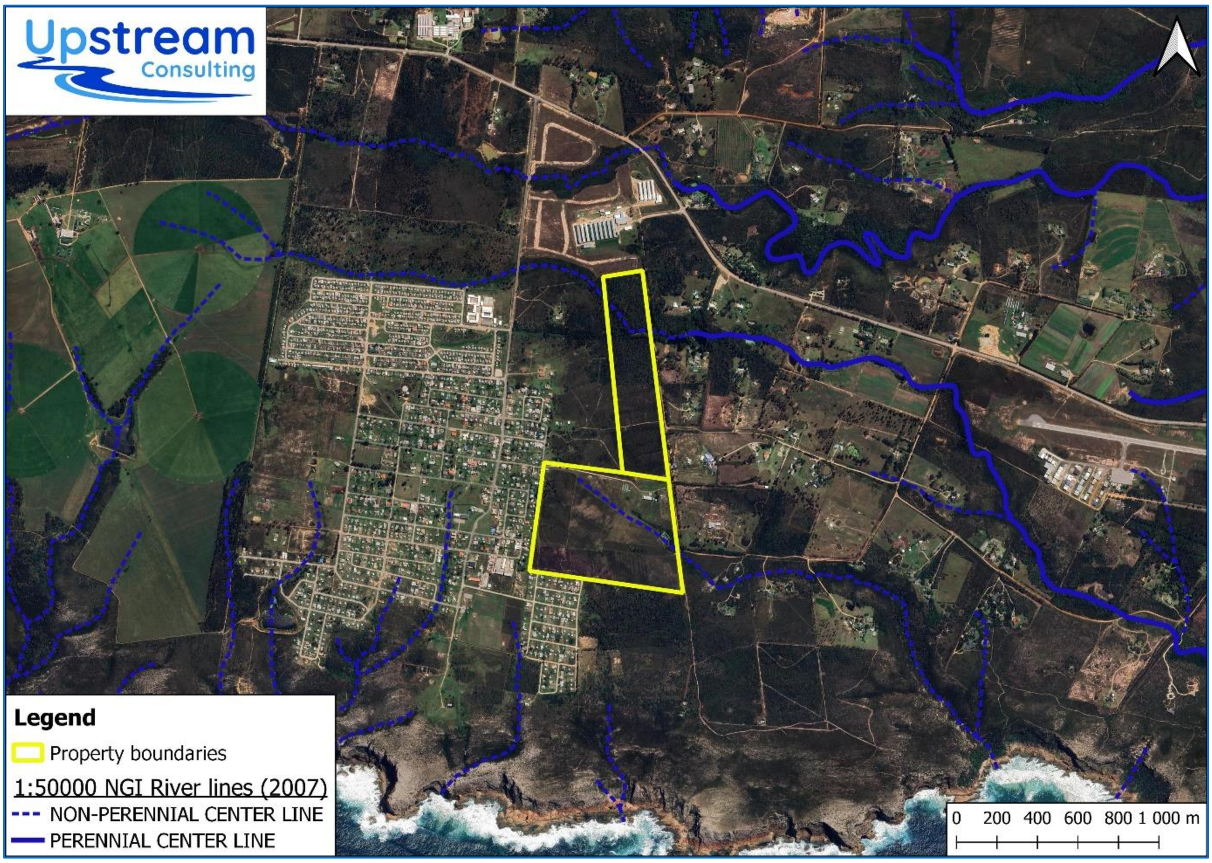

Figure 10: The project site in relation to the national river and wetland inventories (CSIR, 2018)

6.4 Conservation context

The Western Cape Biodiversity Spatial Plan (WCBSP) identifies biodiversity priority areas, CBAs and Ecological Support Areas (ESAs), which, together with Protected Areas, are important for the persistence of a viable representative sample of all ecosystem types and species, as well as the long-term ecological functioning of the landscape as a whole. The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. Critical Biodiversity Areas (CBA's) are required to meet biodiversity targets. According to the WCBSP, these areas have high biodiversity and ecological value and therefore must be kept in a natural state without further loss of habitat or species.

Figure 10 shows that there is an ESA 1 watercourse within Portion 8, and an ESA 2 river/wetland within Portion 7, of Kranshoek Farm 432.

No endemic or conservation worthy aquatic species (Listed or Protected) were observed within the site. Due to either the ephemeral flow, and/or the highly modified condition of the area, it is likely that any aquatic species are disturbance-tolerant species with a low level of biodiversity. The NFEPA project did not identify any rivers or wetlands within this study area.

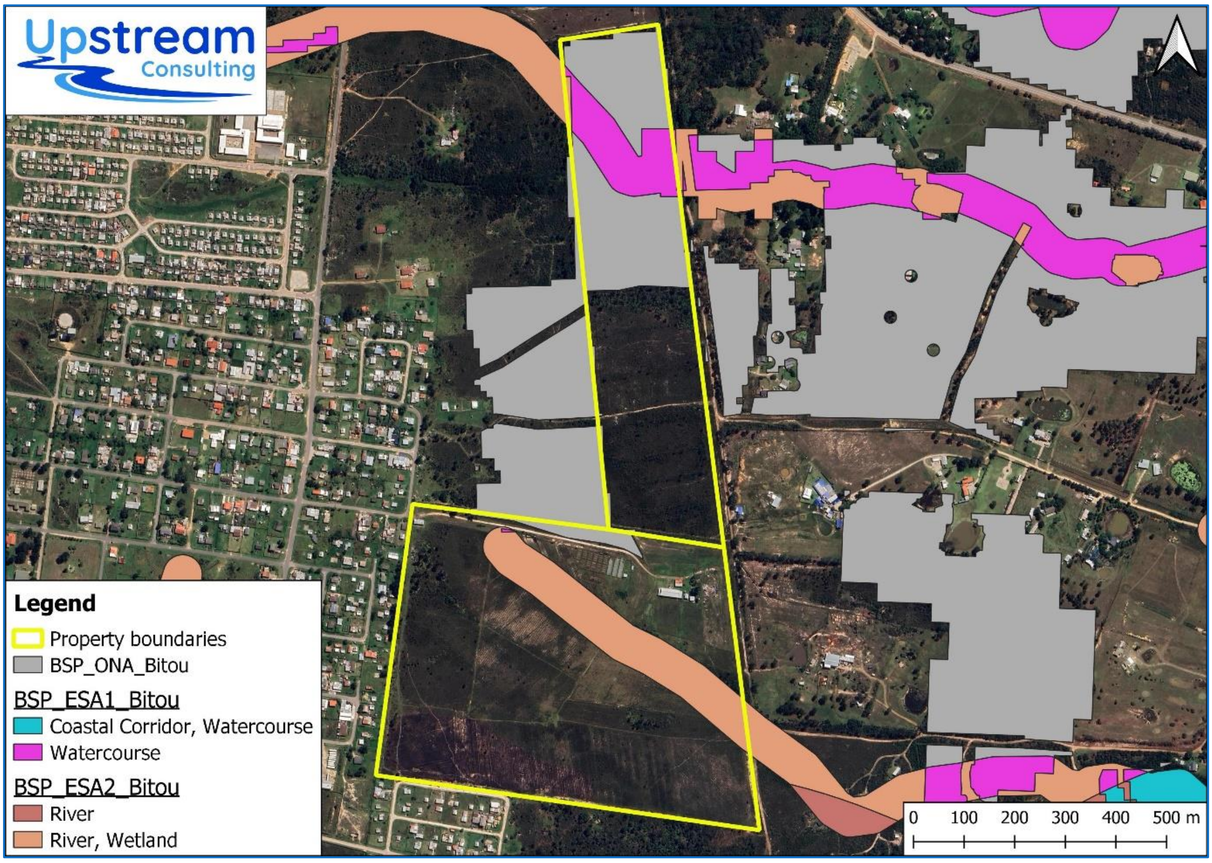

Figure 11: Map of the site in relation to aquatic priority areas identified in the WCBSP (2017)

6.5 HISTORIC CONTEXT

The site has been subjected to land use and cover changes for many decades. Portion 8 is vacant land, previously used for agricultural purposes (plantation/ grazing), which has remained undeveloped. However, it has been indirectly impacted through the edge-effects of surrounding urban development. Historic imagery shows the increasing infestation of alien invasive tree species over the past decade.

Portion 7 has been increasingly transformed by land cultivation since the 2000s (Figure 11). The entire property has either been ploughed and cultivated (Plate 1) or indirectly disturbed due to agricultural activities. By 2011 the wetland habitat on this property has been drained and dammed (Figure 12).

Plate 1: The abandoned cultivated land on Portion 7 of 432

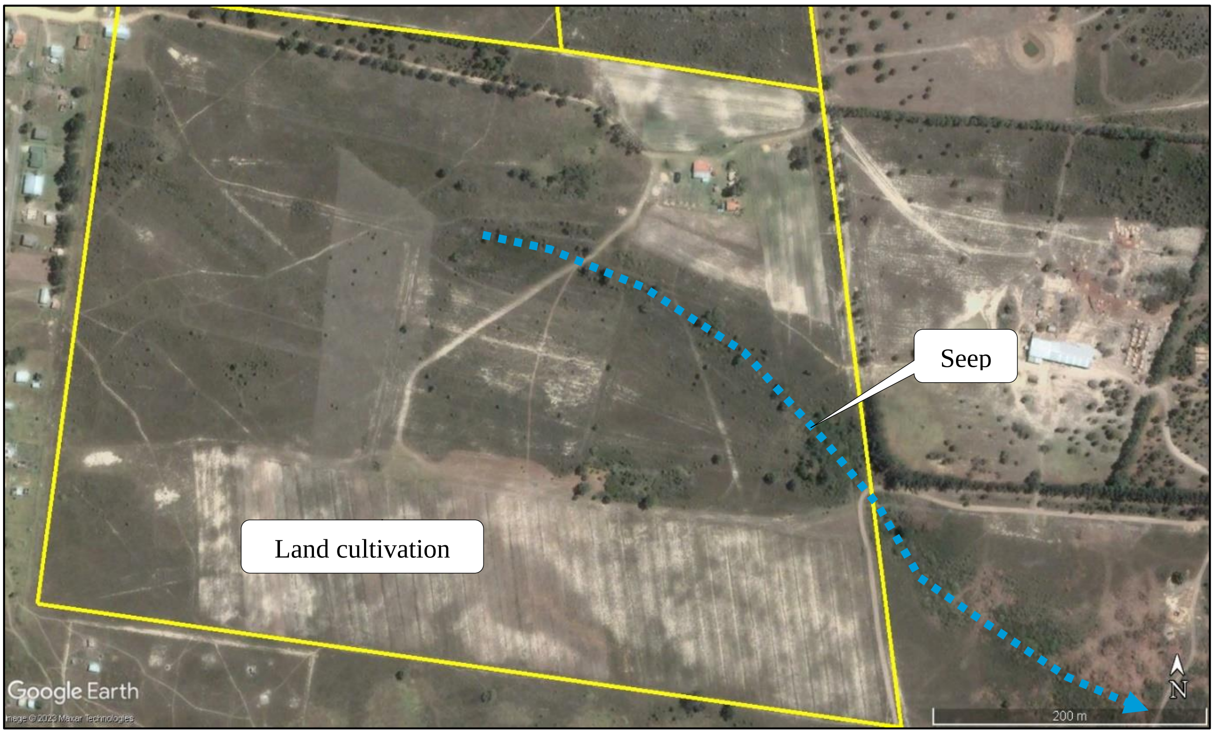

Figure 12: Historic imagery from 2004 showing the seep surrounded by cultivation on Portion 7

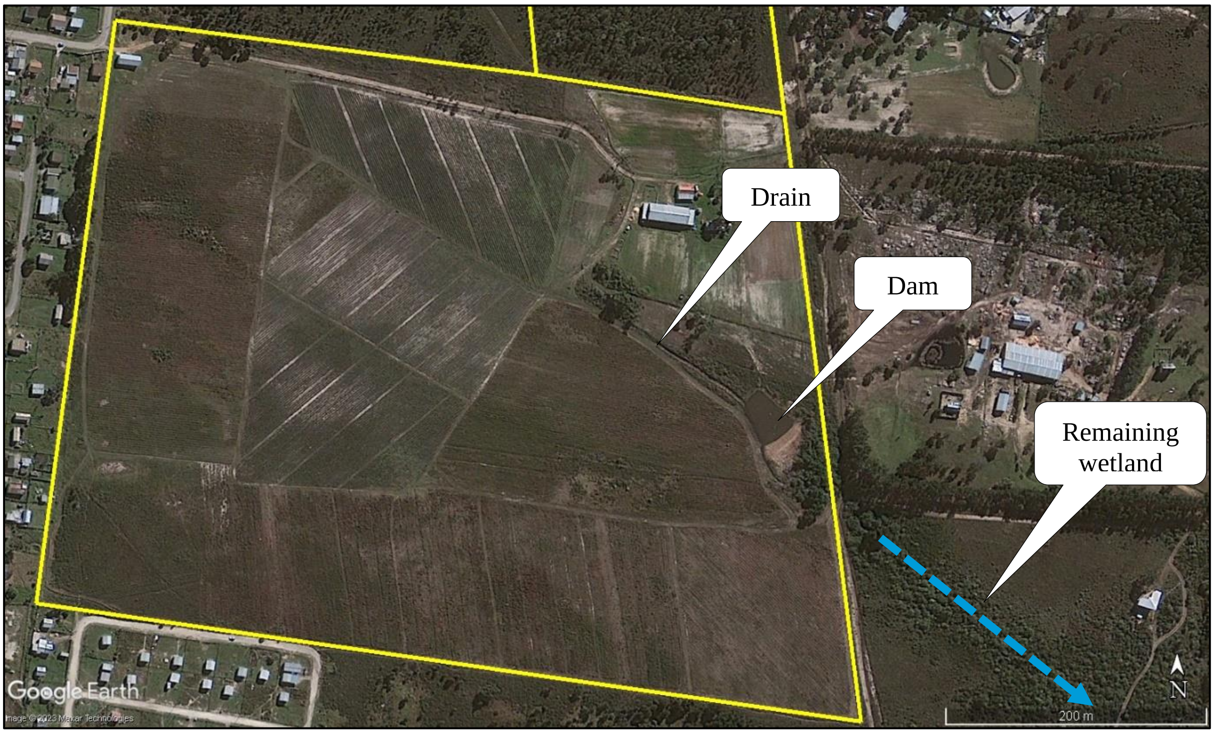

Figure 13: Historic imagery from 2011 showing the cultivated land within Portion 7, with draining and damming of wetland habitat

7 RESULTS

The aquatic habitats within a 500 metre radius of the proposed development were identified and mapped on a desktop level utilising available data. In order to identify the wetland/river types, using Kotze *et al.* (2009) and Ollis *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. Following the desktop findings, the infield site assessment (conducted on the 9th of July 2023) confirmed the location and extent of these systems. Subsequent screening provided an indication of which of these systems may potentially be impacted upon by the project. The findings are detailed in this section below.

7.1 DELINEATION AND CLASSIFICATION

Following the contextualisation of the study area with the available desktop data, a site visit was conducted to groundtruth the findings and delineate the aquatic habitat and map it within the 500m radius of the development area. The additional information collected in the field allowed for the development of an improved baseline aquatic habitat delineation map (Figure 13).

Six watercourses were identified and mapped within a 500m radius of the proposed development. Subsequent screening provided an indication of which of these systems may potentially be impacted upon by the project and required further assessment. There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is located in the landscape.

Due to the topography of the proposed site, resulting in surface runoff towards the east and southeast, it was determined that only three of the identified watercourses will be directly or indirectly affected by the development.

The three watercourses were classified by hydrogeomorphic (HGM) type, using Kotze *et al*. (2009; 2020), Grenfell *et al.* (2019), and Ollis *et al.* (2013), as wetlands. For reference purposes, the assessed HGM units were named as follows:

HGM1 – unchannelled valley bottom wetland

HGM2 – unchannelled valley bottom wetland

HGM3 – seep wetland

Figure 13 shows the watercourses in relation to the development and 500m radius study area.

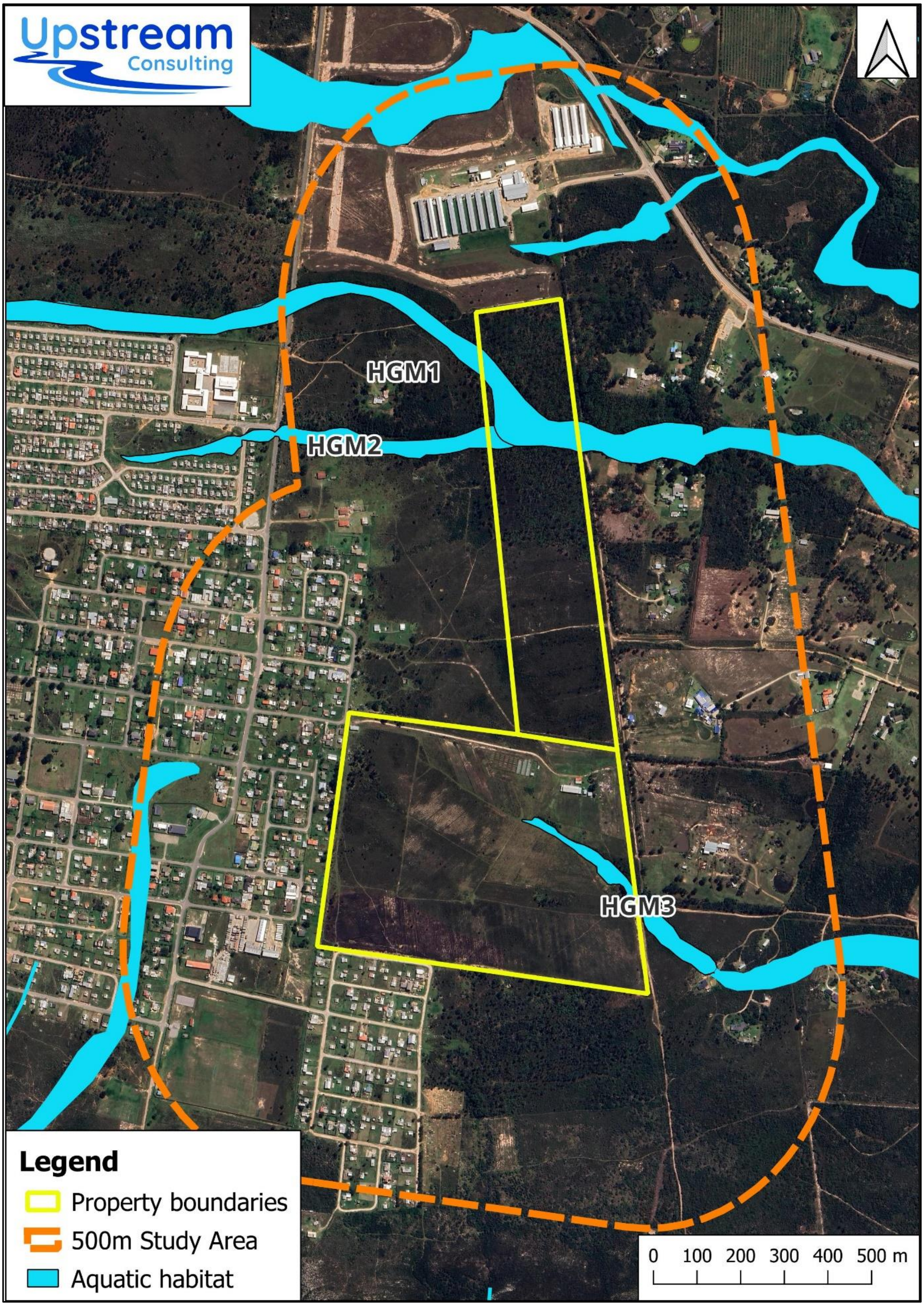

Figure 14: Map of the delineated aquatic habitat

7.2 DESCRIPTION OF AFFECTED AQUATIC HABITAT

7.2.1 Valley bottom wetlands

The HGM1 and HGM2 watercourses are discontinuous valley bottom wetland systems which flow through Portion 8 of Kranshoek 432. These wetlands are largely seasonal, with a narrow permanent zone, and temporary zones located laterally along the shallow valley side. Water inputs are derived from rainfall, and lateral and longitudinal seepage. The HGM2 wetland joins the HGM1 system on Portion 8 of Kranshoek 432. HGM2 flows through the urban area and has been subjected to significant habitat loss and modification.

The reach of the HGM1 wetland on Portions 8 & 9 of Kranshoek 432 is relatively undisturbed and in good ecological condition (Plates 2, 3, and 4). Despite some alien invasive tree infestation, the reach is geomorphologically stable and well-vegetated with relatively high species diversity. The dominant plant species identified in the wetlands were *Cyperus congestus, Carpha glomerata, Eleocharis limosa, Zantedeschia aethiopica, Phragmites australis, Typha capensis, Cliffortia odorata, Leucadendron eucalyptifolium, Chrysanthemoides monilifera, Paspalum urvillei, Commelina benghalensis, Pennisetum clandestinum, Cortaderia selloana, Eucaluptus grandis, Acacia cyclops, Acacia mearnsii,* and *Pinus pinaster.*

The wetland supplies important regulatory and supporting ecosystem services such as flood attenuation, sediment trapping, biodiversity maintenance, and pollutant assimilation (Table 2). However, towards the eastern property boundary the wetland becomes increasingly degraded and ultimately transformed by the construction of a road and dam downstream (Plates 5 and 6). Additionally, the water is severely contaminated by raw effluent when it leaves the property through the road pipe culvert. The source of the effluent was not identified can likely be attributed to a sewage pipeline break or similar waste entering the wetland. Therefore, while there are portions of HGM1 of high ecological value, the wetland becomes critically modified to the east. The significant habitat loss and high level of water contamination results in an overall 'D' (poor) Present Ecological State (PES) score (Table 3). It is recommended that the management objective for these wetlands be to improve the systems though alien plant removal and halting pollution.

Plate 2: Photograph of the upper reach of the HGM1 wetland

Plate 3: The seasonal zone of the HMG1 wetland flowing in an easterly direction through Portion 8 of 432

Plate 4: Mottled soils indicating the seasonal zone of the HGM1 wetland

Plate 5: Photograph of the HGM2 channel flowing from the urban area towards Portion 8 of 432

Plate 6: The channel of the HGM1 wetland exiting the eastern Portion 8 property boundary, through a road pipe culvert into a dam, contaminated with organic waste and invaded by alien tree species

Table 2: WET-Health summary for unchannelled valley bottom wetlands on Portion 8

PES Assessment	HYDROLOGY	GEOMORPHOLOGY	WATER QUALITY	VEGETATION
Impact Score	4,1	2,5	7,6	2,8
PES Score (%)	59%	75%	24%	72%
Ecological Category	**D**	**C**	**E**	**C**
Combined Impact Score	4,2			
Combined PES Score (%)	58%			
Combined Ecological Category	**D**			

Table 3: WET -EcoServices assessment summary for valley bottom wetlands on Portion 8

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,8	0,2	0,0	Very Low
	Stream flow regulation	2,3	0,7	1,1	Low
	Sediment trapping	1,6	0,5	0,4	Very Low
	Erosion control	0,8	1,0	0,0	Very Low

	Phosphate assimilation	1,6	1,0	0,6	Very Low
	Nitrate assimilation	1,5	1,0	0,5	Very Low
	Toxicant assimilation	1,9	2,7	1,7	Moderate
	Carbon storage	1,2	0,0	0,0	Very Low
	Biodiversity maintenance	0,6	2,0	0,1	Very Low
PROVISIONING SERVICES	Water for human use	0,0	0,7	0,0	Very Low
	Harvestable resources	0,0	0,0	0,0	Very Low
	Food for livestock	1,5	1,3	0,7	Very Low
	Cultivated foods	1,8	0,0	0,3	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,1	0,0	0,0	Very Low
	Education and Research	0,1	0,0	0,0	Very Low
	Cultural and Spiritual	2,0	0,0	0,5	Very Low

7.2.2 Seep wetland

HGM3 is a severely modified seep wetland which originates on Portion 7 of Kranshoek 432. Under natural conditions, the seep would flow in a diffuse manner towards the southeast and be vegetated with short sedges and fynbos plants. However, there is presently very little wetland habitat remaining on the property. The upper reach assessed obtained a poor ecological health score (PES= D). The habitat has been transformed for grazing and the wetland has been artificially drained and then dammed (Plates 7-9). The hydrology and geomorphology have been irreversibly changed (Table 4). Downstream the wetland remains intact but the source zone on the property is transformed. The remaining wetland should be retained to regulate stormwater flows from the site, but overall, the seep has Very Low ecological importance and functionality (Table 5).

Plate 7: The channelised source zone of the HGM3 seep on Portion 7 of 432

Plate 8: Photograph a footpath crossing the old, excavated ditch within the affected reach of HGM3 which has drained the wetland

Plate 9:The dam constructed on HGM3 on the eastern border of Portion 7 of 432

Table 4: WET-Health summary for degraded seep on Portion 7

PES Assessment	HYDROLOGY	GEOMORPHOLOGY	WATER QUALITY	VEGETATION
Impact Score	6,2	6,1	2,0	5,8
PES Score (%)	38%	40%	80%	42%
Ecological Category	**E**	**E**	**C**	**D**
Combined Impact Score	5,4			
Combined PES Score (%)	46%			
Combined Ecological Category	**D**			

Table 5: WET -EcoServices assessment summary for degraded seep

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,4	0,1	0,0	Very Low
	Stream flow regulation	3,0	1,3	2,2	Moderate
	Sediment trapping	0,5	0,5	0,0	Very Low
	Erosion control	0,8	0,7	0,0	Very Low
	Phosphate assimilation	0,4	0,5	0,0	Very Low
	Nitrate assimilation	0,4	0,7	0,0	Very Low
	Toxicant assimilation	0,4	0,3	0,0	Very Low
	Carbon storage	1,2	0,0	0,0	Very Low

	Biodiversity maintenance	0,3	0,0	0,0	Very Low
PROVISIONING SERVICES	Water for human use	1,6	0,7	0,4	Very Low
	Harvestable resources	0,0	0,0	0,0	Very Low
	Food for livestock	1,5	1,3	0,7	Very Low
	Cultivated foods	2,0	0,0	0,5	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

7.3 AQUATIC BUFFER ZONES

An aquatic impact buffer zone is defined as a zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels (Macfarlane and Bredin, 2016). Aquatic buffer zones are designed to act as barriers between human activities and sensitive water resources in order to protect them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions and have therefore been adopted as a standard measure to protect water resources and associated biodiversity.

Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane & Bredin (2017) for wetlands and rivers was used. These buffer models are based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of activity, as well as the proposed alteration of hydrological flows. Based then on the information known for the site, a 42m aquatic buffer is recommended from the edge of the wetland habitat on Portion 8 of Kranshoek 432 (HGM1 and HGM2), while a 15m buffer should be applied from the remaining aquatic habitat on Portion 7 of Kranshoek 432 (HGM3). Figure 14 below shows a map of the recommended aquatic buffer zones.

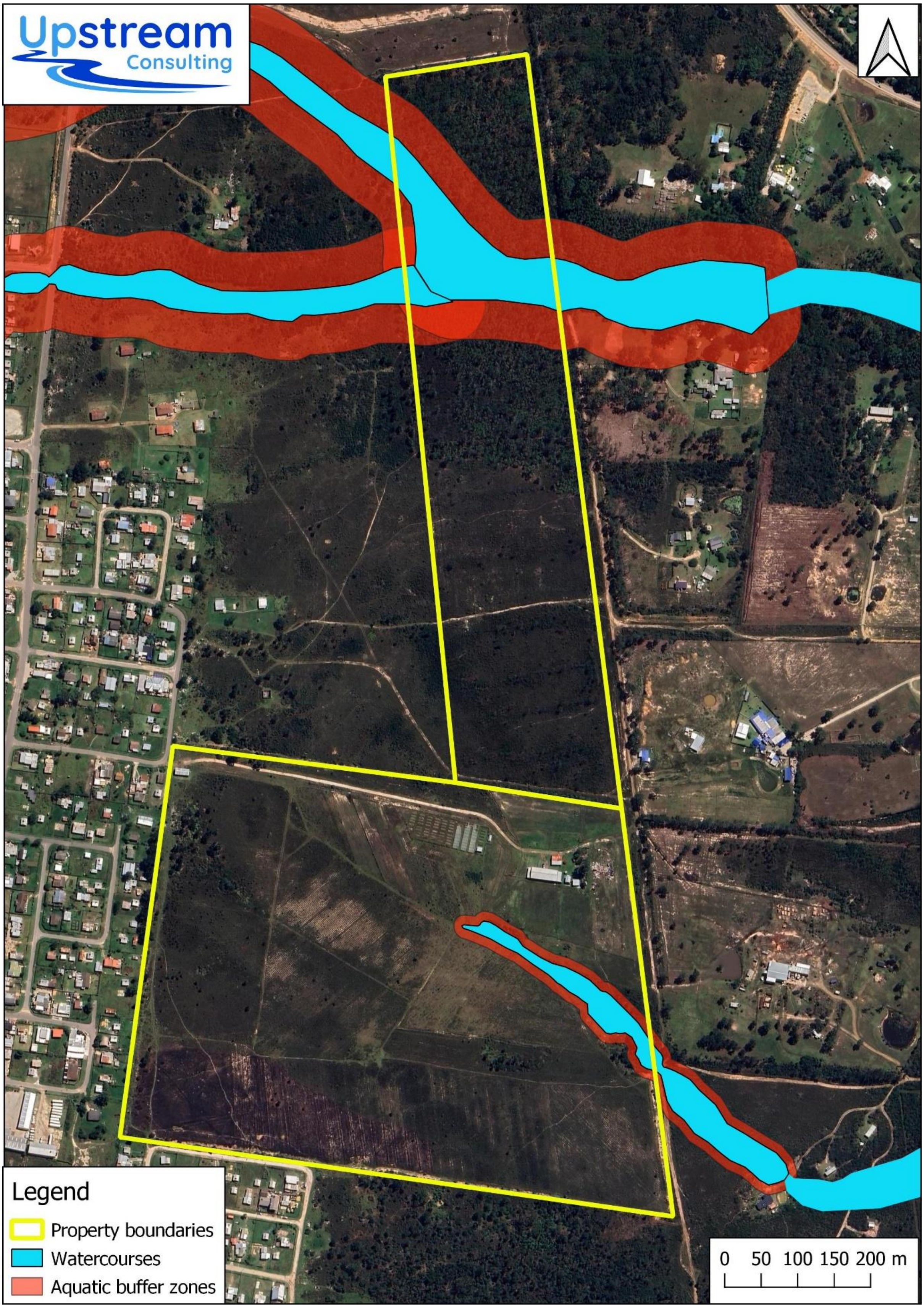

Figure 15: Map of the recommended aquatic buffer zones

8 POTENTIAL IMPACTS

Aquatic ecosystems are particularly vulnerable to human activities and these activities can often result in irreversible damage or longer term, cumulative changes. The significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed. The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined.

The direct and indirect impacts associated with the project are grouped into four encapsulating impact categories where associated or interlinked impacts are grouped. Therefore, the potential impacts assessed, including cumulative impacts, were:

- Impact 1: disturbance to aquatic habitat and biota
- Impact 2: Increased surface water runoff and stormwater flow patterns on form and function during the construction and into the operational phase, i.e. changes to the hydrological regime
- Impact 3: Changes to hydrological regime that could also lead to sedimentation and erosion, which could also occur in the operational phase
- Impact 4: Potential impact on localised surface water quality

Impacts can be managed to acceptable levels with the implementation of the buffer zones and mitigation measures. However, all development layouts encroach into the recommended buffer zone, although to differing degrees.

There are no new impacts associated with the No Go Alternative. However, the reach of wetland on Portion 8 is not being actively managed and will continue to deteriorate in health without much needed intervention.

8.1 AQUATIC HABITAT DISTURBANCE

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by earthworks, vegetation clearing, and encroachment and colonisation of habitat by invasive alien plants. Mitigation, such adhering to the buffer zones and demarcating no-go zones during construction, can prevent any direct impacts to aquatic habitat. On-going management of these buffer areas can prevent indirect impacts, otherwise, invasive alien plants will colonise any disturbed areas which are not rehabilitated and out-compete indigenous vegetation. Without mitigation, the impact can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.

In the Preferred Alternative Revision 9 layout, of December 2023, the social housing zone in the northern area of Portion 8 is planed over wetland habitat. This should be a No-Go area for development or will require wetland offsetting (as a last measure). It will result in wetland loss.

8.2 Hydrological changes

The project will result in changes in the quantity, timing and distribution of water inputs and flows within the watercourses. Hardened/artificial infrastructure will alter the natural processes of rainwater infiltration and surface runoff, promoting increased volumes and velocities of storm water runoff, which can be detrimental to the rivers receiving concentrated flows from the area. According to the SANRAL (2006), urbanisation typically increases the runoff rate by 20 -50%, compared with natural conditions. Increased volumes and velocities of storm water draining from the development and discharging into down-slope watercourses can alter the natural ecology of the systems, increasing the risk of erosion and channel incision/scouring. Stormwater management during operation will be critical in ensuring that runoff characteristics mimic the natural scenario and do not lead to increased floodpeaks and flow velocities which could lead to increased erosion and sedimentation risks that could potentially affect the downstream system. Maintenance of the recommended buffer zones can significantly reduce the level of hydrological change in the watercourses.

Alternative A has the least amount of infrastructure planned within the buffer area, having replaced the residential area for sports facilities, however, all layouts enter the buffer zone. The social housing area in Drawing 23010_PLE_12_Revision 9 is within a wetland.

8.3 Erosion and sedimentation

During construction, the project will require a large area of vegetation on the property to be cleared resulting in soil disturbance and cover changes in the catchment. Vegetation clearing and exposure of bare soils upslope of the aquatic habitat during construction will decrease the soil binding capacity and cohesion of the upslope soils and thus increase the risk of erosion and sedimentation downslope. Ineffective site stormwater management, particularly in periods of high runoff, can lead to soil erosion from confined flows. Formation of rills and gullies from increased concentrated runoff. This increase in volume and velocity of runoff increases the particle carrying capacity of the water flowing over the surface. Where soil erosion problems and bank stability concerns initiated during the construction phase are not timeously and adequately addressed, these can persist into the operational phase of the development project and continue to have a negative impact on downstream water resources in the study area.

During the operational phase, the increase in hardened surface by the development can result in further erosion/sedimentation in the watercourses downslope. Surface runoff and velocities will be increased, and flows may be concentrated by stormwater infrastructure. The project may also promote the establishment of disturbance-tolerant biota, including colonization by invasive alien species, weeds and pioneer plants within the remaining habitat. Although this impact is initiated during the construction phase it is likely to persist into the operational phase. Erosion must be controlled at stormwater outlet structures and the buffer area must be maintained.

8.4 WATER QUALITY

During construction there are a number of potential pollution inputs into the aquatic systems (such as hydrocarbons and raw cement). These pollutants alter the water quality parameters such as turbidity, nutrient levels, chemical oxygen demand and pH. These alternations impact the species composition of the systems, especially species sensitive to minor changes in these parameters. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the nearby watercourse by means of surface runoff or through dumping by construction workers.

In the operational phase, stormwater runoff from developed surfaces may include nutrients, pollutants, raw sewage, and other domestic waste. The establishment of sewage infrastructure in close proximity to watercourses always poses a long-term threat to the water quality and ecological health of aquatic ecosystems due to the relatively high likelihood that surcharge events will occur at some point in the future. A complete shift in the structure and composition of aquatic biotic communities is the result, as well as a general degradation in water resource quality that could have negative impacts to human users. Over the lifetime of the development, surcharge events and/or pipe leakages will likely occur and as a result some pollution as a result of sewage infrastructure is probable. Mitigation measures must be put in place to reduce the intensity of pollution events and ultimately reduce pollutant loads. Micro-litter such as cigarette butts may travel through certain stormwater grids and grids may not be regularly cleared.

It must be noted that the HGM1 and HGM2 wetlands are currently impacted by a large volume of raw effluent entering these systems. This will have already resulted in decreased biodiversity and species loss and needs to be immediately remedied. The halting of this contamination and prevention of future pollution will improve the integrity of the wetlands and have a positive impact.

The Alternative B layout, where the residential zone encroaches into the wetland buffer, will have a higher risk of impacting water quality, than the sports fields of Alternative A. However, any encroachment into the buffer reduces the ability for it to filter pollutants and slow runoff before entering the wetland. No sewage system layouts have been provided for assessment, which is a major limiting factor in assessment of impacts and the recommendation of mitigation measures. It must be assumed that infrastructure may encroach into the buffer zones or intersect the wetlands via pipelines.

8.5 CUMULATIVE IMPACTS

Cumulative impacts on the environment can result from broader, long-term changes and not only as a result of a single activity. They are rather from the combined effects of many activities overtime. In relation to an activity, cumulative impact means *"the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when* *added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities"* (NEMA EIA Reg GN R982 of 2014).

Watercourses are set apart from many other ecosystem types by the degree to which they integrate with and are influenced by the surrounding landscape, or catchment. The physical, chemical and biological characteristics of any watercourse are determined almost entirely by the nature of its catchment and the activities, human and natural, that take place in it (Davies and Day 1998). Widespread land use conversion at a catchment scale can dramatically alter the flow rates, water quality and sediment regimes of watercourses.

The watercourses in the Kranshoek area have all been modified to some degree by anthropogenic activities and none are in pristine ecological health. Additionally, since all the surrounding properties are developed or earmarked for development, the location of this development is logical and must be viewed within a strategic context. However, the remaining wetland habitat is providing refuge for biota, and supplies regulatory ecological services which benefit society. Therefore, no further deterioration or loss of aquatic habitat should be allowed. This management objective conflicts with the plans for increased urban development in the area, which is already resulting in negative cumulative impacts upon water resources and aquatic biodiversity. In the Revision 9 MetroPlan drawing, there is development within wetland habitat on Portion 9 which will result in unacceptable loss and high cumulative impact. Therefore, to counter these cumulative impacts it is important to include buffer zones in development layouts and improve the management of the remaining wetland habitats. Each development is responsible for accommodating sensitive ecological areas and managing stormwater runoff appropriately. Should all activities in the catchment adopt this approach then the cumulative risk is greatly reduced.

The cumulative impact of the project upon aquatic biodiversity is of medium significance but following mitigation it can be decreased to acceptable levels. Alien invasive trees removal, improved wastewater management, and adherence to a buffer area will protect aquatic habitat from the majority of potential impacts. Rehabilitation of the drainage areas as part of the development open space system could improve aquatic habitats that are currently unmanaged and degraded.

9 IMPACT ASSESSMENT

It was determined that, after mitigation, the overall impacts associated with the Preferred Layout, and the Alternative A layout are largely of Medium negative significance to aquatic biodiversity, while Alternative B (which encroaches farther into the buffer zone) will have Medium to High impact significance. There is however opportunity to improve wetland habitat should the project implement wetland rehabilitation and management.

It is important to note that the development in the wetland on Portion 9 of the farm, indicated in the December 2023 layout, has not been assessed in this report. This assessment is restricted to the development within the boundaries of Portion 7 and 8 of Kranshoek 432. Also important to note is that no services layouts have been provided for assessment, which is a limiting factor for accurate results, and has potential to pose a risk to aquatic habitat. Therefore, as a mitigation measure, the services should not be placed within the wetlands or buffer zones and no pipelines should cross the wetland. Should this mitigation measure not be adopted, and service infrastructure is planned within or near the wetlands, then the 'without mitigation' impact significance must be used. It is also assumed that the 'Open Space Zone 2' area on the Preferred layout – Revision 9 will not result in any land/ vegetation type transformation or changes in the buffer or wetland in that area.

Therefore, assuming the above and the implementation of all mitigation measures, the Preferred Layout Alternative will have the lowest impact upon aquatic biodiversity. After mitigation there are no high impacts associated with Alternative A, but the sports field in the north does pose slightly greater disturbance. The Alternative B layout assessed in the 2023 Version 2 aquatic report is unlikely to be pursued and was not re-assessed in this report. The No-Go Alternative was determined to have no new impacts upon aquatic biodiversity. Ideally, the wetlands and buffer areas should be entirely avoided and rehabilitated, to provide natural flood attenuation, pollutant filtering, erosion control, and biodiversity services. Failing this ideal scenario, a development proposal which avoids wetland habitat and incorporates rehabilitation and improved management, is deemed acceptable.

The most significant risks to aquatic biodiversity from the project are associated with sewage leakages, poor stormwater management, and increased alien plant encroachment. These impacts must be prevented with the compilation of a wetland rehabilitation and management programme (attached to the EMPr with buffer map and detailing management actions and responsible persons) and a site-specific stormwater management plan.

The mitigation of negative impacts on biodiversity and ecosystem goods and services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the specific area being affected. Mitigation requires the adoption of the precautionary principle and proactive planning that is enabled through a mitigation hierarchy. Its application is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA 2013). Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality.

Mitigation measures related to the impacts associated with the activities are intended to augment standard/generic mitigation measures included in the project-specific Environmental Management Programme (EMP). The monitoring of the activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be audited by a suitably qualified independent Environmental Control Officer with an appropriately timed audit report. Monitoring should focus on adherence to the aquatic buffer zone (No-Go area), sediment control, and sewage leaks.

9.1 IMPACT TABLES

The impact significance of the proposed project, as well as the alternatives, was determined for each potential impact, direct and indirect for each phase. Refer to impact tables below. The methodology to determine the significance ratings of the potential environmental impacts and risks associated with the alternatives was provided by Sharples Environmental Services cc as well as the impact table template for completion.

The Preferred Alternative is the site development layout compiled in December 2023 by MetroPlan (Drawing No. 23010_PLE_12_Revision 9). Alternative A is shown in the September 2023 development layout plan (MetroPlan, Drawing No 23010_Kra_12_Revision 2). The difference between the two layouts is slight, with the previous layout showing a sports field in the northern section. but housing in the mid-section being slightly farther set back. Both alternatives have the same risk level from sewage pollution as the services layouts are not yet available for assessment.

Therefore, the potential impacts for both layouts are the same, but the Preferred Alternative has a lower risk of impacting the northern wetland habitat as there is no sports facility. Refer to Tables 6 to 10 for the results of impact assessment which show that after mitigation, the development largely has a Medium negative impact significance.

Table 6: Impact 1 – Disturbance of aquatic habitat biota

PHASE:	Construction and operation		
Potential impact and risk:	Disturbance of aquatic habitat biota from clearance of vegetation, earthworks, and further invasive alien plant infestation, which can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.		
Nature of impact:	Negative		
Alternative:	**Preferred Alternative**	**Alternative A**	**No-Go**
Extent and duration of impact:	Local and long-term	Local and long-term	None
Magnitude of impact or risk:	Moderate	Moderate	
Probability of occurrence:	Probable	Highly probable	
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	
Degree to which the impact can be reversed:	Partly	Partly	
Indirect impacts:	Highly probable	Highly probable	
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation	Medium	Medium	
Degree to which the impact can be avoided:	High	Medium	
Degree to which the impact can be managed:	Medium	Low	
Degree to which the impact can be mitigated:	Can be mitigated	Partly	

Proposed mitigation:	• A construction method statement must be compiled and available on site. It must consider the buffer zone and include methods to avoid unnecessary disturbance and prevent material being washed downslope into the wetlands. • Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project. • It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas. Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use. • Where vegetation has been cleared in the buffer and open ground in the riparian area has resulted (i.e. where indigenous vegetation has been replaced by dense alien plant infestations), it is recommended that cover components be reinstated appropriately. Only indigenous species are to be considered. • It is recommended that the wetland be fenced to prevent or at least discourage encroachment by humans and livestock. • The local authority should prevent illegal dumping in this area by providing suitable waste disposal facilities where waste can be recycled and disposed of in a controlled manner. • Engage with the community to explain the reasons why the buffer and the water resources are protected. This could be targeted at learners to prevent the dumping of solid waste and other activities that threaten the watercourses and buffer zones. • The community could be involved in the monitoring. • Placement of signage near the boundary of the buffer zone should also be considered to help mark the boundary and educate the community	Duty of Care- Alien clearing and pollution control

	about the purpose and value of protecting buffer zones. Information can include a description and visual of alien invasive plant species.		
Residual impacts:	Low	Low	
Cumulative impact post mitigation:	Medium	Medium	
Significance rating of impact after mitigation	Low	Low	None

Table 7: Impact 2 – Changes to the hydrological regime

PHASE:	Construction and operation		
Potential impact and risk:	Possible increase in surface water runoff/ patterns on hydrological form and function during the construction and into the operational phase. Poor stormwater management could result in localised changes to flows (volume) that would result in form and function changes within aquatic habitat. The impact can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.		
Nature of impact:	Negative		
Alternative:	**Preferred Alternative**	**Alternative A**	**No-Go**
Extent and duration of impact:	Regional and permanent	Regional and permanent	None
Magnitude of impact or risk:	High	High	
Probability of occurrence:	Definite	Definite	
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	
Degree to which the impact can be reversed:	Barely	Barely	
Indirect impacts:	Highly probable	Highly probable	
Cumulative impact prior to mitigation:	High	High	
Significance rating of impact prior to mitigation	Medium	Medium	
Degree to which the impact can be avoided:	Low	Low	
Degree to which the impact can be managed:	Medium	Medium	
Degree to which the impact can be mitigated:	Partly	Partly	
Proposed mitigation:	• A stormwater management plan must be developed in the preconstruction phase, detailing the stormwater structures and management interventions that must be installed to manage the changes to surface water flows. • When developing a stormwater management plan for the site, it will be critical that due consideration is given to the collection and treatment of stormwater prior to discharge into the natural environment. It is therefore		Duty of Care- Alien clearing and pollution control

	recommended that the stormwater management plan be developed with appropriate ecological input and be developed based on Sustainable Drainage Systems (SUDS). The SUDS systems attempt to maintain or mimic the natural flow systems as well as prevent the wash-off of urban pollutants to receiving waters. • Soft infrastructure must be considered where practical. For example, permeable surfaces can be done via permeable concrete block pavers (such as Amorflex), brick pavers, stone chip, and gravel and may contribute to slowing surface flows (especially if maintained). Baffles in the stormwater conduits are effective. Stormwater managed by the development could be discharged into porous channels / swales ('infiltration channels or basins') running near parallel or parallel to contours within and along the edge of the development. This will provide for some filtration and removal of urban pollutants (e.g. oils and hydrocarbons), provide some attenuation by increasing the time runoff takes to reach low points, and reduce the energy of storm water flows within the stormwater system through increased roughness when compared with pipes and concrete V-drains. • The stormwater management infrastructure must be designed to ensure the runoff from the development is not highly contaminated or concentrated before entering the surrounding area. Any stormwater retention ponds or berms must be located outside of the buffer area. • The adoption of the 42m aquatic buffer zone between the development infrastructure and HGM1. • The volume and velocity of water must be reduced through discharging the surface flow at multiple locations surrounding the development. • Effective stormwater management must include effective stabilisation (gabions and Reno mattresses) of exposed soil. Contingency plans must be in place for high rainfall events which may occur during construction.	

	• If flower/plant beds are to be established adjacent to hard surfaces, then these should be designed to receive storm water from hardened surfaces and should be planted with robust indigenous species that to contribute to storm water management objectives. • Storm water should be harvested onsite from roofed surfaces thus reducing the quantity (volume) of water received by downstream water resources as surface flow. • The project will need to comply with all regulations of the National Water Act (Act 36 of 1998), including the protection of downstream users, and minimise any potential ecological impacts upon water resources.		
Residual impacts:	Medium	Medium	
Cumulative impact post mitigation:	Medium	Medium	
Significance rating of impact after mitigation	Medium	Medium	None

Table 8: Impact 3 – Sedimentation and erosion

PHASE:	Construction and operation		
Potential impact and risk:	Changes to hydrological regimes that could also lead to sedimentation and erosion, that could also occur in the operational phase. Concentrated stormwater flow paths and altered flow patterns causing increased erosion within the watercourses and sedimentation as the disturbed soils are carried by unmanaged surface runoff down slope. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for flora & fauna.		
Nature of impact:	Negative		
Alternative:	**Preferred Alternative**	**Alternative A**	**No-Go**
Extent and duration of impact:	Local and long-term	Regional and long-term	None
Magnitude of impact or risk:	High	High	
Probability of occurrence:	Probable	Highly probable	
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Significant loss	
Degree to which the impact can be reversed:	Partly	Barely	
Indirect impacts:	Probable	Highly probable	
Cumulative impact prior to mitigation:	Medium	High	
Significance rating of impact prior to mitigation	Medium	Medium	
Degree to which the impact can be avoided:	High	High	

Degree to which the impact can be managed:	High	Medium	
Degree to which the impact can be mitigated:	Can be mitigated	Partly	
Proposed mitigation:	• A stormwater management plan must be developed in the preconstruction phase, detailing the stormwater structures and management interventions that must be installed to manage the increase of surface water flows directly into any natural systems. The stormwater management infrastructure must be designed to ensure the runoff from the development is not contaminated before entering the surrounding area. The volume and velocity of water must be reduced through discharging the surface flow at multiple locations surrounding the development. Effective stormwater management must include effective stabilisation of exposed soil. • Sedimentation must be minimised with appropriate measures. Any construction causing bare slopes and surfaces to be exposed to the elements must include measures to protect against erosion using covers, silt fences, sandbags, earthen berms etc. • All stockpiles must be protected and located in flat areas where run-off will be minimised and sediment recoverable. • Construction must have contingency plans for high rainfall events during construction. Even in the operational phase, measures to contain impacts caused during high rainfall events must be planned for and available for use. • The buffer area must be maintained through alien invasive plant species removal (which is the landowner's responsibility regardless of mitigation associated with this project) and the establishment of indigenous vegetation cover to filter run-off before it enters the aquatic habitat. • Stormwater infrastructure must be inspected at least once every year (before the onset of rains) to ensure that it is working efficiently. Any evidence of erosion from this stormwater system must be		Duty of Care- Alien clearing and pollution control

	rehabilitated and the volume/velocity of the water reduced through further structures and/or energy dissipaters.		
Residual impacts:	Low	Medium	
Cumulative impact post mitigation:	Low	Medium	
Significance rating of impact after mitigation	Low	Low	None

Table 9: Impact 4 –Changes to surface water quality

PHASE:	Construction and operation		
Potential impact and risk:	There is potential for surface runoff to be contaminated and enter the watercourses, especially during flood events. During construction, earthworks will expose and mobilise earth materials, and a number of materials as well as chemicals will be imported and used on site and may end up in the surface water. In the operational phase, hydrocarbons and chemicals could potentially enter the watercourses. If not prevented, litter, and contaminants, including sand, silt, and dirt particles, will enter storm water runoff and pollute the watercourse. Micro-litter such as cigarette butts may travel through certain stormwater grids and grids may not be regularly cleared. Sewage leaks are probable and of high risk. This can result in possible deterioration in aquatic ecosystem integrity and species diversity. However, the HGM1 wetland is already highly contaminated by raw effluent.		
Nature of impact:	Negative		
Alternative:	**Preferred Alternative**	**Alternative A**	**No-Go**
Extent and duration of impact:	Regional and long-term	Regional and long-term	None
Magnitude of impact or risk:	High	High	
Probability of occurrence:	Highly probable	Highly probable	
Degree to which the impact may cause irreplaceable loss of resources:	Significant loss	Significant loss	
Degree to which the impact can be reversed:	Partly	Partly	
Indirect impacts:	Highly probable	Highly probable	
Cumulative impact prior to mitigation:	High	High	
Significance rating of impact prior to mitigation	Medium	Medium	
Degree to which the impact can be avoided:	Medium	Medium	
Degree to which the impact can be managed:	Medium	Medium	
Degree to which the impact can be mitigated:	Can be mitigated	Partly	
Proposed mitigation:	• A stormwater management plan and report must be developed for the site. • The Department of Water regional office should be notified, as soon as possible, of any significant chemical spill or leakage to the environment		Duty of Care- Alien clearing and pollution control

	where there is the potential to contaminate surface water or groundwater. • Sewage infrastructure should not encroach into the watercourses and measures must be in place to prevent wastewater from entering the environment under any circumstances. • Stormwater exit points must include a best management practice approach to trap any additional suspended solids and pollutants originating from the proposed development. Also include the placement of stormwater grates (or similar). The use of grease traps/oil separators to prevent pollutants from entering the environment from stormwater is recommended. To ensure the efficiency of these, they must be regularly maintained. • Inlet protection measures to capture solid waste and debris entrained in storm water entering the storm water management system (inlet protection devices) will be incorporated into the design of the system and could include the use of either curb inlet/inlet drain grates and/or debris baskets/bags. • It is also important to note that storm water infrastructure will likely require regular on-going maintenance in the form of silt, debris/litter clearing in order to ensure their optimal functioning.		
Residual impacts:	Medium	Medium	
Cumulative impact post mitigation:	Medium	Medium	
Significance rating of impact after mitigation	Medium	Medium	None

10 CONCLUSION

The aquatic habitats within a 500 meter radius of the proposed development were identified and mapped on a desktop level utilising available data. Following the desktop findings, a site assessment was conducted to verify the location and extent of these systems. Two wetlands were identified and delineated on Portion 8, and one degraded seep was delineated on Portion 7, of Kranshoek Farm 432. These systems were assessed in detail as HGM1, HGM2, and HGM3 for potential impacts from development.

The most significant risks to aquatic biodiversity from the project are associated with sewage leakages, poor stormwater management, and increased alien plant encroachment. These impacts must be prevented with the compilation of a wetland rehabilitation and management programme (attached to the EMPr with buffer map and detailing management actions and responsible persons) and a site-specific stormwater management plan. A 42m aquatic buffer is recommended from the edge of the wetland habitat on Portion 8 of Kranshoek 432 (HGM1 and HGM2), while a 15m buffer should be applied from the remaining aquatic habitat on Portion 7 of Kranshoek 432 (HGM3).

The development layout alternatives are similar, and both allow for the conservation of wetland habitat (depending on the services layouts), but Alternative A places more infrastructure in the northern section with the sports field than the Preferred Alternative which only has Open Space in that area. It was determined that, after mitigation, the overall impacts associated with the project layout is of Medium to Low negative significance to aquatic biodiversity. There are no new impacts associated with the No Go Alternative.

The proposed development requires a Water Use License (WUL) in terms of Chapter 4 and Section 21 (c) and (i) of the National Water Act No. 36 of 1998 and this must be secured prior to the commencement of construction.

In conclusion, from a purely aquatic perspective, there are no fatal flaws associated with development, provided all the mitigation measures are strictly adopted and no sewage infrastructure is placed within or near the wetlands.

11 REFERENCES

BROMILOW, C. 2001. Problem Plants of South Africa: a Guide to the Identification and Control of more than 300 invasive plants and other weeds. Briza Publications, Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 1999a. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2005. A Practical Field Procedure for Identification and Delineation of Wetland and Riparian areas. Edition 1, September 2005. DWAF, Pretoria.

KLEYNHANS, C.J., 1996. Index of Habitat Integrity (IHI).

KLEYNHANS, CJ, THIRION, C AND MOOLMAN, J (2005). A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Department of Water Affairs and Forestry, Pretoria, South Africa.

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S. AND COLLINS, N.B. 2009. WET-Ecoservices: A technique for rapidly assessing ecosystem services supplied by wetlands.

LAWRENCE, D.P., 2007. Impact significance determination - Designing an approach. Environmental Impact Assessment Review 27: 730 - 754.

LE MAITRE, D.C., SEYLER, H., HOLLAND, M., SMITH-ADAO, L., NEL, J.L., MAHERRY, A. AND WITTHÜSER, K. (2018) Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria.

NAIMAN, R.J., AND H. DECAMPS. 1997. The ecology of interfaces -- riparian zones. Annual Review of Ecology and Systematics 28:621-658

MUCINA, L. AND RUTHERFORD, M. C. (EDS) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

POOL-STANVLIET , R., DUFFELL-CANHAM, A., PENCE, G. AND SMART, R. (2017). The Western Cape Biodiversity Spatial Plan Handbook. Stellenbosch: Cape Nature.

ROGERS KH. 1995. Riparian Wetlands. In: Wetlands of South Africa, Cowan GI (ed). Department of Environmental Affairs and Tourism: Pretoria.

VAN GINKEL, C.E., GLEN, R.P., GORDAN-GRAY, K.D., CILLIERS, C.J., MUASYA AND VAN DEVENTER, P.P., 2011. Easy identification of some South African Wetland Plants. WRC Report No. TT 459/10

APPENDIX 1 –DETAILED METHODOLOGY

For reference the following definitions are as follows:

- **Drainage line**: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may not be present.
- **Perennial and non-perennial:** Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contains flows for short periods, such as a few hours or days in the case of drainage lines.
- **Riparian**: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).
- **Wetland**: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).
- **Water course**: as per the National Water Act means -
  (a) a river or spring;
  (b) a natural channel in which water flows regularly or intermittently;
  (c) a wetland, lake or dam into which, or from which, water flows; and
  (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks

11.1 WETLAND DELINEATION AND HGM TYPE IDENTIFICATION

Wetland delineation includes the confirmation of the occurrence of wetland and a determination of the outermost edge of the wetland. The outer boundary of wetlands was identified and delineated according to the Department of Water Affairs wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005a). Wetland indicators were used in the field delineation of the wetlands: position in landscape, vegetation and soil wetness (determined through soil sampling with a soil auger and the examining the degree of mottling).

Four specific wetland indicators were used in the detailed field delineation of wetlands, which include:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.

- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

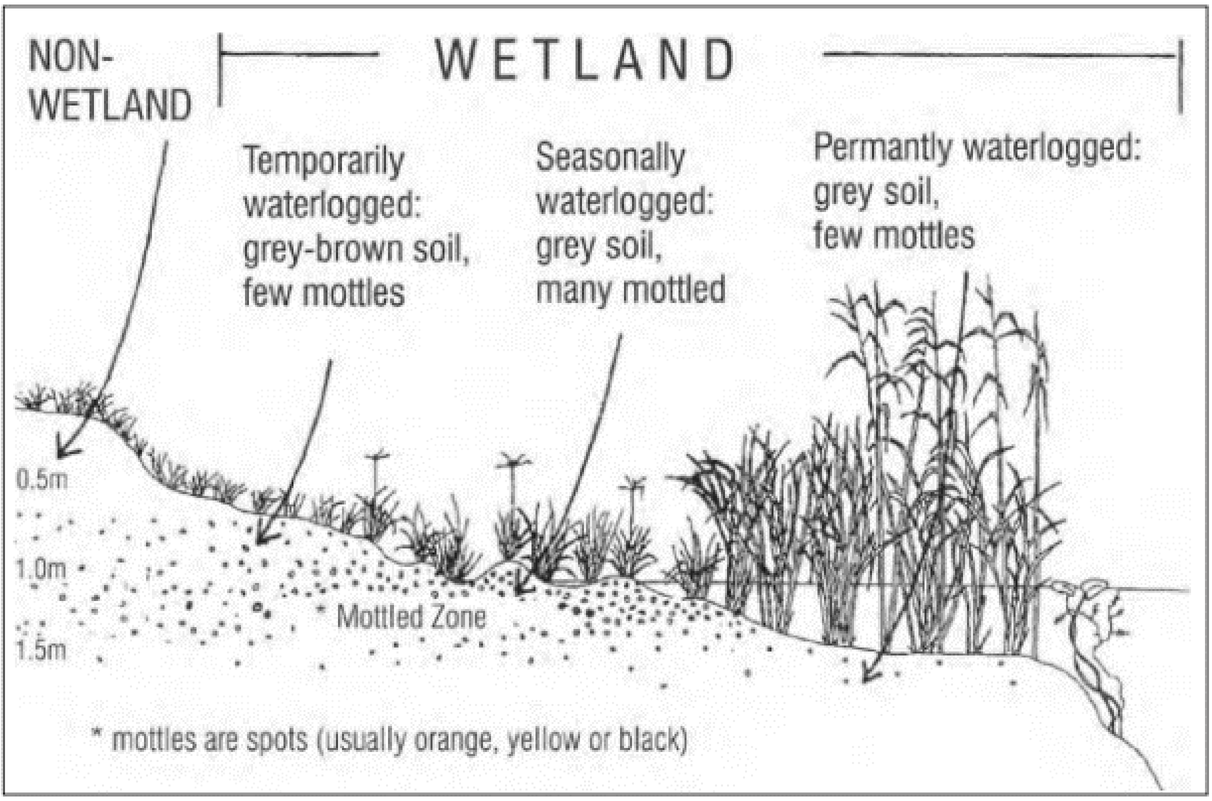

Figure A12.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained (perhaps for several centuries).

The permanent, seasonal and temporary wetness zones can be characterised to some extent by the soil wetness indicators that they display (Table A12.1a)

A12.1a: Soil Wetness Indicators in the various wetland zones

TEMPORARY ZONE	SEASONAL ZONE	PERMANENT ZONE
Minimal grey matrix (<10%)	Grey matrix (<10%)	Prominent grey matrix

Few high chroma mottles	Many low chroma mottles present	Few to no high chroma mottles
Short periods of saturation (less than three months per annum)	Significant periods of wetness (at least three months per annum)	Wetness all year round (possible sulphuric odour)

Table A12.1b: Relationship between wetness zones and vegetation types and classification of plants according to occurrence in wetlands

Vegetation	Temporary Wetness Zone	Seasonal Wetness Zone	Permanent Wetness Zone
Herbaceous	Predominantly grass species; mixture of species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Dominated by: (1) emergent plants, including reeds (*Phragmites australis*), a mixture of sedges and bulrushes (Typha capensis), usually >1m tall; or (2) floating or submerged aquatic plants.
Woody	Mixture of woody species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas.	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species, which are restricted to wetland areas. Morphological adaptations to prolonged wetness (e.g. prop roots).
Symbol	Hydric Status	Description/Occurrence	
Ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)	
Fw/F+	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas	
F	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas	
Fd/F-	Facultative dryland species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)	
D	Dryland species	Almost always grow in drylands	

In order to identify the wetland types, using Kotze *et al.* (2009) and Ollie *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. These have been defined based on the geomorphic setting of the wetland in the landscape (e.g. hillslope or valley bottom, whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated), how water flows through the wetland (diffusely or channelled) and how water exits the wetland (Figure A12.1b).

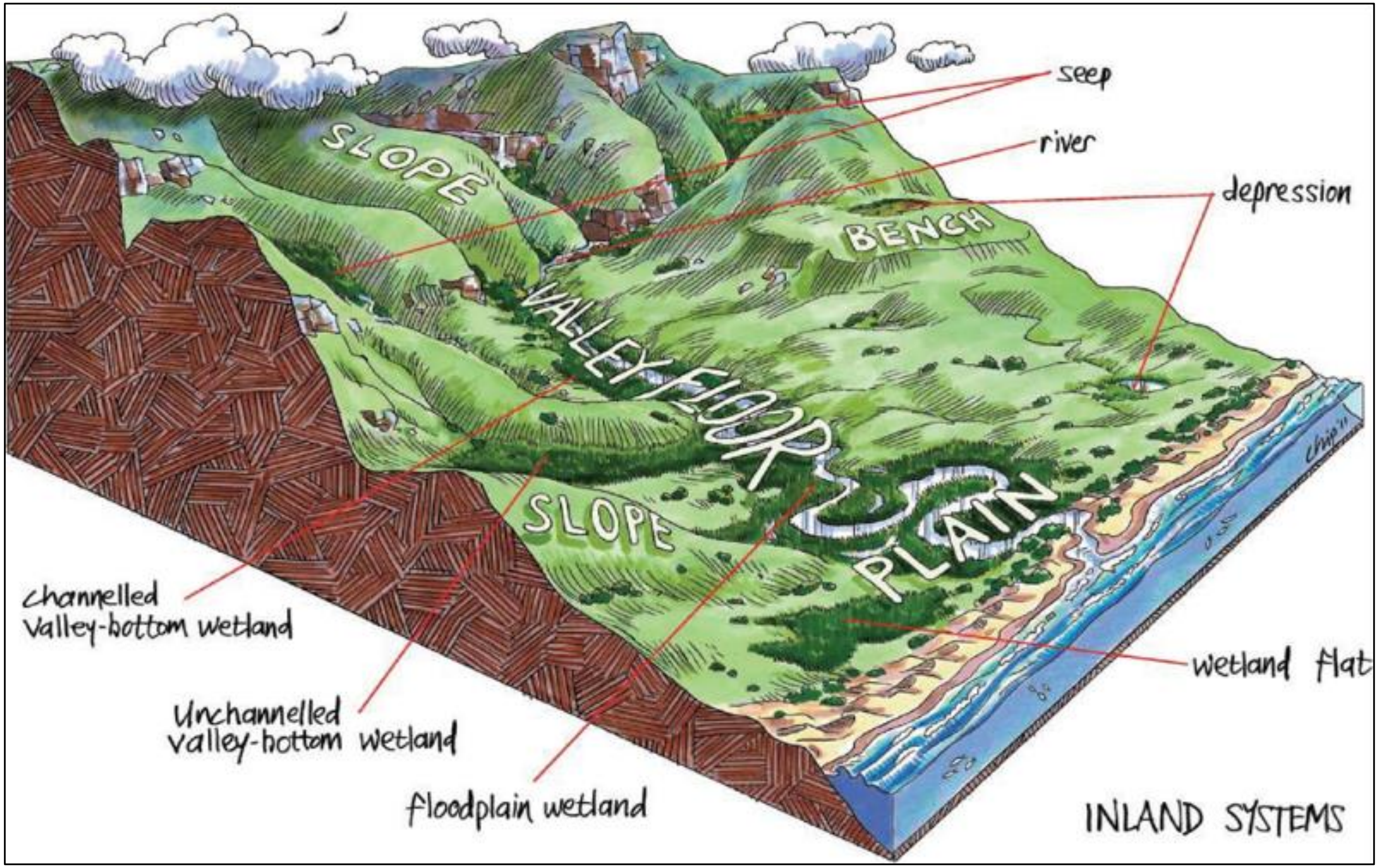

Figure A12.1b: Illustration of wetland types and their typical landscape setting (From Ollie et al. 2013)

11.2 DELINEATION OF RIPARIAN AREAS

Riparian zones are described as "the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas" i , Riparian zones can be thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (Figure 12.2a). Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel.

Like wetlands, riparian areas can be identified using a set of indicators. The indicators for riparian areas are: - **Landscape position**; - Alluvial soils and recently deposited material; - **Topography** associated with riparian areas; and - **Vegetation** associated with riparian areas. Landscape Position As discussed above, a typical landscape can be divided into 5 main units), namely the: - Crest (hilltop); - Scarp (cliff); - Midslope (often a convex slope); - Footslope (often a concave slope); and - Valley bottom. Amongst these landscape units, riparian areas are only likely to develop on the valley bottom landscape units (i.e. adjacent to the river or stream channels; along the banks comprised of the sediment deposited by the channel). Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. Whilst the presence of alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas, it can be used to confirm the topographical and vegetative indicators. Quaternary alluvial soil deposits are often indicated on geological maps, and whilst the extent of these quaternary alluvial deposits usually far exceeds the extent of the contemporary riparian zone; such indicators are useful in identifying areas of the landscape where wider riparian zones may be expected to occur.

Topography and recently deposited material associated with riparian areas The National Water Act definition of riparian zones refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised "macro-channels" which are typical of many of southern Africa's eastern seaboard rivers. Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus the likely presence of wetlands. Vegetation associated with riparian areas unlike the delineation of wetland areas, where redoxymorphic features in the soil are the primary indicator, the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs: - in species composition relative to the adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

As with the delineation approach for wetlands, the field delineation method for riparian areas focuses on two main indicators of riparian zones: - **Vegetation Indicators**, and - **Topography** of the banks of the river or stream.

Additional verification can be obtained by examining for any recently alluvial deposited material to indicate the extent of flooding and thus obtain at least a minimum riparian zone width. The following procedure should be used for delineation of riparian zones: A good rough indicator of the outer edge of the riparian areas is the edge of the macro channel bank. This is defined as the outer bank of a compound channel, and should not be confused with the active river or stream channel bank. The macro-channel is an incised feature, created by uplift of the subcontinent which caused many rivers to cut down to the underlying geology and creating a sort of "restrictive floodplain" within which one or more active channels flow. Floods seldom have any known influence outside of this incised feature. Within the macro-channel, flood benches may exist between the active channel and the top of the macro channel bank. These depositional features are often covered by alluvial deposits and may have riparian vegetation on them. Going (vertically) up the macro channel bank often represents a dramatic decrease in the frequency, duration and depth of flooding experienced, leading to a corresponding change in vegetation structure and composition.

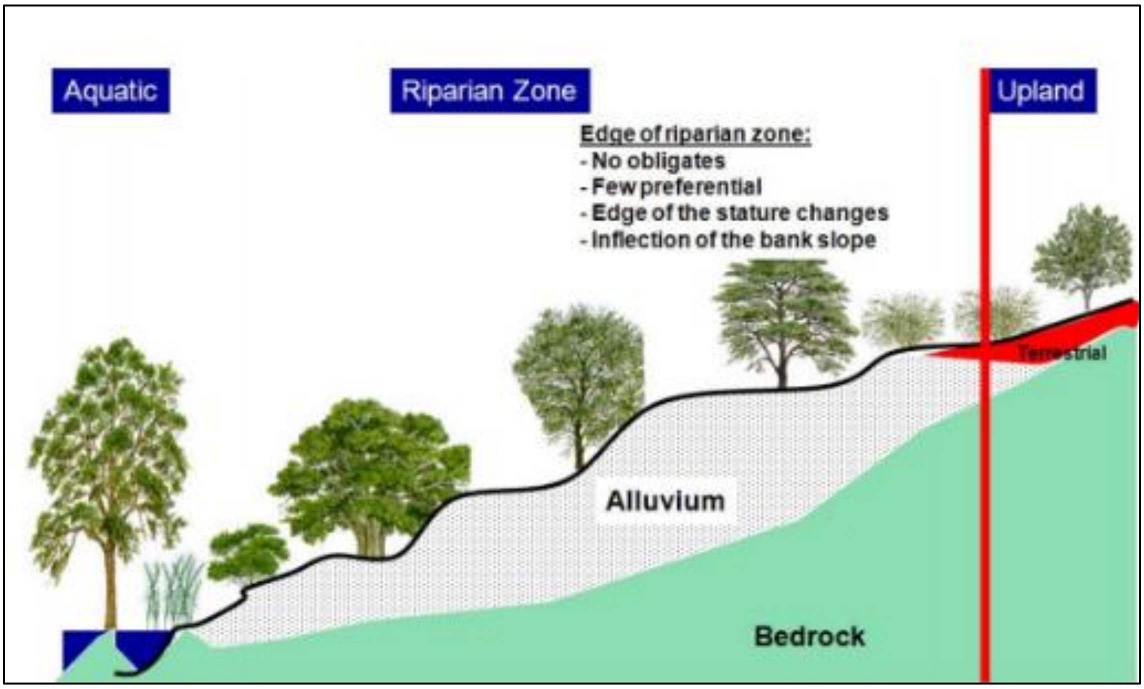

Figure A12.2a: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. Note the coincidence of the inflection (in slope) on the bank with the change in vegetation structure and composition. The edge of the riparian zone coincides with an inflection point on the bank; where there are not obligates upslope; few preferential. The boundary also coincides with the outer edge of the stature differences (DWAF 2008).

11.3 PRESENT ECOLOGICAL STATE (PES) – WETLANDS

WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology and vegetation. For the purposes of rehabilitation planning and assessment, WET-Health helps users understand the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps diagnose the cause of wetland degradation so that rehabilitation workers can design appropriate interventions that treat both the symptoms and causes of degradation. WET-Health is tailored specifically for South African conditions and has wide application, including assessing the Present Ecological State of a wetland.

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils. This module focuses on changes in water inputs as a result of changes in catchment activities and characteristics that affect water supply and its timing, as well as on modifications within the wetland that alter the water distribution and retention patterns within the wetland.
Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland. This module focuses on evaluating current geomorphic health through the presence of indicators of excessive sediment inputs and/or losses for clastic (minerogenic) and organic sediment (peat).
Vegetation is defined in this context as the vegetation structural and compositional state. This module evaluates changes in vegetation composition and structure as a consequence of current and historic onsite transformation and/or disturbance.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. The tool attempts to standardise the way that impacts are calculated and presented across each of the modules. This takes the form of assessing the spatial extent of impact of individual activities and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact (Table A12.2a).

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table A12.2b, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

Table A12.2a: Guideline for interpreting the magnitude of impact on integrity

Impact Category	Description	Score
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 – 10

Table A12.2b. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane et al., 2008).

Impact Category	Description	Range	Pes Category
None	Unmodified, natural.	0 – 0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features	6 – 7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10	F

11.4 WETLAND FUNCTIONAL IMPORTANCE (GOODS AND SERVICES)

WET-EcoServices is used to assess the goods and services that individual wetlands provide, thereby aiding informed planning and decision making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 20 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (e.g. floodplain). Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors (e.g. flow pattern through the wetland).

The overall goal of WET-EcoServices is to assist decision makers, government officials, planners, consultants and educators in undertaking quick assessments of wetlands, specifically in order to reveal the ecosystem services that they supply. This allows for more informed planning and decision making. WET-EcoServices includes the assessment of several ecosystem services (listed in Table A12.4a) - that is, the benefits provided to people by the ecosystem.

Ecosystem services supplied by wetlands	Indirect benefits	Regulating and supporting benefits		Flood attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
				Streamflow regulation	Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
				Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance**[2]			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits		Provision of water for human use	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
				Provision of harvestable resources	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
				Provision of cultivated foods	The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits		Cultural heritage	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
				Tourism and recreation	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
				Education and research	Sites of value in the wetland for education or research

Table A12.4a: Ecosystem services assessed by WET-Ecoservices

11.5 PRESENT ECOLOGICAL STATE (PES) – RIPARIAN

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

DWAF have developed a modified IHI, designed to accommodate the time constraints associated with desktop assessments or for instances where a rapid assessment of river conditions is required. The protocol does not distinguish between instream and riparian habitat and addresses six simple metrics to obtain an indication of Present Ecological State (PES). Each of the criteria are rated on a scale of 0 (close to natural) to 5 (critically modified) (Table A1.1) according to the following metrics:

- Bed modification
- Flow modification
- Inundation
- Bank condition
- Riparian zone condition
- Water quality modification

This assessment was informed by (i) a site visit where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and landuses / activities that could have a detrimental impact on river ecosystems.

Table A1.1: The rating scale for each of the various metrics in the assessment

Rating Score	Impact Class	Description
0	None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.
0.5 - 1.0	Low	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.
1.5 - 2.0	Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.
2.5 - 3.0	Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.
3.5 - 4.0	Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.

4.5 - 5.0	Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.

The six metric ratings of the HGM under assessment are then averaged, resulting in one value. This value determines the Habitat Integrity PES category for the HGM (Table A1.2).

Table A1.2: The habitat integrity PES categories

Habitat Integrity PES Category	Description
A: Natural	Unmodified, natural.
B: Good	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C: Fair	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D: Poor	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E: Seriously modified	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F: Critically modified	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

11.6 ECOLOGICAL IMPORTANCE & SENSITIVITY – RIPARIAN

The ecological importance of a wetland/river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; Resh et al., 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity (Table A1.3).

The scores assigned to the criteria in Table A1.3 were used to rate the overall EIS of each mapped unit according to Table A1.4, below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane et al., 2008).

Table A1.3: Components considered for the assessment of the ecological importance and sensitivity of a riparian system. An example of the scoring has also been provided.

Ecological Importance and Sensitivity assessment (Rivers)		
Determinants		Score (0-4)
BIOTA (RIPARIAN & INSTREAM)	Rare & endangered (range: 4=very high - 0 = none)	0,5
	Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	0,0
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	0,5
	Species/taxon richness (range: 4=very high - 1=low/marginal)	1,5
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	1,0
	Refugia (4=Very high - 1=marginal/low)	1,5
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	1,0
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	1,0
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1,0
	Importance of conservation & natural areas (range, 4=very high - 0=very low)	2
MEDIAN OF DETERMINANTS		1,00
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		LOW, EC=D

Table A1.4: The ratings associated with the assessment of the EIA for riparian areas

Rating	Explanation
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

APPENDIX 2- SPECIALIST CV

CURRICULUM VITAE

Debra Jane Fordham

Cell: 0724448243
Email: debrajanefordham@gmail.com
Date of birth: 26th August 1987
Country of origin: South Africa
ID Number: 8708260094081

Professional profile

Debbie is a registered ecologist (119102), with over 8 years of working experience, largely specialising in aquatic ecology. She has authored over 80 reports and applications and she constantly contributes to the scientific and local community. Most of her projects involve (as a minimum) in-depth wetland and river field delineation (including soil investigations via augering, vegetation identification, and classifying the hydrological characteristics), laboratory analysis (such as water quality and sediment analysis), classification, characterisation, ecological health and ecosystem functioning assessments (using the latest available tools), as well as impact rating, buffer determinations, mitigation recommendations and detailed rehabilitation plans. She is highly proficient using GIS software to incorporate accurate spatial analysis and visual aids (No Go Area maps etc.) into her reports.

Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by Prionium serratum in the Western Cape. She is a member of scientific organisations such as the Society of Wetland Scientists (SWS), the South African Wetland Society (SAWS), the Southern African Association of Geomorphologists (SAAG), and the International Association for Impact Assessment (IAIAsa). Debbie is registered with SACNASP in the field of Ecological Science (Reg Number: 119102).

Tertiary Education

- M.Sc. Environmental Science (Rhodes University):

  Master of Science thesis entitled: The geomorphic origin, evolution and collapse of a peatland dominated by Prionium serratum: a case study of the Tierkloof Wetland, Western Cape.
- BA Hons. Environmental Science (Rhodes University):

  Honours dissertation: The status and use of Aloe ferox. Mill in the Grahamstown commonage, South Africa.

  Courses: Wetland Ecology, Environmental Water Quality /Toxicology, Biodiversity, Non-Timber Forest Products (NTFPs) and Rural Livelihoods, Environmental Impact Assessment (EIA), Statistics
- BA - Environmental Science and Geography (Rhodes University)

Work Experience:

- Ecological specialist (2022/03/01 – present)
- Sharples Environmental Services cc (2016/08/10 – 2022/03/01)

Position: Aquatic Ecologist and WULA Manager

- KSEMS Environmental Consulting (2015/08/10 - 2016/07/31)

Position: Wetland specialist

- AGES EC (Pty) Ltd (2014/10/01 – 2015/08/10)

Position: Aquatic Ecologist and WULA Manager

- Environmental Impact Management Services (2014/02/04-2014/02/07)

Position: Environmental consultant

- Rhodes University Alumni Relations (2010/04/01 – 2010/12/17)

APPENDIX 3 - SITE SENSITIVITY VERIFICATION REPORT

Site verification report – Aquatic Ecology

Government Notice No. 645, dated 10 May 2019, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a project footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

- Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;
- Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;

Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This report has been produced specifically to consider the aquatic ecology theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the Scoping and EIA Reports produced for the projects.

Site sensitivity based on the aquatic biodiversity theme included in the Screening Tool and specialist assessment.

Based on the DFFE Screening Tool, there are areas of Very High Aquatic Biodiversity sensitivity.

The site verification specialist findings were informed by a site visit undertaken in 2017 and more recently in July 2023. This information was then compared to current wetland inventories, 1: 50 000 topocadastral surveys mapping of the site. A baseline map was then developed (Figure 1).

The photographs within Photo Plates 1 and 2 below show the aquatic features present on site.

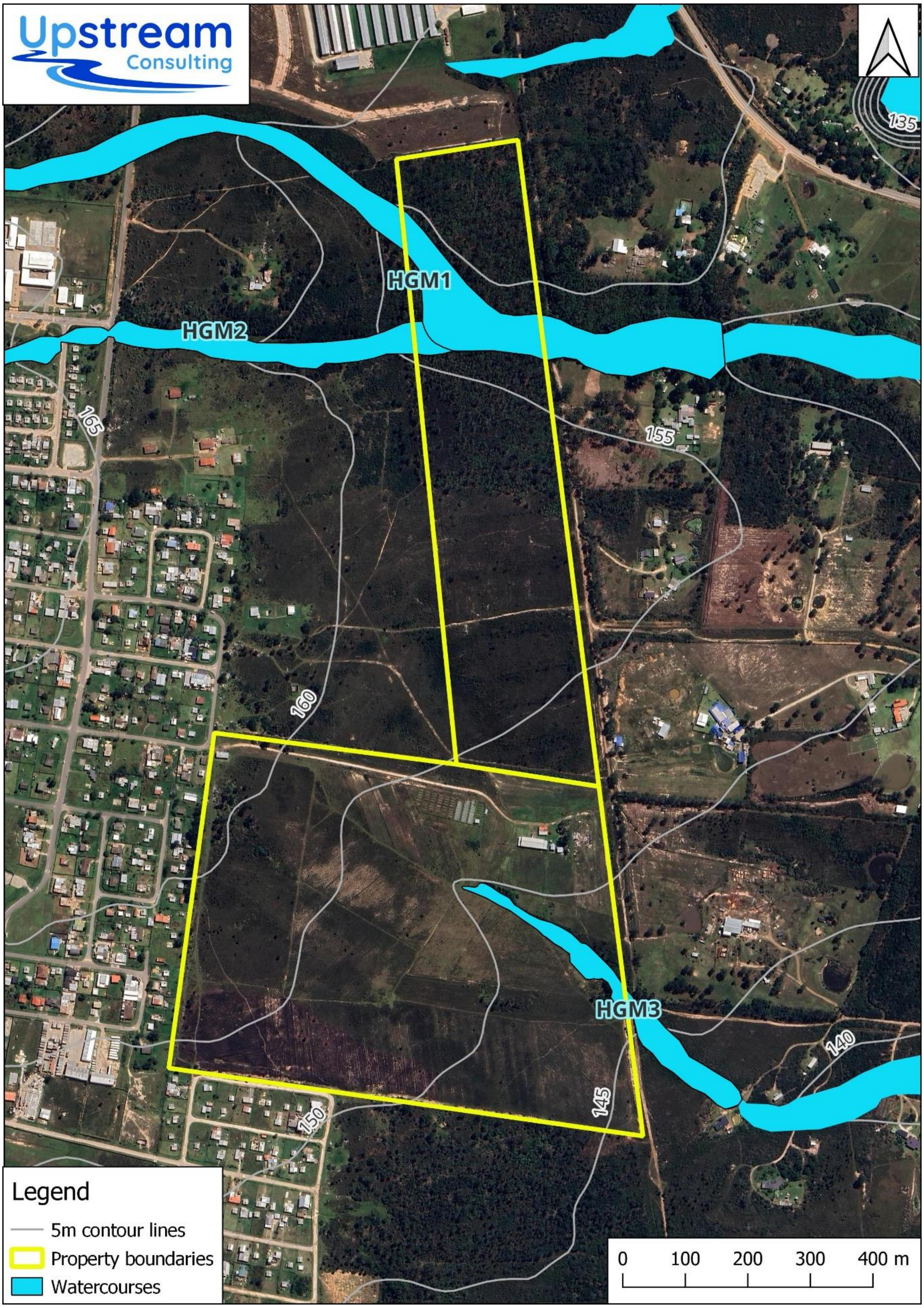

Figure 1: Delineated aquatic habitat within the study area

Plate 1: A photograph of a watercourse flowing through Portion 8 of Kranshoek 432

Plate 2: A photograph of the channelled watercourse and dam on Portion 7 of Kranshoek 432 with arrow showing direction of flow

Motivation of the outcomes of the sensitivity map and key conclusions:

In conclusion, the DFFE Screening Tool resulted in Very High sensitivity ratings within the site footprint, and surrounding area, due to the ESA 1, FEPA subcatchment and SWSA. Following site verification, this Very High sensitivity rating is confirmed. However, it was found that the site is not sensitive from a FEPA nor SWSA perspective, but rather because of the wetlands occurring on site.

It is recommended that a full Aquatic Biodiversity Impact Assessment is undertaken for the project.

The environmental sensitivity input received from the aquatic ecology specialist will be taken forward and considered within the formal EA process and the impact to these areas assessed.