EnviroSwift

Where nature meets development

Freshwater Assessment:

Louw's Bos, Farm RE/502, Stellenbosch, Western Cape

Prepared for:

Stellenbosch Municipality

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June 2019

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Executive Summary

EnviroSwift Western Cape has been appointed to undertake a specialist freshwater assessment of the freshwater features on Louw's Bos Farm, the remaining extent of Farm 502 in Stellenbosch (RE/502), Western Cape (refer to Figure 1 for location). The freshwater assessment is required to inform the Basic Assessment process undertaken in terms of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) regulations (GN326 of 2017) and the application for a water use authorisation in terms of Section 21 of the National Water Act (NWA, 1998).

Stellenbosch Municipality proposes establishment of a memorial park of approximately 70ha on Louw's Bos, Farm RE/502, Stellenbosch. Farm RE/502 is a 707ha tract of land owned by Stellenbosch Municipality and the proposed site falls within the southern portion of the farm, south of Annandale Road. An early alternative was investigated briefly within the northern portion of the farm and the assessment of Desktop Background Information, Wetland Delineation, Present Ecological State, Ecological Importance and Sensitivity and Ecosystem Services included the northern portion of the farm and its watercourses, but the viability of this alternative was ruled out due to freshwater constraints noted in an early draft of this report. A preferred layout and alternative layout have therefore been provided by the applicant within the southern portion of the farm and only impacts related to these layouts are assessed in this report.

Existing agricultural activities, primarily viticulture and cattle farming, are prevalent throughout Farm RE/502, including the proposed site. Annandale Road intersects Farm RE/502 South, and both layouts abut the road to the south. The proposed memorial park development will include the following:

- Construction of hardened infrastructure including a chapel, office, columbarium, gathering spaces, a nursery, maintenance workshop, staff accommodation, public toilets, roads, paved areas and hardened pathways (approximately 15ha);
- Installation of graves (approximately 15ha); and
- Landscaping of the cemetery and of a parkland including a small forest and informal parkland of mixed fynbos vegetation and indigenous trees for shade and screening where appropriate with cleared, unmade pathways in between (40ha). A small (~.28ha) is also proposed upslope of the hardened infrastructure within the landscaped area.

Desktop Assessment

The proposed site lies within the Berg Water Management Area (WMA), the Lower Berg Sub-WMA and the G22H quaternary catchment. It is characterised by Critically Endangered Swartland Granite Renosterveld and Swartland Silcrete Renosterveld terrestrial vegetation types (Mucina and Rutherford, 2009, updated 2012); and Critically Endangered wetland vegetation types West Coast Granite Renosterveld and West Coast Silcrete Renosterveld according to the National Freshwater Ecological Priority Areas (NFEPA, 2011).

The NFEPA (2011) project indicates the presence of a number of artificial and natural wetlands, namely channelled and unchanneled valley bottom and bench flat wetlands, within and adjacent to the Farm The National Geospatial Information Service (NGI) indicates the Bonterivier, a non-perennial river north-north east of Farm RE/502 South and south-south west of Farm RE/502 North. Smaller non-perennial drainage lines extend into both RE/502, North and South, from Bonterivier.

The Western Cape Biodiversity Spatial Plan (WCBSP, 2017) highlights large tracts of Aquatic Type 2 Ecological Support Areas (ESA's 2) within, as well as along, the northern boundary of Farm RE/502 South. ESA's Type 2 are also prevalent within, as well as along, the southern and northern boundary of Farm RE/502 North.

The proposed site falls within the southern portion of the farm and only a small portion of the Bonterivier channelled valley bottom wetland was indicated within the proposed site.

Freshwater Assessment Results

Hand augering within the Farm RE/502 was conducted to determine the presence or absence of hydromorphic soil indicators, and therefore the temporary wetland boundary. Hydromorphic features including mottling, leaching and organic streaking were found in areas within the proposed site correlating with the Aquatic Type 1 ESA's indicated by the WCBSP (2017). In addition to soil indicators,

several wetland obligate plant species were found. The resultant wetland delineations for Farm RE/502 North and South are presented in Figures A and B below:

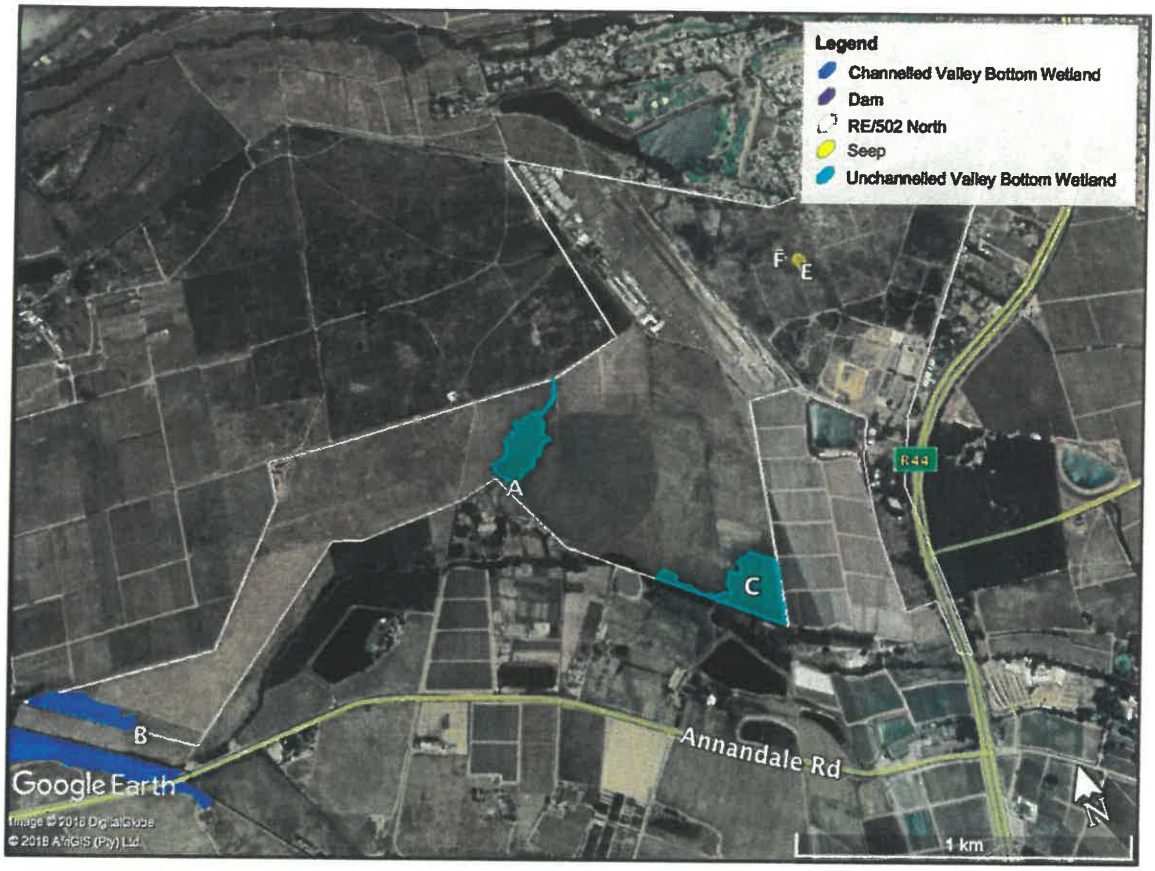

Figure A: Wetland delineations on Farm RE/502 North. A, B, C and D are with reference to the paragraphs that follow the figures.

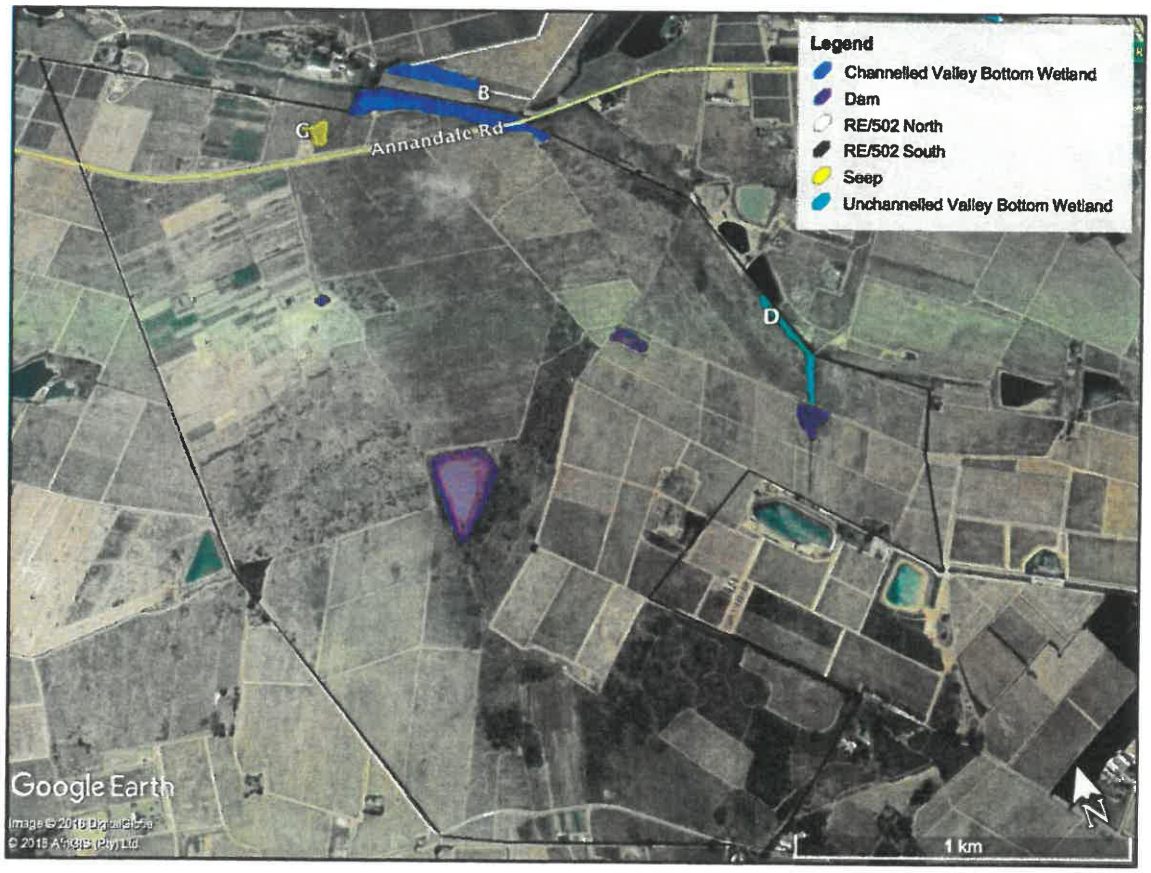

Figure B: Wetland delineations on Farm RE/502 South.

Wetlands A, C, and D were classified as unchanneled valley bottom wetlands, Wetland B was classified as a channelled valley bottom wetland, and Wetland E, F, and G were classified as seeps. In addition, four off-stream dams were delineated on within the proposed site.

After careful consideration of all feasible options for the development layout plans, it is the opinion of the specialist that only Wetland B, is likely to be impacted should the development be authorised. All other watercourses identified are separated from the proposed development by topography or by existing hydrological barriers such as roads. As a result, only Wetland B was assessed in detail.

Wetland B was determined to have a Present Ecological State (PES) within Category D, had a 'Moderate' Ecological Importance and Sensitivity (EIS) and was found to provide Ecosystem Services primarily in the categories of Phosphate, Nitrate, and Toxicant assimilation.

Impact Assessment

Four impacts were assessed given the information presently available for the Preferred and Alternative Layouts on Farm RE/502 South, with and without essential mitigation measures applied. The results are presented in the table below:

Table A: Impact assessment results

Impact 1: Altering the natural flow regime and hydrological zonation					
Construction Phase					
Preferred Layout: Without mitigation	Medium	Local	Short term	Medium	Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Medium	Very Low (-ve)
Alternative Layout: Without mitigation	High	Local	Long term	High	Medium (-ve)
Alternative Layout: With mitigation	Medium	Local	Short term	High	Low (-ve)
Operational Phase					
Preferred Layout: Without mitigation	Very Low	Local	Long term	High	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Long term	High	Very Low (+ve)
Alternative Layout: Without mitigation	High	Local	Permanent	High	High (-ve)
Alternative Layout: With mitigation	Medium	Local	Long term	High	Medium (-ve)
Impact 2: Impact on Water Quality					
Alternatives	**Intensity**	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
Construction Phase					
Preferred Layout: Without mitigation	Medium	Local	Short term	Medium	Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Medium	Very Low (+ve)
Alternative Layout: Without mitigation	High	Local	Short term	High	Medium (-ve)
Alternative Layout: With mitigation	Medium	Local	Short term	High	Low (-ve)
Operational Phase					
Preferred Layout: Without mitigation	Low	Local	Long term	High	Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Long term	High	Very Low (+ve)
Alternative Layout: Without mitigation	Medium	Local	Long term	High	Medium (-ve)
Alternative Layout: With mitigation	Low	Local	Long term	High	Low (-ve)
Impact 3: Wetland Habitat Degradation and Loss					

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Construction Phase					
Preferred Layout: Without mitigation	Low	Local	Short term	Medium	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Low	Very Low (-ve)
Alternative Layout: Without mitigation	High	Local	Permanent	Medium	High (+ve)
Alternative Layout: With mitigation	High	Local	Permanent	Medium	High (+ve)
Operational Phase					
Preferred Layout: Without mitigation	Very Low	Local	Long term	Medium	Very Low (+ve)
Preferred Layout: With mitigation	Low	Local	Long term	Medium	Low (+ve)
Alternative Layout: Without mitigation	Low	Local	Long term	Medium	Very Low (-ve)
Alternative Layout: With mitigation	Very Low	Local	Long term	Medium	Very Low (-ve)
Impact 4: Impact on Biota					
Alternatives	**Intensity**	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
Construction Phase					
Preferred Layout: Without mitigation	Very Low	Local	Short term	Medium	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Medium	Very Low (-ve)
Alternative Layout: Without mitigation	Low	Local	Short term	Medium	Low (-ve)
Alternative Layout: With mitigation	Low	Local	Short term	Medium	Low (-ve)
Operational Phase					
Preferred Layout: Without mitigation	Very Low	Local	Long term	Medium	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Long term	Medium	Very Low (+ve)
Alternative Layout: Without mitigation	Low	Local	Long term	Medium	Low (-ve)
Alternative Layout: With mitigation	Low	Local	Long term	Medium	Low (-ve)
'No Go' Scenario					
	Intensity	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
No Development	Very Low	Local	Permanent	Medium	Very Low (-ve)

No additional cumulative or indirect impacts were identified.

Conclusion and Recommendation

Watercourses within the Farm RE/502 North and South were identified and natural watercourses delineated. A single portion of Wetland B, the Bonterivier was identified as potentially being impacted by the proposed development given the Preferred and Alternative layouts within the proposed site within Farm RE/502 South, and was therefore assessed for PES, EIS and EcoServices.

A freshwater impact assessment was then conducted for the two proposed layouts within the proposed site. The primary difference between the Preferred and Alternative Layouts is that the entrance road in the Alternative Layout traverses part of Wetland B, while in the Preferred Layout no infrastructure encroaches on Wetland B and space is also made available for the 15m buffer zone.

Construction of the road within Wetland B in the Alternative Layout would result in loss of wetland habitat and severe disruption of hydrology. It may also result in increased sediment load due to erosion of infill

used in constructing the road and would most likely result in wetland fauna (particularly amphibian and invertebrate) mortalities, resulting in High and Medium (negative) significance ratings for these impacts.

The Preferred Layout by contrast received a similar or significantly lower impact rating for every impact, with or without mitigation. The impact significance ratings for the construction phase were never higher than Very Low (negative) for the Preferred Layout, with mitigation. The current (pre-construction) land-use has impacted Wetland B significantly and the Preferred Layout would, in the operational phase with mitigation, result in an improvement over the current state in every impact category evaluated and the impact ratings were Very Low or Low (positive) for all four impacts.

No cumulative or indirect impacts were identified. A slow decline was found to be most likely in the case of the 'No Go' scenario, and the Preferred Layout is therefore the lowest impact option of all. It is therefore recommended that the proposed development be implemented in accordance with the Preferred Layout with implementation of all essential mitigation measures and that the necessary environmental and water use authorisations be granted.

Contents

List of Figures

List of Tables

Disclaimer

EnviroSwift (Pty) Ltd has exercised all due care in the reviewing of all available information. The wetland assessment provided are entirely reliant on the accuracy and completeness of the provided specialist studies as well as professional judgement. EnviroSwift (Pty) Ltd does not accept responsibility for any errors or omissions in the assessment and therefore does not accept any consequential liability arising from commercial decisions made, which are based on the information contained in this report. Opinions presented in this report apply to conditions/site conditions applicable at time of review and those conditions which are reasonably foreseeable.

Glossary[1]

Alluvial soil: A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.

Biodiversity: The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.

Buffer: A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.

Catchment: The area contributing to runoff at a particular point in a river system.

Chroma: The relative purity of the spectral colour which decreases with increasing greyness.

Critical Biodiversity Areas: Areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.

Delineation (of a wetland): To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.

Ecoregion: A recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region.

Ephemeral stream: A stream that has transitory or short-lived flow.

Groundwater: Subsurface water in the saturated zone below the water table.

Habitat: The natural home of species of plants or animals.

Hue (of colour): The dominant spectral colour.

Hydromorphic soil: A soil that, in its undrained condition, is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).

Hydrology: The study of the occurrence, distribution and movement of water over, on and under the land surface.

[1] Adapted from DWA (2005) and WRC Report No. TT 434/09.

Hydrophytes:	Also called obligate wetland plants - plants that are physiologically bound to water where at least part of the generative cycle takes place in the water or on the surface.
Halophytes:	Salt tolerant plants.
Helophytes:	Also called facultative wetland plants - essentially terrestrial plants of which the photosynthetically active parts tolerate long periods of submergence or floating on water.
Indicator species:	A species whose presence in an ecosystem is indicative of particular conditions (such as saline soils or acidic waters).
Intermittent flow:	Flows only for short periods.
Macrophyte:	A large plant - in wetland studies usually a large plant growing in shallow water or waterlogged soils.
Perennial:	Permanent - persisting from year to year.
Riparian area delineation:	The determination and marking of the boundary of the riparian area.
Riparian habitat:	Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils (deposited by the current river system) 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.
Shrub:	A shrub is a small to medium-sized woody plant.
Temporary zone:	The zone that is alternately inundated and exposed.
Terrain unit morphological classes:	Areas of the land surface with homogenous form and slope.
Watercourse (NWA):	(a) A river or spring; (b) A natural channel in which water flows regularly or intermediately; (c) A wetland, lake or dam into which or from which water flows; and (d) Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse.
Water table:	The upper surface of groundwater or that level below which the soil is saturated with water. The water table feeds base flow to the river channel network when the river channel is in contact with the water table.
Wetland:	An area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

Acronyms

CBA	Critical Biodiversity Area
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EIS	Ecological Importance and Sensitivity
FEPA	Freshwater Ecological Support Area
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
IHIA	Intermediate Habitat Integrity Assessment
MAP	Mean Annual Participation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
OESA	Other Ecological Support Area
PES	Present Ecological State
QDS	Quarter Degree Square

REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
Sub-WMA	Sub - Water Management Area
VEGRAI	Riparian Vegetation Response Assessment Index
WCBF	Western Cape Biodiversity Framework
WMA	Water Management Area
WUL	Water Use Licence

Specialist Details and Experience

Joshua Gericke (Pr.Sci.Nat. 117997)

Joshua holds a Bachelor of Science Honours degree in Environmental Management from the University of Cape Town and graduated in 2008. He has completed several short courses in freshwater, estuarine and coastal resource management and in identification of freshwater and marine fish, birds and plants. He has more than 8 years of experience in management of freshwater, estuarine and coastal systems with the City of Cape Town. He has also consulted periodically on topics related to freshwater, estuarine and coastal ecology and management since 2010, and in 2017 began consulting full time.

Jocelyn Anderson (Cand.Sci.Nat. Registration pending)

Jocelyn graduated from the University of Cape Town with a Bachelor of Science degree in Applied Biology, and Ecology & Evolution. She later went on to complete her honours in Environmental Management from the University of South Africa. Jocelyn has just over two years of experience working in the nature conservation field where she has honed her bird and plant identification skills. Jocelyn began consulting part-time in the beginning of 2018 and has working experience in wetland assessments, wetland delineations, and risk assessments.

Natasha van de Haar (Pr.Sci.Nat. 400229)

Natasha is a registered Professional Natural Scientist (Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (SACNASP). She also holds a Masters Degree in Science (M.Sc.) in the field of Botany. Over the course of Natasha's career, she completed a number of floral identification short courses and also obtained a certificate of competence for wetland assessments from Rhodes University. She is also a member of the South African Wetland Society, Botanical Society of SA as well as the Western Cape Wetlands Forum.

Her career kicked off as a field ecologist in 2009, focusing on floral biodiversity and ecological functioning, with special mention of wetland ecology and functioning within South Africa (all provinces). She further worked as a specialist project member in Mauritius, Lesotho and Ghana. During the course of her career she obtained extensive experience in conducting terrestrial as well as wetland related surveys in the mining, residential and infrastructure development industries as well as development of several alternative energy facilities. Natasha also gained experience in Biodiversity Offset Initiatives as well as RDL/protected plant permit applications. Presently her main focus is wetland assessments including delineation as well as present ecological state and function assessments.

1 Introduction

1.1 Project Background

EnviroSwift Western Cape has been appointed to undertake a specialist freshwater assessment of the freshwater features on Louw's Bos Farm, the remaining extent of Farm 502 in Stellenbosch (RE/502), Western Cape (refer to Figure 1 for location). The freshwater assessment is required to inform the Basic Assessment process undertaken in terms of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) regulations (GN326 of 2017) and the application for a water use authorisation in terms of Section 21 of the National Water Act (NWA, 1998).

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Existing agricultural activities, primarily viticulture and cattle farming, are prevalent throughout Farm RE/502, including the proposed site. Annandale Road intersects Farm RE/502 South, and both layouts abut the road to the south. The proposed memorial park development will include the following:

- Construction of hardened infrastructure including a chapel, office, columbarium, gathering spaces, a nursery, maintenance workshop, staff accommodation, public toilets, roads, paved areas and hardened pathways (approximately 15ha);
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- Landscaping of the cemetery and of a parkland including a small forest and informal parkland of mixed fynbos vegetation and indigenous trees for shade and screening where appropriate with cleared, unmade pathways in between (40ha). A small (~.28ha) is also proposed upslope of the hardened infrastructure within the landscaped area.

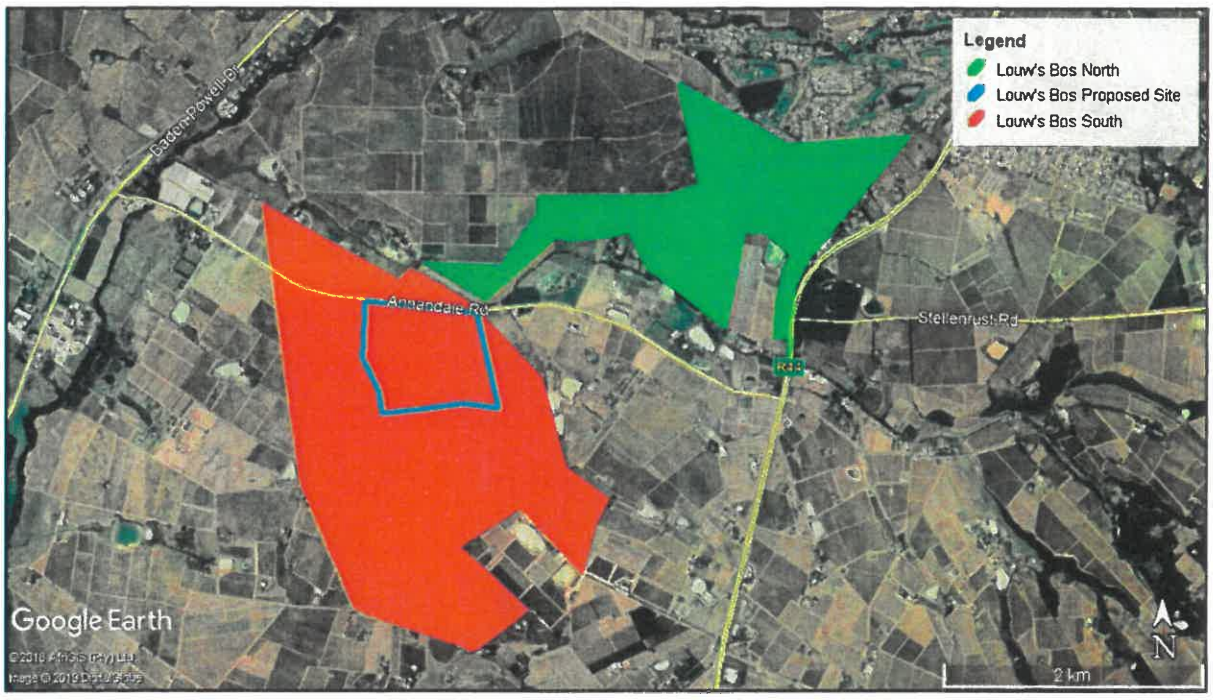

Figure 1: Louw's Bos, Farm RE/502 North and South in relation to its surroundings (Google Earth Pro, 2018). Note the position of the proposed site within Louw's Bos South.

LEGEND

A: Memorial Park Centre
- Chapel
- Offices & Storage
- Toilets
- Gathering Space

B: Service Zone
- Workshop & Storage
- Office
- Holding Nursery
- Staff Accomodation

C: Defined Zone
- Family & Groups
- Heroes Acre

D: Columbarium Zone
- Niche & Memorial Walls
- Floor Panels

E: Traditional Graves
- Headstones

F: Informal Zones
- Lawn Graves
- Trees as headstones
- Future Expansion
- Parkland

G: General parking

H: Bus/ taxi parking

I: Buffer Zone
- Fynbos Rehabilitation
- Environmental Education

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LOUW'S BOS
MEMORIAL PARK
STELLENBOSCH

DWG.110-C3 Revision 4 16-04-2019

OvP Associates . Landscape Architects
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C.K Rumboll & Partners . Town Planners
022 482 1845

Figure 2: Preferred Layout. Note central position of the entrance road.

Figure 3: Alternative Layout. Note position of the entrance on the far right.

1.2 Scope of Work

The scope of work which informed the Freshwater Specialist Assessment included:

- Assessment of relevant background information including the National Freshwater Ecological Database (NFEPA, 2011), the Western Cape Biodiversity Spatial Plan (WCBSP, 2017), the National Geospatial Information (NGI) Service topographical maps and vector data, and pertinent academic resources;
- A site assessment including delineation of the wetland boundary nearest the proposed development in accordance with best practice guidelines such as (Department of Water Affairs and Forestry - DWAF, 2008) and Job, et. al. (2009);
- Assessment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and wetland ecosystem services according to industry best practice methods;
- Assessment of freshwater impacts and development of mitigation measures; and
- Clarification of the potential freshwater legislative constraints applicable to the development.

1.3 Limitations and Assumptions

The following limitations apply to this study:

- Only natural watercourses within the proposed site were identified and delineated during the field survey. Off-stream dams and agricultural drainage channels were excluded from the assessment where they were deemed to be of entirely unnatural origins.
- A Garmin E-Trex 20 GPS was used to delineate natural watercourses within the proposed site and accuracy is therefore limited to the stated accuracy of the GPS of approximately 3m. All effort is made to improve on the stated accuracy including the use of the waypoint averaging function at the most critical points. It is however the opinion of the specialist that this limitation is of no material significance and that the freshwater constraints have been adequately identified.
- This study is limited to the upper 50cm of soil in accordance with the Updated Manual for Identification and Delineation of Wetland and Riparian Areas (Department of Water Affairs and Forestry - DWAF, 2008) and the Application of the DWAF (2008) Method to Wetland Soils of Western Cape (Job *et. al.* 2009).
- A single site assessment was conducted on 2 November 2018 during early Summer. Therefore, comments on hydrology are limited. However, this limitation is or isn't a concern and explain...
- The proposed site has undergone extensive transformation as a result of anthropogenic activities; therefore, it is the opinion of the specialist that the site can be considered a difficult case due to the degree of disturbance and the lack of natural vegetation.

1.4 Legislation

1.4.1 National Water Act (36 of 1998)

The purpose of the NWA is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors -
(g) protecting aquatic and associated ecosystems and their biological diversity; and
(h) reducing and preventing pollution and degradation of water resources.

In order to understand and interpret the Act correctly, the following definitions are applicable to this project:
``**pollution"** means the direct or indirect alteration of the physical, chemical or biological properties of a water resource;
``**protection",** in relation to a water resource, means -
(a) maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way;
(b) prevention of the degradation of the water resource; and
(c) the rehabilitation of the water resource;

``**resource quality**" means the quality of all the aspects of a water resource including -
(a) the quantity, pattern, timing, water level and assurance of instream flow;
(b) the water quality, including the physical, chemical and biological characteristics of the water;
(c) the character and condition of the instream and riparian habitat; and
(d) the characteristics, condition and distribution of the aquatic biota;
"watercourse" means -
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks; and
``**water resource**" includes a watercourse, surface water, estuary, or aquifer.

The NWA deals with pollution prevention, and in particular the situation where pollution of a water resource occurs or might occur as a result of activities on land. The person who owns, controls, occupies or uses the land in question is responsible for taking measures to prevent pollution of water resources. The measures may include measures to -
(a) cease, modify or control any act or process causing the pollution;
(b) comply with any prescribed waste standard or management practice;
(c) contain or prevent the movement of pollutants;
(d) eliminate any source of the pollution;
(e) remedy the effects of the pollution; and
(f) remedy the effects of any disturbance to the bed and banks of a watercourse.

Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence.

1.4.2 General Notice 509 (2016) of the NWA

According to GN509 of 2016 the extent of a watercourse means:
a) a river, spring or natural channel in which water flows regularly or intermittently "within the outer edge of the 1 in 100 year floodline or riparian habitat measured from the middle of the watercourse from both banks", and for b) wetlands and pans "within a 500 m radius from the boundary (temporary zone) of any wetland or pan" (when the temporary zone is not present then the seasonal zone is delineated as the wetland boundary), and for c) lakes and dams "purchase line plus a buffer of 50 m".

According to the GN509 a General Authorisation (GA) may be acquired for the use of water in terms of section 21 c and i of the NWA within the regulatory zone or extent of a watercourse where the Risk Class as determined by the new Risk Assessment Matrix is Low.

1.4.3 National Environmental Management Act (107 of 1998)

The NEMA states the following:

"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment."

The Act also makes special mention of the importance of the protection of wetlands:
"Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure."

2 Method of Assessment

2.1 Desktop Assessment

The scope of work includes a desktop assessment using available national and provincial databases including the Western Cape Biodiversity Spatial Plan (WCBSP, 2017), the National Freshwater Ecosystem Priority Areas project (NFEPA, 2011) and maps and vector data form the National Geospatial Information (NGI) directorate.

The WCBSP (2017) categorises natural features into Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), and Other Natural Areas (ONAs), which are defined in the plan as follows:

Table 1: WCBSP category definitions and management objectives.

MAP CATEGORY	DEFINITION	DESIRED MANAGEMENT OBJECTIVE	SUB-CATEGORY
Protected Area	Areas that are proclaimed as protected areas under national or provincial legislation.	Must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity. A benchmark for biodiversity.	n/a
Critical Biodiversity Area 1	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.	CBA: River CBA: Estuary CBA: Wetland CBA: Forest CBA: Terrestrial
Critical Biodiversity Area 2	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a functional, natural or near-natural state, with no further loss of natural habitat. These areas should be rehabilitated.	CBA: Degraded
Ecological Support Area 1	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Maintain in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.	ESA: Foredune ESA: Forest ESA: Climate Adaptation Corridor ESA: Coastal Resource Protection ESA: Endangered Ecosystem ESA: River ESA: Estuary ESA: Wetland ESA: Watercourse Protection ESA: Water Source Protection ESA: Water Recharge Protection
Ecological Support Area 2	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Restore and/or manage to minimise impact on ecological infrastructure functioning; especially soil and water-related services.	ESA: Restore from NN
ONA: Natural to Near-Natural	Areas that have not been identified as a priority in the current systematic biodiversity plan, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	Minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. Offers flexibility in permissible land uses, but some authorisation may still be required for high-impact land uses.	ONA: Natural to Near-Natural ONA: Degraded
No Natural Remaining	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructure functions, even if they are never prioritised for conservation action.	Manage in a biodiversity-sensitive manner, aiming to maximise ecological functionality. Offers the most flexibility regarding potential land uses, but some authorisation may still be required for high-impact land uses.	No Natural Remaining

2.2 Watercourse Identification and Delineation

A field survey was undertaken on the 2nd of November 2018.

For the purpose of the identification of water resources, the definition as provided by the NWA (Act no. 36, 1998) was used to guide the site assessment. The NWA defines a water resource as a watercourse, surface water, estuary or aquifer, of which the latter two are not applicable to this assessment due to an estuary being associated with the sea and, in line with best practice guidelines, wetland and riparian assessments only include the assessment of the first 50 cm from the soil surface, therefore aquifers

are excluded. In addition, reference to a watercourse as provided above includes, where relevant, its bed and banks.

In order to establish if the watercourses in question can be classified as 'wetland habitat' or 'river habitat', the definitions as drafted by the NWA (Act no. 36, 1998)[2] were taken into consideration:

- A 'wetland' is land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil; and
- 'Riparian' habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized 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'.

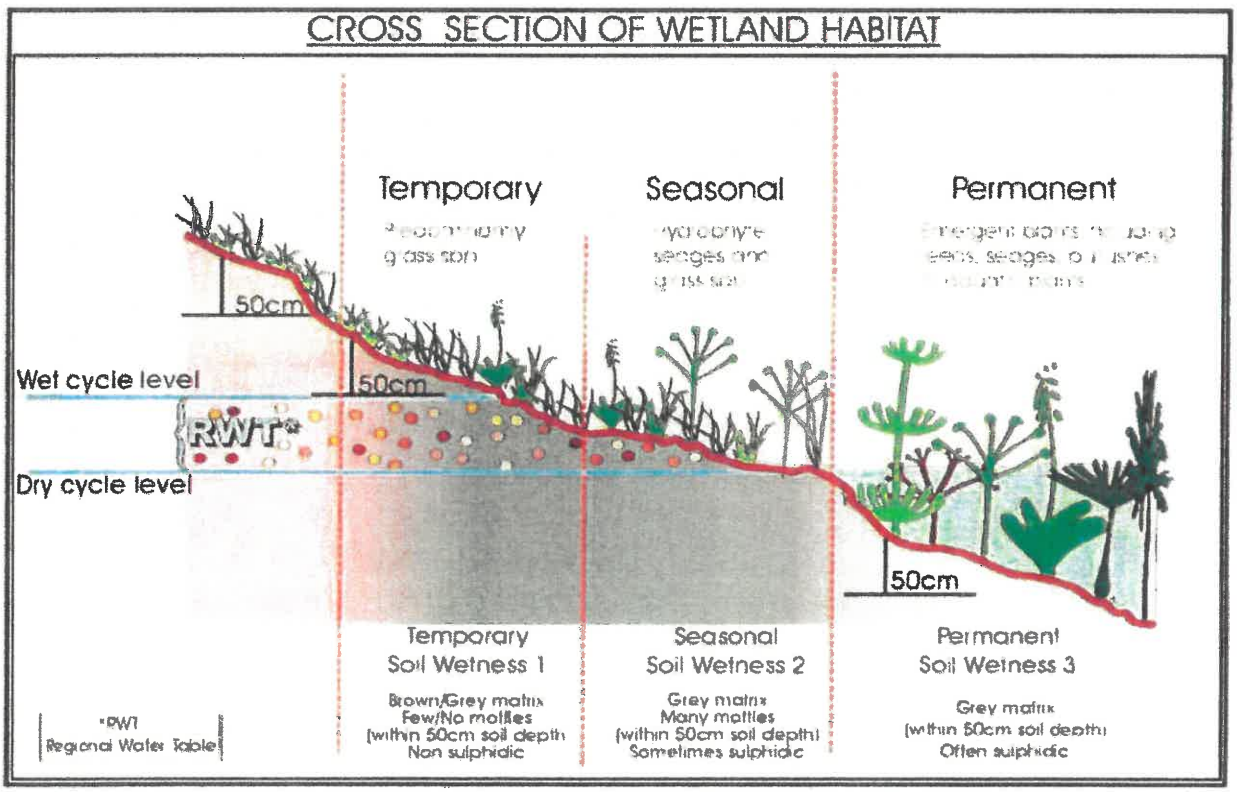
Freshwater habitat was identified with the use of the definitions provided above and the delineation took place according to the method supplied by DWAF (2005, updated 2008). Several indicators are prescribed in the watercourse delineation guideline to facilitate the delineation of either the temporary wetland zone or the rivers riparian zone.

Indicators used to determine the boundary of the wetland temporary zone include:

1) The position in the landscape;
2) The type of soil form;
3) The presence of wetland vegetation species; and
4) The presence of redoximorphic soil features, which are morphological signatures that appear in soils with prolonged periods of saturation.

Indicators used to determine the boundary of the riparian zone include:

1) Landscape position;
2) Alluvial soils and recently deposited material;
3) Topography associated with riparian areas; and
4) Vegetation associated with riparian areas.



[2] The definitions as provided by the NWA (Act No. 36 of 1998) are the only legislated definitions of wetlands in South Africa.

Figure 4: Cross section through a wetland (after DWAF, 2005).

Table 2: Vegetation characteristics used in the delineation of wetlands (after DWAF, 2005).

Terrestrial / Non wetland	Temporary	Seasonal	Permanent / Semi-permanent
Dominated by plant species which occur extensively in non-wetland areas; hydrophytic[3] species may be present in very low abundance	Predominantly grass species; mixture of species which occur extensively in non-wetland areas and hydrophytic plant species which are restricted largely to wetland areas	Hydrophytic sedge and grass species which are restricted to wetland areas	Dominated by emergent plants, including reeds, sedges and bulrushes or floating or submerged aquatic plants

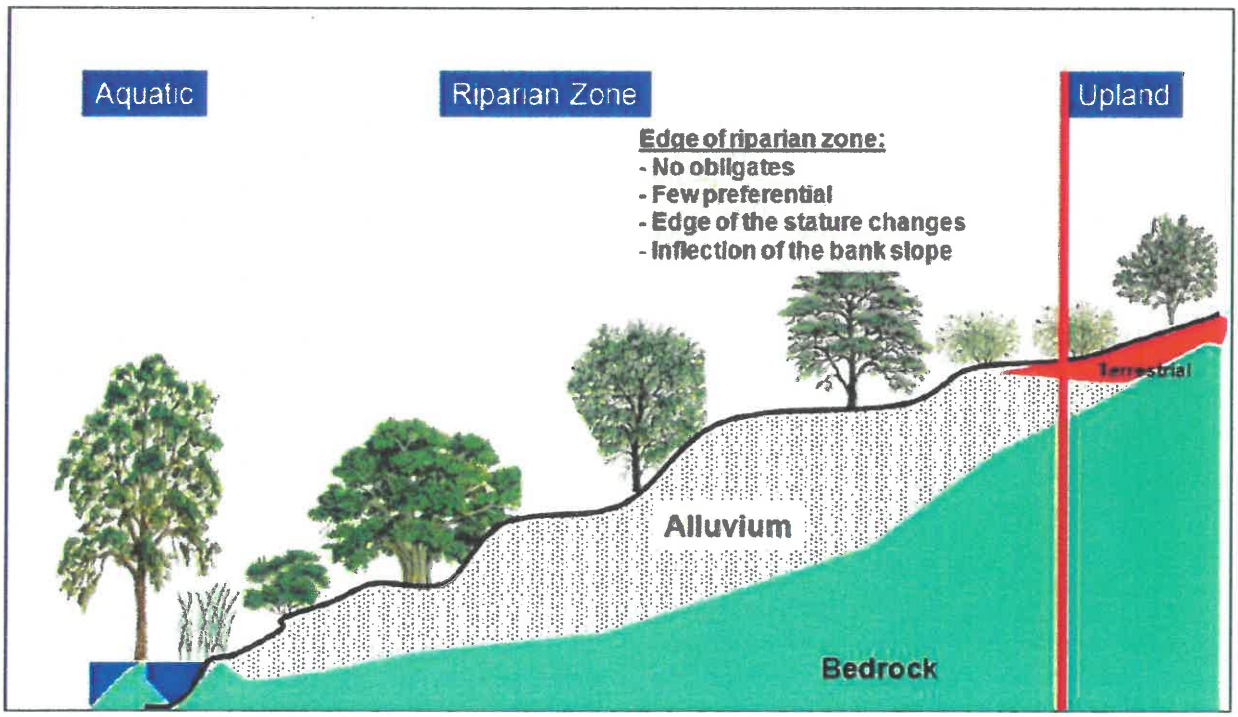


Figure 5: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river (DWA, 2008).

[3] Plants that are physiologically bound to water where at least part of the generative cycle takes place in the water or on the surface.

2.3 Freshwater Feature Classification

Ecosystems included within the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (hereafter referred to as 'the Classification System') developed by Ollis *et. al.*, (2013) encompass those that the Ramsar Convention defines, rather broadly, as 'wetlands', namely areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (cited by Ramsar Convention Secretariat, 2011). The inland component of the Classification System has a six-tiered structure presented in the figure below.

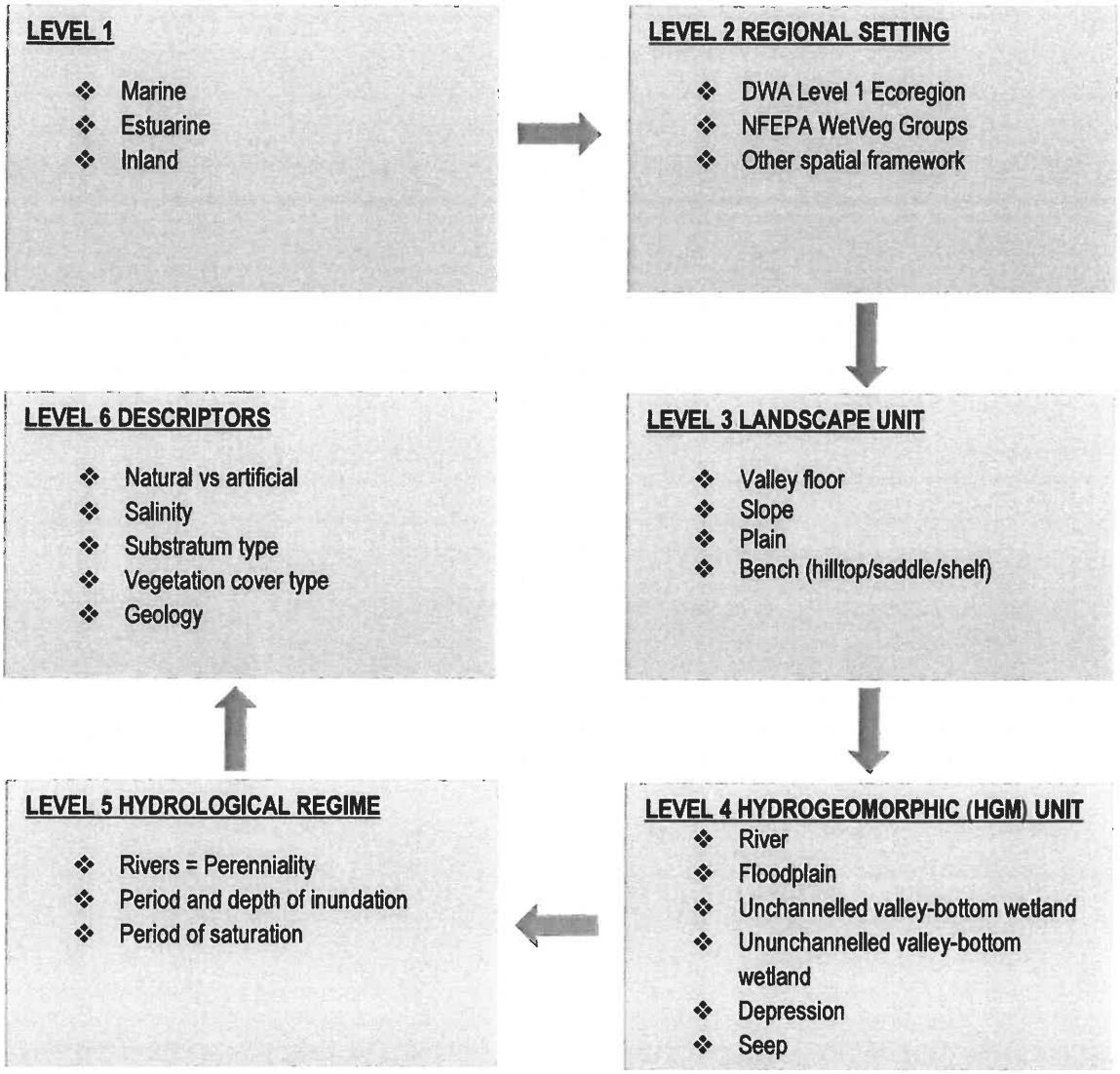


Figure 6: Classification System for wetlands and other aquatic ecosystems in South Africa.

2.4 Ecosystem Services

WET-EcoServices (Kotze *et. al.* 2007) was designed for inland palustrine wetlands and has been developed to help assess 15 key goods and services that individual wetlands provide in order to allow for more informed planning and decision making. Central to WET-EcoServices is the characterisation of Hydrogeomorphic (HGM) units by which the wetland can be divided into units of a similar character. The rationale behind characterising the HGM units of a wetland is that areas belonging to the same HGM type and falling within a similar geological and climatic setting are likely to have a similar structure and exhibit similar processes.

In addition, WET-EcoServices allows for the assessment of potential and actual ecosystem service outcomes of rehabilitation projects by applying the assessment to 'with rehabilitation' and 'without rehabilitation' situations and comparing the difference between the two.

2.5 Present Ecological State (PES)

WET-Health (Macfarlane, 2007) is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules. The modules may then be combined to determine an overall PES for the wetland. A Level 1 WET-Health assessment was undertaken as part of this assessment.

Table 3: PES classes

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

2.6 Ecological Importance and Sensitivity (EIS)

The EIS method applied to wetlands is based on the assessment tool developed by Rountree *et. al.* (2014) and was used to determine the ecological importance and sensitivity of wetlands, incorporating the traditionally examined criteria used in EIS assessments of other water resources by the Department of Water Affairs (DWA) and thus enabling consistent assessment approaches across water resource types.

Hydro-functional importance and basic human needs have been assessed as part of the WET-EcoServices and were therefore excluded. In the method a series of determinants are assessed on a scale of 0 to 4, where "0" indicates no importance and "4" indicates very high importance.

2.7 Recommended Ecological Category (REC)

The Recommended Ecological Category (REC) is determined by the PES score as well as importance and/or sensitivity. Water resources which have a PES falling within an E or F ecological category are deemed unsustainable. In such cases the REC must automatically be increased to a D. Where the PES is determined to be within an A, B, C or D ecological category, the EIS components must be evaluated to determine if any of the aspects of importance and sensitivity are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated and either set at the same ecological category or higher depending on feasibility. This is recommended to enable important and/or sensitive water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

2.8 Impact Assessment

A method of assessment summary is provided below; the detailed method is provided in Appendix 1.

The following criteria were taken into consideration when determining the impact of the proposed activities:

- The nature of the impact i.e. positive, negative, direct, indirect;
- The extent and location of the impact;
- The duration of the impact i.e. short term, long term, intermittent or continuous;
- The magnitude/intensity of the impact i.e. high, medium, low; and

- The likelihood or probability of the impact occurring.

Mitigation measures were subsequently identified and recommended for all impacts to reduce the overall impact significance to an acceptable level, where and if possible. Mitigation measures were aimed to ensure that:

- More environmentally sound designs / layouts / technologies, etc., are investigated and implemented, if feasible;
- Environmental benefits of a proposed activity are enhanced;
- Negative impacts are avoided, minimised or remedied; and
- Residual negative impacts are within acceptable levels.

3 Results

3.1 Desktop Assessment

3.1.1 Regional Setting

The proposed site is situated within the South Western Coastal Belt Ecoregion the main attributes of which are listed in Table 4 below. It is furthermore within the Berg Water Management Area (WMA), the Lower Berg Sub-WMA and the G22H quaternary catchment (NFEPA, 2011 and Kleinhans, 2005).

Table 4: Main attributes of the South Western Coastal Belt Ecoregion (Kleinhans, 2005)

Main Attributes	South Western Coastal Belt
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; **Plains Moderate Relief;** Closed Hills; Mountains; Moderate and High Relief.
Vegetation types (dominant types in bold) (Secondary)	Sand Plain Fynbos; Mountain Fynbos; **West Coast Renosterveld;** Dune Thicket; Strandveld Succulent Karoo
Altitude (m a.m.s.l) (Primary)	0-300; 300-900 limited
Mean annual precipitation (mm) (modifying)	0 to 1500
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	30 to 60
Rainfall seasonality	Winter
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	24 to 32
Mean daily max. temp. (°C): July	12 to 20
Mean daily min. temp. (°C): February	12 to 18
Mean daily min temp. (°C): July	4 to 10
Median annual simulated runoff (mm) for quaternary catchment	<5; 20 to >250

3.1.2 Local Setting

The proposed site is situated on the outskirts of the town of Stellenbosch. The area is nestled below the Hottentots Holland Mountain Catchment Area on a gentle gradient with a slope of between 0-10%.

It is expected to exhibit moderate temperatures and rainfall conditions that are typical of the South Western Coastal Belt Ecoregion.

The applicable terrestrial vegetation type is predominantly Swartland Granite Renosterveld with patches of Swartland Silcrete Renosterveld, both listed as Critically Endangered according to the WCBSP (refer to Figure 7). The NFEPA (2011) project's applicable Wetland Vegetation type is West Coast Granite Renosterveld and West Coast Silcrete Renosterveld (Figure 8), listed as Critically Endangered.

The local soil structure consists of undifferentiated soils with a marked clay accumulation, underlain by the Cape Granite suite. Additionally, soils may occasional include Quaternary quartz sand of the Springfontein Formation and alluvium, refer to Figure 9 (Cape Farm Mapper, 2018). Quartzitic sands, if encountered, are not expected to mottle readily (Job *et. al.*, 2009).

The main geographical attributes of the proposed site are summarised in Table 5 below and in the figures that follow.

Table 5: Main attributes applicable to the proposed site according to Cape Farm Mapper (2018).

Main Attributes	Farm RE/502, Stellenbosch
Terrain:	Slopes of between 0° and 3°.
Geology:	Cape Granite
Soils:	Forms: Plinthic catena, undifferentiated. Depth: 450 to 750mm Clay: 15% Erodibility: High
Vegetation types:	Swartland Granite Renosterveld and Swartland Silcrete Renosterveld. Refer to Figure 7.
Wetland vegetation types:	West Coast Granite Renosterveld and West Coast Silcrete Renosterveld. Refer to Figure 8
Altitude:	80 to 100m above mean sea level.
Mean annual precipitation:	666 mm
Mean annual temp:	16.5°C
Mean daily max. temp: February	27.6°C
Mean daily max. temp: July	17°C
Mean daily min. temp: February	15.2°C
Mean daily min temp: July	7°C
Median annual runoff	120.51 mm/annum

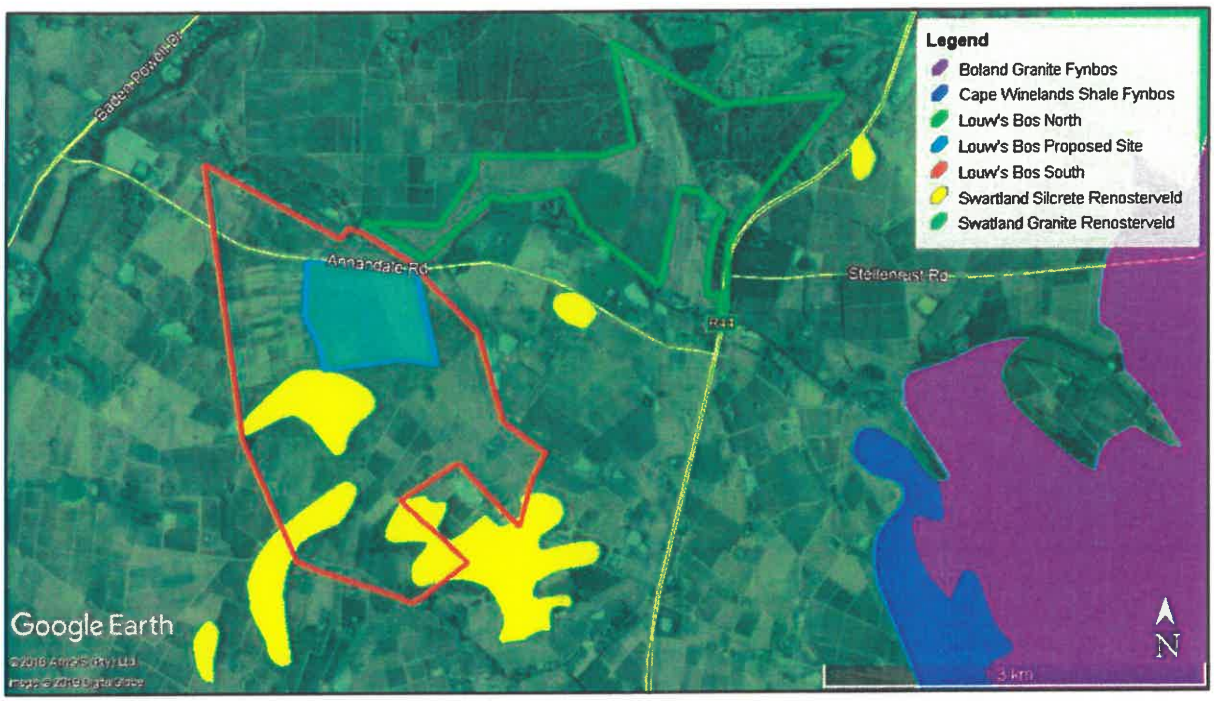


Figure 7: Terrestrial vegetation types according to Mucina and Rutherford (2009, updated 2012). Note that the proposed site falls within the Swartland Granite Renosterveld vegetation type.

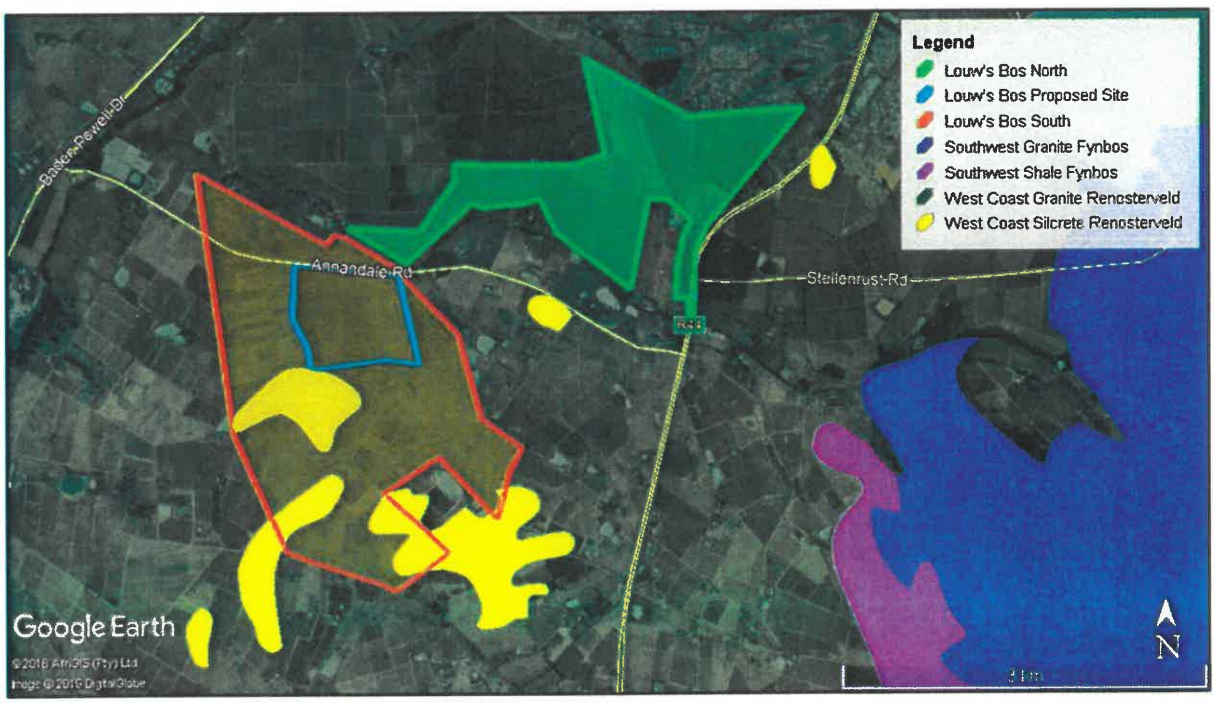


Figure 8: Wetland vegetation types according to NFEPA (2011). The proposed site falls within the West Coast Granite Renosterveld wetland vegetation type.

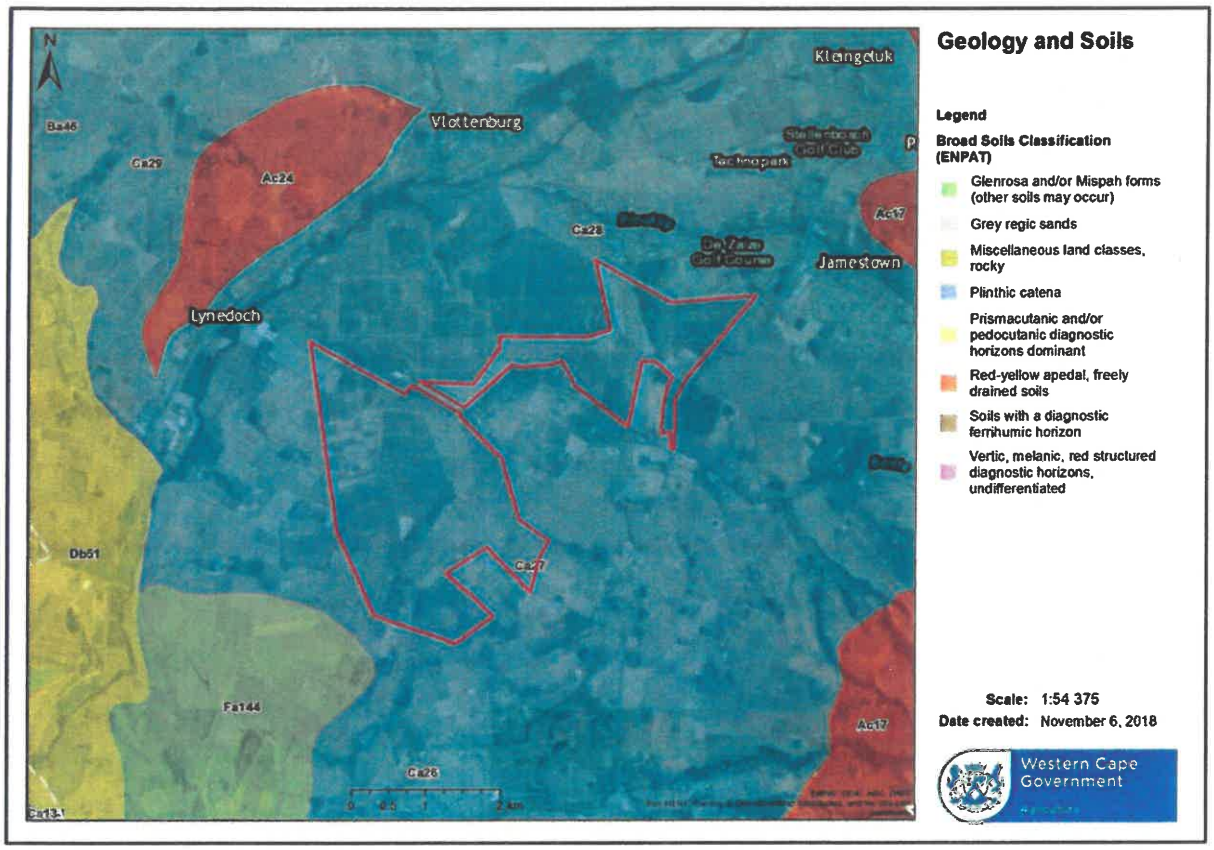


Figure 9: Geology and soils (Cape Farm Mapper, 2018).

3.1.3 Watercourses Within 500m

The NWA defines a regulated area of 500m around wetlands, within which risks to these wetlands must be considered. Additionally, the NWA requires that risks to rivers, streams and drainage lines are also considered within a regulated area defined by the 1:100-year floodline. Floodlines are not available in this case, so all known rivers, streams, drainage lines and wetlands, within 500m of the proposed site, according to the available desktop resources, are presented below.

The NFEPA (2011) project indicates the presence of a number of artificial and natural wetlands, namely channelled and unchanneled valley bottom wetlands as well as artificial bench flat wetlands, within and adjacent to the proposed site. In addition, the National Geospatial Information Service (NGI) indicates many of these artificial bench flat wetlands as dams. The NGI also indicates the Bonterivier, a non-perennial river north-north east of Farm RE/502 South and south-south west of Farm RE/502 North. Smaller non-perennial drainage lines extend into both RE/502, North and South, from Bonterivier (refer to Figure 10). Neither NFEPA nor NGI databases indicate any watercourses within the proposed site (Refer to Figure 11).

The WCBSP (2017) highlight large tracts of Aquatic Type 2 ESAs within, as well as along, the northern boundary of Farm RE/502 South. ESA's Type 2 are also prevalent within, as well as along the southern and northern boundary of Farm RE/502 North (refer to Figure 12). The only watercourse indicated by the WCBSP (2017) within the proposed site however is a small portion of Aquatic ESA Type 2 that overlaps the north-eastern corner (Refer to Figure 13).

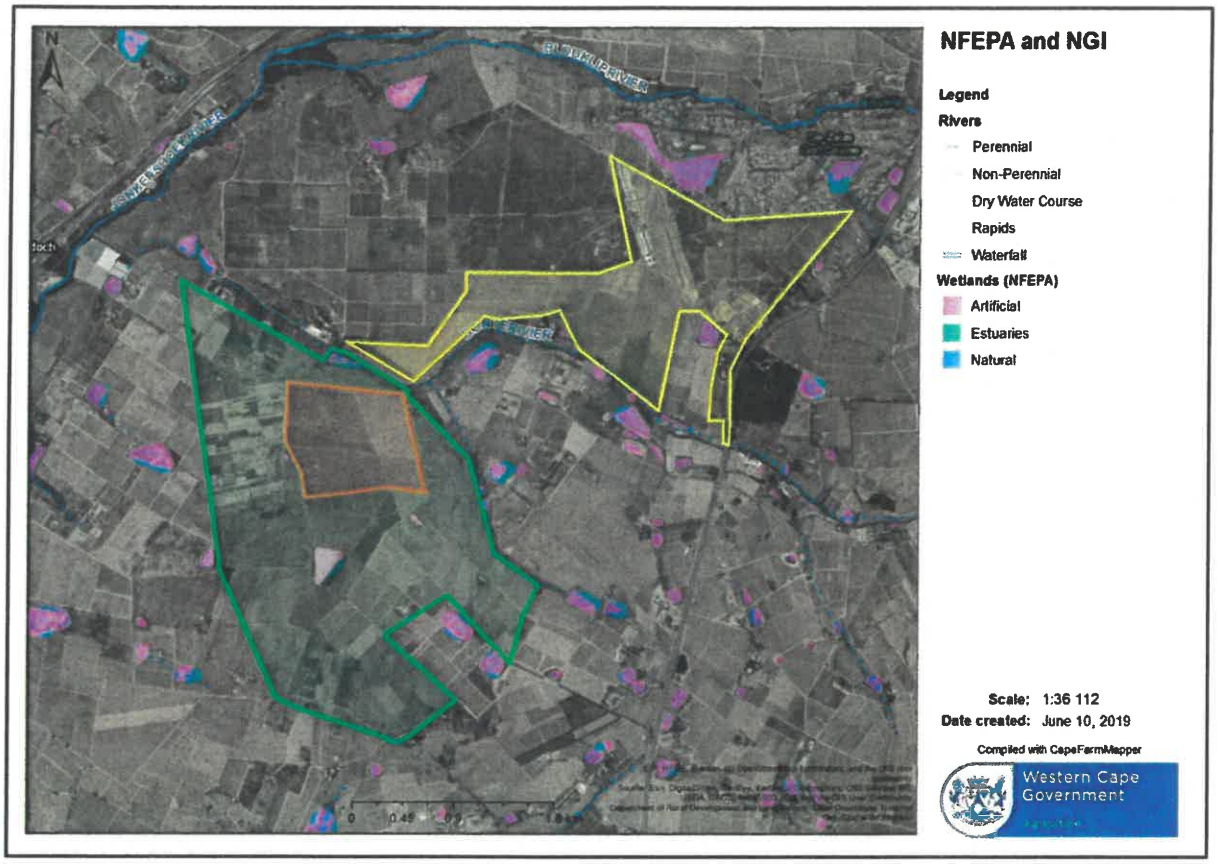


Figure 10: NFEPA (2011) wetlands and the NGI rivers and dams, Farm RE/502. Louw's Bos North is in yellow, South is in Green and the proposed site is in orange in Figures 10 to 14.

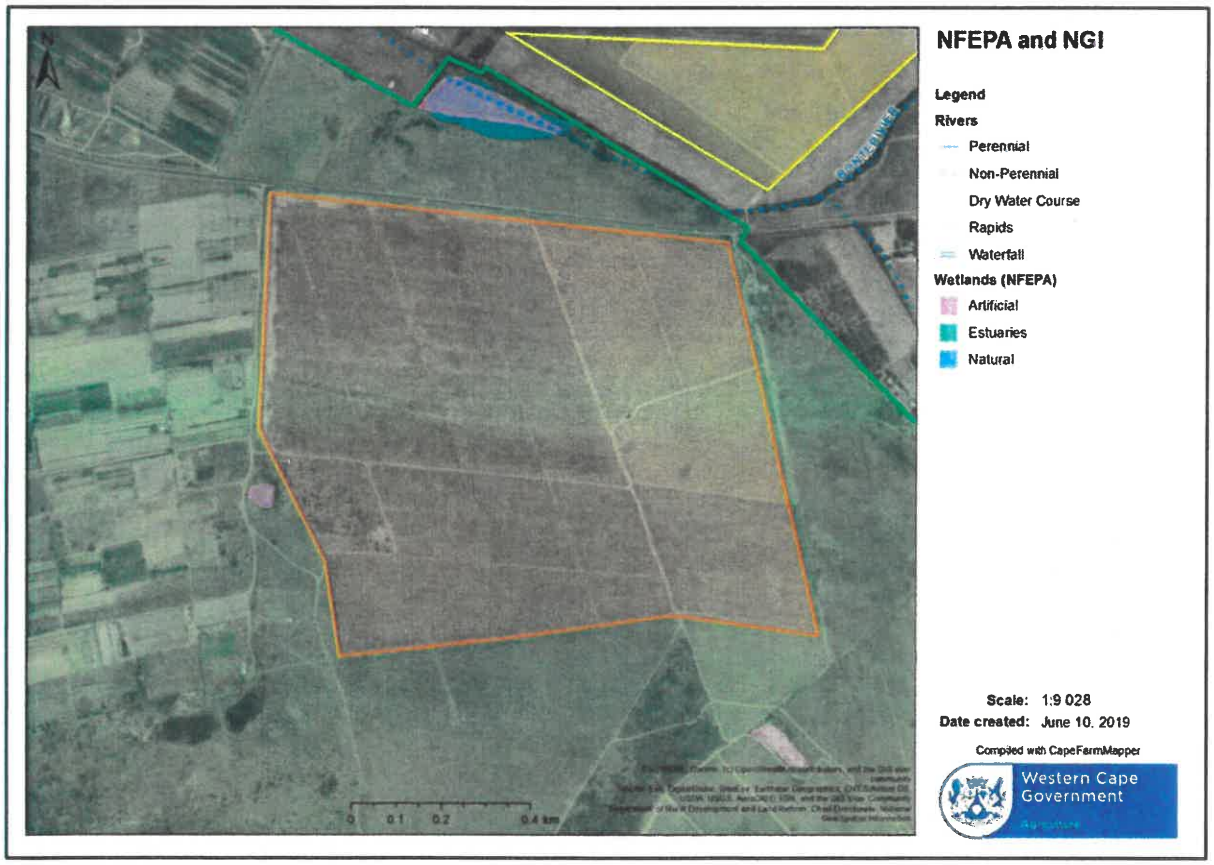


Figure 11: NFEPA (2011) wetlands and the NGI rivers and dams, proposed site. None are indicated within the proposed site.

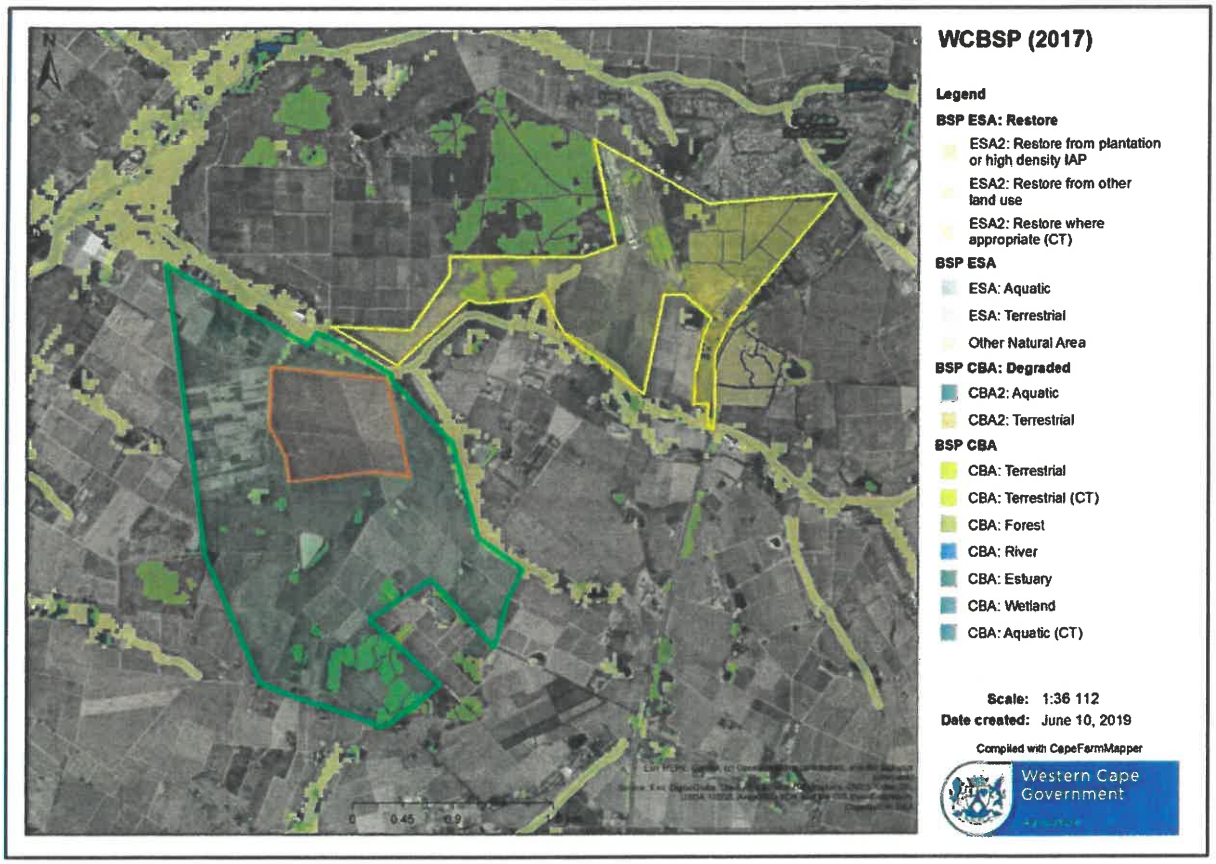


Figure 12: The WCBSP (2017) in and around Farm RE/502.

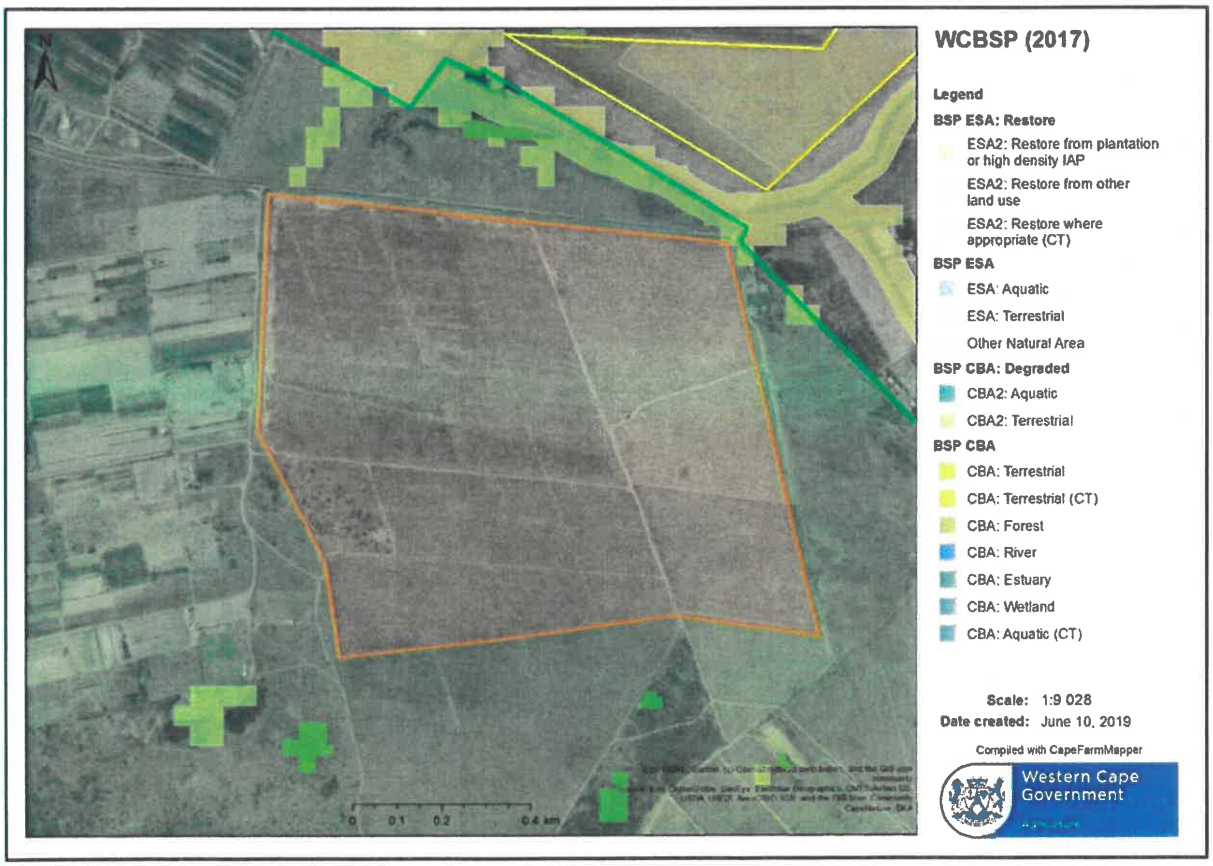


Figure 13: The WCBSP (2017) in and around the proposed site. Note the ESA2 watercourse that overlaps the north-eastern corner slightly.

3.2 Description of Onsite Watercourses

3.2.1 Hydromorphic Soils

Hand augering was conducted in and around the watercourse boundaries defined by the WCBSP (2017). All watercourses that were identified were found to exhibit hydromorphic soil indicators indicative of wetland conditions. Where wetland conditions were confirmed, augering was then conducted to locate and determine the outer temporary boundary of the wetland.

Soils encountered in terrestrial areas were typical of terrestrial conditions and presented as brown, uniform, and sandy with little organic matter. Terrestrial soil samples would not stay in the open auger head and were uniform and brown within the upper 50cm.

Soils sampled in wetland areas were found to be grey and sandy. Leaching, organic streaking and mottling was observed in soils sampled in wetland areas (refer to Figure 14 and Figure 15). Alluvial soils were encountered in some of the wetland soil samples augered in Farm RE/502 North (refer to Figure 15).

Figure 14: Mottled soil found within wetlands indicated by blue circles.

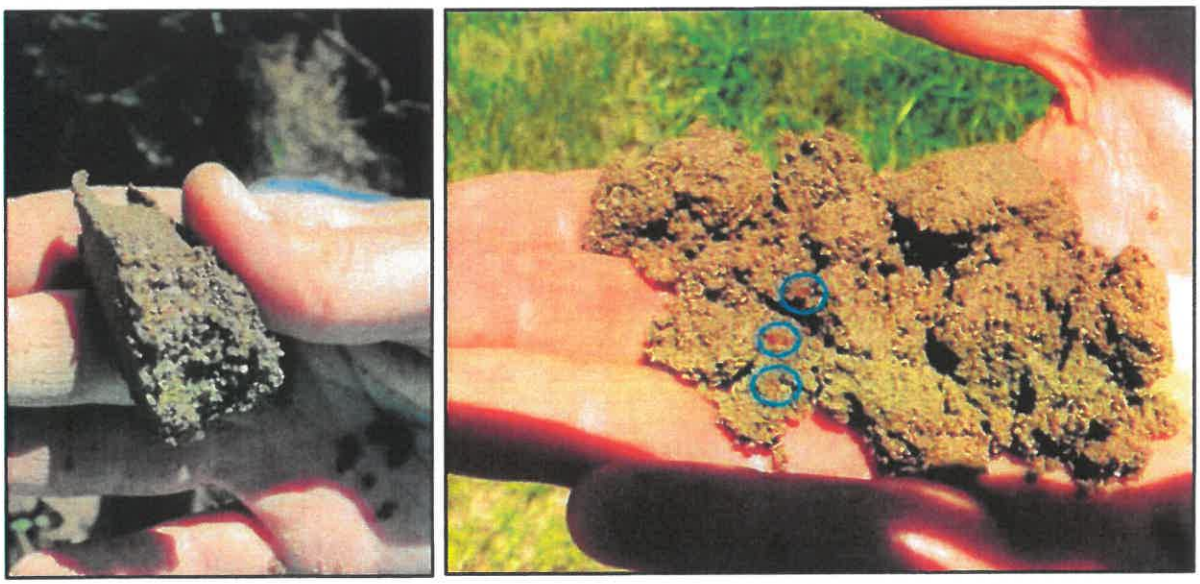


Figure 15: Sandy alluvial soils found within RE/502 North (left) and mottling, indicated by blue circles (right).

3.2.2 Hydrophytic Vegetation

Vegetation within the farm RE/502 was largely disturbed as a result of agricultural activities and was dominated by open pastures, wheat fields, and vineyards. Alien invasive species were encountered on site, predominantly on RE/502 South.

Where wetland soils were present, vegetation was dominated by *Restio quadratus*, *Pycreus polystachyos* (refer to Figure 16), *Juncus krausii*, *Pennisetum macrourum*, *Isolepis prolifera*, *Zantedeschia aethiopica*, *Typha capensis* (refer to Figure 16), *Phragmites australis*, and *Cyperus*

thunbergii in varying combination within the wetlands identified. The alien invasive *Arundo donax* was encountered frequently within the Bonterivier.

All of these species are known to occur in wetlands and the latter nine are listed as wetland obligate in either Appendix C of DWAF (2008) or in van Ginkel *et. al.* (2011).

Figure 16: *Pycreus polystachyos* (circled in blue) (left) and *Typha capensis* (right).

Figure 17: View of wetland vegetation and pastures on Farm RE/502.

3.3 Watercourse Delineation

A site-based delineation of watercourses was undertaken on 2 November 2018, during which all freshwater habitat was considered characteristic of wetlands. Therefore, the method advocated by DWAF (2005, updated 2008) for the delineation of wetland temporary zones was followed. The presence of mottling, gleying, leaching, elevated organic content, hydrophytic vegetation, and soil hydrology within the upper 50cm of the soil were all used in varying combinations as indicators of the wetland temporary zone boundaries.

All natural wetlands and artificial wetland conditions associated with off-stream farm dams were delineated. Agricultural drainage channels that in the opinion of the specialist were of entirely artificial origins were not delineated.

Delineated wetlands throughout most of the proposed site correlated largely with the WCBSP (2017) wetlands layer. In total 5 wetlands were delineated within the proposed site (refer to Figure the bullet points below summarise the number, type and location of each HGM unit identified:

- Two wetland seeps north-east of the aerodrome on RE/502 North, and one north-north west of Annandale Road on RE/502 South; labelled E, F, and G.
- One unchanneled valley bottom south of Annandale Road RE/502 South and two within the south-south west portion of RE/502 North; labelled A, C, and D.
- One channelled valley bottom wetland that coincides with the indicated Bonterivier, was delineated directly south and north of Annandale Road on Farm RE/502, labelled B. It should be noted that the channelled valley bottom was only delineated within RE/502 North and South

as per the terms of reference, and not within Farm 557, Stellenbosch that separates RE/502 North and South at this point. The delineation is therefore fragmented, but in reality represents two portions of a single system (refer to Figure 18 and Figure 19). Therefore, although fragmented, wetland B was assessed as one HGM unit.

A small wetland indicated by the WCBSP (2017) within Farm RE/502 South just to the northwest of the large central dam was not found despite an extensive search. Four artificial off-steam dams and associated wetland habitat were however delineated on Farm RE/502 South (refer to Figure 19).

Dams, and wetlands labelled: D, E, F, and G, were not included in the assessment as they would not, in the opinion of the specialist, be impacted by any of the development layouts proposed (including the preferred and alternative layouts presented and all earlier layouts evaluated for suitability) due to the, topography and hydrological barriers such as Annandale Road. Therefore, wetlands A, B, and C were the only watercourses assessed in detail. Surface water was only present within the impounded portion of Wetland A and within the Bonterivier (Wetland B).

Note that only a small portion of the Wetland B (the Bonterivier Channelled Valley Bottom Wetland) falls within the proposed site. Wetlands A and C would potentially have been impacted by the early layout evaluated within Louw's Bos North but are not at risk of impact from the current Preferred and Alternative Layouts that fall within the proposed site. Wetlands A and C were assessed for PES, EIS and Ecosystem Services and the results of these assessments are included below, but they will not be assessed in the impact assessment.

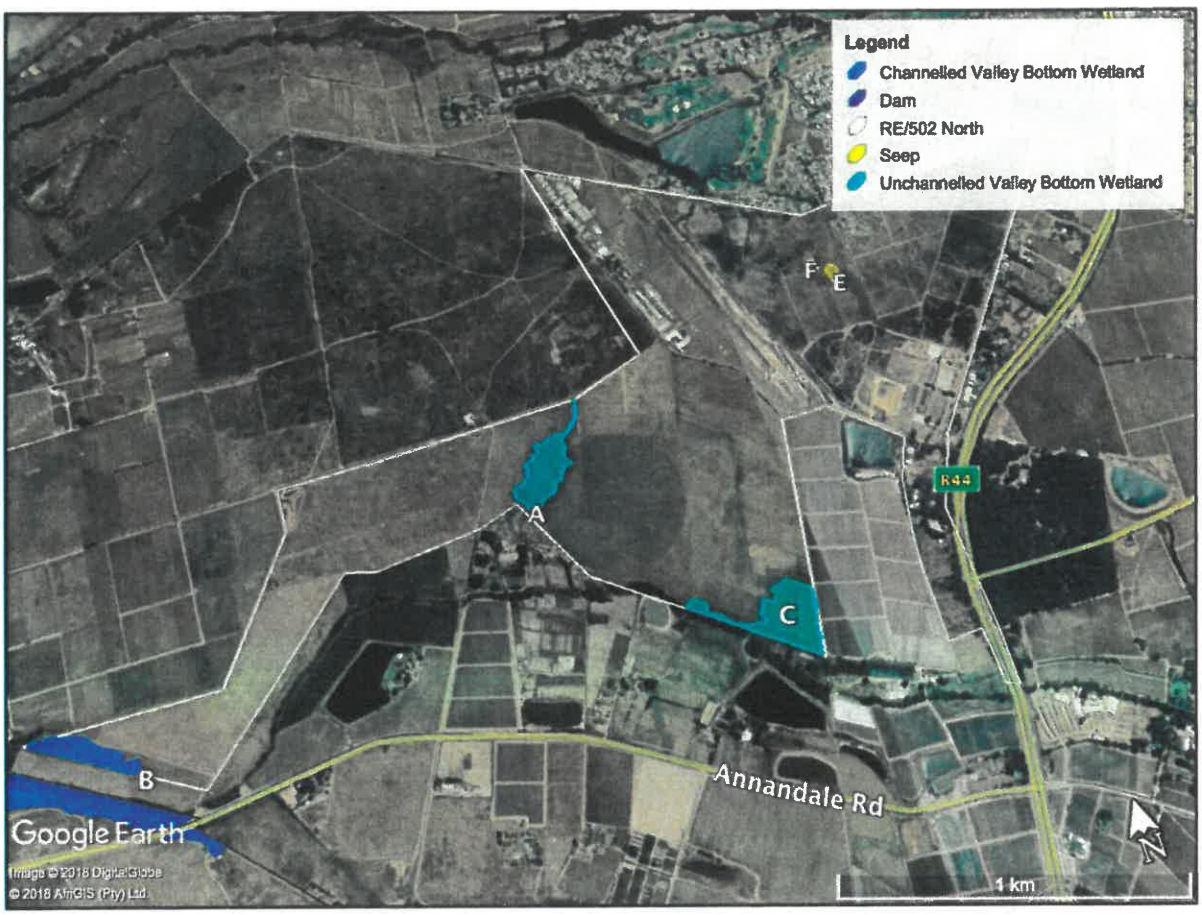


Figure 18: Wetland and dam delineations on Farm RE/502 North.

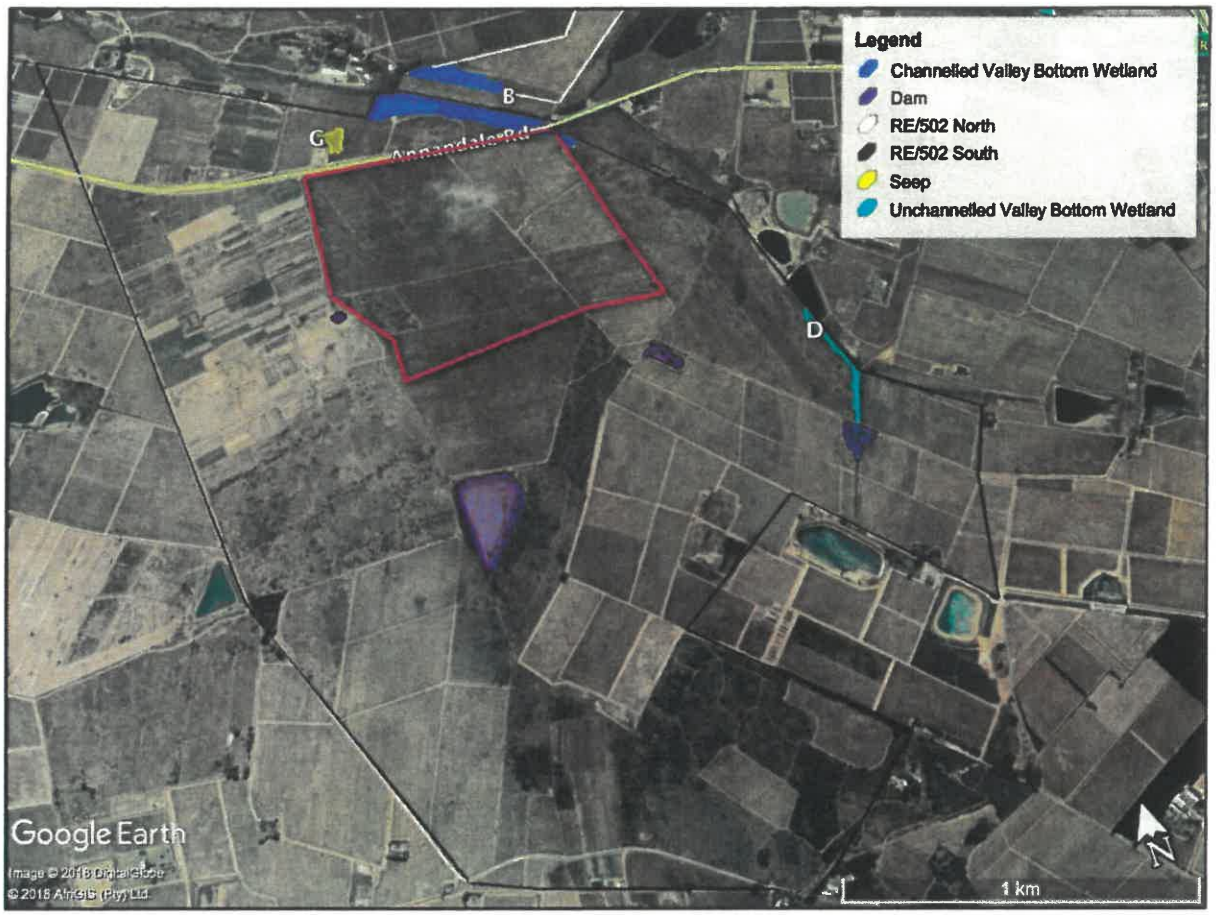


Figure 19: Wetland and dam delineations on Farm RE/502 South. Note that only a small portion of the channelled valley bottom wetland along the Bonterivier falls within the proposed site.

3.4 Freshwater Feature Classification

The proposed site falls within the South Western Coastal Belt Ecoregion, the Berg Water Management Area (WMA) and the Lower Berg sub-Water Management Area (sub-WMA) as defined by NFEPA (2011). The table below summarise the results from **Level 3** through to **Level 6** of the wetland and aquatic ecosystem classification user manual (Ollis *et. al.* 2013). Attributes of watercourses A, B and C are represented in Table 6 below. Photographs of each of the three wetlands are included as Figures x, y and z below.

Table 6: Level 3, 4, 5 and 6 of the wetland and aquatic ecosystem classification

Level 3 (Landscape Setting)	**Valley floor**: the base of the valley, situated between two distinct valley side slopes, where alluvial or fluvial processes typically dominate. (**Wetlands A, B and C**)
Level 4 (Hydrogeomorphic unit)	**Unchannelled valley-bottom wetland**: a valley-bottom wetland without a river channel running through it. (**Wetlands A and C**) **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it. (**Wetland B**)
Level 5 (Hydrological regime)	**Permanently inundated**: with surface water present throughout the year, in most years. (**Wetland B**) **Seasonally inundated**: with surface water present for extended periods during the wet season/s (generally between 3 to 9 months duration) but drying up annually, either to complete dryness or to saturation. (**Wetlands A and C**)
Level 6 (Descriptors)	**Natural**: existing in, or produced by nature; not made or caused by humankind. (**Wetlands A, B and C**)

3.5 Ecosystem Services

The WET-EcoServices tool (Kotze *et. al.*, 2007) was applied to the two unchannelled valley bottom wetlands (labelled A and labelled C) and the channelled valley bottom wetland (labelled B) found within the proposed site in its present, predevelopment state.

Fifteen Ecosystem Services were assessed and the results are presented in Figure 20 and in Table 7. Brief explanations of the most noteworthy results are provided below:

- The highest score for any category for each of the three wetlands was between 2.4 and 2.6, so none of the wetlands scored highly in any category.
- The three wetlands all scored zero for Harvestable Natural Resources, Provision of Cultivated Foods, Cultural Significance and Tourism, Recreation and Scenic Value categories.
- The three wetlands all scored relatively highly for the assimilation of phosphates, nitrates and toxicants, partly because the wetland types are rather effective in this role, but also because the agricultural land use in the three catchments provide relatively high levels of these substances.
- Wetland B scored higher than Wetlands A and C for sediment trapping and erosion control since it has a much larger catchment and provides these services directly to the Bonterivier.
- None of the wetlands scored highly for carbon storage as none of the wetlands contain significant volumes of peat.
- Maintenance of biodiversity did not receive a high score as all three wetlands exhibited decreased diversity due to the high degree of human disturbance, with the least disturbed wetland (Wetland C) receiving the highest score. The three scores were elevated somewhat by the availability of habitat that would be suitable for an array of threatened species, given the critically endangered nature of the wetland vegetation type.
- Water supply for direct human use did not score highly as water for direct human use is not taken from any of the wetlands directly. All however provide water to the Bonterivier from which large volumes are abstracted downstream of the three wetlands.

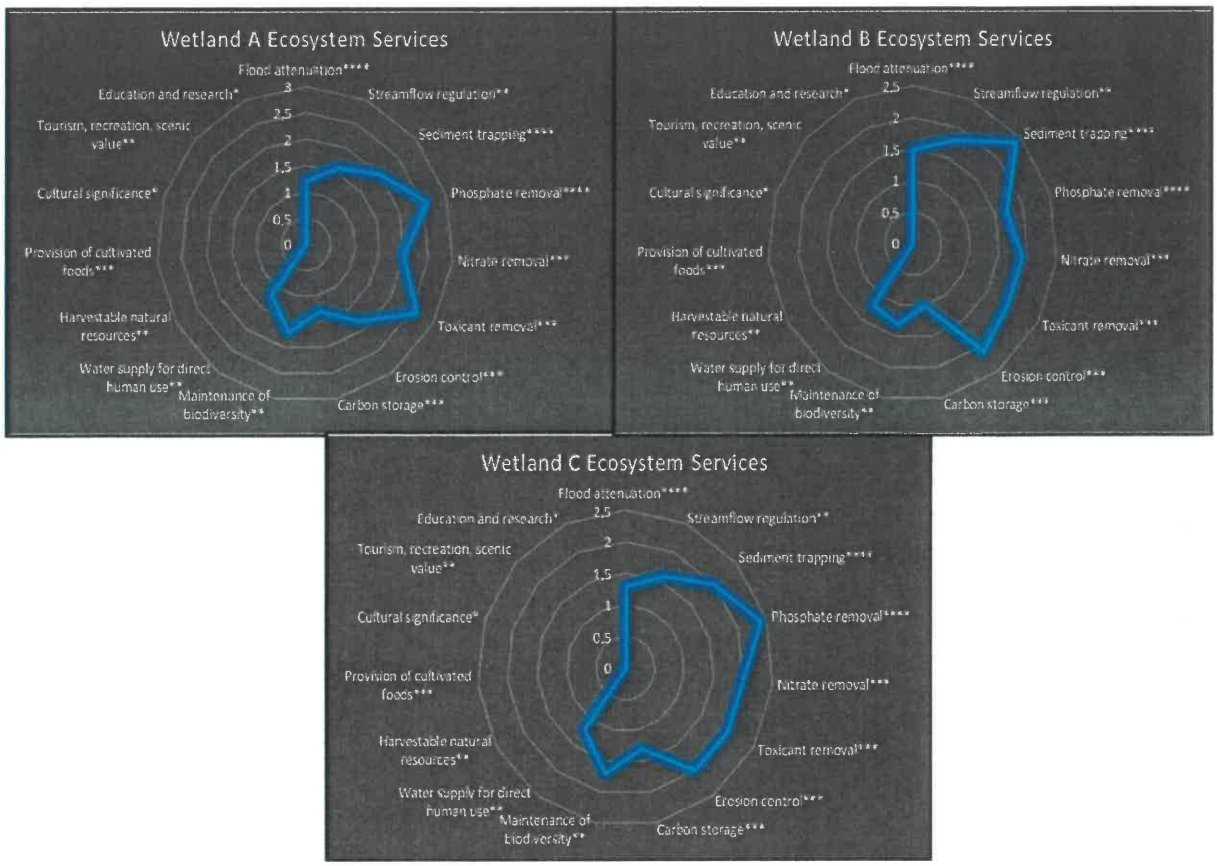


Figure 20: Spider diagrams indicating the range of Ecosystem Services provided by Wetlands A, B, and C.

Table 7: Classes for determining the likely extent to which a benefit is being supplied based on the overall score for that benefit (after Kotze *et. al.*, 2007).

Score (range 0 – 4)	<0.5	0.5-1.2	1.3-2.0	2.1-2.8	>2.8
Rating of the likely extent to which a benefit is being supplied	Low	Moderately Low	Intermediate	Moderately High	High

Table 8: WET-EcoServices results table for Wetland A, B, and C indicating scores pre-development.

Wetland Ecosystem Services			
Indirect Benefits (regulating and supporting benefits)	**Wetland A**	**Wetland B**	**Wetland C**
Flood attenuation****	1.2	1.5	1.3
Streamflow regulation**	1.6	1.8	1.6
Sediment trapping****	2	2.4	2
Phosphate removal****	2.6	1.7	2.4
Nitrate removal***	2	1.9	2
Toxicant removal***	2.6	1.9	2
Erosion control***	1.8	2.1	2
Carbon storage***	1.3	1	1.3
Direct Benefits			
Maintenance of biodiversity**	1.7	1.3	1.7
Water supply for direct human use**	1.2	1.2	1.2
Harvestable natural resources**	0	0	0
Provision of cultivated foods***	0	0	0
Cultural significance*	0	0	0
Tourism, recreation, scenic value**	0	0	0
Education and research*	0	0	0

Size is seldom important *; Size is usually moderately important**; Size is usually very important***; Size is always very important****

3.6 Present Ecological State

WET-Health is a measure of the similarity of a wetland to a natural or reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules. The probable trajectory of change is also considered. A level 1 WET-Health tool was applied to Wetlands A, B, and C in its present, predevelopment state. The key reasoning behind the WET-Health assessment scores calculated are summarised below:

- Wetland A exhibited moderate gully erosion within the upper half thereof likely due to increased storm peak flows related to decreased surface roughness within the surrounding pasture and in the portion of the catchment upstream that has been severely invaded by *Acacia saligna* and *Acacia mearnsii*, resulting in reduced surface roughness at ground level. The outflow at the downstream boundary has been artificially constricted to protect houses constructed on an adjacent property resulting in unnatural permanent wetland conditions within approximately 5% of the HGM unit. The wetland exhibited few alien invasive species and relatively good habitat conditions in the half not affected by gully erosion.
- Wetland B exhibited relatively severe degradation in the form of geomorphological changes where roads and bridges have been constructed over or near it. It is also subjected to abstraction upstream and to transformation of much of the large catchment for agricultural purposes. This has likely resulted water quality impairment and severe changes in hydrology.

- Wetland C has been subjected to severe grazing and wetland habitat has been severely degraded in terms of plant species diversity and vegetation cover. The flow regime has been impacted by the reduced surface roughness within the pasture that dominates the catchment.

The results of the individual WET-Health assessments are summaries in the tables below.

Table 9: WET-Health results table for Wetland A.

	Hydrology	Geomorphology	Vegetation
Impact category –	D	C	C
Ecological trajectory – without development	→	↓	↓

Table 10: WET-Health results table for Wetland B.

	Hydrology	Geomorphology	Vegetation
Impact category	E	C	E
Ecological trajectory – without development	→	↓	↓

Table 11: WET-Health results table for Wetland C.

	Hydrology	Geomorphology	Vegetation
Impact category	C	B	E
Ecological trajectory – without development	→	↓	↓

→ State is likely to remain stable over the next 5 years.
↓ State is likely to deteriorate slightly over the next 5 years.
↓↓ State is expected to deteriorate substantially over the next 5 years.
Note that the impact trajectory does reflects the likely change in state without undertaking the proposed development.

The overall wetland health scores[4] calculated for wetland A, B and C in their present state are as follows:

- Wetland A and C: Category C – Moderately modified: A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact and
- Wetland B: Category D – Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.

3.7 Ecological Importance and Sensitivity

The EIS method applied to wetlands is based on the assessment tool developed by Rountree *et. al.* (2014). The assessment was conducted for Wetlands A, B, and C in their present, predevelopment state.

The key aspects considered during this EIS assessment are summarised below:

- It is likely, given the Critically Endangered conservation status of the West Coast Granite Renosterveld and West Coast Silcrete Renosterveld vegetation types that a large number of floral and faunal species dependent on wetland habitat presently considered to be of conservation concern once inhabited these wetlands prior to extensive disturbance taking place. However, none were identified during the site survey and most have likely been lost due to the degraded nature of the three wetlands, but some more hardy species may remain. Of the three wetlands, Wetland A has been subjected to least ecological degradation and would therefore most likely sustain the highest number and diversity of species listed to be of conservational concern.
- The three wetlands are not located within a formally protected area, however, the West Coast Granite Renosterveld, and West Coast Silcrete Renosterveld wetland vegetation groups are listed Critically Endangered within the region and as a result all three wetlands have been recognised as important for conservation of freshwater resources and habitat within the WCBSP.

[4] (hydrology score) x 3 + (geomorphology score) x 2 + (vegetation score) x 2 / 7 = overall wetland health

- The three wetlands have a low diversity of habitat types within the portions of the features located within the proposed site.

Wetland A, B, and C's overall EIS scores were identical, despite significant differences in scoring for individual categories. Wetland A for instance scored higher than B or C in the first category, but the difference was not sufficient to change the median score. A score of three was calculated which fall within the "moderate" EIS category.

Table 12: Results of the EIS Assessment for Wetland A, B, and C

	Wetland A		Wetland B		Wetland C	
ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Score (0-4)	Confidence (1-5)	Score (0-4)	Confidence (1-5)
Biodiversity support						
Presence of Red Data species: Endangered or rare Red Data species present	2	1	1	1	1	1
Populations of unique species: Uncommonly large populations of wetland species	0	1	0	1	0	1
Migration/breeding/feeding sites: Importance of the unit for migration, breeding site and/or feeding	1	2	1	2	1	2
Landscape scale						
Protection status of the wetland: National (4), Provincial, private (3), municipal (1 or 2), public area (0-1)	1	5	1	5	1	5
Protection status of the vegetation type: SANBI guidance on the protection status of the surrounding vegetation	4	5	4	5	4	5
Regional context of the ecological integrity: Assessment of the PES (habitat integrity), especially in light of regional utilisation	2	4	1	4	2	4
Size and rarity of the wetland type/s present: Identification and rarity assessment of the wetland types	2	4	2	4	2	4
Diversity of habitat types: Assessment of the variety of wetland types present within a site	2	4	3	4	2	4
Sensitivity of the wetland						
Sensitivity to changes in floods: Floodplains at 4; valley bottoms 2 or3; pans and seeps 0 or 1	2	4	3	4	2	2
Sensitivity to changes in low flows/dry season: Unchannelled VB's probably most sensitive	4	4	3	4	4	2
Sensitivity to changes in water quality: Esp natural low nutrient waters – lower nutrients likely to be more sensitive	2	3	2	3	2	3

ECOLOGICAL IMPORTANCE AND SENSITIVITY	2		2		2	

Table 13: Description of EIS Results

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

3.8 Recommended Ecological Category (REC)

The calculated PES scores of the two unchanneled valley bottom wetlands, Wetlands A and C, fall within a PES Category C; and the channelled valley bottom wetland, Wetland B falls within a PES Category D (refer to section 3.6). Wetland A, B, and C are considered to be of an identical EIS within the 'Moderate' Category.

Given the Moderate EIS of the wetlands, the following Ecological Categories are Recommended:

1. Portions of Wetland A would most likely fall within a PES Category B if assessed in isolation, but other portions exhibit considerable degradation, having been ploughed and heavily degraded, with considerable erosion present. An impoundment is also present at the downstream extreme of the wetland. Rehabilitating the more degraded portions of the wetland would require considerable effort and would have a low chance of succeeding sufficiently to improve the entire wetland to a Category B. The impoundment would also have to be removed, but this would endanger the dwellings downslope of the impoundment. It is therefore not realistically feasible that an improvement from a Category C would be likely, and the REC is therefore within a Category C.
2. Wetland B falls within a PES Category D. Despite the impacts of the agricultural catchment, alien clearing within the portions of this wetland that fall within Farm RE/502 in accordance with the requirements of the National Environmental Management Biodiversity Act and its regulations would be sufficient to improve the PES to a Category C. The REC is therefore a Category C.
3. Wetland C falls within a PES Category C. Given the intensive agricultural activity surrounding and within this wetland that is unlikely to cease, it will take considerable effort to remain within a Category C and no improvement to a higher category is feasible. The REC is therefore also a Category C.

3.9 Buffer Determination

The Macfarlane (2016) Buffer Zone Guidelines and Calculator was applied to each wetland individually and it was found that a minimum buffer of 15m would be sufficient to safeguard wetland habitat during both the construction and operational phases of the proposed development for all three wetlands (refer to Figure 21). This method takes into account the nature of the wetlands, the proposed adjacent land use, and assumes that the buffer is densely vegetated with indigenous vegetation.

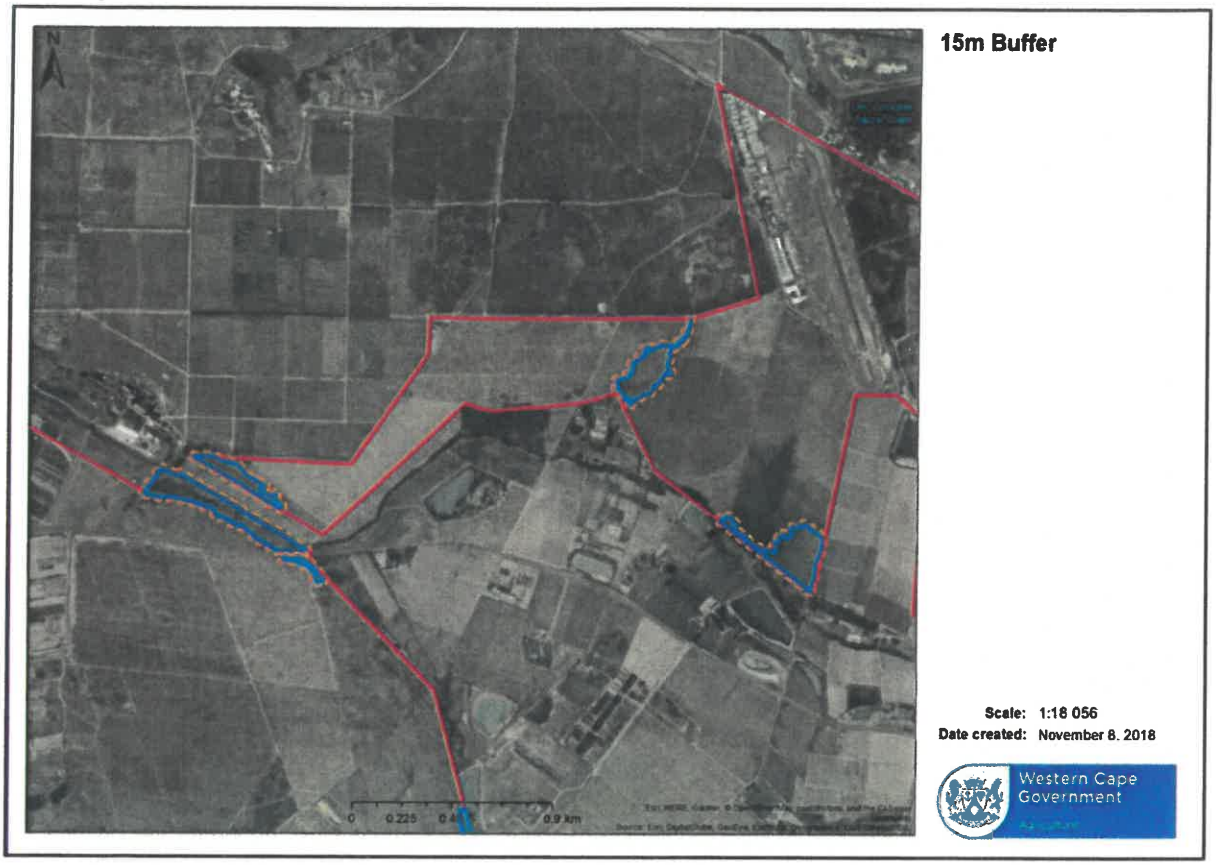


Figure 21: Minimum effective buffer of 15m applied to Wetland A, B and C. The farm boundaries are in red, the watercourses in blue and the buffer in dashed orange.

4 Assessment of Impacts

4.1 Activity Description

Construction of the proposed development for either preferred or alternative layout would entail the following:

- Clearing of approximately 70ha of farmland to accommodate all of the below;
- Construction of approximately 15ha of hardened infrastructure by conventional methods including concrete and tar;
- Installation of toilets and sewage infrastructure including construction of a package plant;
- Construction of a stormwater system including vegetated detention ponds that overflow into the Annandale Road stormwater system;
- Landscaping of approximately 40ha of parkland, including planting of indigenous gardens, trees and lawns and construction of pathways and benches;
- Presence of construction vehicles within the proposed site;
- Installation of an irrigation pond and water feature fed by an existing off-stream irrigation dam further upslope of the proposed site.

Operation of the memorial park would, for both layouts, entail:

- Installation and presence of graves;
- Use of sewage facilities;
- Use of fertilizer, herbicides and pesticides within the parkland and nursery areas;
- Presence of vehicles on roads, parking lots and the security track.
- Maintenance of all infrastructure.

The alternative layout connects the entrance road to an existing electrical substation access road which would require significant upgrading. This entrance road traverses the portion of Wetland B that falls

within the proposed site and the upgrading thereof and construction of the link to this road would result in encroachment into the wetland. The preferred layout includes a new entrance road that does not encroach on the wetland but enters nearly 900m away.

Given the topography of the proposed site and the location of Annandale Road, only a small portion of the proposed development would fall within the catchment of Wetland B.

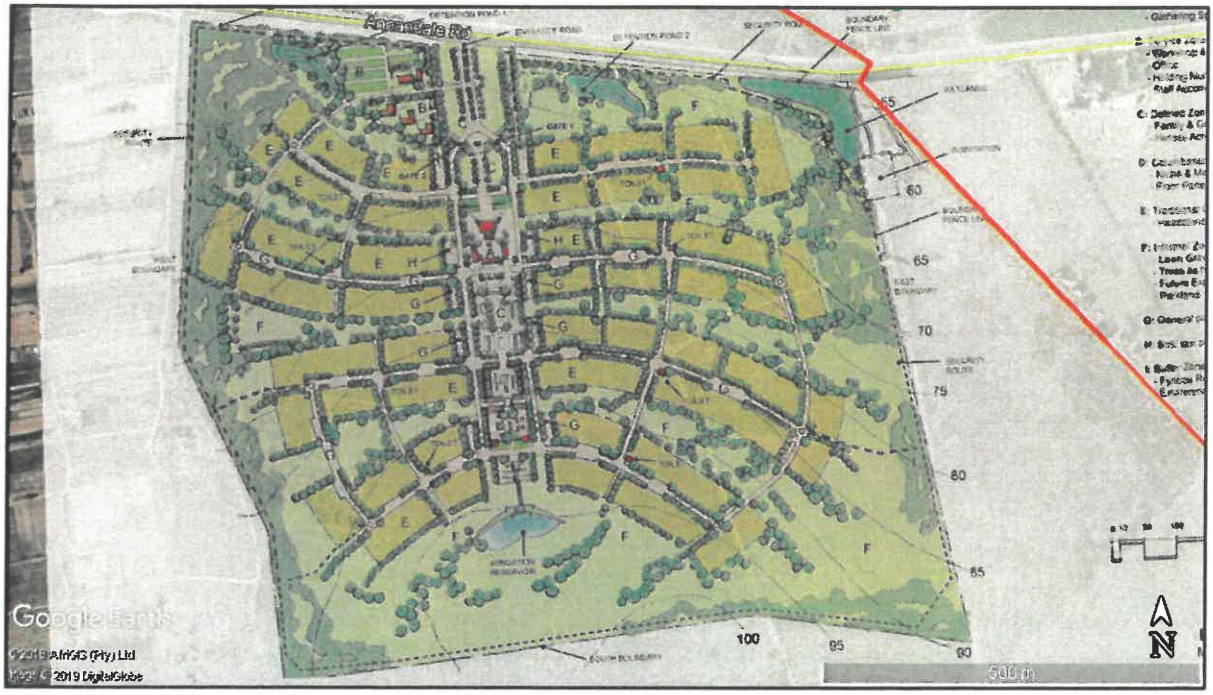


Figure 22: Georeferenced view of the preferred alternative layout. Note that the potion of Wetland B within the proposed site and its 15m buffer are rehabilitated as part of the parkland.

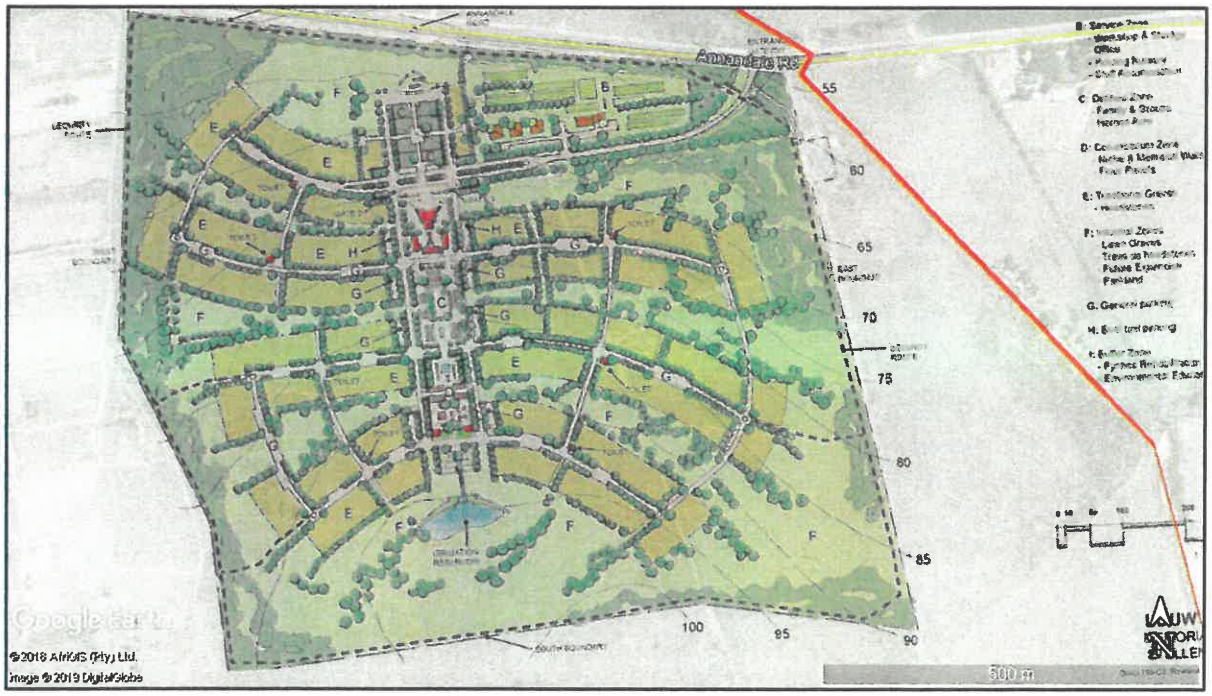


Figure 23: Georeference alternative layout. Note that the entrance road divides the portion of Wetland B that fall within the proposed site in two.

4.2 Direct Impacts

Authorisation of the following water use[5] will be required for the proposed development:

(i) altering the bed, banks, course or characteristics of a watercourse.

It is a requirement of the WUL application process that potential impact on the following general characteristics be determined:

- Impact on the flow regime;
- Impact on the water quality;
- Impact on biota – the animal and plant life of a particular region or habitat;
- Impact on wetland and riparian habitat.

These four potential direct impacts therefore formed the foundation of the impact assessment and no additional potential impacts were identified.

Consider putting the two paragraphs with the impacts in the activity section here, it will fit nicely

4.2.1 Impact 1 – Altering the natural flow regime and hydrological zonation

4.2.1.1 Construction Phase

Clearing during the construction phase within the catchment of the portion of Wetland B that falls within the proposed site would result in a significant increase in runoff and storm peak flows reaching the wetland for either layout. Infilling of parts of the wetland for construction of the entrance road as proposed in the Alternative Layout would interrupt flow within the wetland considerably, dividing the wetland in two (refer to Figure 23 above). Compaction of large parts of the wetland would most likely occur during construction of the Alternative Layout entrance road unless the vehicles are actively restricted to the road's footprint.

The impact given the Preferred Layout was found to be of Low (negative) significance with increased runoff and storm peak flows being the primary impact. With implementation of the essential mitigation measures however the impact is likely to be Very Low (negative).

Essential Mitigation Measures:

- Undertake initial clearing and initiate construction of hard infrastructure in the dry season (October to March).
- Establish a 15m buffer between the proposed development and Wetland B, within which vegetation indigenous to the applicable terrestrial vegetation type is planted at a density of at least 4 plants per square metre;
- Plant the buffer zone in May prior to initiating clearing of the remainder of the proposed site;
- Monitor the buffer zone on a monthly basis until 80% vegetation cover is achieved.
- If 80% cover is not achieved within 12 months of planting, seek advice from a SACNASP registered botanist or wetland specialist.
- In the Alternative Layout, ensure that all construction vehicles remain within the road area and do not enter the remainder of the wetland.

4.2.1.2 Operational Phase

The presence of hardened infrastructure within the catchment of the portion of Wetland B that falls within the proposed site will result in increased runoff and storm peak flows. Most of the runoff from the

[5] As listed within Section 21 of the NWA.

hardened areas will however be diverted into the stormwater detention ponds and into the formal stormwater system. The vegetated parkland would furthermore act as a hydrological buffer by increasing infiltration. The net result will most likely be a reduction in stormwater input and storm peak flows.

Watering within the parkland adjacent to Wetland B may influence zonation significantly by increasing summertime water availability. This impact may however be largely mitigated by restricting watering volumes and by encouraging evapotranspiration in the area watered and in the buffer area.

Wetland B is however part of a system that is very large and any change within the proposed site will impact only a small percentage of the overall catchment, which limits the potential impact on Wetland B. Given the reduced infiltration rates and resulting increased runoff and storm peak flows associated with agricultural land use prevalent in the catchment, this minor reduction in runoff and storm peak flows would represent a small step towards the natural runoff conditions. Mitigation measures would further reduce storm peak flows.

The proposed entrance road in the Alternative Layout within Wetland B would disrupt flow within the wetland significantly in either direction. Flow from the Bonterivier will be restricted to northern portion of the wetland, while flow from upslope would be impounded within the southern portion.

The depth and nature of interflow within the portion of the hillslope above Wetland B earmarked for construction of hard infrastructure and installation of graves has not been determined, and the impact on interflow can therefore not be commented on with any certainty at this time and it is recommended that a geotechnology survey be conducted to inform this portion of the impact assessment prior to drafting of the final freshwater assessment for inclusion in the Final Basic Assessment Report.

The likely impact of the preferred layout on flow regime and hydrological zonation was found to be Very Low (negative) due primarily to the potential impact of watering on wetland zonation, but with the presence of a buffer, well maintained parkland and restricted watering, this impact is likely to be insignificant, and the reduction in storm peak flows and overall runoff due to installation of the stormwater system is likely to result in a net Very Low (positive) impact.

The entrance road in the Alternative Layout would interrupt flow significantly within the affected portion of Wetland B, effectively dividing it in two. This is the most significant factor in the Alternative Layout and without mitigation a High (negative) impact significance is likely. With mitigation however, this impact can be reduced to a Medium (negative) significance.

Essential Mitigation Measures:

- Harvest rainwater from the entire area of the roofs of all buildings for use in irrigation of the parkland and any other planted areas;
- Ensure that all parking lots, roads and hardened areas drain via the stormwater system into the vegetated detention ponds;
- Restrict watering within Wetland B's catchment to a maximum of 3mm on average per day during summer on the lawns and 1mm on average per day in the beds.
- Maintain the portion of the parkland that falls directly upslope of Wetland B densely such that lawns and beds maintain at least 80% cover and exposed ground is kept to 20% or less.
- Maintain the vegetated buffer such that at least 80% cover is maintained.
- For the Alternative Layout, construct the entrance road over culverts, without hardening or compacting the beds of the culverts such that the maximum possible hydrological connectivity is maintained between the two parts of the divided wetland.

4.2.1.3 Results

Impact 1: Altering the Flow Regime and Hydrological Zonation					
Alternatives	**Intensity**	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
Construction Phase					
Preferred Layout: Without mitigation	Medium	Local	Short term	Medium	Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Medium	Very Low (-ve)
Alternative Layout:	High	Local	Long term	High	Medium (-ve)

Without mitigation					
Alternative Layout: With mitigation	Medium	Local	Short term	High	Low (-ve)
Operational Phase					
Preferred Layout: Without mitigation	Very Low	Local	Long term	High	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Long term	High	Very Low (+ve)
Alternative Layout: Without mitigation	High	Local	Permanent	High	High (-ve)
Alternative Layout: With mitigation	Medium	Local	Long term	High	Medium (-ve)

4.2.2 Impact 2: Impact on Water Quality

4.2.2.1 Construction Phase

Construction of brick and mortar and other hard infrastructure involves the use of various chemicals including cement, sulphuric acid, paint, paint thinners and petrochemicals associated with construction vehicles all of which may spill and be carried by runoff into the wetlands downslope thereby impacting water quality. Site clearing and preparation may also leave large areas of exposed sand available for erosion which may significantly increase the sediment load in the runoff entering the wetland downslope, and this would be particularly significant during infilling of the Alternative Layout road area.

Compost, and fertiliser used in landscaping of the parkland area and elsewhere may increase the nutrient load in runoff potentially leading to eutrophication of the wetland (if in high volume) and herbicide used in alien clearing of the site may also impact runoff quality significantly.

It should be noted however that runoff from the pastures the presently occupy the site would likely contain significant nutrient and likely also herbicide on a significantly larger scale than would be introduced by the proposed construction activities. Present runoff also likely contains significant sediment since the agricultural land use results in a low overall vegetation cover and increased runoff.

The net impact on water quality for the Preferred Layout during the construction phase is therefore Low (negative), but with mitigation can likely be reduced beyond pre-construction levels to achieve a Very Low (positive) significance. The Alternative Layout involves road construction within the wetland which increases the likelihood of spillage of construction chemicals and petrochemicals from construction vehicles into the wetland, and the likelihood of sediment from infill material entering the remainder of the wetland is very high. The water quality impact for the Alternative Layout was therefore determined to be of Medium (negative) significance, which can be reduced to Low (negative) significance through implementation of the essential mitigation measures.

Essential Mitigation Measures:

- Ensure that all construction chemicals are mixed and poured within the construction footprint on a bunded surface designated for this purpose by an Environmental Control Officer (ECO) at least 50m from Wetland B;
- Ensure that all construction vehicles remain within the construction footprint and are parked and serviced on a bunded surface designated for this purpose by an ECO at least 50m from Wetland B or at an appropriate location offsite;
- Establish the 15m buffer zone as described in 4.2.1.1.
- Place compost and fertilizer within the holes dug for planting when landscaping and do not place compost and fertilizer on the soil surface;
- Use herbicide only for direct stump treatment of Acacias and other woody alien invasive species. Control invasive annuals by hand-pulling;
- Conduct site clearing and commence construction during the dry season (October to March) to reduce the likelihood of erosion of exposed sediments;
- Install 10cm high sediment fences along the downslope boundary of all cleared areas to retain sediment;
- Make use of erosion blankets where sediment is stockpiled during construction or where the wetland has been infilled in construction of the proposed road Alternative Layout entrance road so as to minimise erosion;

- For the Alternative Layout entrance road, establish vegetation on all infilled areas within Wetland B that are not directly covered by a hard, non-erodible surface.

4.2.2.2 Operational Phase

Routine use of compost and fertilizer in the landscaped areas and the presence of laterite roads and pathways (if used) would result in increased nutrient load (particularly phosphates and nitrates) in runoff. Use of the sewage system would also most likely result in some leakage and spillage during the operation phase that may add to the nutrient load in Wetland B, although most would be diverted into the detention ponds and stormwater system.

Herbicides may also be used for continued control of alien invasive species and may enter the wetland via runoff. Runoff from roads and parking lots will likely contain limited volumes of oil and petrochemicals, but this is diverted into the stormwater system. Some incidental runoff is however likely from the Alternative Layout entrance road into the wetland, which would most likely contain some petrochemicals.

Erosion from graves and unmade or laterite roads and pathways would add to the sediment load within runoff. Concrete leaches hydroxyl ions which would raise the pH of runoff and groundwater and may therefore increase the pH of soil and water within the wetland. The impact is likely limited however, since the vegetation and soil types are not associated with acidic runoff, groundwater and soil and the wetland is an open system within which the hydroxyl ions are not likely to collect.

It should be noted that the present land use as a pasture and for a portion of Farm RE/502 North (alternative layout) as cropland is presently subjected to broad scale use of fertilizers and herbicides (particularly within the cropland) likely results in a greater volume of input of fertiliser and herbicide into the wetlands downslope than the proposed development would, with mitigation. No terracing or other runoff retention measures have been implemented within the present pastures and runoff is likely to carry more sediment under present conditions than after the proposed development, given the essential mitigation.

The presence of graves may increase the nutrient load within interflow which may impact the downslope wetland and may also increase the nutrient load in groundwater. Geotechnical and groundwater assessments will be required to inform these aspects of the water quality impact and will need to be included in the final Freshwater Assessment for inclusion in Final Basic Assessment Report.

The water quality impact for the Preferred Layout was found to be Low (negative) without mitigation, but by implementing the buffer, controlling fertilizer and compost use and applying the other mitigation measures, a Very Low (positive) rating was achieved indicating a slight improvement over the current land-use. The water quality impact rating for the Alternative Layout without mitigation was determined to be Medium (negative) largely due to infilling-related sedimentation, but this can reduced to Low (negative) with mitigation.

Essential Mitigation Measures:

- Dig fertilizer and compost into the soil whenever used to minimised nutrient load in runoff;
- Maintain the 15m buffer zone as described in 4.2.1.2;
- Confine all vehicles to roads and parking lots.
- Do not use laterite in the construction of roads and pathways;
- Use herbicide only for direct stump treatment of Acacias and other woody alien invasive species and control invasive annuals by hand-pulling.
- In the alternative layout, maintain vegetation within the non-hardened infilled areas within Wetland B.

4.2.2.3 Results

Impact 2: Impact on Water Quality					
Alternatives	**Intensity**	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
Construction Phase					
Preferred Layout: Without mitigation	Medium	Local	Short term	Medium	Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Medium	Very Low (+ve)
Alternative Layout: Without mitigation	High	Local	Short term	High	Medium (-ve)
Alternative Layout: With mitigation	Medium	Local	Short term	High	Low (-ve)
Operational Phase					
Preferred Layout: Without mitigation	Low	Local	Long term	High	Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Long term	High	Very Low (+ve)
Alternative Layout: Without mitigation	Medium	Local	Long term	High	Medium (-ve)
Alternative Layout: With mitigation	Low	Local	Long term	High	Low (-ve)

4.2.3 Impact 3: Wetland Habitat Degradation and Loss

4.2.3.1 Construction and Operational Phases

Direct loss of approximately 1250m^2 of the 6500m^2 portion of Wetland B that falls within the proposed site would occur should the Alternative Layout be implemented. The Preferred Layout is not likely to lead to any wetland loss, but through rehabilitation of the 15m buffer zone and through improved catchment land-use, wetland habitat is expected to be protected or slightly improved.

Other negative construction and operational phase impacts for both layouts would include incidental vegetation disturbance from vehicle access and trampling, both of which are not difficult to mitigate through access control, and limited smothering of wetland plants from windblown litter.

For the construction phase, the impact of the Preferred Layout on wetland habitat is likely to be Very Low (negative) both with and without mitigation as no construction activities are plan within or near to the wetland. The construction phase impact of the Alternative Layout received a High (negative) rating with and without essential mitigation due to the unavoidable loss of wetland habitat associated with this layout.

For the operational phase, the Preferred Layout is likely to result in a slight improvement in habitat due to the due to the improved catchment land-use upslope of Wetland B and therefore received a Very Low (positive) rating without mitigation. Implementation of the buffer and the other mitigation measures increases the positive rating to Low (positive). The Alternative Layout received a Very Low (negative) rating both with and without mitigation largely due to the degree of vehicle and pedestrian activity within the wetland due to the presence of the entrance road.

Essential Mitigation Measures

The following mitigation measures are deemed essential to minimise impact on wetland habitat:

- Demarcate the boundary of Wetland B prior to initial site clearing;
- In the case of Alternative Layout, undertake a floral search and rescue within the wetland portion of the entrance road footprint prior to initial clearing, moving plants into the remainder of the wetland.
- Restrict vehicular access to Wetland B during construction and operational phases, except where necessary for construction of the Alternative Layout entrance road, in which case vehicles must be restricted to the construction footprint;

- Restrict pedestrian access to the wetland by means of danger tape or fencing during the construction phase, and by means of roped bollards or a similar attractive means of fencing during the operational phase;
- Ensure that all contractors are aware of a 'no-littering' policy while on the construction site during the construction phase;
- Ensure that all visitors are aware of a "no-littering" and "no bins" policy while within the memorial park by erecting signage at all entrances;
- Inspect the entire proposed site weekly during the construction and operational phases and remove all litter.

4.2.3.2 Results

Impact 3: Wetland Habitat Degradation and Loss					
Alternatives	**Intensity**	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
Construction Phase					
Preferred Layout: Without mitigation	Low	Local	Short term	Medium	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Low	Very Low (-ve)
Alternative Layout: Without mitigation	High	Local	Permanent	Medium	High (+ve)
Alternative Layout: With mitigation	High	Local	Permanent	Medium	High (+ve)
Operational Phase					
Preferred Layout: Without mitigation	Very Low	Local	Long term	Medium	Very Low (+ve)
Preferred Layout: With mitigation	Low	Local	Long term	Medium	Low (+ve)
Alternative Layout: Without mitigation	Low	Local	Long term	Medium	Very Low (-ve)
Alternative Layout: With mitigation	Very Low	Local	Long term	Medium	Very Low (-ve)

4.2.4 Impact 4: Impact on Biota

4.2.4.1 Construction Phase

No direct construction activities are planned for the wetland in the Preferred Layout and no direct loss of wetland biota is therefore likely. Construction of the Alternative Layout entrance road through the wetland is however very likely to result in direct mortality of various forms of wetland biota, particularly amphibians and invertebrates.

The only other possible impact would be in the form of illegal harvesting, trapping and hunting often associated with natural areas adjacent to construction sites, which would be negative if it occurred.

Without mitigation, the construction phase impact of the Preferred Layout on Biota was rated as Very Low (negative) with or without mitigation. The Alternative Layout received a Low (negative) significance rating due to the likely loss of biota during construction of the entrance road. Search and rescue before construction will reduce the significance marginally, but it will remain Low (negative)

Essential Mitigation Measures

- Establish the 15m buffer zone as described in 4.2.1.1.
- Undertake a fauna search and rescue in the area demarcated for the Alternative Layout entrance road one day prior to initial clearing, releasing the fauna immediately after initial clearing is completed.
- Ensure that all contractors are informed that no harvesting of plants, trapping or hunting of wildlife is allowed within the wetland areas, and establish an appropriate fine for the contracting company should any employees be found engaging in these activities.

4.2.4.2 Operational Phase

Increased human activity in and around the wetland during the operational phase would likely increase the frequency of fires within the wetland which leads to increased mortality of biota. In the Alternative Layout, the presence of the entrance road makes this impact particularly likely as cigarettes may be flicked into the wetland from passing vehicles, and this phenomenon is not easily mitigated against and the impact significance rating for the Alternative Layout is therefore Low (negative) with or without mitigation.

The impact significance rating is therefore likely to be Very Low (negative) for the Preferred Layout without mitigation. The addition of the buffer zone for forage and implementation of other mitigation measures would however increase the carrying capacity of this small portion of Wetland B and most likely lead to increased amphibian and invertebrate populations, resulting in a Very Low (positive) rating with mitigation.

Essential Mitigation Measures

- Display signage at the entrance to the Memorial Park forbidding disposal of cigarettes and warning of fire risk.

4.2.4.3 Results

Impact 4: Impact on Biota					
Alternatives	**Intensity**	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
Construction Phase					
Preferred Layout: Without mitigation	Very Low	Local	Short term	Medium	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Short term	Medium	Very Low (-ve)
Alternative Layout: Without mitigation	Low	Local	Short term	Medium	Low (-ve)
Alternative Layout: With mitigation	Low	Local	Short term	Medium	Low (-ve)
Operational Phase					
Preferred Layout: Without mitigation	Very Low	Local	Long term	Medium	Very Low (-ve)
Preferred Layout: With mitigation	Very Low	Local	Long term	Medium	Very Low (+ve)
Alternative Layout: Without mitigation	Low	Local	Long term	Medium	Low (-ve)
Alternative Layout: With mitigation	Low	Local	Long term	Medium	Low (-ve)

4.3 'No Go' Scenario

The 'No Go' scenario would result in a slowly degrading PES for the portion of Wetland B that falls within the proposed site due to ongoing activities related to agriculture and the electrical substation.

'No Go' Scenario					
	Intensity	**Extent**	**Duration**	**Probability of impact occurring**	**Significance**
No Development	Very Low	Local	Permanent	Medium	Very Low (-ve)

4.4 Indirect Impacts

No indirect impacts were identified.

4.5 Cumulative Impacts

No cumulative impacts were identified.

5 Conclusion and Recommendation

Watercourses within the Farm RE/502 North and South were identified and natural watercourses delineated. A single portion of Wetland B, the Bonterivier was identified as potentially being impacted by the proposed development given the Preferred and Alternative layouts within the proposed site within Farm RE/502 South, and was therefore assessed for PES, EIS and EcoServices.

Two other wetlands (A and C) were also assessed for PES, EIS and EcoServices as they were likely to have been impacted by a possible layout that was evaluated in Farm RE/502 North. This layout was however excluded due to freshwater constraints that became apparent during the drafting of this report, and the presented Preferred and Alternative Layouts were pursued instead. The PES, EIS and EcoServices evaluations were however included in the report for record but are no longer relevant to the proposed development.

A freshwater impact assessment was then conducted for the two proposed layouts within the proposed site. The primary difference between the Preferred and Alternative Layouts is that the entrance road in the Alternative Layout traverses part of Wetland B, while in the Preferred Layout no infrastructure encroaches on Wetland B and space is also made available for the 15m buffer zone.

Construction of the road within Wetland B in the Alternative Layout would result in loss of wetland habitat and severe disruption of hydrology. It may also result in increased sediment load due to erosion of infill used in constructing the road and would most likely result in wetland fauna (particularly amphibian and invertebrate) mortalities, resulting in High and Medium (negative) significance ratings for these impacts.

The Preferred Layout by contrast received a similar or significantly lower impact rating for every impact, with or without mitigation. The impact significance ratings for the construction phase were never higher than Very Low (negative) for the Preferred Layout, with mitigation. The current (pre-construction) land-use has impacted Wetland B significantly and the Preferred Layout would, in the operational phase with mitigation, result in an improvement over the current state in every impact category evaluated and the impact ratings were Very Low or Low (positive) for all four impacts.

No cumulative or indirect impacts were identified. A slow decline was found to be most likely in the case of the 'No Go' scenario, and the Preferred Layout is therefore the lowest impact option of all. It is therefore recommended that the proposed development be implemented in accordance with the Preferred Layout with implementation of all essential mitigation measures and that the necessary environmental and water use authorisations be granted.

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Appendix 1 – Impact Assessment Criteria[6]

The criteria used to determine impact consequence are presented in the tables below.

Table 1: Description of criteria considered when assessing potential impacts.

CRITERIA	DESCRIPTION OF ELEMENTS THAT ARE CENTRAL TO EACH ISSUE	
Extent of the impact	SITE SPECIFIC	Site specific/Local: Extends only as far as the activity
	LOCAL	Limited to the site and its immediate surroundings
	REGIONAL	Regional/Provincial: Will have an impact on the region/province
	NATIONAL	National: Will have an impact on a national scale – particularly if an ecosystem or species of national significance is affected
Duration of impact	SHORT TERM	Construction phase
	MEDIUM TERM	Operational phase
	LONG TERM	Where the impact will cease after the operational or working life of the activity, either due to natural processes or by human intervention
	PERMANENT	Where mitigation or moderation by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient or temporary
Intensity of impact	VERY LOW INTENSITY	Natural, cultural and social functions and processes are not affected
	LOW INTENSITY	Affects the environment in such a way that natural, cultural and social functions and processes continue, although in a slightly modified way
	MEDIUM INTENSITY	Affects the environment in such a way that natural, cultural and social functions and processes continue, although in a modified way
	HIGH INTENSITY	Natural, cultural or social functions or processes are altered to the extent that they will temporarily or permanently cease
Probability of impact occurring	LOW	Improbable
	MEDIUM	Probable
	HIGH	Highly probable
	DEFINITE	Impact will occur regardless of any prevention methods
Determination of significance		
	LOW	The impacts will have a minor or insignificant influence on the watercourse.
	MEDIUM	The impacts will have a moderate influence on the watercourse. The impact can be ameliorated (lessened or improved) by a modification in the project design or implementation of effective mitigation measures.
	HIGH	The impacts will have a high influence on the watercourse. The impact can be ameliorated (lessened or improved) by a modification in the project design or implementation of effective mitigation measures. Should have an influence on decision, unless it is mitigated
	VERY HIGH	The impacts will have a major influence on the watercourse. The impacts could have the no-go implications on portions of the development regardless of any mitigation measures that could be implemented. Influence decision, regardless of any possible mitigation.

SIGNIFICANCE RATING	LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC SIGNIFICANCE RATING		
	INTENSITY	EXTENT	DURATION
Very High	High	National	Permanent / Long Term
	High	Regional	Permanent / Long Term
	Medium	National / Regional	Permanent
High Significance	High	Regional	Medium Term

[6] Adapted from SRK Impact assessment methodology

SIGNIFICANCE RATING	LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC SIGNIFICANCE RATING		
	INTENSITY	EXTENT	DURATION
	High	National	Short Term
	High	Local	Long Term / Permanent
	Medium	National	Medium Term
	Medium	Regional	Long Term
Medium Significance	High	Local	Medium Term
	Medium	Local	Permanent
	High	Regional	Short Term
	Medium	National	Short Term
	Medium	Regional	Medium Term
	Medium	Local	Long Term / Permanent
	Low	National	Medium Term
	Low	Regional	Long Term
Low Significance	High	Local	Short term
	Medium	Local	Short Term / Medium Term
	Medium	Regional	Short Term
	Low	National	Short Term
	Low	Regional	Medium Term
	Low	Local / Site specific	Long Term
	Low	Local	Permanent
Very Low Significance	Very Low	Local	Long Term / Permanent
	Low	Local	Short term
	Low	Site specific	Medium / Short Term
	Very low	Site specific / Local	Short Term