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FRESHWATER HABITAT IMPACT ASSESSMENT

for the proposed

DEVELOPMENT OF HEROLDS BAY COUNTRY ESTATE ON A PORTION OF PORTION 7 OF FARM BUFFELSFONTEIN NO. 204, HEROLDS BAY, WESTERN CAPE

PREPARED FOR: Herolds Bay Country Estate
Contact Person: Mr Jacques Cronje
Email: jacques@gfaholdings.co.za

PREPARED BY: Sharples Environmental Services cc
Contact Person: Debbie Bekker
Email: debbie@sescc.net

DATE: 19 March 2019

DECLARATION OF INDEPENDENCE

Independent Specialist Consultant

I, Debbie Bekker, declare that I:

- Act as an independent specialist consultant, in this application, in the field of wetland and riparian ecology;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the amended Environmental Impact Assessment Regulations, 2014;
- Have, and will have, no vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the amended Environmental Impact Assessment Regulations, 2014; and
- Will provide the competent authority with access to all the information at my disposal regarding the application, whether such information is favourable to the applicant or not.

The following report has been prepared:

- As per the requirements of Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 326 Government Gazette, 7 April 2017.
- In accordance with Section 13: General Requirements for Environmental Assessment Practitioners (EAPs) and Specialists as well as per Appendix 6 of GNR 982 - Environmental Impact Assessment 2014 Regulations and the National Environmental Management Act, 1998.
- With consideration to Cape Nature's standard requirements for biodiversity assessments.
- In accordance with DEA&DP's Guideline on Involving biodiversity specialists in the EIA process
- Independently of influence or prejudice by any parties.

Report citation:
Sharples Environmental Services cc, 2019. Freshwater Habitat Impact Assessment for the proposed development of a portion of portion 7 of farm Buffelsfontein No.204, Herolds Bay, Western Cape

PROJECT TEAM

The authors of this report are in agreeance with the 'Declaration of Independence'.

SPECIALIST	QUALIFICATIONS	DETAILS
DEBBIE BEKKER M.SC	M.Sc - Environmental Science BA (Hons) - Environmental Science BA - Environmental Science and Geography	Debbie is a qualified aquatic ecologist and environmental scientist. Debbie holds a BA (Environmental Science and Geography), BA (Hons) and M.Sc in Environmental Science from Rhodes University. She was awarded her Master of Science degree, by thesis, in Wetland Science, entitled: The origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape. She has specialised in aquatic habitat assessment and has produced numerous aquatic habitat impact assessment reports. She is well established in her specialist field and has worked in various provinces within South Africa.
MARITA BURGER BSC (HONS)	BSc (Hons) – Environmental Science BSc - Environmental and Biological Science	Marita is an environmental assessment practitioner. She holds a BSc in Environmental and Biological Sciences and a BSc Hons in Environmental Science. Her interests currently lie in the water use license application (WULA) process under the National Water Act (1998).

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1 INTRODUCTION

Sharples Environmental Services cc (SES) has been appointed by Mr Cronje to conduct a Freshwater Specialist Impact Assessment for proposed development on Portion 7 of the farm Buffelsfontein No.204, Herolds Bay, Western Cape.

1.1 Background

It is proposed to develop on a part of portion 7 of the farm Buffelsfontein which is located directly north of the coastal town of Herolds Bay. The development will have a mixed-use component which entails combining residential, recreational and agricultural land uses. It is proposed that the development will include 102 single residential erven, 68 group housing units, a filling station with convenience shop and an ancillary neighbourhood centre with commercial and office space.

Two alternative layouts have been proposed. Alternative A has been described above and is included on Page 7. This entails many residential units and stretches from the eastern and southern boundary to the dam. Alternative B (Page 8) will have fewer residential units and will be further away from the dam. This option will include the development of the filling station and convenience shop, but on a smaller area with no space for the neighbourhood centre. Alternative B is indicated as Alternative A on the layout itself. This is from earlier planning and can be ignored for the purpose of this report.

The preliminary engineering services design provides some information on services related to freshwater. It was calculated that the Average Annual Daily Demand (AADD) would be 127 kl/day. The site would get its potable water from the municipality. For this purpose, an additional 160mm bulk water line needs to be connected to the existing 200mm municipal water line along the Oubaai Main Road. The George Municipality has confirmed that bulk water for the development is available. Average Dry Weather Flow (ADWF) to be created by the development is calculated as approximately 114 kl/day.

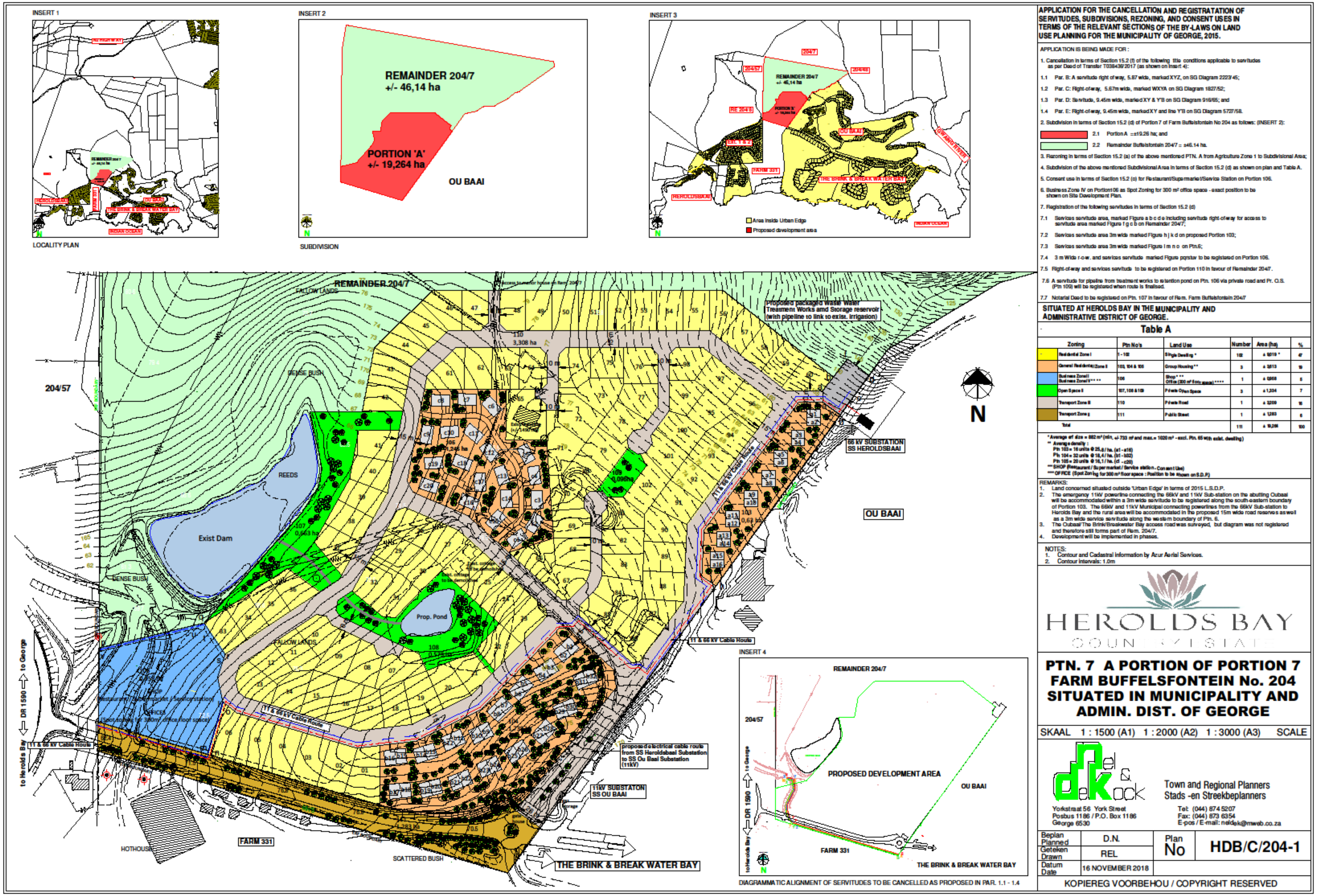
However, sewage created by the development cannot be accommodated by the Herolds Bay Waste Water Treatment Works (WWTW). Therefore, it is proposed to construct a package plant on the north eastern edge of the development. It will have a preliminary settling tank and a secondary BIOROCK trickling filter which will result in clear and odourless effluent which can be used for irrigation. In the primary settling tank, the sludge will settle and digest at the bottom of the tank and the scum will develop on the surface. The effluent in the middle will then be solid free and will move through a brush filter into the secondary system. The brush filter retains suspended solids and fats which enables better quality treatment. The BIOROCK trickling filter has layers of different required bacteria for a complete treatment process. Air is introduced by a draft aeration system. The air flows freely through the BIOROCK filter, providing oxygen to the aerobic bacteria to breathe and feed on the waste in the effluent. The plant has low operational and maintenance costs as it requires no electricity for the treatment process. The quality of the raw sewage and treated effluent will be monitored monthly by taking samples and sending it for analysis.

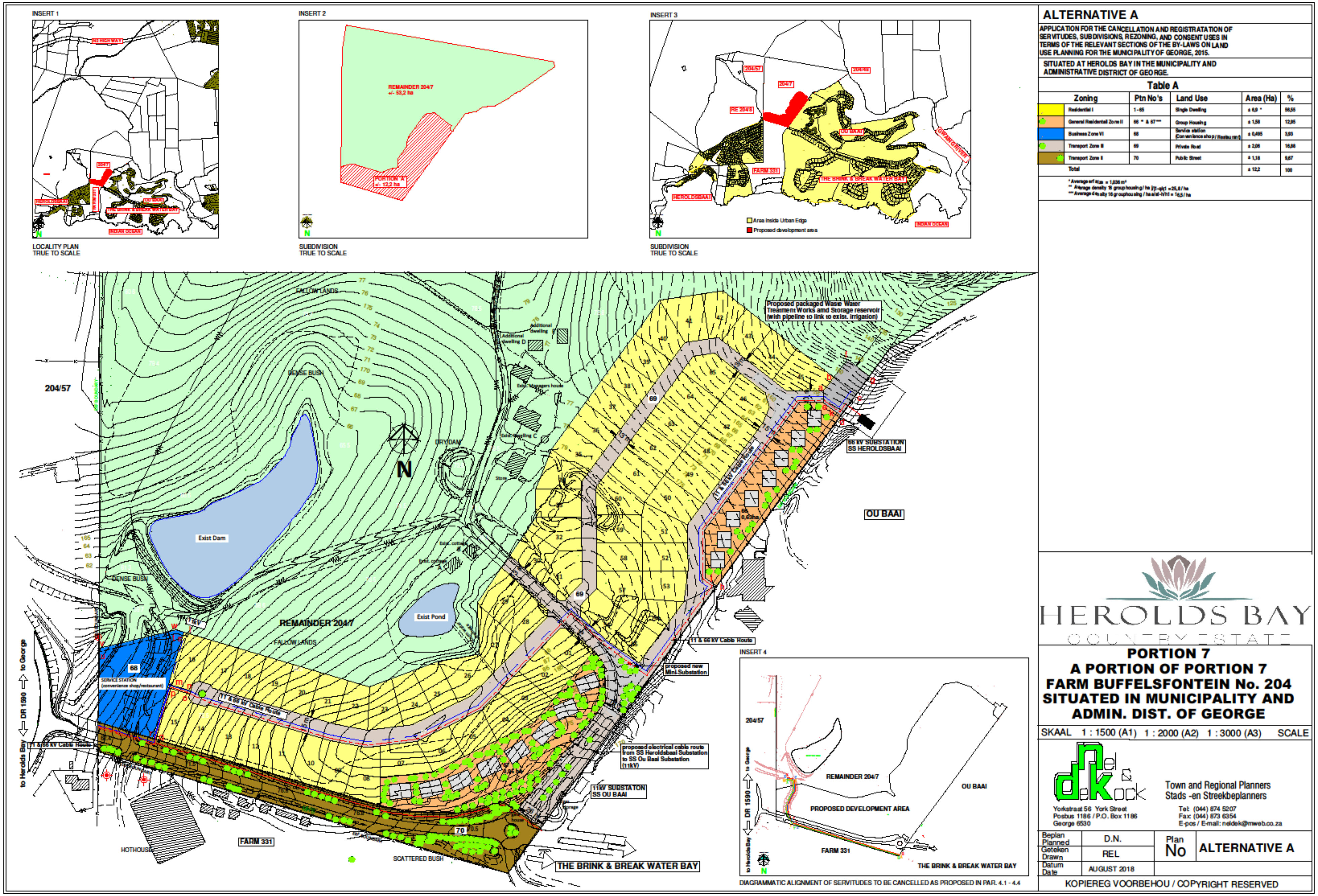
It is our understanding that the treated effluent will be used for irrigation on agricultural land next to the development. However, the engineering report states that irrigation will take place on the development. This will be confirmed with the landowner for water use application and engineering purposes.

Alternative connection points for sewage was studied for both the eastern and western side of the development. The eastern portion accounts for about 45% of the site and drains towards Oubaai Golf Estate. It was established that the Oubaai WWTW can accommodate the surplus flow generated by the eastern side of the new development. On the western side the remaining 55% of the development will drain in the direction of Herolds Bay which does not have the capacity to accommodate the extra flow. It is therefore suggested to pump the sewage from a pump station on the western extreme of the property, over the watershed to the eastern side. Horizontal Directional Drilling could also be implemented for drainage from a few properties to the south.

Stormwater design for the development is significant as there is no formal stormwater network in place. The engineering report indicates that no ground water or perched water are visible and that moderate water retention is expected. Stormwater movement is predicted to be moderate due to the flat to undulating gradient. The silty sands might erode as a result of stormwater runoff. The aim is to provide this by a combination of surfaced roadways, kerbs, channels, cut-off drains, stormwater pipes and various other minor structures. To the north eastern side, it is proposed that the stormwater from 45% of the property be discharged into the natural stream which is a tributary of the Gwaiing river. The southwestern side of the property drains northwest and eventually southwest towards Herolds Bay. The suggestion here is to discharge the stormwater into a natural stream which will cross underneath the R404 through an existing culvert. A small amount of stormwater will be discharged into an existing stormwater system. The entry point is located at the circle at the current access point to the site.

ALTERNATIVE A





ALTERNATIVE A
APPLICATION FOR THE CANCELLATION AND REGISTRATATION OF SERVITUDES, SUBDIVISIONS, REZONING, AND CONSENT USES IN TERMS OF THE RELEVANT SECTIONS OF THE BY-LAWS ON LAND USE PLANNING FOR THE MUNICIPALITY OF GEORGE, 2015.
SITUATED AT HEROLDS BAY IN THE MUNICIPALITY AND ADMINISTRATIVE DISTRICT OF GEORGE.
Table A
Zoning | Ptn No's | Land Use | Area (Ha) | %
Residential I | 1 - 65 | Single Dwelling | ± 6,9 * | 56,55
General Residential Zone II | 66 ** & 67*** | Group Housing | ± 1,58 | 12,95
Business Zone VI | 68 | Service station (Convenience shop / Restaurant) | ± 0,495 | 3,93
Transport Zone III | 69 | Private Road | ± 2,06 | 16,88
Transport Zone II | 70 | Public Street | ± 1,18 | 9,67
Total | ± 12,2 | 100
INSERT 1
LOCALITY PLAN
TRUE TO SCALE
INSERT 2
REMAINDER 204/7
+/- 53,2 ha
PORTION 'A'
+/- 12,2 ha
SUBDIVISION
TRUE TO SCALE
INSERT 3
Area inside Urban Edge
Proposed development area
SUBDIVISION
TRUE TO SCALE
204/57
FALLOW LANDS
DENSE BUSH
Exist Dam
Exist Pond
REMAINDER 204/7
DRY DAM
N
Proposed packaged Waste Water Treatment Works and Storage reservoir (with pipeline to link to exist. irrigation)
66 kV SUBSTATION
SS HEROLDSBAAI
OU BAAI
11 & 66 kV Cable Route
proposed new Mini-Substation
proposed electrical cable route from SS Heroldsbaai Substation to SS Ou Baai Substation (11kV)
11kV SUBSTATON
SS OU BAAI
SERVICE STATION
(convenience shop/restaurant)
FARM 331
HOTHOUSE
SCATTERED BUSH
THE BRINK & BREAK WATER BAY
to Herolds Bay DR 1590 to George
INSERT 4
REMAINDER 204/7
PROPOSED DEVELOPMENT AREA
OU BAAI
FARM 331
THE BRINK & BREAK WATER BAY
DIAGRAMMATIC ALIGNMENT OF SERVITUDES TO BE CANCELLED AS PROPOSED IN PAR. 4.1 - 4.4
HEROLDS BAY
COUNTRY ESTATE
PORTION 7
A PORTION OF PORTION 7
FARM BUFFELSFONTEIN No. 204
SITUATED IN MUNICIPALITY AND ADMIN. DIST. OF GEORGE
SKAAL 1 : 1500 (A1) 1 : 2000 (A2) 1 : 3000 (A3) SCALE
Town and Regional Planners
Stads -en Streekbeplanners
Yorkstraat 56 York Street
Posbus 1186 / P.O. Box 1186
George 6530
Tel: (044) 874 5207
Fax: (044) 873 6354
Beplan Planned D.N.
Geteken Drawn REL
Datum Date AUGUST 2018
Plan No ALTERNATIVE A
KOPIEREG VOORBEHOU / COPYRIGHT RESERVED

1.2 Location

The site is largely bordered by farmland. Herolds Bay is located to the southwest of the site with the well-known Oubaai Golf Estate to the east. The Gwaiing river passes the site approximately 700 m to the northeast with one of its tributaries originating on the border of the site. The Indian Ocean is less than 1 km south of the site.

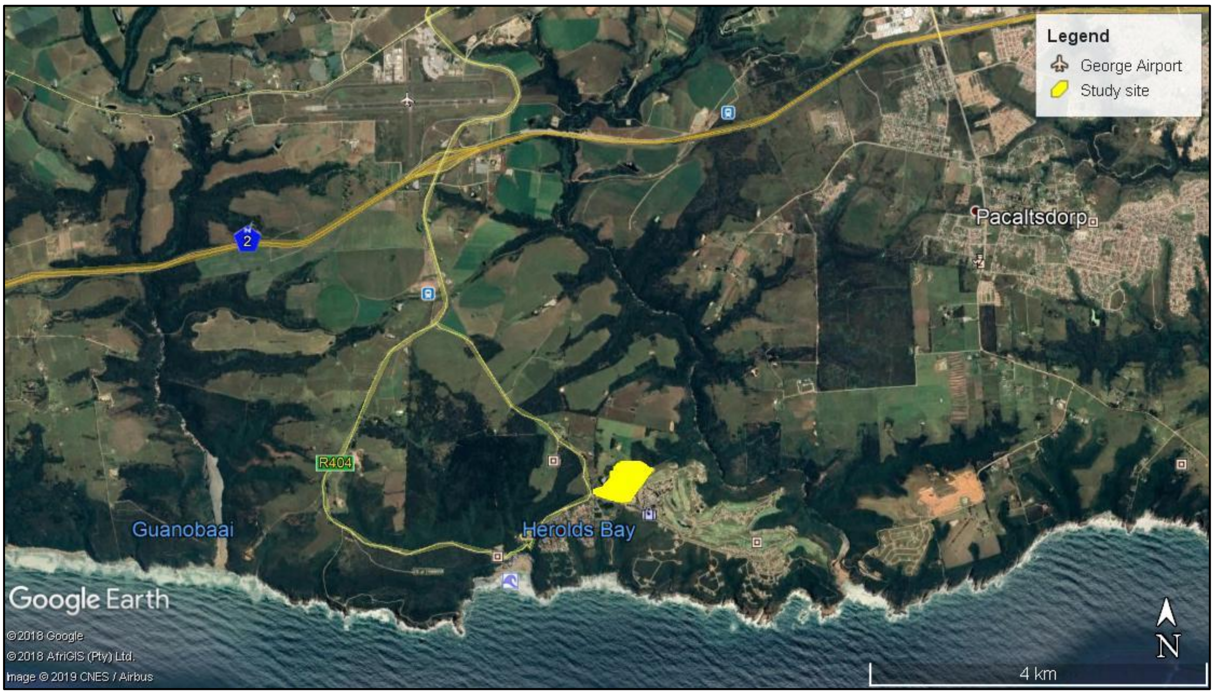


Figure 1: Location of the proposed site in relation to Herolds Bay and the N2

1.3 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.
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	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. The water uses under Section 21 (NWA) that are associated with the proposed development are most likely Section 21 (c) and (i) and

	potentially Section 21 (a) and (e). Also, according to the Department of Water and Sanitation (DWS), any structures within a 500 metre radius from the boundary of a wetland constitutes a Section 21(c) and (i) water use and as such requires a water use licence.
General Authorisations (GAs)	Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a license which should be obtained from the Department of Water and Sanitation (DWS). The project will require a Water Use Authorisation or General Authorisation in terms of Section 21 (c) and (i) of the National Water Act (NWA), Act 36 of 1998, as the development will cross a watercourse. Government Notice R509 of 2016 was issued as a revision of the General Authorisations (No. 1191 of 1999) for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA. Determining if a water use licence is required is associated with the risk of impacting on that watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA). The project could also qualify for a GA in terms of Section 21 (e) of the National Water Act (NWA), Act 36 of 1998 as irrigation with water containing waste will take place. Government Notice No. 665 of 2013 revised the conditions of a GA for Section 21 (e). Whether a water use licence or general authorisation is required will be subject to the amount and quality of water to be irrigated.
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 arising from bioprospecting involving indigenous biological resources; and the establishment of a South African National Biodiversity Institute.
Conservation of Agricultural Resources Act 43 of 1967	To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

1.4 Scope of Work

The Scope of Work in accordance with the specific Terms of Reference are described below:

Phase 1 (Contextualisation of study area)

- ✓ Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information (including but not limited to 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 site utilising available site-specific data such as aerial photography, contour data and water resource data.
- ✓ A risk/screening assessment of the identified aquatic ecosystems (as well as within the surrounding NWA regulated area) to determine which ones will be impacted upon by the proposed development and therefore require ground-truthing and detailed assessment.

Phase 2 (Delineation and classification)

- ✓ Ground truthing, infield identification, delineation and mapping of any potentially affected 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*.
- ✓ Field delineation must follow the accepted national protocol and should result in a map that includes the identified boundary and the field data collection points (which should include at least one point outside the wetland or riparian area), and a report that explains how and when the boundary was determined.
- ✓ 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).
- ✓ Description of the identified watercourses with photographic evidence

Phase 3 (Aquatic Assessment)

- ✓ Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitats, utilising the latest tools, such as:
  - → Level 2 WET-Health Version 2 tool (Macfarlane *et al*., 2009) – PES
  - → WET-Ecoservices (Kotze *et al*., 2009) and/or the Wetland EIS assessment tool of Rountree and Kotze (2013). - Functional assessment
- ✓ Conduct a Present Ecological State (PES) and Present Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats, utilising:
  - → Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
  - → DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS
- ✓ Indicate the Recommended Ecological Category (REC) of the impacted aquatic ecosystems.

Phase 4 (Impact Assessment)

- ✓ 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 must be rated with and without mitigation to determine the significance of the impacts.
- ✓ Complete the Department of Water and Sanitation Risk Matrix.

Phase 5 (Mitigation and monitoring)

- ✓ 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.
- ✓ Determination and mapping of any necessary buffer zones with consideration to the *Buffer zone guidelines for rivers, wetlands and estuaries* (Macfarlane & Bredin, 2016).
- ✓ Rehabilitation guidelines for disturbed areas and monitoring.

2 STUDY AREA

The area receives rainfall throughout the year with most rainfall recorded in March and October and least in June/July. The average annual rainfall is 755 mm which is almost equal to the potential evaporation rate of 850 mm. The average temperature for the area is a moderately cool 16˚C, with summer temperatures rising to a maximum of 23.6˚C and winters reaching a minimum of 8˚C. Analysis of the climate in this area for future water requirements and planning must however consider the predicted impacts of climate change; such as decreased rainfall and increased temperatures.

The geology of the site is comprised of phyllite, schist and quartzite of the Kaaimans Group with a possibility of some gneissic granite and granodiorite (Figure 2). Soils have a strong texture contrast with a marked clay accumulation, strongly structured and non-reddish colour. It has moderate erodibility with a depth of 450 mm to 750 mm. According to the engineering services report a light brown silty sand of significant depth is present throughout the site. Darker brown silt is visible in lower lying areas. The report further states that materials appear slightly moist and relatively loose. A low to moderate water retention rate is likely to occur. The slope of the site ranges from flat to undulating with steep undulating in the north eastern section as can be seen from the contours in Figure 3. The engineering report confirms that no natural slope instability occurs.

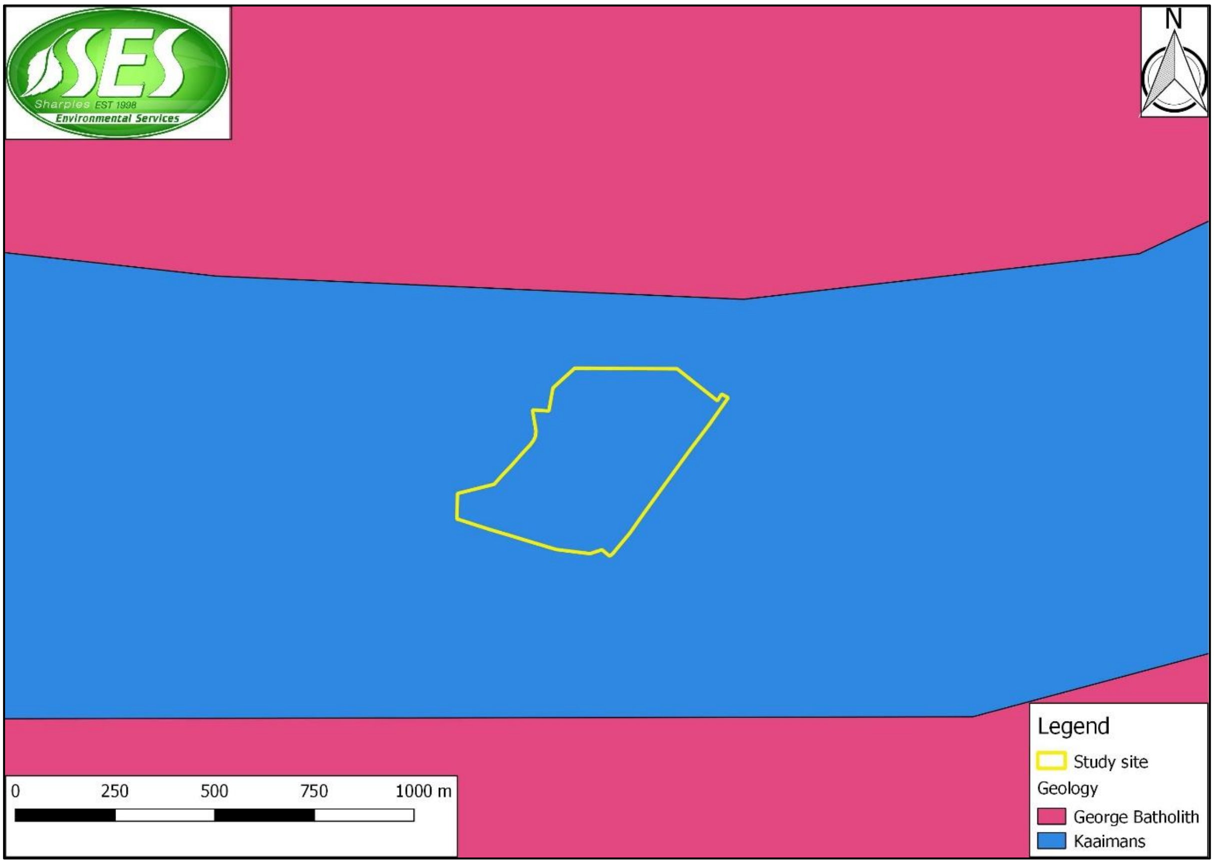


Figure 2: Geology of the study site

Rivers in this area all flow from the Outeniqua Mountains in the north, over the coastal plain and towards the Indian Ocean, forming narrow estuaries at the mouth. The Gwaiing River is the major river in the catchment and is no exception. Its tributary rivers start in the mountains and merge just below Fancourt in George to form the Gwaiing River. It then flows through agricultural land, past the George Airport, cross the N2 and mouths into the ocean directly east of Oubaai Golf Estate. Various tributary streams flow into the river while it crosses the coastal plain.

Figure 3 shows the proposed development area falls within Quaternary catchment K30B, draining towards the Indian Ocean in the south. The surface runoff within the property is almost equally divided; with approximately half of the area draining west/southwest and the remaining, slightly smaller portion draining in an easterly direction towards the Gwaiing River.

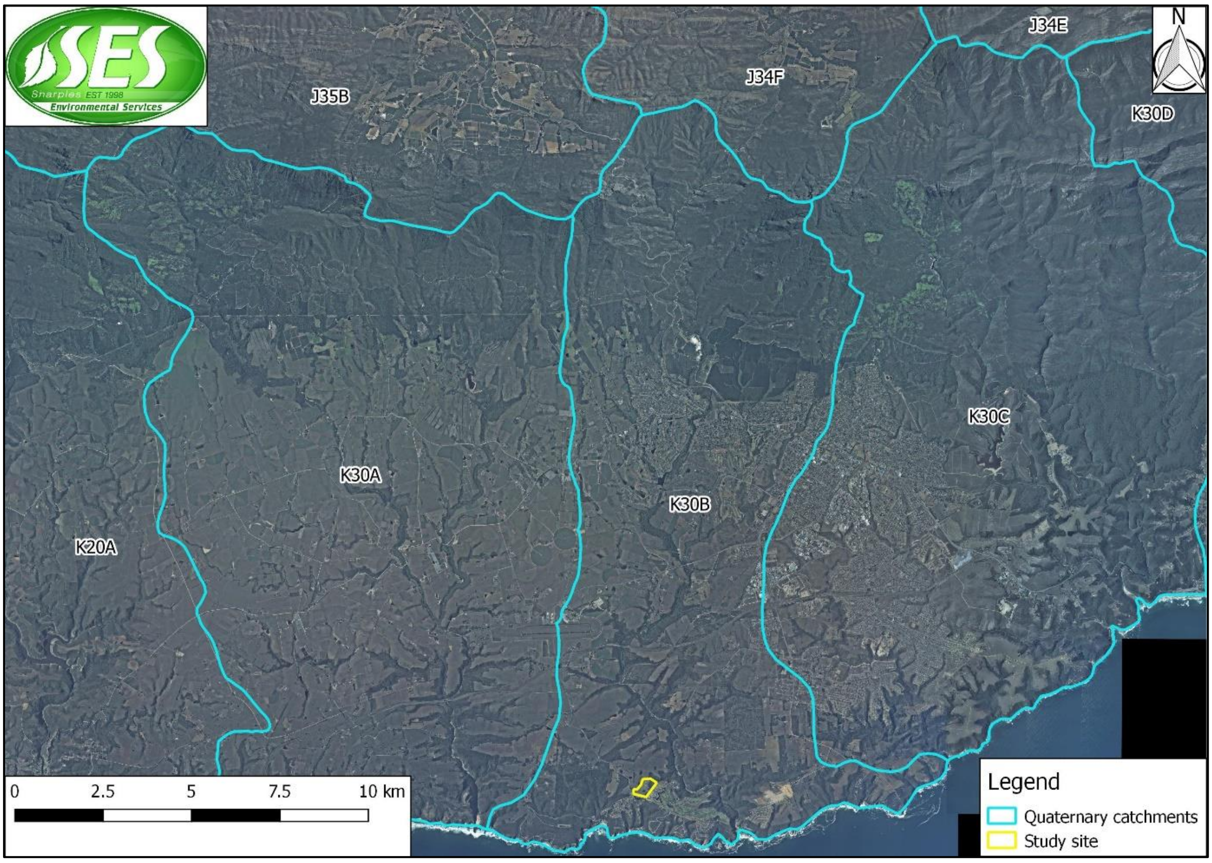


Figure 3: Map showing the study site in relation to quaternary catchments

Mapping the locality of aquatic habitat is essential for classification of the different wetland and river ecosystem types across the country, which in turn can be used with other data to identify aquatic systems of conservation significance. The National Freshwater Ecosystem Priority Area project (NFEPA) provides strategic spatial priority areas for conserving South Africa's aquatic ecosystems and supporting sustainable use of water resources. These priority areas are called Freshwater Ecosystem Priority Areas (FEPAs) and the main output of the NFEPA project was the creation of FEPA maps. FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (Driver *et al.* 2011).

The NFEPA project did not identify any rivers or wetlands within the proposed development. The closest river is the Gwaiing River which flows to the east. This was identified by NFEPA but not classified further. The NFEPA project identified a wetland south of the property, between Herolds Bay and the entrance to the entrance to the Oubaai Golf Estate. However, it was rated as not a FEPA. Google Earth imagery show agricultural land use and a small dam in the supposed wetland area dating back to 2003. Therefore, an error in the mapping of this area is presumed.

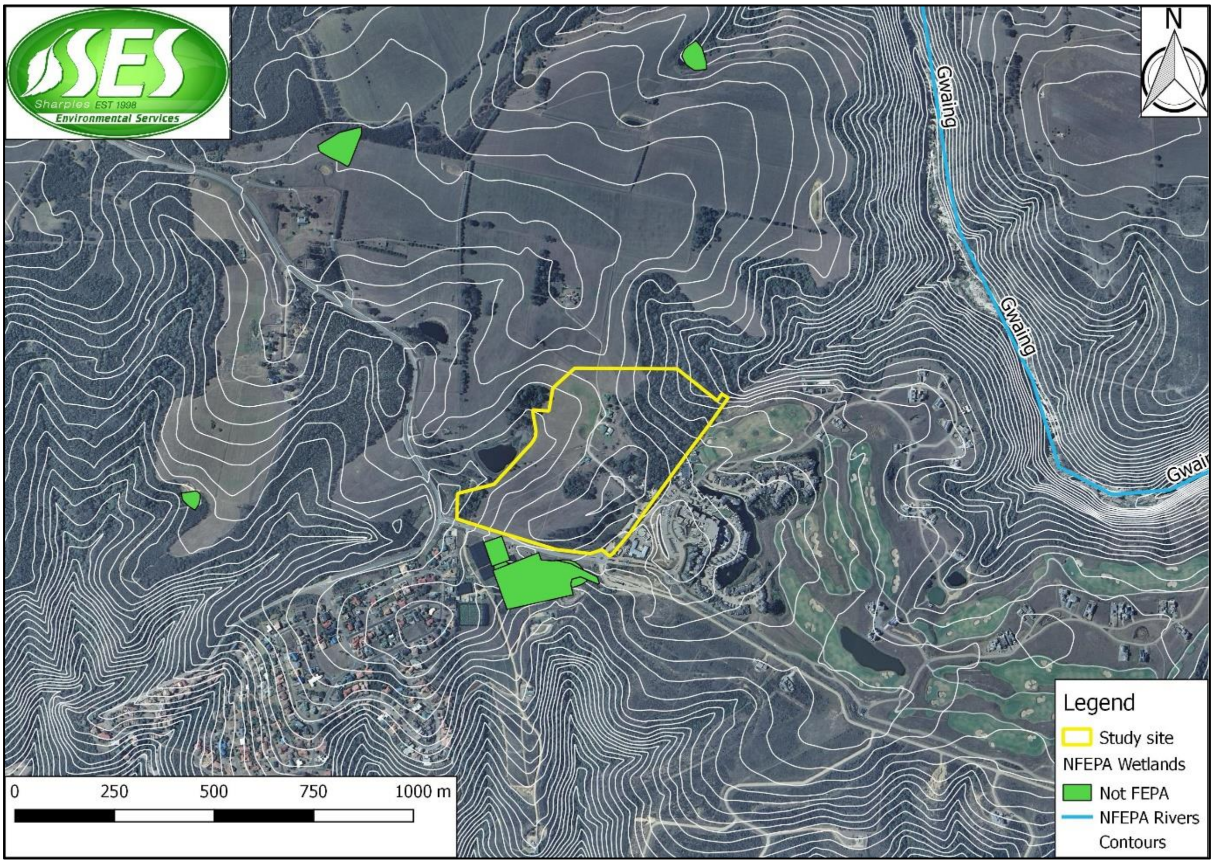


Figure 4: Areas identified by the NFEPA project in relation to the site

The vegetation of the site is indicated as Garden Route Granite Fynbos (Mucina and Rutherford, 2012) which means the development will be within a critically endangered ecosystem (Figure 5 & 6). The ecosystem threat status has been updated from Endangered in 2011 to Critically Endangered in 2014 and maintained this status in 2016. A botanical report has been compiled for the site and further details regarding the vegetation can be obtained within it.

Figure 5: Vegetation types at, and close to the study site

Figure 6: A map of threatened ecosystems in relation to the site

The Western Cape Biodiversity Spatial Plan (WCBSP) identifies areas crucial for conserving a representative sample of biodiversity and maintaining ecosystem functioning. The north eastern portion of the study site (Figure 7) are considered a Critically Biodiversity Area 2 (CBA2) and should thus, according to the biodiversity spatial plan (Pence, 2017), be restored to its natural state as far as possible. The tributary that drains towards the Gwaiing River to the east is also considered terrestrial CBA2. However, the river and its bordering wetland and terrestrial areas are considered being natural CBA1.

Development within the study site and CBA2 sections will influence the downstream CBA1 which should be maintained in a natural state. An Ecological Support Area (ESA) in need of restoration, is just inside the proposed development area on the southwestern side. This area is the origin of a tributary stream, becoming a CBA2 further down. The tributary stream flows past and then through Herolds Bay.

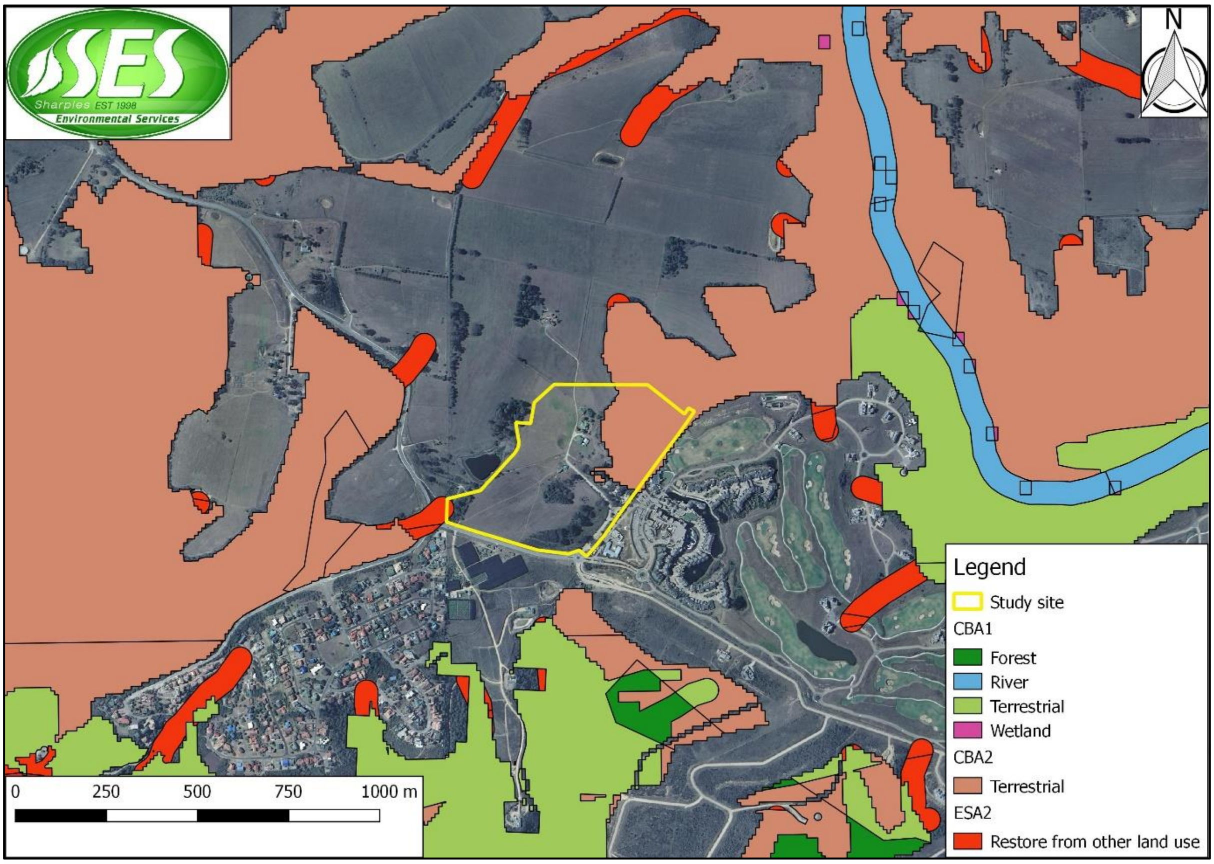


Figure 7: The proposed development site in relation to the Western Cape Biodiversity Spatial Plan (Pence, 2017)

3 APPROACH AND METHODS

3.1 Desktop Assessment Methods

- The contextualization of each study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information in a Geographical Information System (GIS). It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourse. The conservation planning information aids in the determination 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 2.18 GIS software (Table 2).
- These results, as well as professional experience, allowed for the identification of specific watercourses that could potentially be impacted by the development and therefore required ground truthing and detailed assessment. The following data sources listed within Table 2 assisted with the assessment.

Table 2: Utilised data and associated source relevant to the proposed project

Data	Source
Google Earth Pro™ Imagery	Google Earth Pro™
DWS Eco-regions (GIS data)	DWS (2005)
South African Vegetation Map (GIS Coverage)	Mucina & Rutherford (2006)
National Biodiversity Assessment Threatened Ecosystems (GIS Coverage)	SANBI (2011)
Geology	Surveyor General, Cape Farm Mapper
Contours (elevation) - 5m intervals	Surveyor General
NFEPA river and wetland inventories (GIS Coverage)	CSIR (2011)
NEFPA river, wetland and estuarine FEPAs (GIS Coverage)	CSIR (2011)
Western Cape Biodiversity Framework 2017: Critical Biodiversity Areas of the Western Cape.	Pence (2017)
Climate	Cape Farm Mapper (Ver 2.1.3)

3.2 Baseline Assessment Methods

- An infield site assessment was conducted on the 22nd of February and on the 14th of March 2019 to confirm the location and extent of the systems identified as likely to be impacted by the proposed project. 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. 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).

- Infield delineation was undertaken with a hand-held GPS, 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).
- Determination of the Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of any affected wetland habitats.
    - The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 2 WET-Health assessment tool (Macfarlane *et al.* 2008), 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.
    - Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The WET-Ecoservices tool (Kotze *et al*., 2009) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. 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).
    - The Ecological Importance and Sensitivity (EIS) of freshwater habitats is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). The Wetland EIS Tool was utilised to determine EIS (Kleynhans, 1999).
- 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
- The PES and EIS results then allowed for the determination of management objectives for the potentially impacted aquatic ecosystems. Refer to the Table below and Annexure 10 for a list and description of the tools utilised.

Table 3: Tools utilised for the assessment of water resources impacted upon by the proposed project.

METHOD/TOOL*	SOURCE	REFERENCE	APPENDIX (ANNEXURE)
Delineation of wetland and/or Riparian areas	*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas.*	(DWAF 2005)	12.1
Classification of wetlands and/ or other aquatic ecosystems	*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa & WET-Ecoservices*	(Ollis *et al*., 2013), Kotze *et al*., 2009)	12.2
Present Ecological State (PES) Assessment (Wetland)	*WET-Health Assessment*	(McFarlane *et al.* 2009)	12.3
Functional Importance Assessment (Wetland)	*WET-Ecoservices Assessment*	(Kotze *et al*., 2009)	12.5
Ecological Importance & Sensitivity (EIS) Assessment (wetland)	*DWAF Wetland EIS Tool*	(Duthie 1999)	12.6
Present Ecological State (PES) Assessment (River)	*Rapid IHI (Index of Habitat Integrity) tool developed Kleynhans (1996), Modified by DWAF*	(Ecoquat)	12.4
Ecological Importance & Sensitivity (EIS) Assessment (River)	*DWAF EIS tool developed by Kleynhans (1999)*	(Kleynhans, 1999)	12.7

3.3 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 for each alternative 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. A methodology for assigning scores to the respective impacts is described in Annexure 12.
- 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.
- Any necessary buffer areas or No-Go areas are visually represented. The buffer zone was determined by a tool developed by Macfarlane and Bredin (2016) called *Buffer zone guidelines for rivers, wetlands and estuaries*, site-based information and professional opinion. The final buffer requirement includes the implementation of practical management considerations/ mitigation measures.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are relevant:

- The location of the proposed infrastructure was extrapolated from a layout in a PDF document provided by the client. A boundary shapefile was created based upon the layout document. No shapefile has been received from the client yet, which has the potential to affect the accuracy of the mapping.
- No construction method statements nor a detailed stormwater management plan were supplied.
- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this are therefore likely to miss certain ecological information due to seasonality, thus limiting accuracy and confidence.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed development, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota was undertaken. See botanical report for detailed vegetation information.
- 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 and only provide a very general indication of the composition of the riverine vegetation communities.
- 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 development projects. The degree of confidence is considered good.
- The study does not include flood line determination and flood line data was not provided.
- It is assumed that the recommendations within this report will be implemented.

5 RESULTS

Several watercourses were identified within the regulated area, with three in close proximity or within the property (Figure 8). However, the watercourse located to the south of the site has been physically disconnected by a road. Therefore, it is only the watercourse in the west of the property (named Stream A for the purposes of this study) and the watercourse to the north east (named Stream B), that will be impacted by the development. The construction and operational phases of this project are highly likely to impact the habitat, biota, and water quality of both systems, and they were therefore assessed further.

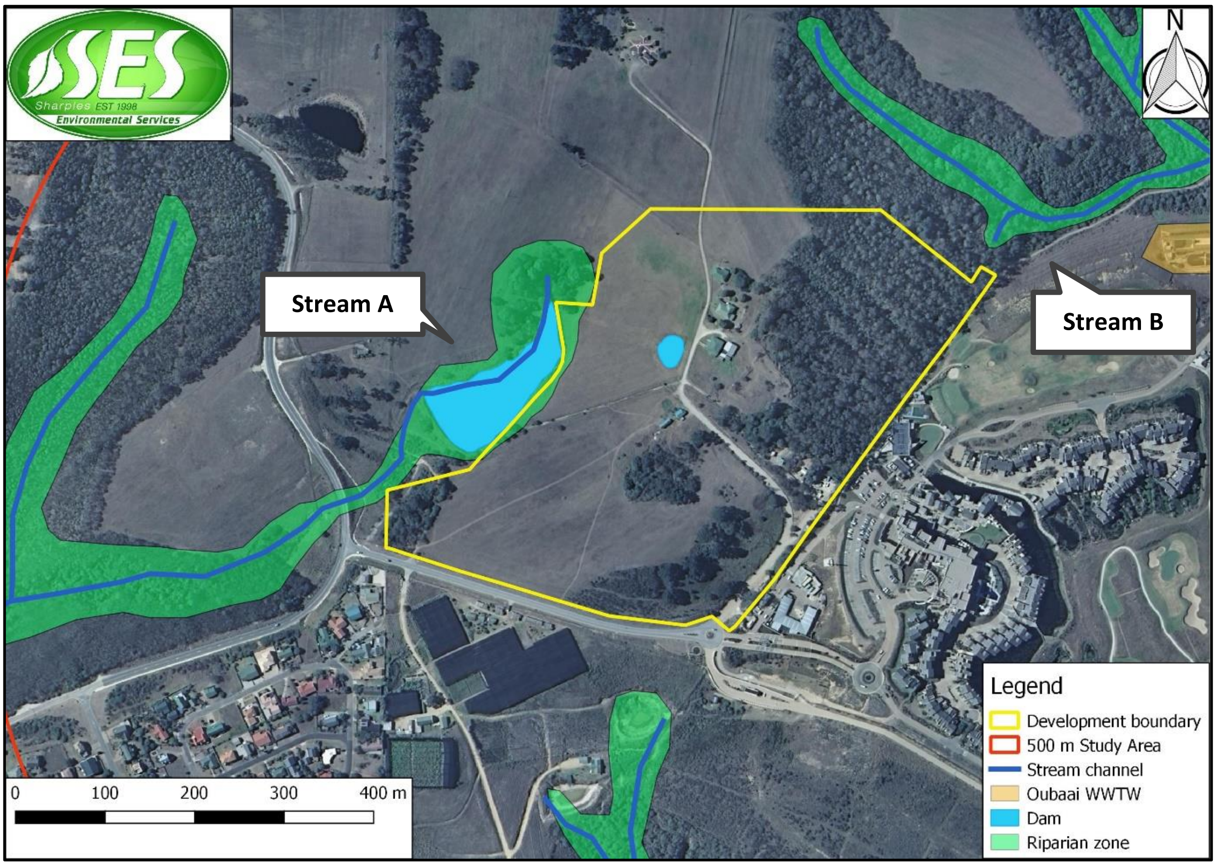


Figure 8: The proposed site and study area in relation to the identified aquatic habitat

5.1 Stream A characteristics

This non perennial stream (although flowing at the time of study) originates within the property boundary, where it has been dammed, and then flows in a south westerly direction, past Herold's Bay town, and to the popular Herold's Bay beach itself. The reach assessed, above the tar road, is surrounded by irrigated pasture for livestock farming. Agriculture has encroached in the riparian area and there is limited thicket vegetation remaining. Figure 9 below is historical imagery from 1957 which shows that the agricultural activities in the area were established long ago. However, the dam had not yet been constructed.

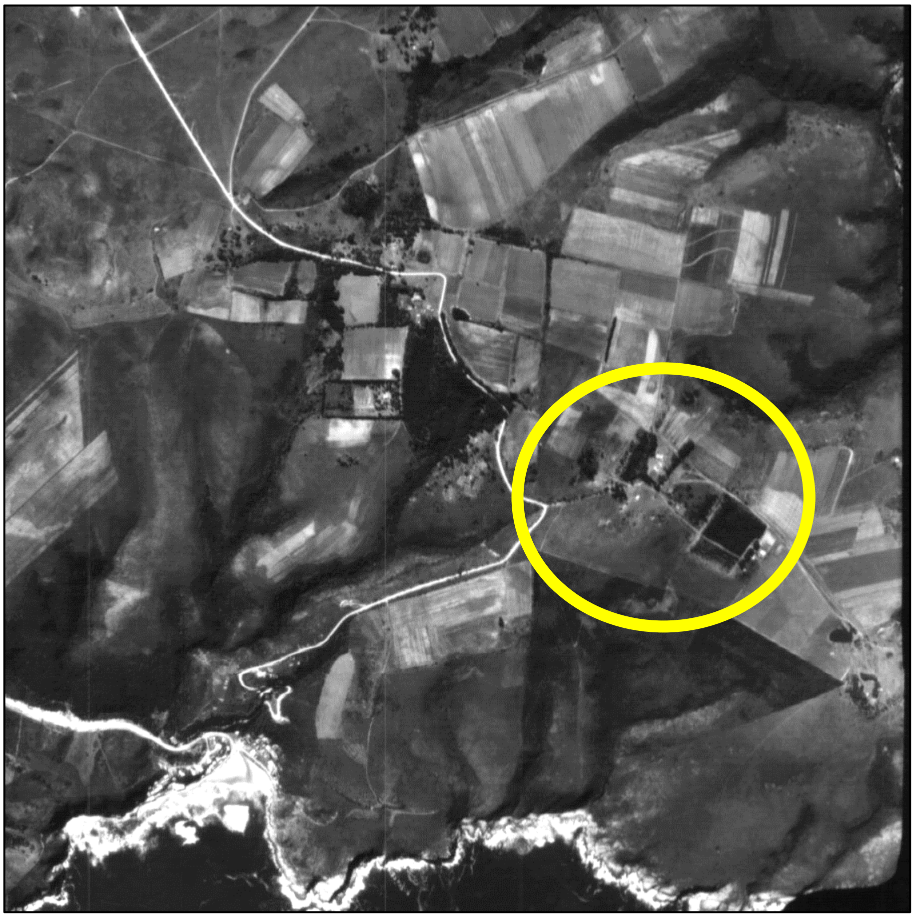


Figure 9: Historic aerial imagery from 1957 with the general study area indicated by the yellow circle

The dam provides water for irrigation, livestock, and a small amount for domestic use (Figure 10a). The water quality is likely to be negatively impacted by the farming activities. Downstream of the dam the stream has eroded slightly into a single, straight channel (with sandy substrate) and passes through a narrow road culvert into another, smaller dam (Figure 10b). In the reach south of the road the vegetation becomes dominated by Black Wattle trees (*Acacia mearnsii*).

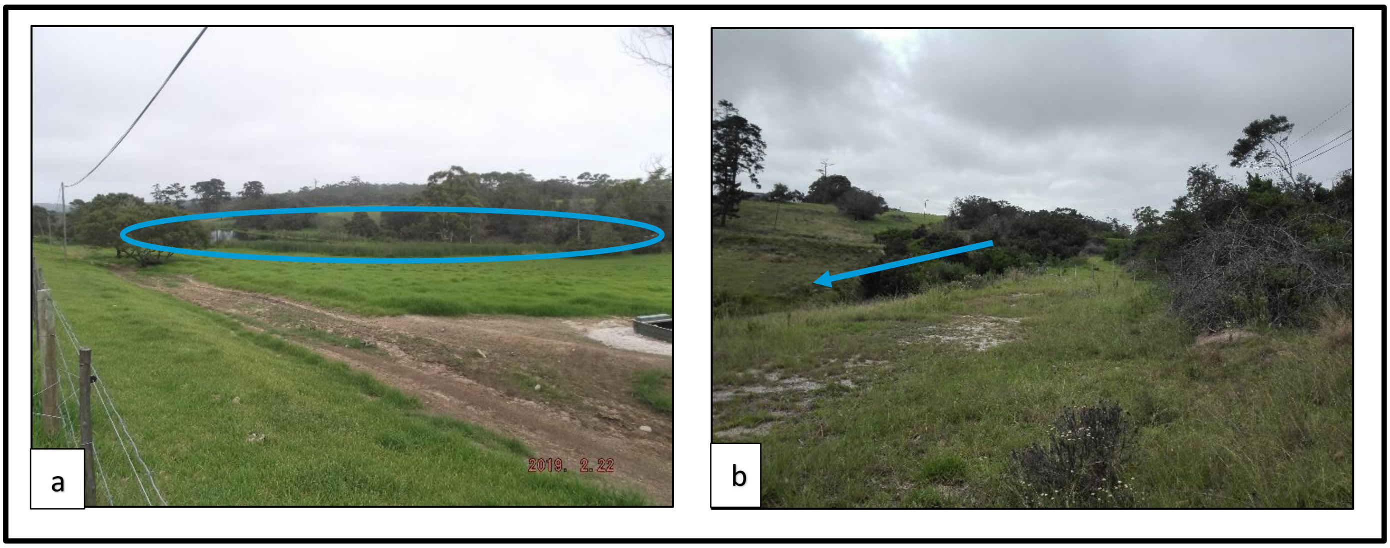


Figure 10: Photographs of (a) the dam on site, and (b) the characteristics of the stream below the dam

It was determined that due to large modifications to the hydrological regime, water quality, geomorphology, and vegetation the Present Ecological State (PES) of the stream is within the 'D' category (Poor health). A large loss of natural habitat, biota and basic ecosystem functions has occurred. The state of this river, without further modifications, will likely remain largely the same in the near future.

The ecological importance and sensitivity (EIS) category of Stream A was determined as being 'Low' (D category). It has been significantly modified and limited natural habitat remains. The longitudinal connectivity is interrupted in several locations along the system and the non perennial nature results in less refuge for biota. It is likely these waters are already subjected to significant water quality changes from the natural condition that has resulted in the dominance of disturbance tolerate species and thus the species/taxon richness is not expected to be significant at any scale. But the dam is likely to provide some refuge to certain biota during times of environmental stress, at a local scale. There are no rare/endangered, vulnerable or sensitive species expected and the area is not important for the conservation of ecological diversity on any scale. However, the dam on the stream does provide significant direct benefits to society through its use for water storage and irrigation.

Therefore, through using the PES and EIS findings it can be determined that the recommended management objective for this system be to maintain it in its current state.

5.2 Stream B characteristics

This stream originates near the north eastern corner of the proposed development boundary. It is a steeply sloped, small tributary to the Gwaiing River. It is currently dry and likely to flow only intermittently during high rainfall events. The channel bed is approximately 1.5 m in width and consists of sandy loam sediments. The banks are stable, at 1 m in height, and there is no evidence of erosion in the system. The riparian zone is dominated by indigenous Southern Afrotemperate Forest with only a few Black Wattle (*Acacia mearnsii*) and Blue Gum (*Eucalyptus grandis*) individuals having encroached. However, beyond this area on the surrounding slopes where previous anthropogenic disturbance has occurred, the vegetation becomes entirely dominated by Black Wattle and soil instability is noticeable. Refer to botanical study for further details regarding the vegetation.

Therefore, in the reach closest to the proposed site, it is largely alien invasive trees that are impacting the riparian system. The bed and banks are stable, it is well vegetated, and there was no evidence of direct pollutants. However, further downslope the riparian area has been impacted by a road and the Oubaai Estate Waste Water Treatment Works (WWTW).

Figure 11: Photograph showing the bare and dry channel of Stream B in the forest

It was determined that the stream is largely natural with few modifications. It obtained a 'B' habitat integrity PES category as a small change in natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged. The exposure of bare soils due to the farming and alien trees in the catchment may have increased sediment inputs but there is no discernible sedimentation within the stream. There are no road crossings or erosion causing any significant bed modification. Regarding the hydrology, the invasive trees will have altered the catchment hydrology but presently the hydrological regime of the stream is close to the perceived natural condition. Overall, the modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small. The state of this river, without further modifications, will likely remain largely the same in the near future.

The ecological importance and sensitivity (EIS) category of Stream B was determined as being 'Low' (D category). It does not provide significant diversity in habitat as it has a uniform substrate and flows intermittently. It is not overly sensitive to water quantity and quality changes and no biota will depend on it for their entire life cycle. It is highly unlikely to provide habitat for any rare or endangered species and is not conserved in any way. Additionally, it does not currently provide any direct services to society. It does however act as a small corridor to the Gwaiing River downstream, which is of High ecological importance and sensitivity, and thus must be managed accordingly.

Therefore, through using the PES and EIS findings it can be determined that the recommended management objective for this system be to maintain it in its current state.

6 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. 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.

The direct and indirect impacts associated with the project are grouped into four encapsulating impact categories where associated or interlinked impacts are grouped. Impacts have been separated into construction and operational phases of the project within these categories.

6.1 Disturbance/loss of aquatic vegetation and habitat

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by vegetation clearing, disturbance of riparian habitat, encroachment and colonisation of habitat by invasive alien plants.

6.1.1 Construction Phase

There is potential for loss or disturbance of riparian zone vegetation during construction from machinery, vehicles and workers. The movement of topsoil and incorrectly placed stockpiles could bury aquatic habitat. Due to construction, alien invasive species may encroach further into any disturbed areas and outcompete indigenous vegetation thereby reducing aquatic biodiversity.

6.1.2 Operational Phase

There is less direct risk to aquatic habitat during the operational phase as it will have been transformed already during construction. The project may promote the establishment of disturbance-tolerant biota, including colonization by invasive alien species, weeds and pioneer plants if there is any ongoing disturbance near the riparian zone. Although this impact is initiated during the construction phase it is likely to persist into the operational phase. Additionally, the stormwater infrastructure of the housing and associated road network will increase and concentrate flows into the systems. This may indirectly lead to erosion in the remaining wetland habitat that compromises the remaining vegetated habitat.

6.2 Sedimentation and erosion

Sedimentation and erosion refers to the alteration in the physical characteristics of the river as a result of increased turbidity and sediment deposition, caused by soil erosion and earthworks that are associated with construction activities, as well as instability and collapse of unstable soils during project operation. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for aquatic dependent flora & fauna.

6.2.1 Construction Phase

Vegetation clearing and exposure of bare soils upslope of freshwater habitat during construction will decrease the soil binding capacity and cohesion of the soils and thus increase the risk of erosion and sedimentation downslope. The relatively steep slopes surrounding Stream B increase the risk of erosion. This activity may cause the burying of aquatic habitat. 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. Soil compaction resulting in reduced infiltration and increased surface runoff together with the artificial creation of preferential flow paths due to construction activities, will result in increased quantities of flow entering the systems.

6.2.2 Operational Phase

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 downstream. The increase in hardened surface by development will be considerable and, if not mitigated against, will result in erosion. Surface runoff and velocities will be increased, and flows will be concentrated by stormwater infrastructure.

6.3 Water Pollution

Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species). Additionally, litter indirectly decreases the aesthetic value of the systems.

6.3.1 Construction Phase

During construction there are a number of potential pollution inputs into the wetlands (such as hydrocarbons and raw cement). The likelihood of these entering Stream A is larger as there will be construction works directly surrounding the system. 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. Sudden drastic changes in water quality can also have chronic effects on aquatic biota in general and result in localised extinctions. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the system by means of surface runoff or through dumping by construction workers. Raw cement entering the systems through incorrect batching procedure and/or direct disposal. The incorrect positioning and maintenance of the portable chemical toilets and use of the surrounding environment as ablution facilities may result in sewage and chemicals entering the systems.

6.3.2 Operational Phase

If not prevented, litter, and contaminants, including sand, silt, and dirt particles, will enter storm water runoff and pollute the systems. Micro-litter such as cigarette butts may travel through certain stormwater grids and grids may not be regularly cleared. The number of vehicles on the property due to the development increases the potential for pollutants to enter the system. During maintenance of the development there could be water pollution impacts similar to those encountered in the construction phase. The establishment of sewer pipes in close proximity to watercourse always poses a long term threat to the water quality and ecological health of freshwater ecosystems due to the relatively high likelihood that surcharge events will occur at some point in the future. This is amplified by the risks associated with the packaging plant situated upslope of Stream B. 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 downstream human users e.g. abstraction from the Gwaiing River. 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 sewerage infrastructure is inevitable. However, the proposed mitigation measures will go a long way to reducing the intensity of pollution events and ultimately reduce pollutant loads.

6.4 Flow Modification

The changes in the quantity, timing and distribution of water inputs and flows within the watercourses. Possible ecological consequences associated with this impact may include deterioration in freshwater ecosystem integrity, reduction/loss of habitat for aquatic dependent flora & fauna, and a reduction in the supply of ecosystem goods & services.

6.4.1 Construction Phase

Land clearing and earth works in and adjacent to the dam and riparian systems will reduce infiltration rates and increase the surface runoff volume and velocity. Such changes in surface roughness and runoff rates may lead to some rill and gully erosion. Altered water inputs from upslope disturbances as well as modified water distribution and retention patterns will ultimately affect the hydrological integrity of water resources.

6.4.2 Operational Phase

One has to ensure that surface flows are slowed and enter the rivers in a diffuse pattern. This is likely to be more difficult to accomplish with the Alternative A proposed layout. Ultimately, the operational surface will alter the natural processes of rain water infiltration and surface runoff, promoting increased volumes and velocities of storm water runoff, which can be detrimental to the rivers receiving concentrated flows off of 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 area and discharging into the rivers will alter the natural ecology, increasing the risk of erosion and channel incision/scouring.

7 IMPACT SIGNIFICANCE ASSESSMENT

The impact significance of the proposed development was determined for each potential impact of the project (Table 4) There are fewer risks to Stream A associated with the Alternative B layout as the development footprint is set further back from the dam. However, both proposed layout alternatives will have the same impact upon Stream B. But due to the modified state of Stream A, and the non perennial characteristics of Stream B (which is also beyond 32 m of the proposed footprint), the impacts can be managed to acceptable levels. The No-Go Alternative will have no impact upon freshwater habitat assuming the land owner abides by legislated requirements. The impacts are considered to be easily mitigated (and some can be completely avoided) provided that mitigation measures, especially the No-Go areas, and monitoring are implemented and adhered to during the construction and operational phase of the project.

Cumulative impacts on the environment can result from broader, long term changes and not only as a result of a single activity or development. They are rather from the combined effects of many activities overtime. Rivers are longitudinal systems where different reaches interact in a continuum along the length of the river. This is vitally important to understand in the context of cumulative impacts from developments. Activities in the upper reaches influence the processes of the lower reaches and it must therefore be viewed as a whole. However, due to increasing urban development, the combination of development impacts becomes cumulatively more significant. This could result in further modifications (although slight) to the Gwaiing River and Estuary and the Heralds Bay beach. However, of more importance to these systems is the monitoring of existing water uses and non-compliance that is impacting freshwater and estuarine health.

Table 4: Evaluation of potential impacts of Alternative A on aquatic habitat

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Construction Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	Local (2)	Medium (3)	Moderate (6)	Probable (3)	**Medium (33)**	Partly	High	No
		With Mitigation	Site only (1)	Short (2)	Low (4)	Improbable (2)	**Low (14)**	Partly	Low	No
	Erosion & sedimentation	Without Mitigation	Regional (3)	Medium (3)	Moderate (6)	Highly Likely (4)	**Medium (48)**	Partly	Medium	No
		With Mitigation	Site only (1)	Very Short (1)	Low (4)	Probable (3)	**Low (18)**	Barely	Low	No
	Water Pollution	Without Mitigation	Regional (3)	Short (2)	Moderate (6)	Probable (3)	**Medium (33)**	Partly	High	No
		With Mitigation	Local (2)	Very short (1)	Minor (2)	Very Improbable (1)	**Low (5)**	Barely	Low	No
	Flow modification	Without Mitigation	Local (2)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (44)**	Partly	Medium	No
		With Mitigation	Site only (1)	Permanent (5)	Minor (2)	Probable (3)	**Low (24)**	Barely	Low	No

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Operational Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	Site only (1)	Permanent (5)	Low (4)	Improbable (2)	**Low (20)**	Barely	Medium	No
		With Mitigation	Site only (1)	Permanent (5)	Small (0)	Very Improbable (1)	**Low (6)**	Barely	Low	No
	Erosion & sedimentation	Without Mitigation	Regional (3)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (56)**	Partly	Medium	No
		With Mitigation	Site only (1)	Permanent (5)	Low (4)	Probable (3)	**Low/Medium (30)**	Barely	Low	No
	Water Pollution	Without Mitigation	Regional (3)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (56)**	Partly	High	Yes
		With Mitigation	Site only (1)	Permanent (5)	Minor (2)	Improbable (2)	**Low (16)**	Barely	Low	No
	Flow modification	Without Mitigation	Regional (3)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (56)**	Partly	Medium	Yes
		With Mitigation	Local (2)	Permanent (5)	Minor (2)	Probable (3)	**Low (27)**	Barely	Low	No

Table 5: Evaluation of potential impacts of Alternative B on aquatic habitat

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Construction Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	Local (2)	Medium (3)	Low (4)	Probable (3)	**Low (27)**	Barely	Medium	No
		With Mitigation	Site only (1)	Short (2)	Minor (2)	Very Improbable (1)	**Low (5)**	Partly	Low	No
	Erosion & sedimentation	Without Mitigation	Regional (3)	Medium (3)	Low (4)	Highly Likely (4)	**Medium (40)**	Partly	Medium	No
		With Mitigation	Site only (1)	Very Short (1)	Minor (2)	Probable (3)	**Low (12)**	Barely	Low	No
	Water Pollution	Without Mitigation	Local (2)	Short (2)	Low (4)	Probable (3)	**Low (24)**	Partly	Medium	No
		With Mitigation	Local (2)	Very short (1)	Minor (2)	Very Improbable (1)	**Low (5)**	Barely	Low	No
	Flow modification	Without Mitigation	Local (2)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (44)**	Partly	Medium	No
		With Mitigation	Site only (1)	Permanent (5)	Minor (2)	Probable (3)	**Low (24)**	Barely	Low	No

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Operational Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	Site only (1)	Permanent (5)	Minor (2)	Improbable (2)	**Low (16)**	Barely	Low	No
		With Mitigation	Site only (1)	Permanent (5)	Small (0)	Very Improbable (1)	**Low (6)**	Barely	Low	No
	Erosion & sedimentation	Without Mitigation	Local (2)	Permanent (5)	Low (4)	Highly Likely (4)	**Medium (44)**	Partly	Medium	No
		With Mitigation	Site only (1)	Permanent (5)	Small (0)	Improbable (2)	**Low (12)**	Barely	Low	No
	Water Pollution	Without Mitigation	Regional (3)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (56)**	Partly	High	No
		With Mitigation	Site only (1)	Permanent (5)	Minor (2)	Improbable (2)	**Low (16)**	Barely	Low	No
	Flow modification	Without Mitigation	Regional (3)	Permanent (5)	Low (4)	Highly Likely (4)	**Medium (48)**	Partly	Medium	No
		With Mitigation	Local (2)	Permanent (5)	Minor (2)	Probable (3)	**Low (27)**	Barely	Low	No

8 MITIGATION MEASURES

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). The mitigation measures detailed within this report must be taken into consideration during financial planning of the construction phase of the development. This to ensure that sufficient funds are available to implement all the measures required to maintain the current PES score of the watercourses impacted upon.

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. Consideration should also be given to the rehabilitation of the watercourse where feasible. Mitigation measures related to the impacts associated with the construction activities are intended to augment standard/generic mitigation measures included in the project-specific Environmental Management Programme (EMPr).

The monitoring of the development 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. In the case where there is extensive damage to any aquatic system, where rehabilitation is required, a suitably qualified aquatic specialist must audit the site. Monitoring for non-compliance must be done on a daily basis by the contractors. Photographic records of all incidents and non-compliances must be retained. This is to ensure that the impacts on the aquatic habitat are adequately managed and mitigated against and the successful rehabilitation of any disturbed areas within any system occurs. Monitoring should especially focus on preventing water pollution, avoiding riparian habitat, and determining the success of the stormwater management plan.

The following mitigation measures must be adhered to and monitored:

8.1 Design Phase: Buffer Zones

Aquatic buffer zones which 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. 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). Typical threats to buffer zone areas in this area include transformation (e.g. new infrastructure) and alien plant encroachment.

Regarding Alternative A, the layout design does not provide any significant buffer to Stream A at the dam and there are also potential risks associated with building in this low lying area. It is recommended that the footprint be set further back from the dam and the watercourse below. From an aquatic perspective, this area is the main difference between the two layout designs. The proposed package plant is in the same location in both layouts (in the northern area of the site) and is a risk to Stream B. It is recommended that it also be set further back from the riparian area and that it complies with the provisions of the National Water Act (1998).

At a minimum, however, by implementing a 32 m buffer zone from the boundary of the riparian areas, as well as adopting the other mitigation measures, the proposal will not have high aquatic impacts (Figure 12). Therefore, the No-Go boundary must be demarcated during works, and no disturbance may occur past this point during any stage. An important component of these buffers is that they represent minimum setbacks from the riparian zone. Functions such as stormwater attenuation, sewage lines, water lines, roads and pathways must lie outside of this setback area. No sewage pump stations must be located within 32 m of a watercourse. These factors must be accounted for in the final design layout and construction method statement, as even the construction footprint must not encroach into the buffer area at any time.

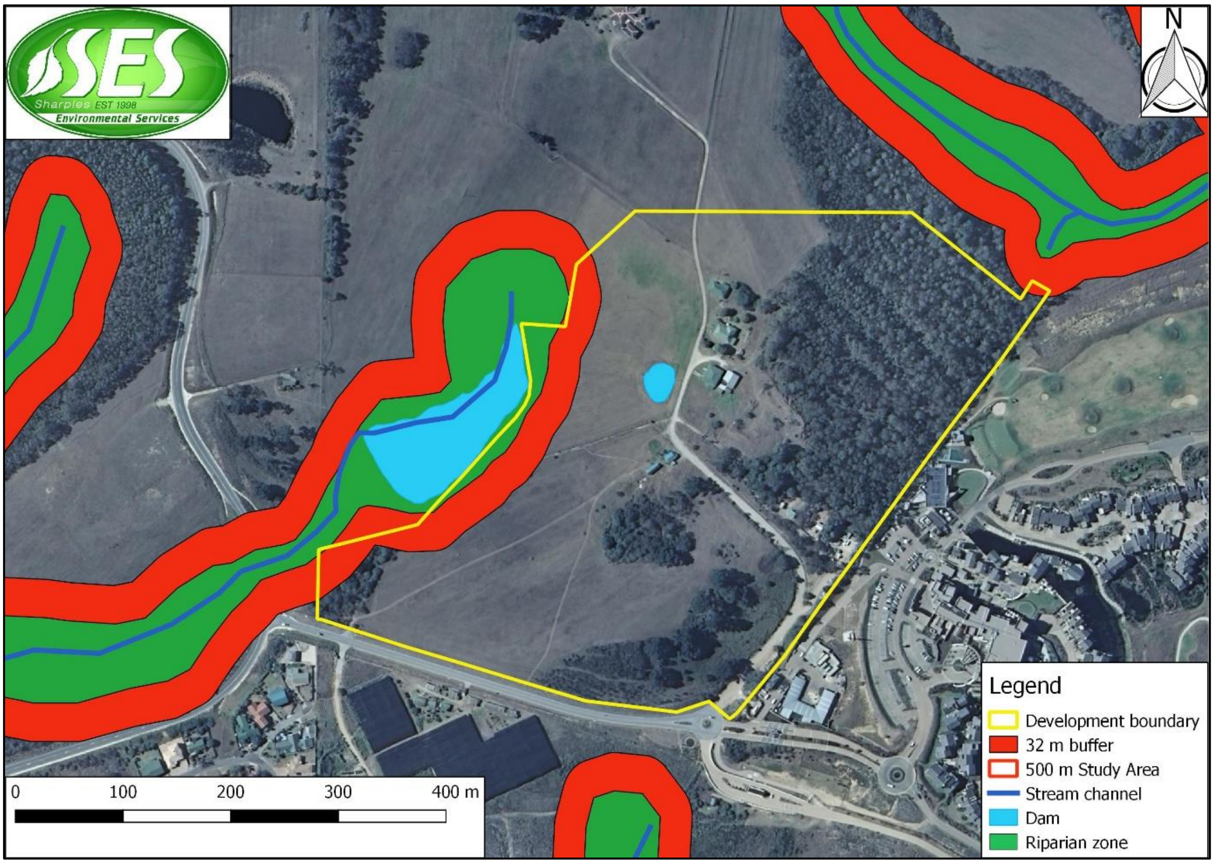


Figure 12: The study area in relation to the watercourses and recommended 32 m buffer zone

The mitigation of impacts should focus on managing the runoff generated by the development and introducing it responsibly into the receiving environment. The stormwater flows must enter the riparian buffer areas in a diffuse flow pattern without pollutants. It must be noted that a formal stormwater management plan has not been undertaken. 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, as well as waste water, prior to discharge into any natural environment. It is therefore recommended that the stormwater management plan be developed with appropriate ecological input and be developed based on Sustainable Drainage Systems (SUDS).

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). 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 (Figure 13). 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.

Figure 13: Examples of soft infrastructure incorporated into the stormwater management design

Frequent stormwater outlets must be designed to prevent erosion at discharge points. All erosion protection measures (e.g. Reno-mattresses) must be established to reflect the natural slope of the surface and located at the natural ground level. All stormwater infrastructure, such as reno mattresses at pipe outlets, must be located within the development footprint and not encroach into the buffer areas.

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. Key maintenance will include litter and sediment clearing and the servicing and maintenance of key collection points like catch pits, detention tanks etc. Such maintenance should be the responsibility of the relevant owners/estate associations and budgeted for.

Stockpiles must not be located within 50 metres of the rivers. The furthest threshold must be adhered to. They should not be placed in vegetated areas that will not be cleared. Erosion control measures including silt fences, low soil berms and/or shutter boards must be put in place around the stockpiles to limit sediment runoff from stockpiles. Alternatively, the exposed slopes must drain into small temporary stormwater and silt traps/ponds.

Regular inspections during the operational phase should also be undertaken to ensure that functions are not undermined by inappropriate activities.

8.2 Post-construction/ Rehabilitation Phase

Although it is recommended that no construction should be allowed to occur within or impact upon watercourses under the current proposal, there is always potential for accidental disturbance therefore guidelines for rehabilitation of aquatic habitats are provided. The aim of the rehabilitation is to ensure the necessary procedures are appropriately implemented in the natural environment that may be negatively affected by the development. The plan will promote the re-establishment of the ecological functioning of any area disturbed by construction activities. Also consult WET-RehabEvaluate, WET-RehabMethods (Cowden and Kotze, 2009), and the river rehabilitation manual developed by Day *et al.* 2016, for further information.

Important guidelines for rehabilitation are:

- The 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 freshwater habitat. Please see the Annexure for control options for likely alien invasive plants species.
- The solid domestic waste must be removed and disposed of offsite. All post-construction building material and waste must be cleared in accordance with the EMPr.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- Erosion features that have developed due to construction within the aquatic habitat due to the project are required to be stabilised. This may also include the need to deactivate any erosion headcuts/rills/gullies that may have developed.
- 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.
- Alien/ invasive species shall not be stockpiled, they should be removed from site and dumped at an approved site.
- Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
- A monitoring programme shall be in place, not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental

issues and impacts such as increased surface runoff. The monitoring should be regular and additional visits must be taken when there is potential risk to watercourses.

8.3 Operational Phase

- The stormwater management infrastructure must be designed to ensure the runoff from the development is not highly concentrated before entering the buffer area. The volume and velocity of water must be reduced through discharging the surface flow at multiple locations surrounding the development, preventing erosion.
- Any evidence of erosion from this stormwater system must be rehabilitated and the volume/velocity of the water reduced through further structures and/or energy dissipaters. These structures must be incorporated within the layout area.
- The recommended use and maintenance of grease traps/oil separators to prevent pollutants from entering the environment from stormwater.
- Appropriate waste water infrastructure must be designed to prevent any such water from entering the surrounding environment.
- Maintenance of the freshwater habitat and buffer area must be implemented for it to remain effective. Apart from erosion control and alien invasive plant eradication, the encroachment of any further infrastructure or vehicles must be prevented.
- Engage with the homeowners to explain the reasons why the buffer and the water resources are protected and what human activities are allowed. Encourage recreational activities within the buffer area that are not in conflict with water resource management. The community could be involved in the monitoring e.g. the packaging plant effluent.

9 CONCLUSION

The assessment identified two freshwater ecosystems within the 500 m regulated area that are likely to be impacted by the proposed development. Although neither of the proposed alternatives present any fatal flaws, Alternative B will have a lower impact upon freshwater habitat and is therefore the preferred layout from an aquatic perspective. It is highly recommended that the final layout be amended to avoid an appropriate buffer area as well as investigate other locations for the packaging plant that are a lower risk to Stream B. At present, the project will not qualify for GA and will need to go through the water use licence application process with the BGCMA for authorisation.

10 REFERENCES

ARMITAGE, N., VICE, M., FISHER-JEFFES, L., WINTER, K., SPIEGEL, A., & DUNSTAN, J. 2013. Alternative Technology for Stormwater Management: *The South African Guidelines for Sustainable Drainage Systems.* Report to the Water Research Commission. Pretoria

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.

COWDEN, C. & Kotze, D.C. 2009. WETRehabEvaluate: Guidelines for monitoring and evaluating wetland rehabilitation projects. WRC Report No TT 342/09, Water Research Commission, Pretoria.

CSIR (Council for Scientific and Industrial Research). 2010. National Aquatic Ecosystem Priority Areas (NFEPA). Council for Scientific and Industrial Research, Pretoria, South Africa.

DAY, L., ROWNTREE, M., & KING, H. 2016. The Development of a Comprehensive Manual for River Rehabilitation. WRC Report No TT 646/15. Water Research Commission, Pretoria.

Department of Water Affairs (DWA), 2014. Reserve Determination Studies for the Selected Surface Water, Groundwater, Estuaries and Wetlands in the Gouritz Water Management Area: Desktop EcoClassification Report. Prepared by Scherman Colloty & Associates cc. Report no. RDM/WMA16/00/CON/0213.

Department of Water Affairs (DWA), 2010. Resource Directed Measures: Reserve Determination studies for selected surface water, groundwater, estuaries and wetlands in the Outeniqua catchment: Ecological Water Requirements Study – Main Report: Outeniqua Reserve Study (K10-K50, K60G). Report No. RDM/K000/02/CON/0907.

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.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2007. Internal Guideline: Generic Water Use Authorisation Application Process

Department of Water Affairs (DWA), 2014. *Reserve Determination Studies for Surface Water, Groundwater, Estuaries and Wetlands in the Gouritz Water Management Area:* Desktop EcoClassification Report. Prepared by Scherman Colloty & Associates. Report no. RDM/WMA16/00/CON/0213.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2009. DWAF Training Manual: National Water Act Section 21(c) and (i) Water Uses. Version: November 2009.

DRIVER, A., NEL, J.L., SNADDON, K., MURRAY, K., ROUX, D.J., HILL, L., SWARTZ, E.R., MANUEL, J. AND FUNKE, N. 2011. *Implementation Manual for Aquatic Ecosystem Priority Areas. Report to the Water Research Commission*. Pretoria

DWAF. 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa

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

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.

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

MACFARLANE, D.M. and Bredin, I.P. 2016. Buffer zone guidelines for rivers, wetlands and estuaries. Part 2: Practical Guide. WRC Report No (tbc), Water Research Commission, Pretoria.

MACFARLANE, D.M., KOTZE, D.C., ELLERY, W.N., WALTERS, D., KOOPMAN, V., GOODMAN, P. & GOGE, C. 2008. WET-Health: A technique for rapidly assessing wetland health, Version 2.

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

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

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

SOUTH AFRICAN NATIONAL PARKS. 2014. Outeniqua National Park: State of Knowledge. South African National Parks unpublished report.

TURPIE J; Taljaard S; van Niekerk L; Adams J; Wooldridge T; Cyrus D; Clark B; & Forbes N. 2013. The Estuary Health Index: A standardised metric for use in estuary management and the determination of ecological water requirements. WRC Report No 1930/1/12.

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 (Grasses, Resticios, Sedges, Rushes, Bulrushes, Eriocaulons and Yellow-eyed grasses). WRC Report No. TT 459/10.

11 ANNEXURE (METHODOLOGIES)

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.

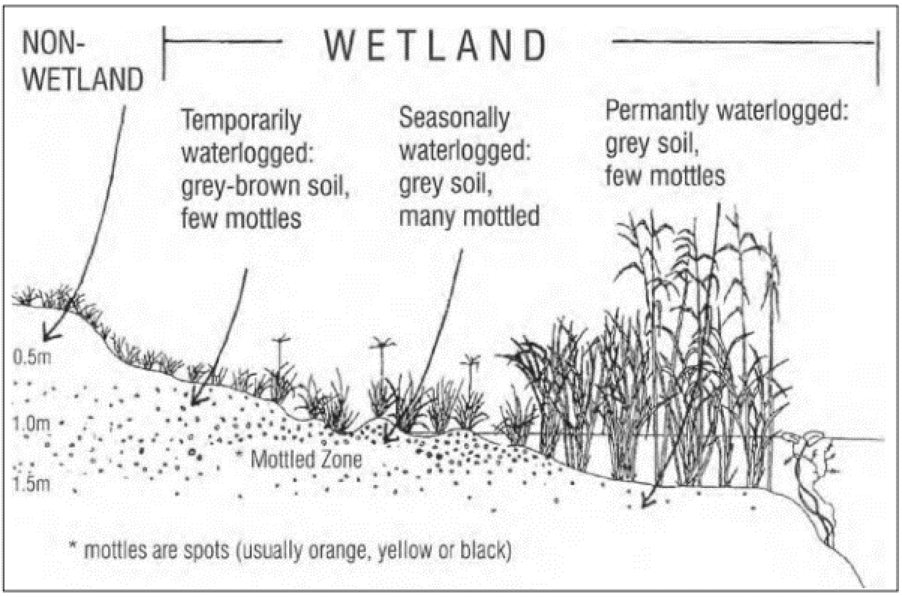


Figure A11.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

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 A11.1a)

A11.1a: 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 A11.1b: 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.

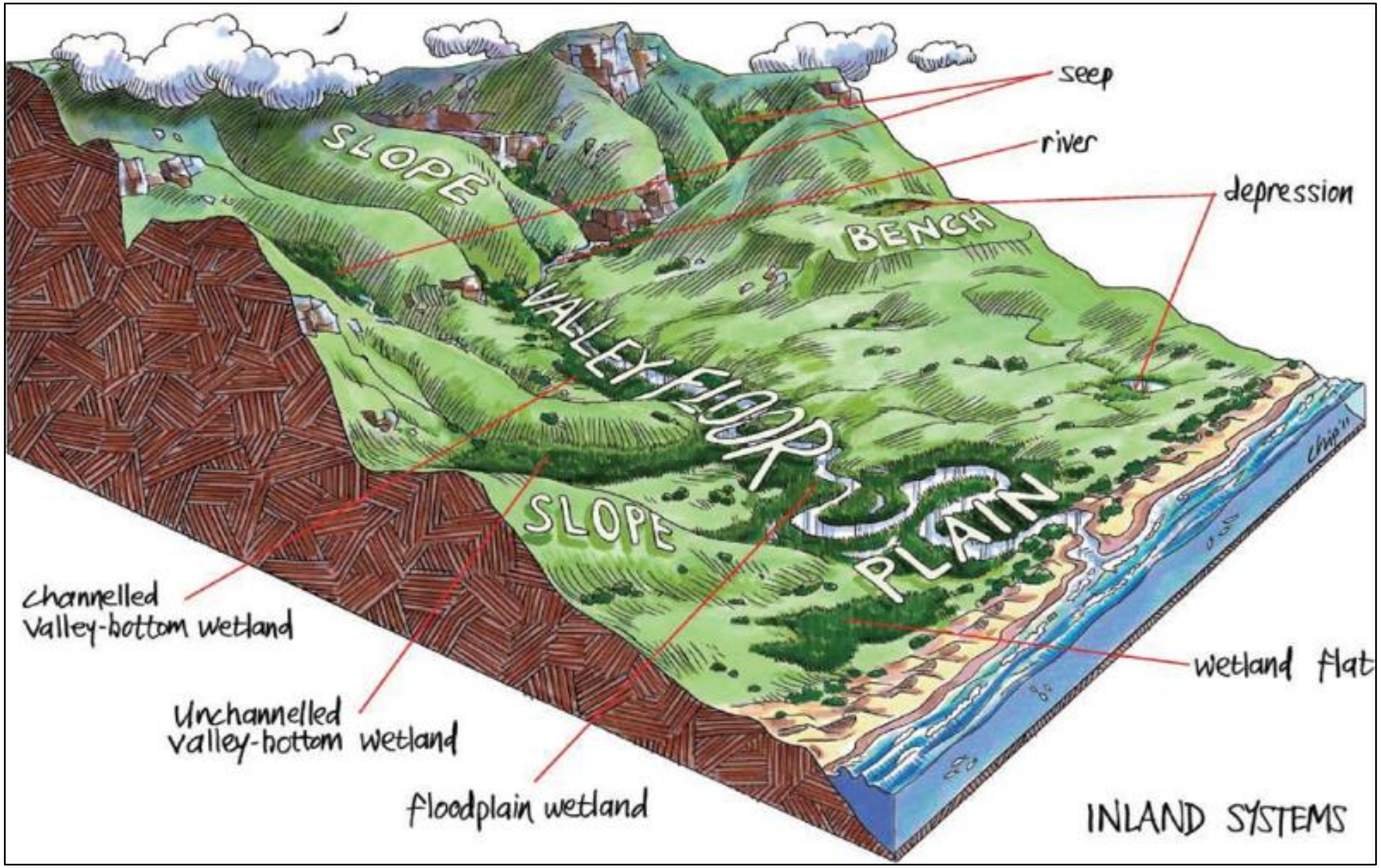


Figure A11.1b: Illustration of wetland types and their typical landscape setting (From Ollie <u>et al.</u> 2013)

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 8). 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 (Figure 2), 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.

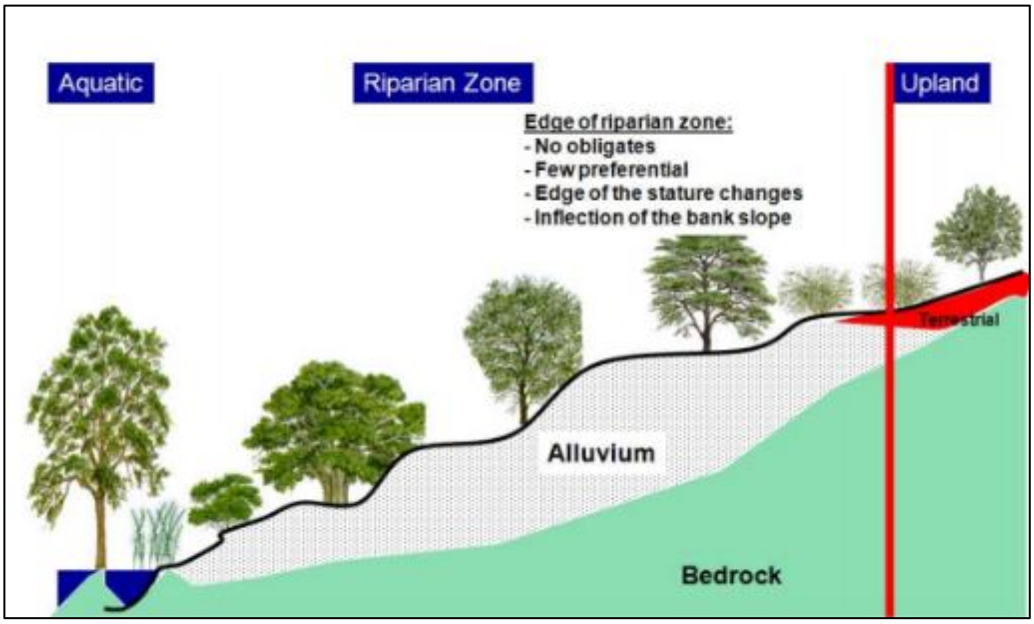


Figure A11.2a: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. (DWAF 2008).

11.3 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 A11.6a) 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 A11.6a: 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 A11.6b).

Table A11.6b: 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.

11.4 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 A11.7a).

Table A11.7a: 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

The scores assigned to the criteria in Table A11.7a were used to rate the overall EIS of each mapped unit according to Table A11.7b, 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 A11.7b: 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

11.5 Direct, Indirect and Cumulative Impacts Methodology

Direct, indirect and cumulative impacts should be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration**, wherein it will be indicated whether:
  - The lifetime of the impact will be of a very short duration (0-1 years) –a score of 1.
  - The lifetime of the impact will be of short duration (2-5 years) –a score of 2;
  - Medium term (5-15 years) – assigned a score of 3;
  - Long-term (> 15 years) – assigned a score of 4; or
  - Permanent – assigned a score of 5.
- The **magnitude**, quantified on a scale of 0-10, where:
  - 0 is small and will have no effect on the environment,
  - 2 is minor and will not result in an impact on processes,
  - 4 is low and will cause a slight impact on processes,
  - 6 is moderate and will result in processes continuing but in a modified way,
  - 8 is high (processes are altered to the extent that they temporarily cease), and
  - 10 is very high and results in complete destruction of patterns and processes.
- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5, where:
  - 1 is very improbable (probably will not happen),
  - 2 is improbable (some possibility, but low likelihood),
  - 3 is probable (distinct possibility),
  - 4 is highly likely (most likely) and;
  - 5 is definite (impact will occur regardless of any prevention measures).
- The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources; and
- The degree to which the impact can be mitigated.
- The significance is calculated by combining the criteria in the following formula, **S = (E+D+M) P**:
  - S = significance weighting
  - E = extent
  - D = duration
  - M = magnitude
  - P = probability
- The significance weightings for each potential impact are as follows:
  - <30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop the area),
  - 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
  - >60 points: High (i.e. where the impact must have an influence on the decision process to develop the area).

12 ANNEXURE: ALIEN INVASIVE PLANT CONTROL

Table showing control options for likely alien invasive plants species (Adapted from Day et al. 2016)

Acacia cyclops (Rooikrans)		**Manual:** Hand pulling or hoeing of seedlings or saplings. Grubbing, hoeing and digging out of immature stage up to 2 m. Felling and cutting of stump to the ground for larger mature trees. **Bio-Control:** Indigenous field mice eat the seeds. Rooikrans seed weevil. Flower galler (*Dasineura dielsi* Rubsaamen). Seed feeder (*Melanterius servulus*).
Acacia mearnsii *(Black Wattle)*		**Manual:** Hand pulling of seedlings or saplings <40 cm. Grubbing. Hoeing. Digging of immature trees up to 2 m. Felling used for large mature trees. Ringing, ring of 10 cm width in large plants. **Chemical:** Seedlings – Mamba, Garlon 4, Viroaxe. Tree stumps – Timbrel 3A. **Bio Control:** Stump fungus *(Cylindrobasidium laeve)* applied to freshly cut stumps. Seed weevil (*Melanterius maculates*).
Arundo donax (Spanish Reed)		**Manual:** Repeated removal. Cutting of stalks. However, cut stalks can re-root and manual methods generally unsustainable. **Chemical:** 3Apply MAMBA or Nexus GLYPHOSATE 360 Reg. NO L7113: Act /Wet no 36/ 1947. This is a broad spectrum herbicide so applicable in dense monospecific stands. Ideally use as foliar spray, just before winter (as this is the time that translocation in plant nutrients to the root-mass takes place in preparation for winter dormancy and toxin transfer to roots is most effective. If stands too dense for good foliar application, cut stems and then apply as foliar to resprouting material – but note that cut material may resprout and transfer to roots less effective as cutting stimulates stem growth. If mixed stands, use GLYPHOSATE 360, on cut stems, but note less effective.

Lantana camara		**Manual:** Hand pulling of seedlings or saplings. Grubbing or hoeing of small patches. Cutting is ineffective as plant coppices use of herbicides needed. Large infestation should be crushed or rolled with brush cutters then stumps treated with herbicides. **Chemical:** Seedlings/ saplings – Mamba/Kilo Touchdown / Access. Mature tree stumps – Chopper / Access/ Timbrel 3A. **Bio Control:** Flower galler (Aceria *lantanae* Cook). Leaf miner (*Calycomyza lantanae*). Leaf sucker (Falconia intermedia). Leaf feeder (*Hypena laceratalis* Walker). Leaf miner (*Octotoma scabripennis* Guerin-Meneville). Leaf miner (*Ophiomyia camarae* Spencer). Seed miner (*Ophiomyia lantanae*). Leaf & flower sucker (*Teleonemia scrupulosa* Stal). Leaf miner (*Uroplata girardi* Pic).
Pennisetum Clandestinum (Kikuyu grass)		**Manual:** hand pull by roots; kikuyu often associated with raised fill / disturbed areas – removal will reduce invasion opportunities; Inclusion of hard paths on upland edge of river, buffer or wetland provides hard management edge from which to manage invasion and also reduces to some extent root spread **Chemical:** Spray with Roundup ® while grass is actively growing (not when dormant) and follow up spray any regrowth after 4 months.
Rubus spp (Bramble)		**Chemical:** Mamba max – most effective in autumn when downward sap movement.

Cirsium vulgare (Scottish Thistle)		**Manual:** hand pull
Hedychium gardnerianum (Kahili ginger lily)		**Manual:** hand pull

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Attention: Betsy Ditcham
Sharples Environmental Services cc

3 December 2019

RE: FRESHWATER STATEMENT ON THE PRE-APPLICATION DRAFT BASIC ASSESSMENT REPORT FOR DEVELOPMENT OF HEROLD'S BAY COUNTRY ESTATE

The freshwater assessment report dated March 2019 assessed two development layout alternatives for the Herald's Bay Estate development. It was determined that the development would have a low impact upon freshwater habitat and ecological processes after the implementation of a 32m buffer zone and the recommended mitigation measures. However, additional information has been generated since the compilation of the freshwater report. This letter serves to provide freshwater comment on the aspects of the preferred alternative, presented within the Pre-Application Basic Assessment Report, that were not included within the previous freshwater assessment. The main aspects that require additional comment include:

1. The recommended aquatic buffer area will not be adhered to. The layout encroaches into the buffer area, especially in the south western corner where the petrol station is proposed. Buffer areas are key mitigation measures for housing developments such as this. They slow surface runoff from the hardened surfaces to introduce it into the environment in a manner that does not cause erosion. Buffers are also filter strips that assist in trapping nutrients and other pollutants before they enter the natural environment. Therefore, as the layout of the Pre-App BAR encroaches into buffer area, the proposal will not obtain a low impact rating, as previously anticipated.

2. The details and location of the sewage infrastructure was not previously available for assessment. The pipeline routes have since been proposed and, at times, the infrastructure is located within the buffer zone. While it is ideal to keep all infrastructure outside of the buffer area, a buried pipeline (provided it is outside freshwater habitat) is unlikely to cause any habitat disturbance (after mitigation), and if rehabilitation is conducted properly it will have no physical impact during the operational phase. The only concern is associated with the potential for water pollution due to leakages. However, the pipeline has been routed as close to the setback lines as possible and this activity is not deemed as unacceptable.

3. There will be three package plants on the property, two near freshwater habitats, that will reuse water for irrigation (after being pumped into a pond and flowing towards the dam). This does however result in pollution risks if the plants are not effective and release effluent of poor quality into the environment. The dam is already nutrient rich, indicated by the growth of the aquatic invasive alien plant Hyacinth, and the effluent from the package plant must be monitored appropriately.

4. It is recommended that the commercial area be set further back from the watercourse (as per previous recommendations), as it is currently not only within the aquatic buffer, but within riparian habitat. Additionally, there are more impacts associated with the specific land uses proposed in this area. But the Engineering Report does provide for the mitigation of some of these impacts (such as grease trap at the restaurant). The infilling of this area and approx. 3m retaining wall required for this area does increase the impact significant level.

Therefore, the impact significance of the proposal upon freshwater habitat has increased since the freshwater assessment report dated March 2019. But, although the impacts are no longer determined as Low, the impacts are not deemed to be unacceptable (following mitigation) and the proposal will not cause any significant habitat loss. The Table below is a summary of the impact assessment of the preferred alternative of the Pre-App Draft BAR (including the new information). There are no impacts associated with the No Go Alternative.

Phase	Impact	Mitigation	Significance
Construction Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	**Medium**
		With Mitigation	**Low - Medium**
	Erosion & sedimentation	Without Mitigation	**Medium**
		With Mitigation	**Medium**
	Water Pollution	Without Mitigation	**Medium**
		With Mitigation	**Low - Medium**
	Flow modification	Without Mitigation	**Medium**
		With Mitigation	**Low**
Operational Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	**Low**
		With Mitigation	**Low**
	Erosion & sedimentation	Without Mitigation	**Medium**
		With Mitigation	**Medium**
	Water Pollution	Without Mitigation	**Medium**
		With Mitigation	**Low - Medium**
	Flow modification	Without Mitigation	**Medium**
		With Mitigation	**Low**

Kind regards

Debbie Fordham
Freshwater Ecologist