# Freshwater Impact Assessment:

# Calcutta, Farm 29, Stellenbosch, Western Cape

Prepared for:

**Stellenbosch Municipality**

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# Executive Summary

Stellenbosch Municipality proposes establishment of a memorial park on Calcutta, Farm 29, Stellenbosch. EnviroSwift Western Cape has therefore been appointed to delineate and undertake a specialist assessment of the freshwater features, as defined by the National Water Act (1998), within Farm 29 (the proposed site). The freshwater assessment is required to inform the Basic Assessment process in terms of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) regulations (GN326 of 2017) and the Water Use Authorisation application in terms of Section 21 of the NWA (1998) for the proposed development.

The site is currently not being utilised and is dominated by alien invasive vegetation such as *Lolium perenne*, *Acacia saligna*, and *Eucalyptus* species. A layout for the proposed development of Farm 29 has been provided.

The proposed memorial park development will include the following:

- Construction of hardened infrastructure including a chapel, office, columbarium, public toilets, an access road, gabion-lined drift crossing for a security route, hardened pathways and wooden pedestrian bridge crossings;
- Construction of an irrigation reservoir;
- Installation of graves;
- 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.

*Desktop Assessment*

Farm 29 lies within the Berg Water Management Area (WMA), the Greater Cape Town Sub-WMA and the G22G quaternary catchment. It is characterised by Critically Endangered Swartland Shale Renosterveld terrestrial vegetation type (Mucina & Rutherford, 2006, revised 2009 and 2012); and Critically Endangered West Coast Shale Renosterveld wetland vegetation type.

The National Freshwater Ecological Priority Areas (NFEPA, 2011) project's indicates the presence of a number of unchanneled valley-bottom wetlands as well as a larger channelled valley-bottom wetland within the 500m regulated zone[1]. The National Geospatial Information Service (NGI) indicates a non-perennial drainage line in the western portion of the study area which drains in a south-easterly direction.

The Western Cape Biodiversity Spatial Plan (WCBSP, 2017) highlights a number of spatial biodiversity categories. The study area is dominated by aquatic Type 2 Ecological Support Areas (ESA's 2), and contains tracts of Type 1 and Type 2 Critical Biodiversity Areas[2] (CBA's 1 and 2).

*Freshwater Assessment Results*

Hand augering of Farm 29 was conducted to determine the presence or absence of hydromorphic soil indicators. A number of depression wetlands and a non-perennial drainage line were delineated. Within wetland areas where hydrophytic vegetation was found, wetland soils had a low chroma and exhibited an organic surface layer. Wetland hydrology was also present in some areas along the Farm's western boundary despite the season, with saturated soils and even surface water in places. The non-perennial drainage line exhibited alluvial soils.

The resultant delineations for Farm 29 are presented below:

[1] Authorisation will be required in terms of GN509 for the proposed development within 500m of a wetland.

[2] The stated objective of a CBA1 is to: Maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

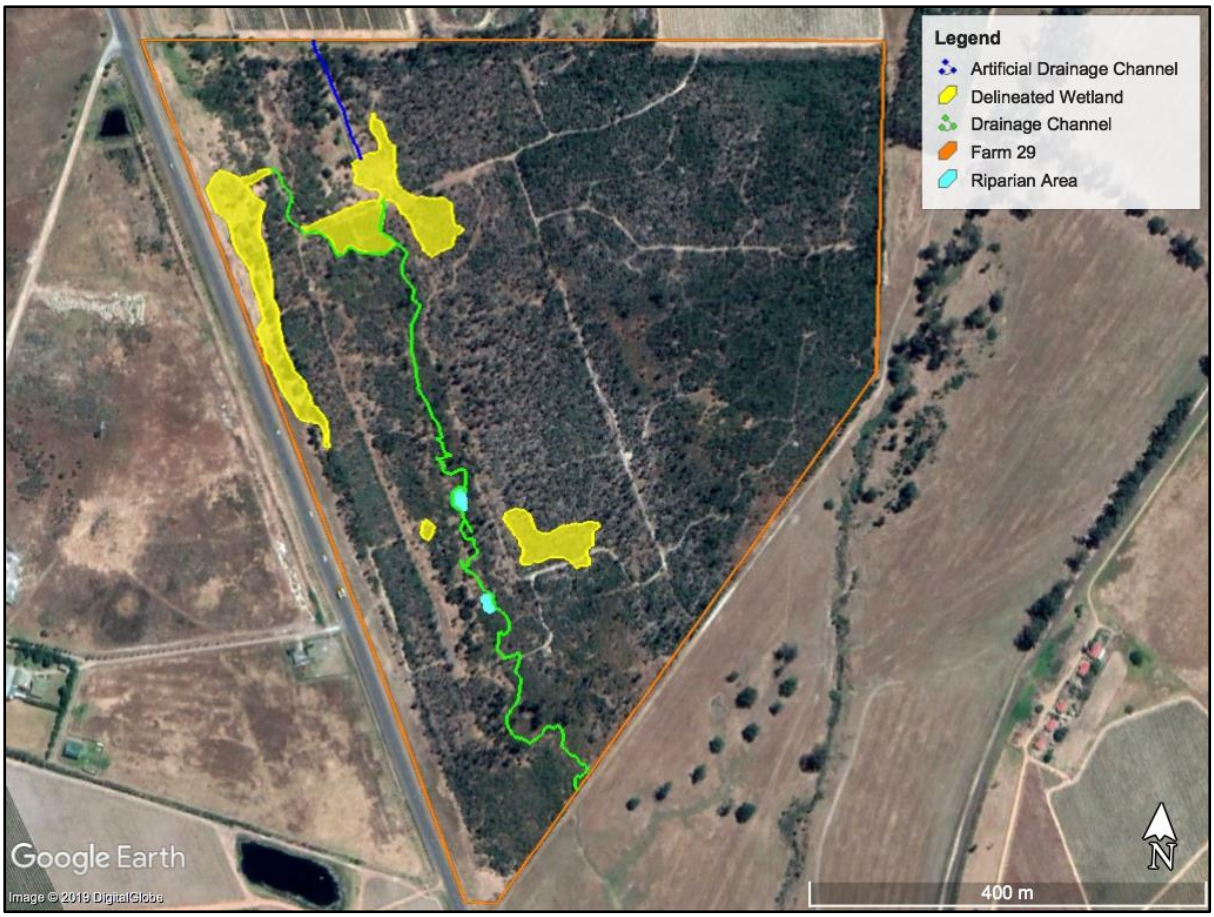


**Figure A: Freshwater feature delineations on Farm 29, Stellenbosch.**

Wetlands delineated were classified as depression wetlands and were assessed as one Hydrogeomorphic (HGM) unit. The non-perennial drainage line and the depression wetlands were evaluated by means of best practice assessment methods to determine current Ecological Importance and Sensitivity (EIS), Present Ecological State (PES) and Eco-services. The drainage line fell within Category D for the Intermediate Habitat Integrity Assessment (IHIA), and the mosaic of depression wetlands were determined to have a PES within Category E. The wetlands and drainage line were found to have a Moderate EIS, providing ecosystem services primarily in the categories of Phosphate and Nitrate removal.

Given the disturbed nature of the site, a Recommended Ecological Category (REC) of C is advocated for the freshwater features. The buffer zone tool for the determination of the minimum effective buffer for wetland ecosystems (Macfarlane *et. al*. 2014) was used in order to calculate a minimum buffer of 15m for the freshwater features delineated on site, during both the construction and operational phases.

*Impact Assessment*

Four potential impacts were identified and assessed given the information presently available, with and without essential mitigation measures applied. The results are presented in the table below:

**Table A: Impact Assessment Results**

| **Impact I: Impact on the Flow Regime** | | | | | |
|---|---|---|---|---|---|
| | **Intensity** | **Extent** | **Duration** | **Probability of impact occurring** | **Significance** |
| **Construction Phase** | | | | | |
| Without mitigation | Medium | Local | Short term | Medium | Low (-ve) |
| With mitigation | Low | Local | Short term | Medium | Very Low (-ve) |
| **Operational Phase** | | | | | |
| Without mitigation | Medium | Local | Medium term | Medium | Low (-ve) |

| | | | | | |
|---|---|---|---|---|---|
| With mitigation | Very Low | Local | Medium term | Low | Very Low (-ve) |
| **Impact 2: Impact on Water Quality** | | | | | |
| | **Intensity** | **Extent** | **Duration** | **Probability of impact occurring** | **Significance** |
| **Construction Phase** | | | | | |
| Without mitigation | Medium | Local | Short Term | High | Low (-ve) |
| With mitigation | Low | Local | Short term | Medium | Very Low (-ve) |
| **Operational Phase** | | | | | |
| Without mitigation | Medium | Local | Long term | High | Medium (-ve) |
| With mitigation | Low | Local | Medium term | Medium | Low (-ve) |
| **Impact 3: Impact on Wetland Habitat** | | | | | |
| | **Intensity** | **Extent** | **Duration** | **Probability of impact occurring** | **Significance** |
| **Construction Phase** | | | | | |
| Without mitigation | Low | Local | Short term | Medium | Very low (-ve) |
| With mitigation | Low | Local | Short term | Medium | Very Low (+ve) |
| **Operational Phase** | | | | | |
| Without mitigation | Low | Local | Long term | Medium | Low (-ve) |
| With mitigation | Low | Local | Long term | Medium | Low (+ve) |
| **Impact 4: Impact on Biota** | | | | | |
| | **Intensity** | **Extent** | **Duration** | **Probability of impact occurring** | **Significance** |
| **Construction Phase** | | | | | |
| Without mitigation | Medium | Local | Long term | High | Medium (-ve) |
| With mitigation | Very Low | Local | Short term | Medium | Very Low (+ve) |
| **Operational Phase** | | | | | |
| Without mitigation | Very Low | Local | Medium term | Medium | Very Low (-ve) |
| With mitigation | Very Low | Local | Medium term | Medium | Very Low (+ve) |
| | Intensity | Extent | Duration | Probability of impact occurring | Significance |
| **'No Go Scenario'** | Low | Local | Permanent | High | Low (-ve) |

Nutrient loading and the accumulation of toxicants such as Copper Chrome Arsenate (CCA) is cumulative when all sources of nutrients and toxicants considered enter the system thereby exacerbating the negative impact on water quality and biota. No wetland habitat will be lost through the proposed development, and habitat is expected to improve with the implementation of mitigation measures. Therefore, the cumulative impact on vegetation will be positive.

*Conclusion and Recommendation*

A mosaic of depression wetlands and a non-perennial drainage line were identified and delineated within Farm 29. The non-perennial drainage line and the depression wetlands identified were therefore assessed in terms of PES, EIS and Eco-services. The drainage line fell within the IHIA Category D, while the mosaic of depression wetlands had an overall PES score of Category E. Given the disturbed nature of the site, a REC category of C is advocated for all of the freshwater features. Application of the best practice method for determination of an appropriate minimum buffer found that a buffer of 15m during the construction and operational phases would be appropriate for the freshwater features delineated on Farm 29.

Following the Impact Assessment, it was found that the significance of the majority of the impacts associated with the proposed development can be reduced with the implementation of the essential mitigation measures provided. After mitigation, the significance of the impacts was either very low or low (negative) with the impact on wetland habitat and biota being very low or low (positive). The proposed development without mitigation would result in an overall negative impact; however, with the implementation of the essential mitigation measures and 15m buffer around each freshwater feature, the project would represent a significant positive improvement over present conditions. It is therefore the opinion of the specialist that Environmental and Water Use Authorisations be granted for this project.

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# Glossary[3]

**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

[3] As provided by DWA (2005) and WRC Report No. TT 434/09.

| | |
|---|---|
| | 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. |
| **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;<br>(b) A natural channel in which water flows regularly or intermediately;<br>(c) A wetland, lake or dam into which or from which water flows; and<br>(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

| | |
|---|---|
| **CCT** | City of Cape Town |
| **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. 120338)**

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.

# Disclaimer

EnviroSwift (Pty) Ltd has exercised all due care in the reviewing of all available information. The freshwater assessment provided is 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.

# 1 Introduction

## 1.1 Project Background

EnviroSwift Western Cape has been appointed to delineate and undertake a specialist assessment of the freshwater features on the 40ha Calcutta Farm 29 in Stellenbosch, Western Cape (refer to Figure 1 for location). The freshwater assessment is required to inform the Basic Assessment process undertaken in terms of NEMA EIA regulations (GN326 of 2017) and the application for a water use authorisation in terms of Section 21 of the NWA (1998) for the proposed development.

Stellenbosch Municipality proposes establishment of a memorial park on Calcutta, Farm 29, Stellenbosch. The site is currently not being utilised and is dominated by alien invasive vegetation such as *Lolium perenne*, *Acacia saligna*, and *Eucalyptus* species. A layout for the proposed development of Farm 29 has been provided (refer to Figure 2 below).

The proposed memorial park development will include the following activities:

- Construction of approximately 18ha of hardened infrastructure including a chapel, office, columbarium, public toilets, an access road, hardened pathways and compacted graves.
- Construction of three watercourse crossings including a drift crossing for a security route over a stream, and two wooden pedestrian bridge crossings, over the same stream;
- Construction of a stormwater retention pond, an artificial wetland for treatment of stormwater and use of stormwater for irrigation purposes;
- 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 made and unmade pathways in between;
- Installation of a sewage package plant.

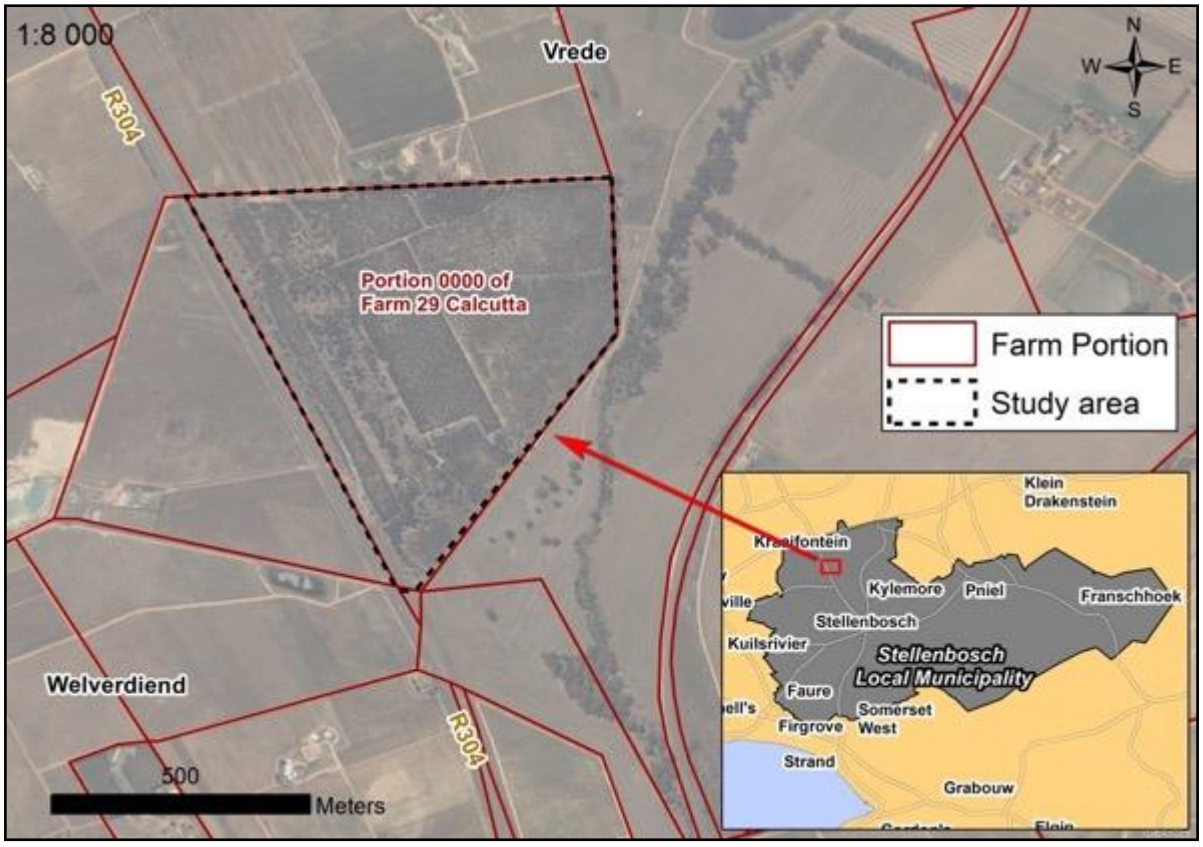


**Figure 1: Location of Calcutta, Farm 29 within Stellenbosch Local Municipality.**


**Figure 2: Proposed development layout plan for Farm 29, Stellenbosch. Note that the freshwater delineations shown have been produced by EnviroSwift Pty (Ltd) (refer to Section 3.3 and Figure 15 below). The sewage package plant will be installed within area A.**

## 1.2 Scope of Work

The scope of work which informed this assessment consisted of:

- Assessment of relevant background information including NFEPA (2011), the WCBSP (2017), the NGI Service topographical maps and vector data, and pertinent academic resources;
- Assessment of the site including delineation of wetland temporary boundaries in accordance with best practice guidelines such as (Department of Water Affairs and Forestry - DWAF, 2008) and Job, *et. al.* (2009);
- Assessment of the PES, EIS and WET-Ecoservices according to best practice methods;
- Assessment of potential freshwater impacts and provision of mitigation measures; and
- Clarification of the potential freshwater legislative constraints applicable to the development.

## 1.3 Limitations and Assumptions

The following limitations applied to the freshwater assessment.

- A Garmin E-Trex 20 GPS was used to delineate all wetland temporary zones identified on the proposed site and accuracy is therefore limited to the stated accuracy of the GPS of approximately 3m. All effort was 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 (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 9 November 2018 during early summer; therefore, comments on hydrology are limited;
- The site has undergone extensive disturbance, resulting in limited indigenous vegetation and cryptic soils. The site can be considered a difficult case due to the degree of transformation and the lack of natural vegetation. A follow up site assessment is recommended during winter, after site clearing (refer to conclusion).

## 1.4 Applicable 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 within the regulatory zone of a watercourse where the Risk Class as determined by the 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

Desktop resources and databases were consulted in order to contextualise the study area and findings of the field survey. Spatial and non-spatial resources accessed for this assessment include inter alia the NFEPA, (2011), the WCBSP (2017), as well as maps and vector data form the National Geospatial Information directorate. The WCBSP (2017) categorises natural features into Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), and Other Natural Areas (ONAs). These categories, as well as the applicable sub-categories, are defined in the table overleaf.

**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<br>CBA: Estuary<br>CBA: Wetland<br>CBA: Forest<br>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<br>ESA: Forest<br>ESA: Climate Adaptation Corridor<br>ESA: Coastal Resource Protection<br>ESA: Endangered Ecosystem<br>ESA: River<br>ESA: Estuary<br>ESA: Wetland<br>ESA: Watercourse Protection<br>ESA: Water Source Protection<br>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<br>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 of the study area was undertaken on 9 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 field survey. 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 watercourses can be classified as 'wetland habitat' or 'river habitat', the definitions as drafted by the NWA (Act no. 36, 1998)[4] 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. Refer to **Figure 3** and **Figure 4**.

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.

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

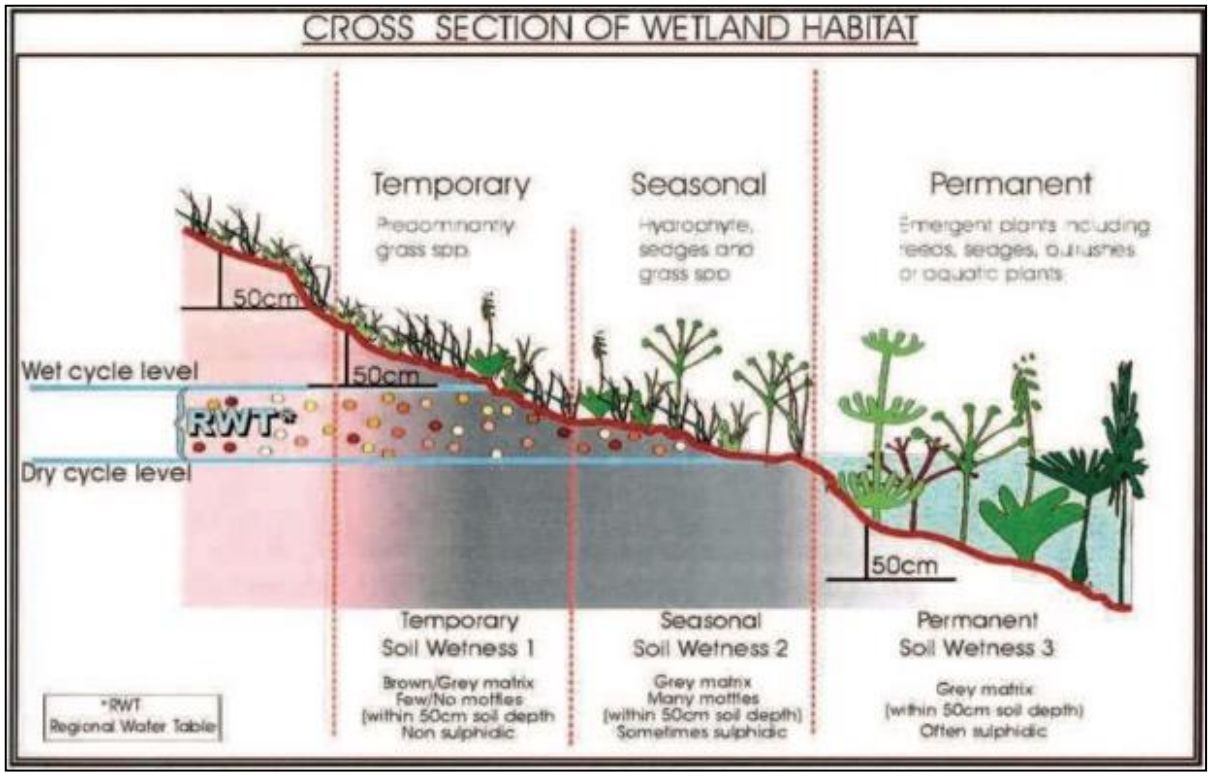


**Figure 3: Cross section through a wetland (after DWAF, 2005).**

**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[5] 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 |

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

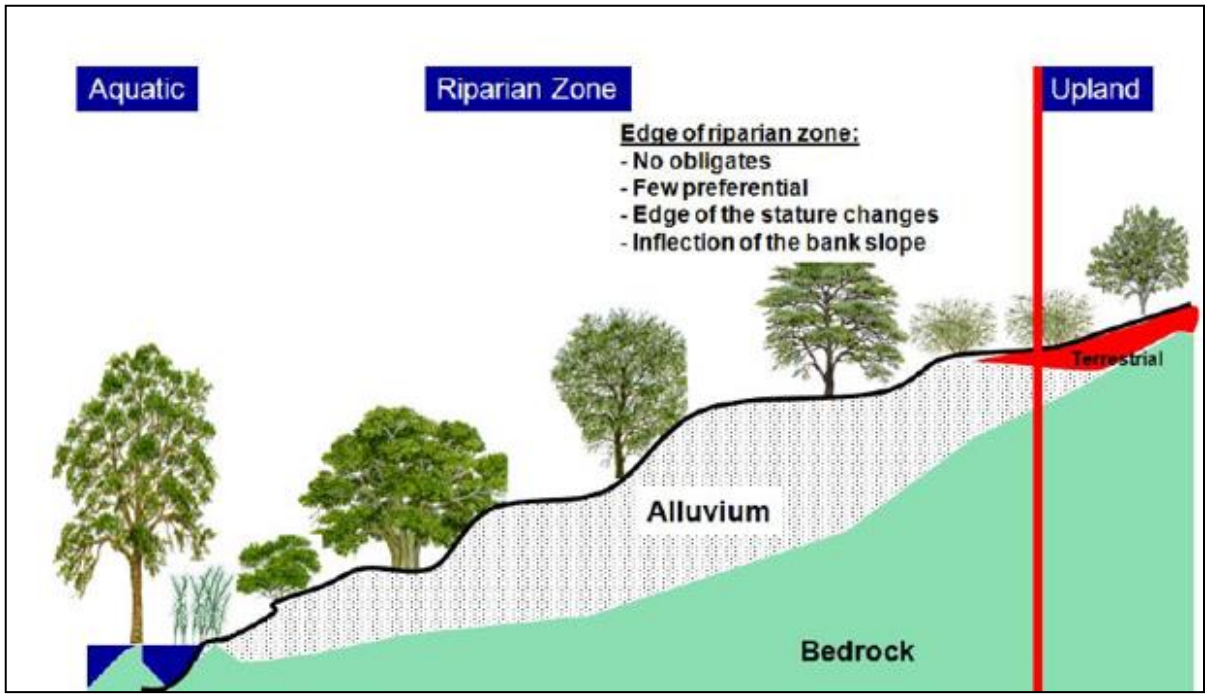


**Figure 4: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river (DWA, 2008).**

## 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.

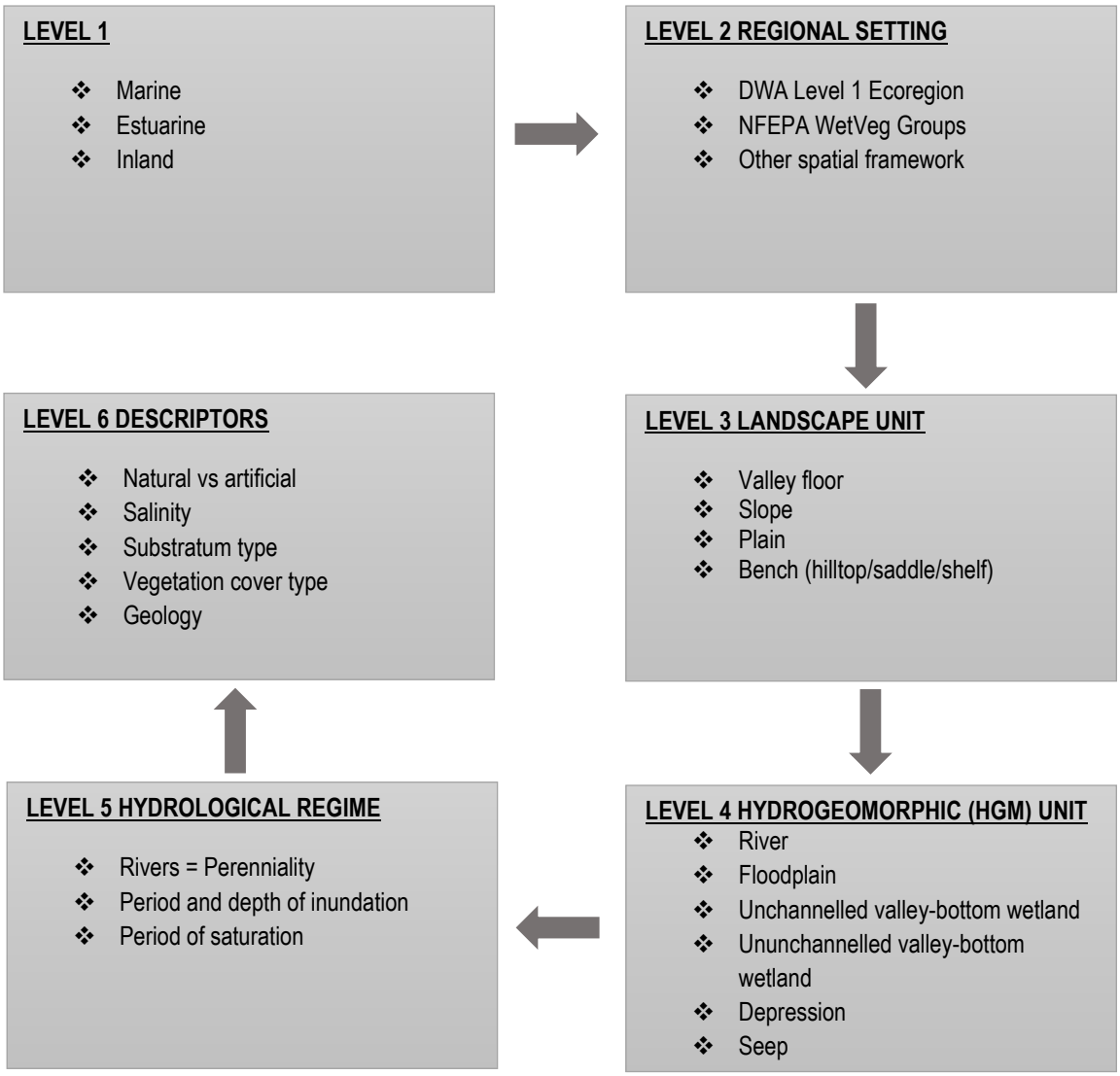


**Figure 5: Classification System for wetlands and other aquatic ecosystems in South Africa.**

## 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)

### 2.5.1 River, Streams and Drainage Lines

The river IHIA is utilised in order to determine the PES of rivers. The river IHIA is based on two components of the watercourse, the riparian zone and the instream channel. Assessments are made separately for both aspects, but data for the riparian zone is primarily interpreted in terms of the potential

impact on the instream component. The method involves the rating of the perceived modification of nine instream criteria and eight riparian criteria against a set scoring guideline. The final score is derived by calculating the average scores, which places the final score in one of the categories listed below. Note that for drainage lines that lack riparian zones, the method is adapted in that only the instream criteria are assessed.

**Table 3: Intermediate habitat integrity categories (From Kleynhans, 1996).**

| CATEGORY | DESCRIPTION | SCORE (% OF TOTAL) |
|---|---|---|
| A | Unmodified, natural. | 90-100 |
| B | Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged. | 80-90 |
| C | Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged. | 60-79 |
| D | Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. | 40-59 |
| E | The loss of natural habitat, biota and basic ecosystem functions is extensive. | 20-39 |
| F | Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible. | 0 |

### 2.5.2 Wetlands

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 A Level 1 WET-Health assessment was undertaken as part of this assessment.

**Table 4: Descriptions of WET-Health score categories.**

| 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)

### 2.6.1 Rivers

The EIS method applied to rivers is based on the approach adopted by the DWA as detailed in the document "Resource Directed Measures for Protection of Water Resources" (1999). 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. The EIS score also provides guidance on the recommended ecological category of the watercourse assessed.

### 2.6.2 Wetlands

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 Buffer Determination

The recently published Buffer Zone Guidelines for Rivers, Wetlands and Estuaries (Macfarlane and Bredin, 2016), allows the user to rate key elements such as threats posed by land use / activities on the water resource, climatic factors, the sensitivity of the water resource (i.e. river, wetland or estuary), and buffer zone attributes in order to determine the size a buffer would need to be in order to sufficiently protect a river, wetland or estuary.

## 2.9 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 and Local Setting

Calcutta, Farm 29, falls within the Southwestern Coastal Belt Ecoregion, the main features of which are summarised in Table 5. Local climatic, topographic and soil conditions for Farm 29 are shown by Table 6. The study area is furthermore within the Berg Water Management Area (WMA), the Greater Cape Town Sub-WMA and the G22G quaternary catchment.

**Table 5: Overview of the Southwestern Coastal Belt Ecoregion (adapted from DWA, 2005)**

| Main Attributes | Southwestern Coastal Belt |
|---|---|
| Geology | Granite, quartzitic sandstone, quartzite, conglomerate, slate |
| Vegetation | Sand Plain Fynbos; Mountain Fynbos; West Coast Renosterveld; Dune Thicket; Strandveld Succulent Karoo |
| Landscape | Closed hills; mountains; moderate and high relief |
| Mean altitude | 300-900 |
| Rainfall seasonality | Winter |

**Table 6: Local climate, topography and soil conditions (adapted from Cape Farm Mapper, 2015)**

| Parameters | Local Conditions |
|---|---|
| Mean annual precipitation (mm) | 519 mm |
| Mean annual runoff (mm/annum) | 58.6 mm |
| Mean annual temperature (°C) | 16.7° C |
| Elevation (m above mean sea level) | 140-145m |
| Slope classification (%) | 0-10% |
| Soil characteristics | Soils with a marked clay accumulation, strongly structured and a non-reddish colour. In addition one or more of vertic, melanic and plinthic soils may be present. Soils are expected to be overlain by quartzitic sand of the springfontein formation |
| Soil depth (mm) | >= 450 mm and < 750 mm |
| Soil clay content (%) | < 15% |

According to the National Vegetation Map of South Africa by Mucina and Rutherford (2006, revised 2009 and 2012), Farm 29 is located within the Swartland Shale Renosterveld vegetation type refer to Figure 6). Swartland Shale Renosterveld is listed as critically endangered (CR) on the National List of Threatened Terrestrial Ecosystems (2011). The NFEPA (2011) project's Wetland Vegetation type is West Coast Shale Renosterveld, listed as CR (refer to Figure 7). Soils are expected to have a marked clay accumulation overlain by quartzitic sand of the Springfontein Formation.

Farm 29 is largely flat, sloping from east to west at gradients of between 0 and 10%, but with artificially infilled high ground in the southwest (refer to **Figure 8**). Farm 29 has an elevation of between 142m and 157m above mean sea-level (AMSL).

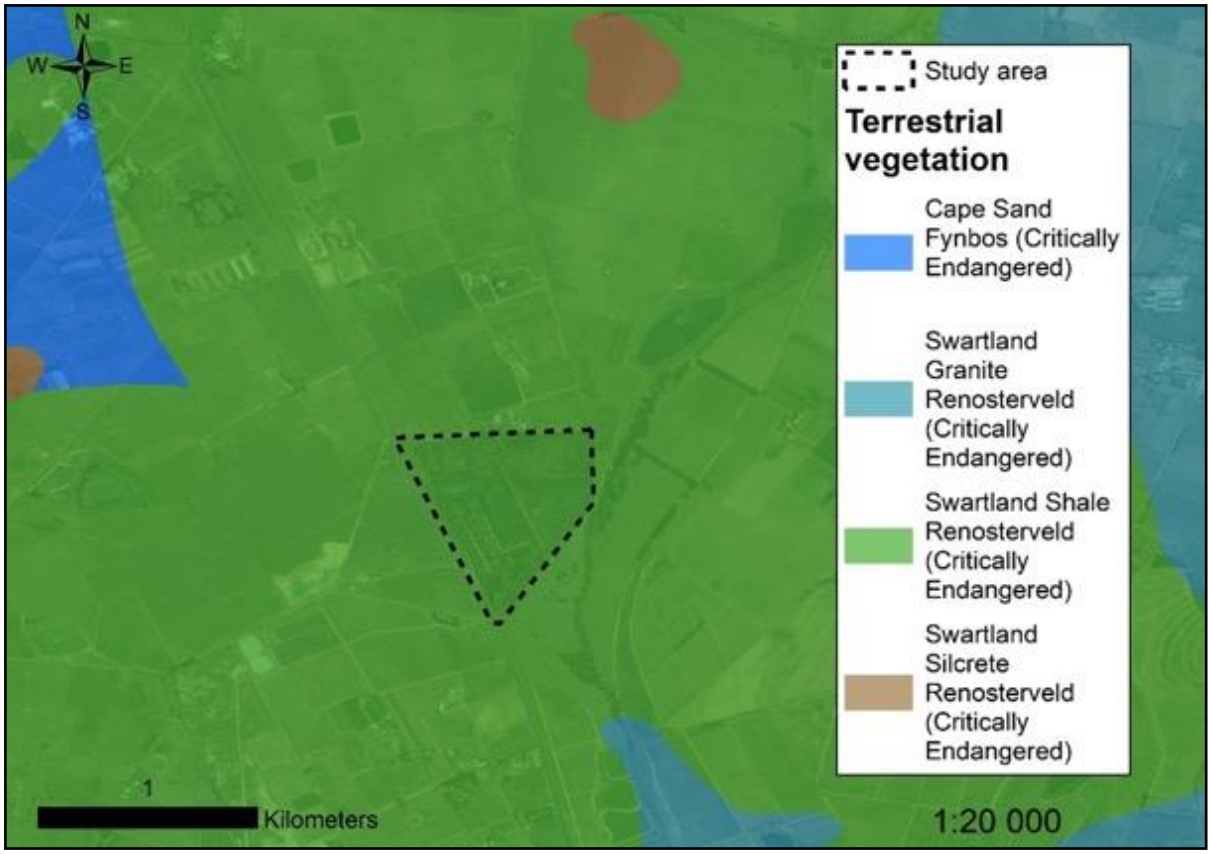


**Figure 6: Terrestrial vegetation types according to the National Vegetation Map (Mucina and Rutherford, 2006; updated 2012).**

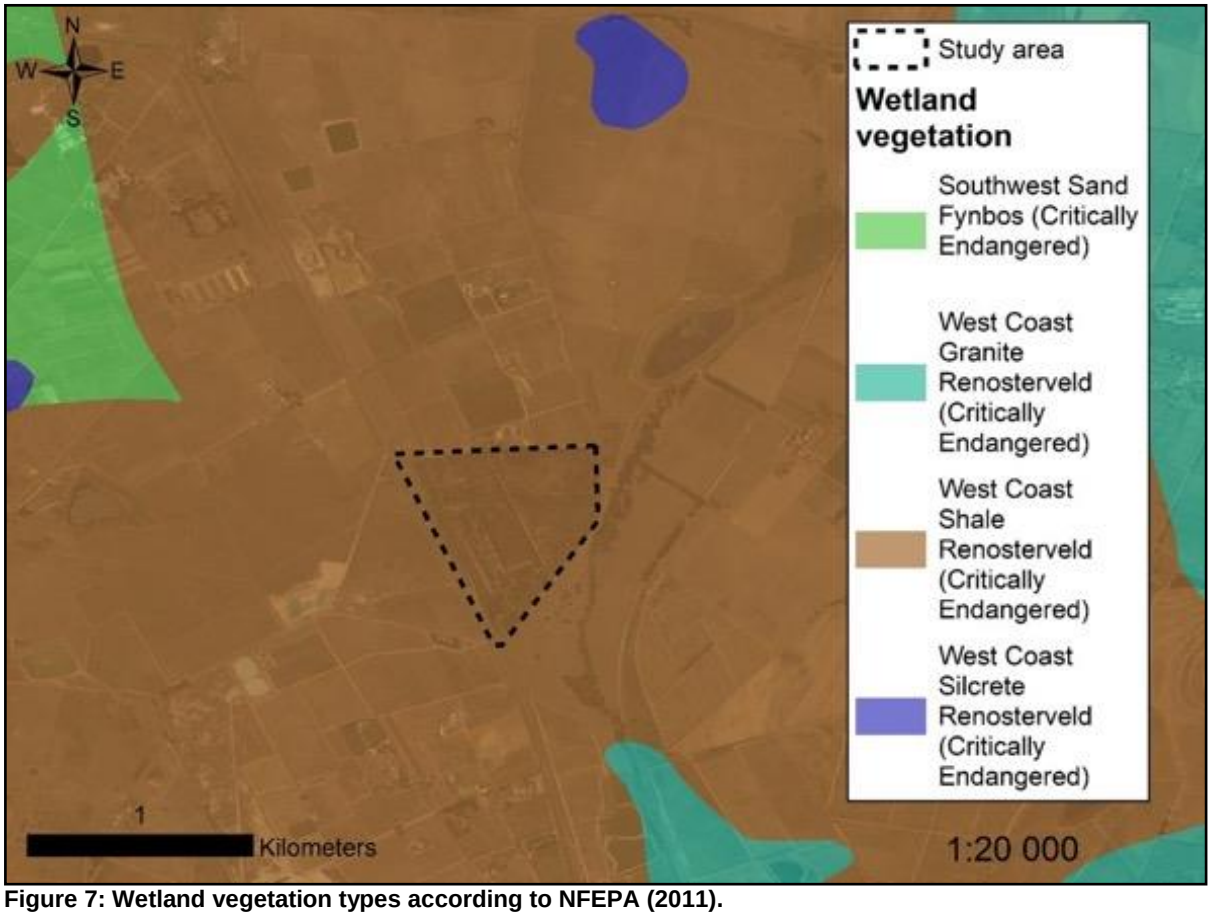


**Figure 7: Wetland vegetation types according to NFEPA (2011).**

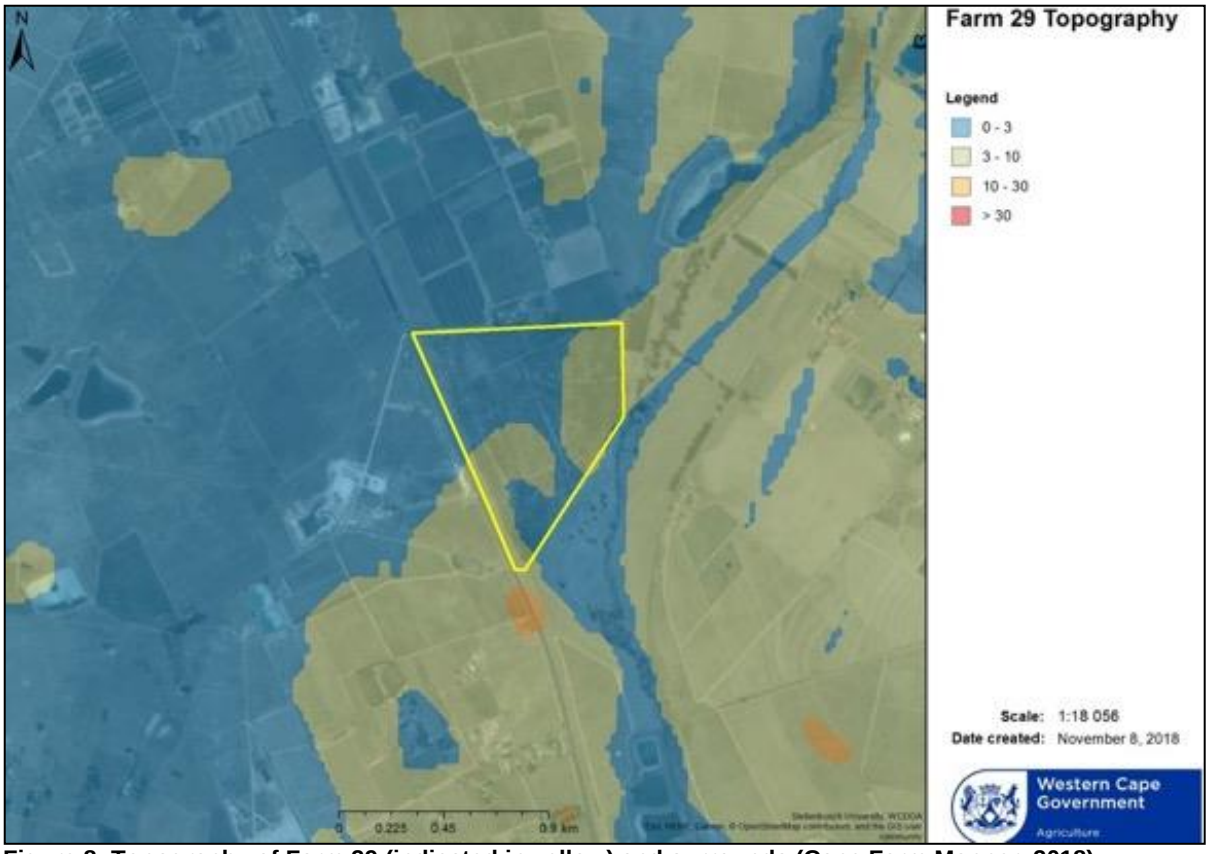


**Figure 8: Topography of Farm 29 (indicated in yellow) and surrounds (Cape Farm Mapper, 2018).**

### 3.1.2 Watercourses and Regulated Zones Coinciding with the Proposed Site

The NWA (1988) 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 study area, according to the available desktop resources, are presented below.

Within the 500m regulated area, the NFEPA wetland layer (2011) indicates the presence of a number of unchanneled valley-bottom wetlands as well as a larger channelled valley-bottom wetland within the 500m regulated area (refer to Figure 9). In addition, the NGI Service topo-cadastral map indicates a non-perennial drainage line in the western portion of the study area which drains in a south-easterly direction, refer also to Figure 9.

According to the WCBSP (2017) the study area intersects a number of spatial biodiversity categories. Figure 10 depicts the spatial location of the study area relative to the categories described by

Table 1, and shows that the study area is dominated by the ESA 2 category, and contains elements of CBA 2 and CBA 1 as well. The possibility of wetland CBA 1 features is also highlighted by Figure 10. The presence of threatened vertebrate and plant species, and the role played by natural vegetation in water resources protection within the critically endangered Renosterveld vegetation type are the reasons cited by the WCBSP (2017) for the relatively high conservation value of the study area.

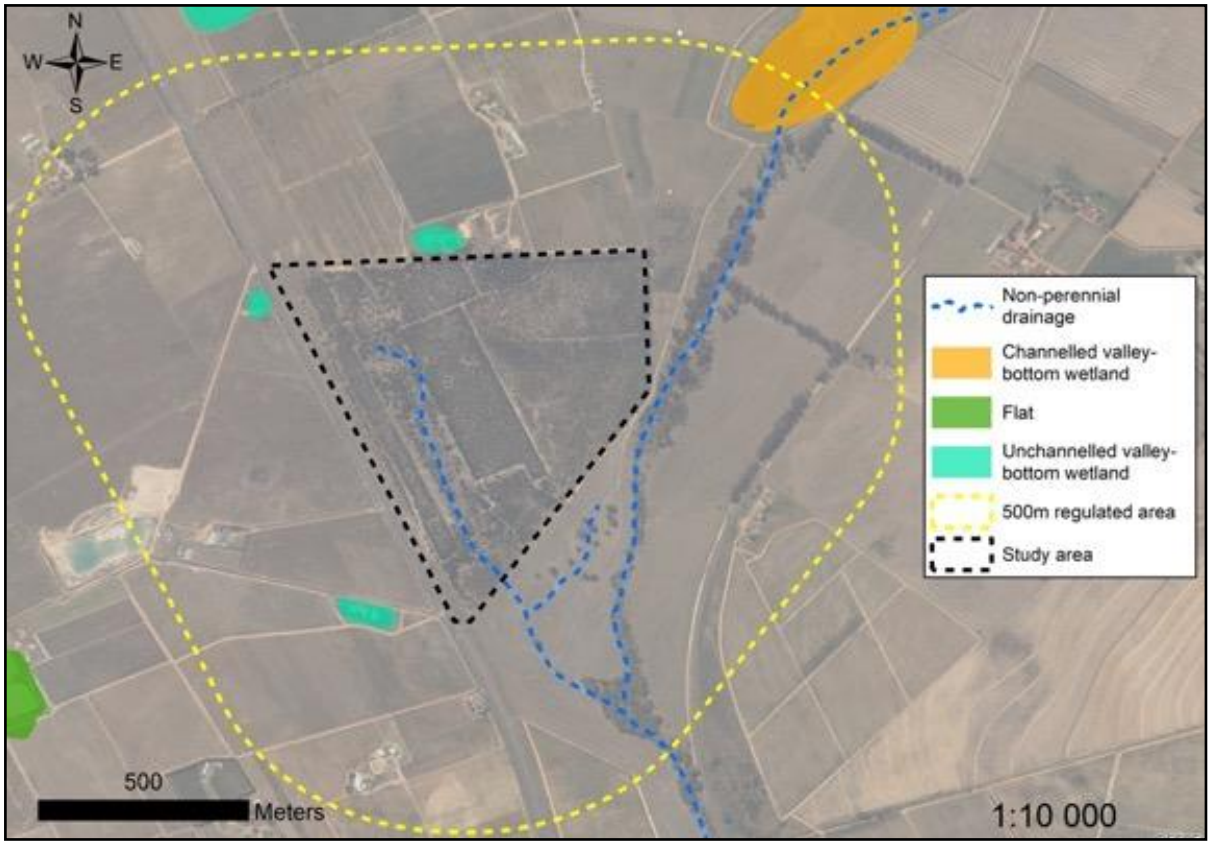


**Figure 9: Known watercourses according to the NFEPA and NGI Service.**

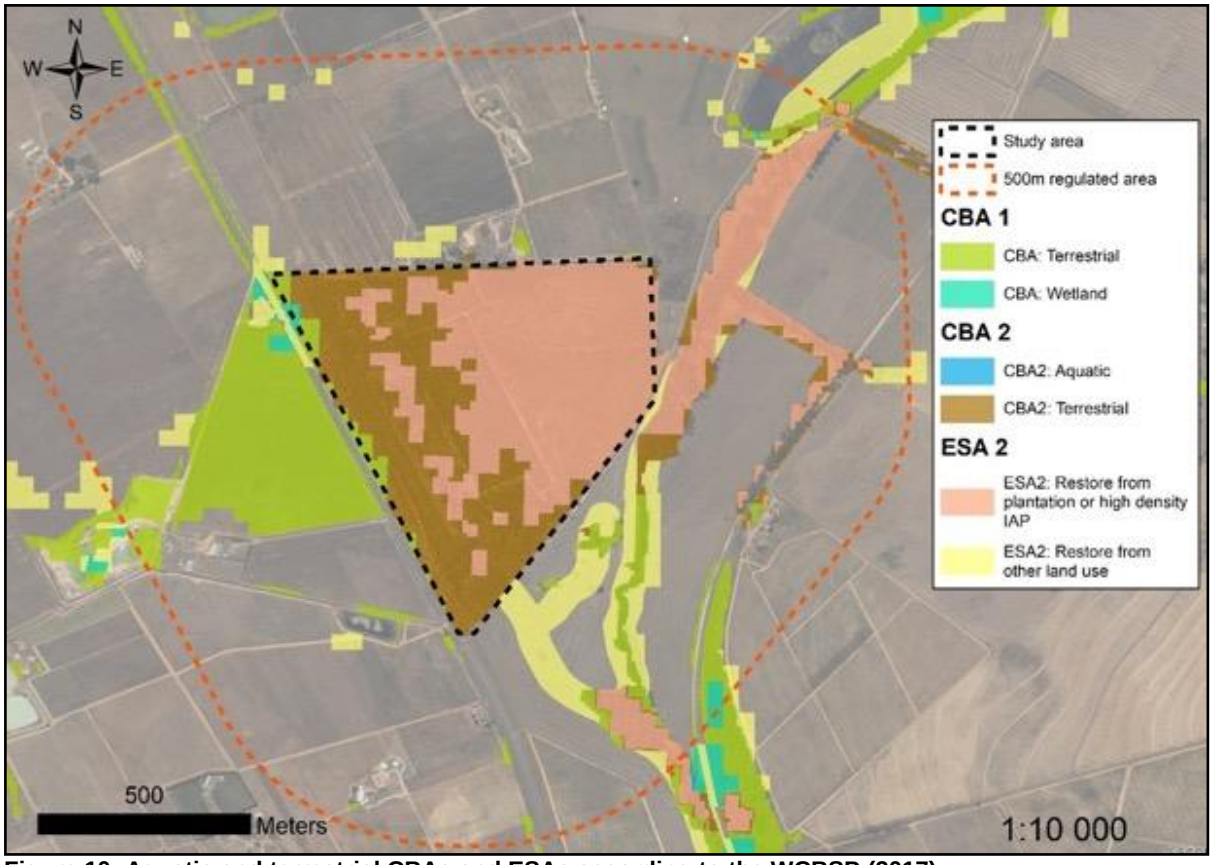


**Figure 10: Aquatic and terrestrial CBAs and ESAs according to the WCBSP (2017).**

## 3.2 Site Description

### 3.2.1 Soil

Hand augering was conducted within areas where other possible wetland indicators such as hydrophytic vegetation or a fractured soil surface were found in order to locate and determine the outer boundary of freshwater features within Farm 29 and to discern between wetland and riverine conditions.

Terrestrial soils were uniform and brown and exhibited a high clay content. Wetland soils had a low chroma and exhibited an organic surface layer (refer to Figure 11). Wetland hydrology was also present despite the season, with saturated soils and even surface water in places. Surprisingly, the soils did not mottle even where seasonal wetland hydrology was clearly evident. Soils throughout much of Farm 29 exhibited signs of historical disturbance and churning. Soil samples within the drainage line were found to be alluvial.

**Figure 11: Representative moist wetland soil sample with an extensive organic surface layer.**

### 3.2.2 Vegetation

It was found that all watercourses within Farm 29 were severely degraded due primarily to the presence of dense forests of *Acacia saligna* and *Eucalyptus spp.* along with dense stands of alien grasses, particularly *Lolium perenne*. Sparse wetland vegetation was encountered, however where wetland soils were present, vegetation such as *Chasmanthe aethiopica, Juncus acutus*, *Pennisetum macrourum*, *Zantedeschia aethiopica* and *Typha capensis* (refer to Figure 12, Figure 13, and Figure 14), were occasionally present. These species are known to occur in wetlands and the latter four are listed as wetland obligate in either Appendix C of DWAF (2008) or in van Ginkel *et. al.* (2011).

Riparian zones were substantially eroded and largely devoid of indigenous vegetation along the non-perennial drainage line; however, pockets of indigenous *Sersia glauca* and *S. laevigata* were encountered.

**Figure 12: *Juncus acutus* (left), *Chasmanthe aethiopica* and *Pennisetum macrourum* (right).**

**Figure 13: *Typha capensis* within a portion of the drainage line.**

**Figure 14: Southern portion of the drainage line, with *Zantedeschia aethiopica*.**

### 3.2.3 Freshwater Feature Classification

Farm 29 is situated within the Southwestern Coastal Belt Ecoregion, the Berg Water Management Area (WMA), and the Greater Cape Town Sub-WMA as defined by NFEPA (2011). The table below summarise the results from **Level 4** through to **Level 6** of the wetland and aquatic ecosystem classification user manual (Ollis *et. al.* 2013).

**Table 7: Level 4, 5 and 6 of the wetland and aquatic ecosystem classification applied to the wetlands and stream. The descriptors that relate to the stream are above in each box, and those relating to the wetlands are below.**

| | |
|---|---|
| **Level 4 (Hydrogeomorphic unit)** | **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit. |

| | |
|---|---|
| | **Depression:** a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates. |
| **Level 5 (Hydrological regime)** | **Non-perennial:** does not flow continuously throughout the year, although pools may persist.<br>**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. |
| **Level 6 (Descriptors)** | **Natural**: existing in, or, produced by nature; not made or caused by humankind.<br>**Artificial:** produced by human beings, not naturally occurring. |

## 3.3 Watercourse Delineation

A site-based delineation of watercourses within Farm 29 was undertaken on 9 November 2018. The method supplied by DWAF (2005, updated 2008) for delineation of wetlands and riparian zones was followed. The presence of hydromorphic and alluvial soil features, hydrophytic vegetation, and soil hydrology within the upper 50cm of the soil were all used in varying combinations as indicators of temporary wetland and riparian boundaries.

Two drainage lines and a mosaic of depression wetlands were delineated on Farm 29 (refer to Figure 16 below). The drainage line indicated by the NGI was found to be largely present and although wetlands were found within the northern parts thereof, it was found largely to be a true ephemeral drainage line dominated by alluvial soils without hydromorphic soil features present. The drainage line was found to have been subjected to substantial erosion related to the presence of invasive species and may in the past have had more substantial riparian zones and may have provided additional water to wetlands near its banks.

The northernmost portion of the drainage line indicated in the delineation map below (between the northernmost wetland and the northern boundary) is artificial and has been excavated historically such that the fall is northwards and up-slope, likely installed as a measure to drain the wetlands at the southern extreme of the channel.

A mosaic of depression wetlands were delineated within the southern and north-western portion of the site (refer to Figure 15). Wetlands delineated on Farm 29 were not in line with the WCBSP (2017) ESA 2 wetlands discussed in section 3.1.2, as no wetlands were found within the upper eastern portion of Farm 29.

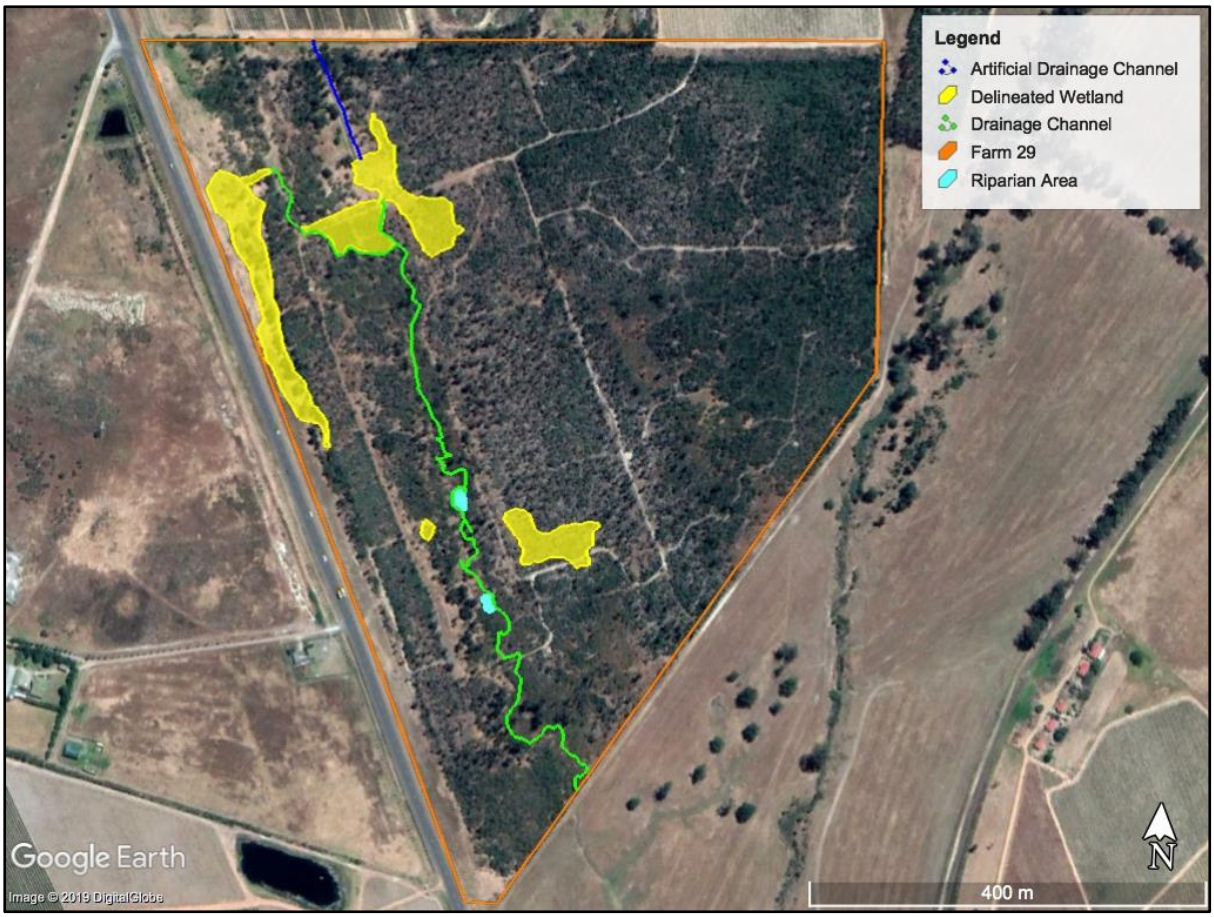


**Figure 15: Freshwater feature delineations on Farm 29, Stellenbosch.**

## 3.4 Ecosystem Services

The WET-EcoServices tool (Kotze *et. al.,* 2007) was applied to the mosaic of depression wetlands found within Farm 29 in order to determine function and service provision of the wetland mosaic in its present, predevelopment state.

Fifteen Ecosystem Services were assessed and the results are presented in Figure 16. Brief explanations of the most noteworthy results are provided below:

- The mosaic of depression wetlands is of high importance in terms of the assimilation of phosphates, nitrates and toxicants due largely to the extent to which the larger catchment of the wetland is transformed for agricultural purposes which likely results in a high volume of input of nutrients and toxicants;

- Streamflow regulation and flood attenuation both are moderately significant ecosystem services provided by the wetland mosaic. The wetlands absorb water under flood conditions and release it slowly, thereby decreasing flood peak flows within the adjacent drainage lines and increasing the length of time that they flow for;

- The moderately high score for sediment trapping is consistent with both the general function of a depression wetland on a landscape scale. Overtopping of the drainage line during flood conditions would also result in sediment trapping on a limited scale;

- The moderately high score for erosion control is largely the result of the sediment trapping and streamflow regulation functions filled by the wetland mosaic;

- The mid-range score for provision of biodiversity is due largely as a result of the CR wetland vegetation type, and the potential provision of rare habitat should the wetlands be rehabilitated, and not to the range or importance of biodiversity currently present within the site;

- There is no legitimate human use of these wetlands at present beyond dumping, so Education and Research, Tourism, Recreation and Scenic Value, Cultural Significance, Provision of Cultivated Foods, Harvestable Natural Resources and Water Supply for Direct Human Use all scored zero or near zero.

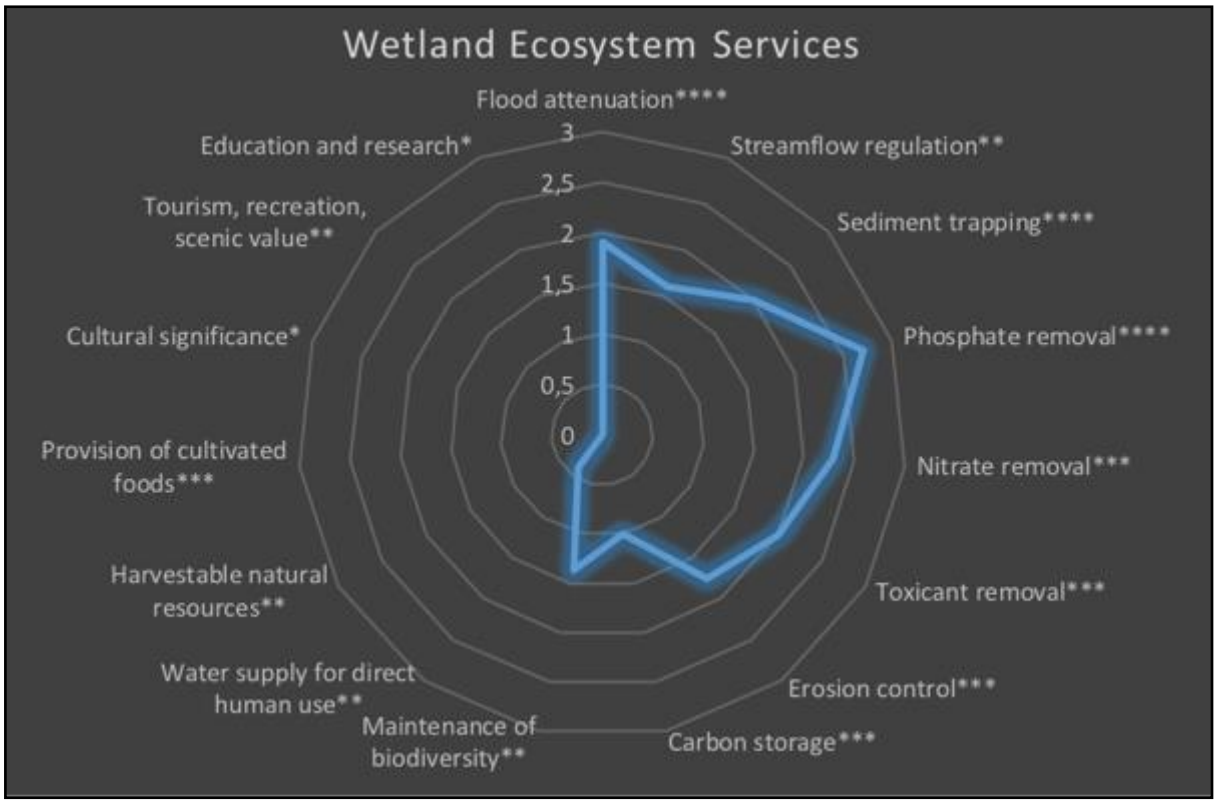


**Figure 16: Spider diagram indicating the range of ecosystem services provided by the mosaic of depression wetlands.**

**Table 8: 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 9: WET-EcoServices results table for the mosaic of depression wetlands indicating scores pre-development.**

| Wetland Ecosystem Services | |
|---|---|
| **Indirect Benefits (regulating and supporting benefits)** | |
| Flood attenuation**** | 1,9 |
| Streamflow regulation** | 1,6 |
| Sediment trapping**** | 2 |
| Phosphate removal**** | 2,7 |
| Nitrate removal*** | 2,3 |
| Toxicant removal*** | 2 |
| Erosion control*** | 1,8 |

| | |
|---|---|
| Carbon storage*** | 1 |
| **Direct Benefits** | |
| Maintenance of biodiversity** | 1,4 |
| Water supply for direct human use** | 0,4 |
| Harvestable natural resources** | 0 |
| Provision of cultivated foods*** | 0 |
| Cultural significance* | 0 |
| Tourism, recreation, scenic value** | 0 |
| Education and research* | 0 |

## 3.5 Present Ecological State

### 3.5.1 Non-perennial Drainage Line

In order to determine the PES of the non-perennial drainage line, the river IHIA was applied. The IHIA is founded on the assessment of two separate modules of a watercourse namely riparian habitat and instream habitat.

The key reasoning behind the river IHIA results are summarised below:

- Water abstraction:
    - The area is heavily invaded by alien vegetation in the riparian zone and catchment, which would result in significantly increased evapotranspiration rates.
- Flow modification:
    - The transformation of the broader catchment for agricultural purposes would likely result in a modification in flow;
    - Stacks of dead alien invasive vegetation, namely woody *Acacia saligna* branches, were encountered throughout the channel thereby affecting the flow.
- Channel and bed modification:
    - The drainage line has become severely eroded as the *Acacia saligna* and *Eucalyptus* forest and alien annual grasses have resulted in an almost complete loss of indigenous catchment and streamside vegetation which would ordinarily have stabilised the bed and banks. The reduced surface roughness within the catchment has also likely resulted in increased storm peak flows which further exacerbates erosion;
    - Roads have been constructed and reinforced over or near the channel;
    - The drainage line beds have further been modified by application of dense stacks of dead *Acacia saligna* branches.
- Water quality modification:
    - Runoff from surrounding agricultural activities in the broader catchment would likely carry phosphates, limited toxicants, and nitrates and would likely result in impaired water quality.
- Inundation:

- Previously cleared alien vegetation has been brush piled within some parts of the drainage line and may have caused minor inundation over short periods of time.

- Exotic Macrophytes and Fauna:
  - The riparian zone, instream area, and surrounding farm is severely invaded by alien vegetation;
  - No exotic fauna was noted.

- Solid waste disposal:
  - Dumping was noted in portions of riparian and instream areas.

- Indigenous vegetation removal:
  - Severe encroachment of alien invasive vegetation and a lack of indigenous vegetation was evident. Indigenous vegetation would likely have been removed during the construction of access roads.

- Bank erosion:
  - Significant erosion of the channel was observed.

The overall habitat integrity score for the drainage line was 40.7, which falls within a low IHIA Category D: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.

**Table 10: Descriptive classes for the assessments of modifications to the habitat integrity (after IHIA, 1999).**

| IMPACT CATEGORY | DESCRIPTION | SCORE |
|---|---|---|
| None | No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability. | 0 |
| Small | The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability is also very small. | 1–5 |
| Moderate | The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is also limited. | 6 – 10 |
| Large | The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced. | 11 – 15 |
| Serious | The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area is affected. Only small areas are not influenced. | 16 – 20 |
| Critical | The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section is influenced detrimentally. | 21 - 25 |

**Table 11: Results of the IHI assessment for the non-perennial drainage line.**

| | Impact score, Pre-development | Weight | IHI Score, Pre-development |
|---|---|---|---|
| **Instream criteria** | | | |
| Water abstraction | 18 | 14 | 10,08 |
| Flow modification | 18 | 13 | 9,36 |
| Bed modification | 16 | 13 | 8,32 |
| Channel modification | 18 | 13 | 9,36 |
| Water quality | 8 | 14 | 4,48 |
| Inundation | 1 | 10 | 0,4 |

| | | | |
|---|---|---|---|
| Exotic macrophytes | 15 | 9 | 5,4 |
| Exotic fauna | 0 | 8 | 0 |
| Solid waste disposal | 8 | 6 | 1,92 |
| **Provisional Instream Habitat Integrity** | | | 50,68 |
| **Riparian zone criteria** | | | |
| Indigenous vegetation removal | 20 | 13 | 10,4 |
| Exotic vegetation encroachment | 25 | 12 | 12 |
| Bank erosion | 18 | 14 | 10,08 |
| Channel modification | 20 | 12 | 9,6 |
| Water abstraction | 24 | 13 | 12,48 |
| Inundation | 0 | 11 | 0 |
| Flow modification | 22 | 12 | 10,56 |
| Water quality | 8 | 13 | 4,16 |
| **Provisional Riparian Zone Habitat Integrity** | | | 30,72 |
| **Overall Habitat Integrity** | | | **40,7** |
| PES Category | | | D |

### 3.5.2 Depression Wetlands

The WET-Health method was used to assess the PES of the depression wetland mosaic. This method assesses 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 the depression wetland mosaic in its present, pre-development state. All areas of wetland within the mosaic were similar in terms of hydrogeomorphology and in terms of the impacts of thereon and the mosaic was therefore assessed as a single hydrogeomorphic unit.

The key reasoning behind the WET-Health assessments is summarised below:

- The dense, mature forest of alien invasive *Acacia saligna* and various *Eucalyptus* species in and around the wetlands has resulted in almost complete loss of wetland vegetation and has severely impacted wetland hydrology through abstraction and subsequently a reduction in flow.

- Construction of an artificial drainage channel in the north of the property has severely impacted wetland hydrology, by draining the wetland mosaic that feeds the ephemeral drainage line.

- Erosion of the natural drainage line, as a result of natural vegetation loss and a reduction in surface roughness in and around the channel, has caused the channel to become more efficient in transporting runoff away from the wetlands and has likely decreased the residence time of water within the wetlands.

- Stormwater input form the nearby tar road has likely increased runoff and storm peak flow into the wetlands to the west of the stream.

- Runoff from surrounding agricultural activities in the broader catchment would likely result in impaired water quality as it would likely carry phosphates and nitrates from fertilizer, toxicants from herbicide and insecticide, and would likely carry significant sediment volumes.

The findings of the assessment are as follows:

**Table 12: WET-Health results table for the mosaic of depression wetlands.**

| | Hydrology | Geomorphology | Vegetation |
|---|---|---|---|
| Impact category – without development | E | C | F |
| 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.

The overall wetland health scores[6] calculated for the mosaic of depression wetlands is 7.1 a Category E – "The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable" (Macfarlane, 2007).

## 3.6 Ecological Importance and Sensitivity

### 3.6.1 Non-perennial Drainage Line

The EIS assessment method applied to rivers, based on the approach adopted by the DWA as detailed in the document "Resource Directed Measures for Protection of Water Resources" (1999), was applied to the non-perennial drainage line. The key aspects considered during this EIS assessment are summarised below and the results are provided in the table to follow:

- No species of conservation concern were noted in the drainage line during the site assessment. Aquatic animal species of conservation concern are not likely to inhabit this watercourse due to its ephemeral and disturbed nature. It is likely however, given the vegetation type, that some plant species of conservation concern are present within the riparian zone as dormant bulbs or seeds.

- The species richness of the drainage line is very low, and only a few indigenous species were noted during the site assessment.

- The portion of the drainage line that falls within the proposed site is largely homogenous and habitat diversity is low. The drainage line does however meander significantly and this has created several natural erosion banks, which is an increasingly rare habitat type for many species. This increased the score slightly for habitat diversity.

- The drainage line is important as a potential migration route for indigenous hydrophilic plants and invertebrates to travel between downstream watercourses and the wetland mosaic. Unfortunately alien and invasive species can also make use of the corridor.

- The impact of a change in the hydrological regime may be significant. The drainage line falls within a soil type that is highly susceptible to erosion. The geomorphological impacts of increased storm peak flows may be very significant.

- Non-perennial systems naturally experience periods of poor water quality when flow ceases and pools slowly dry up. At these times, evaporation concentrates nutrients and toxicants within the pools and dissolved oxygen levels may become extremely low. These systems are therefore usually resilient in terms of water quality. Perennial watercourses downstream of the proposed site may however be much more sensitive to water quality impairment and this must therefore be addressed, even if the watercourse within the site is not threatened significantly.

- The drainage line is small and has a low surface roughness, but it meanders significantly and there are therefore areas of slower flow where sediment may be trapped.

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

- The drainage line is not a protected area, but it has been designated as an ESA2, and falls within a terrestrial CBA2. Its conservation value is therefore recognised, and must be taken into account if the site is developed.

- The ecological integrity of the watercourse is has been severely impacted. The hydrological regime has been impacted by the introduction of stormwater and by the presence of invasive forest throughout the proposed site. Its natural course appears to be intact however, and rehabilitation is not excessively difficult in this case.

| **Determinant** | **Score (0-4)** | **Confidence (1-4)** |
|---|---|---|
| **PRIMARY DETERMINANTS** | | |
| Rare and endangered Species | 2 | 2 |
| Populations of unique Species | 1 | 2 |
| Species/taxon richness* | 1 | 3 |
| Diversity of habitat types or features* | 2 | 4 |
| Migration route/breeding and feeding site for riverine species:<br>Importance in terms of the link it provides for biological functioning. | 2 | 4 |
| Sensitivity to changes in the natural hydrological regime*:<br>Determined by the size of the feature, available habitat types and frequency of flood events. | 3 | 3 |
| Sensitivity to water quality changes*:<br>Determined by the size of the feature, available habitat types and frequency of flood events. | 1 | 3 |
| Energy dissipation and particulate/element removal:<br>Roughness coefficient/Storage capacity and size. | 2 | 3 |
| **MODIFYING DETERMINANTS** | | |
| Protected status:<br>Ramsar Site, National Park, Wilderness area and Nature Reserve. | 1 | 4 |
| Ecological integrity:<br>Degree of change of the flood regime, water quality and habitat from reference conditions. | 2 | 4 |
| TOTAL | 18 | |
| MEDIAN | 2 | |
| **OVERALL EIS** | **Moderate** | |
| **EIS Category** | **Range of Median** | **Recommended Ecological Category** |
| Very high<br>Watercourses that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these watercourses is usually very sensitive to flow and habitat modifications. | >3 and <=4 | A |
| High<br>Watercourses that are considered to be ecologically important and sensitive. The biodiversity of these watercourses may be sensitive to flow and habitat modifications. | >2 and <=3 | B |
| Moderate<br>Watercourses that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these watercourses is not usually sensitive to flow and habitat modifications. | >1 and <=2 | C |
| Low/marginal<br>Watercourses that are not ecologically important and sensitive at any scale. The biodiversity of these watercourses is ubiquitous and not sensitive to flow and habitat modifications. | >0 and <=1 | D |

### 3.6.2 Depression Wetlands

The EIS method applied to wetlands is based on the assessment tool developed by Rountree *et. al*. (2014). The assessment was conducted for the mosaic of depression wetlands in its present, predevelopment state.

The key aspects considered during this EIS assessment are summarised below and in the table to follow:

- It is likely, given the CR conservation status of the West Coast Shale Renosterveld vegetation type applicable to the wetlands, that species presently considered to be of conservation concern once inhabited these wetlands. None were identified during the site assessment and may have been lost due to the degraded nature of the wetlands, but it is more likely that some bulbs, annuals or even perennial plants are present, but were dormant at the time of the site assessment;

- The wetlands are not formally protected, however, the West Coast Shale Renosterveld wetland vegetation group is CR within the region and parts of the site have been recognised as important within the WCBSP;

- The PES score for the wetland mosaic was found to be within the category of Largely modified therefore scored lower for ecological integrity;

- The wetlands have seasonal and temporary zones and even a small permanent zone and therefore .

- Amphibians are likely to use the wetlands as breeding and feeding sites.

- The depression wetlands are sensitive to changes in annual runoff volumes to a limited degree as such changes may shift wetland zonation.

- The wetlands are sensitive to water quality impacts since depressions of this nature don't flush easily and are susceptible to accumulation of toxicants. Nutrients also accumulated in depression wetlands under natural conditions, so this is less of a concern than toxicant accumulation.

A score of 2 calculated is indicative of a Moderate EIS. The wetlands 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.

**Table 13: Results of the EIS Assessment for the mosaic of depression wetlands.**

| **ECOLOGICAL IMPORTANCE AND SENSITIVITY** | Score (0-4) | Confidence (1-5) |
|---|---|---|
| **Biodiversity support** | | |
| Presence of Red Data species:<br>Endangered or rare Red Data species present | 1 | 2 |
| Populations of unique species:<br>Uncommonly large populations of wetland species | 0 | 4 |
| Migration/breeding/feeding sites:<br>Importance of the unit for migration, breeding site and/or feeding | 2 | 2 |
| **Landscape scale** | | |
| Protection status of the wetland: | 1 | 5 |

| | | |
|---|---|---|
| National (4), Provincial, private (3), municipal (1 or 2), public area (0-1) | | |
| Protection status of the vegetation type:<br>SANBI guidance on the protection status of the surrounding vegetation | 4 | 5 |
| Regional context of the ecological integrity:<br>Assessment of the PES (habitat integrity), especially in light of regional utilisation | 1 | 3 |
| Size and rarity of the wetland type/s present:<br>Identification and rarity assessment of the wetland types | 2 | 3 |
| Diversity of habitat types:<br>Assessment of the variety of wetland types present within a site | 3 | 3 |
| **Sensitivity of the wetland** | | |
| Sensitivity to changes in floods:<br>Floodplains at 4; valley bottoms 2 or3; pans and seeps 0 or 1 | 1 | 3 |
| Sensitivity to changes in low flows/dry season:<br>Unchannelled VB's probably most sensitive | 2 | 3 |
| Sensitivity to changes in water quality:<br>Esp natural low nutrient waters – lower nutrients likely to be more sensitive | 2 | 2 |
| **ECOLOGICAL IMPORTANCE AND SENSITIVITY** | 2 | 3 |

**Table 14: 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 |

## 3.7 Recommended Ecological Category

The PES for the mosaic of depression wetlands was found to fall within Category E; (refer to section 3.5). A low PES Category D: Largely modified, was found for the drainage line. and an EIS score within the Moderate category was calculated for both the wetland mosaic and the drainage line.

The minimum acceptable PES score for any watercourse is within a Category D (Rountree et. al. 2014), and the drainage line already within a Category D. This score may be achieved for the wetland mosaic through alien clearing alone, as this would allow wetland vegetation to recover and hydrology to improve substantially. Given however that the proponent wishes to undertake rehabilitation of the watercourses, it is feasible that a PES of C may be reached for both. An REC of C is therefore advocated for the wetland mosaic and the drainage line.

## 3.8 Buffer Determination

The buffer zone tools for the determination of the minimum effective buffers for wetlands and rivers respectively (Macfarlane *et. al*. 2014), were utilized in order to determine the appropriate buffer areas required for the mosaic of depression wetlands and drainage line. A buffer area of 15m (construction and operational phase) was calculated for both the wetland mosaic and the drainage line. (refer to Figure 17). The most significant factors that influenced the buffer width are listed below.

Factors that tended to increase buffer width:

- Critically endangered status of the terrestrial and aquatic vegetation types;
- High erodibility coefficient of the soil;
- Increased runoff and storm peak flows as a result of catchment hardening through the proposed development.
- Possible water quality impacts related to landscaping and use of compost and fertiliser.

Factors that reduced buffer width:

- The largely flat topography of the proposed site;
- Moderate EIS for both watercourses;
- Low PES of both watercourses;
- High density of the probable post-rehabilitation buffer vegetation.

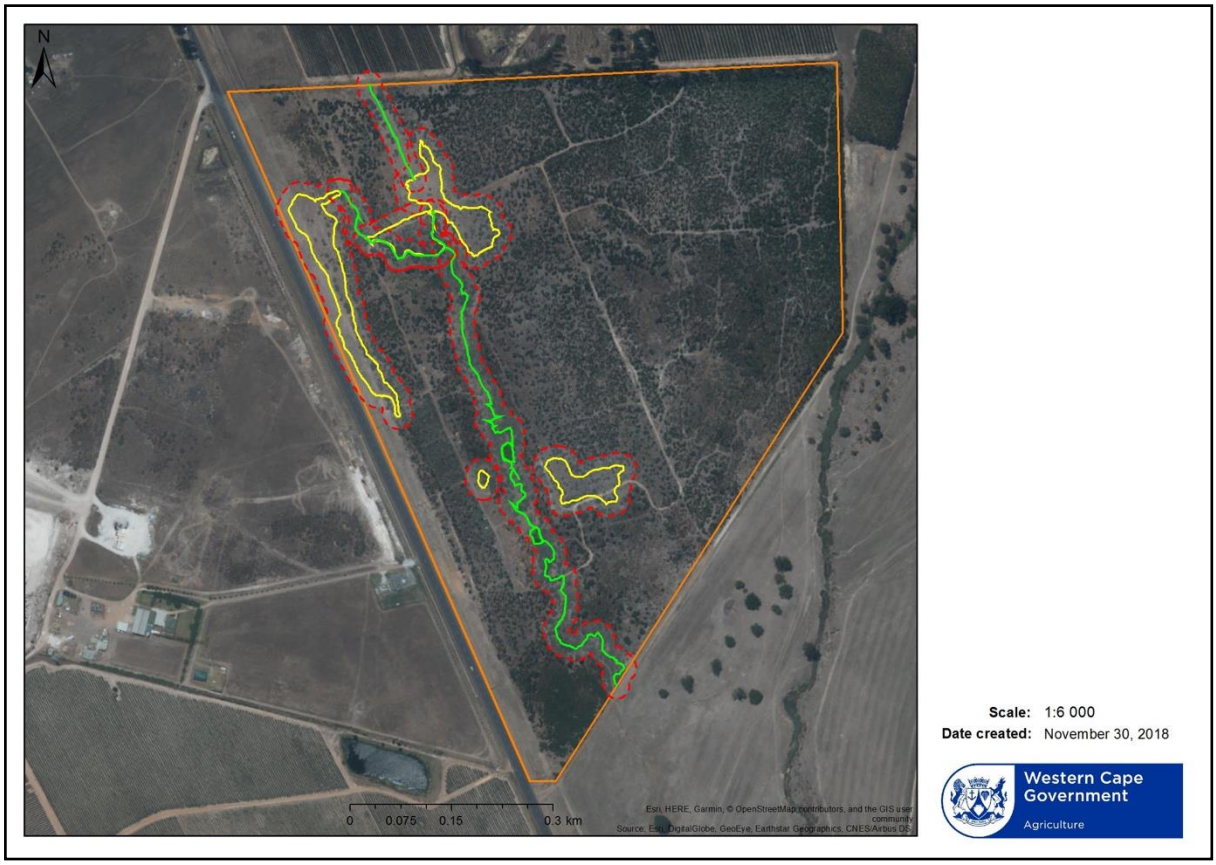


**Figure 17: Minimum effective buffer of 15m applied to assessed freshwater features. Please note that the artificial drainage channel identified in Figure 15 is shown with a buffer in this map, but will in reality be infilled as part of the proposed rehabilitation effort.**

# 4 Assessment of Impacts

## 4.1 Activity Description

Development of the proposed memorial park would involve construction of extensive hard infrastructure, installation of limited sewage infrastructure (including a sewage package plant), installation of graves and landscaping of an extensive parkland including planting of indigenous trees and fynbos, watering, and use of fertiliser and possibly herbicides. The mosaic of depression wetlands, drainage line and buffer zone have been accommodated and construction within the watercourses and buffer has been limited to three drainage line crossings. Two crossings will take the form of pedestrian bridges and one will be a drift that is constructed by means of grass blocks (cement blocks with holes in them to allow for plant growth), packed along the stream bed. (refer to Figure 2 in Section 1). The southern fence line will also cross the stream and will extend down to the stream bed.

Potential impacts associated with the construction of the proposed memorial park are therefore associated with site clearing and preparation, access by heavy vehicles, soil compaction, the use of concrete and chemicals, and the use of compost, fertiliser and herbicides during alien clearing and landscaping activities, along with direct impacts from construction of the three stream crossings. Potential impacts related to the operational phase of the proposed memorial park are predominantly associated with the routine use of compost, fertiliser and herbicides, and the presence of hardened infrastructure.

Mitigation measures that are proposed below are substantial and include intensive rehabilitation of all watercourses within the proposed site. The proposed rehabilitation measures require environmental and water use authorisations in their own right and therefore form part of the activities applied for.

The proposed layout including the position of the sewage package plant and the two swales is presented in Figure 18 below.


**Figure 18: The proposed layout including services.**

## 4.2 Direct Impacts

Authorisation of the following water use[7] will be required for the proposed development:

(c) impeding or diverting flow within a watercourse.

(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 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.

### 4.2.1 Impact 1 – Impact on the flow regime

#### *4.2.1.1 Construction Phase*

Construction of the proposed development would most likely result in an increase in runoff from areas that have been cleared. This would likely also result in an increase in runoff and storm peak flow velocities, with a greater impact on the southern reaches of the drainage line, and wetlands C and D. The potential impact is limited by the extremely gentle topography.

Without mitigation the increase in runoff from site clearing and the associated impact on the flow regime is low (negative). A significance score of very low (negative) with the implementation of the mitigation measures is achievable.

*Essential Mitigation Measures*

- Demarcate (by means of danger tape, fencing or a similar barrier) and rehabilitate buffer zones prior to initial site clearing in accordance with an approved Freshwater Rehabilitation Maintenance and Management Plan (FRMMP).
- Undertake site clearing and initiate construction and landscaping during the dry, summer months (November – March).

#### *4.2.1.2 Operational Phase*

The proposed development involves the presence of hardened infrastructure predominantly north-northeast of the delineated wetlands. This would likely increase runoff within the affected catchment and storm peak flows within watercourses and the drainage line. This would likely change the overall hydrology within the catchment area primarily affecting wetlands A and D which are east of the drainage line. This impact is however greatly reduced through the proposed implementation of a stormwater retention pond (see irrigation reservoir on Figure 2) south-southeast of wetland A.

In addition, the proposed construction of wooden pedestrian bridge crossings over and within portions of the drainage line may reduce flow within the drainage line during the operational phase. This is

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

however dependent on the design and materials used for the proposed crossings. The significance of this activity is therefore low when mitigation measures are considered.

Watering of the landscaped area would augment the current water volumes during the summertime dry period which may cause a shift in wetland zonation and seasonality, depending on the scale. This impact may be reduced considerably through mitigation.

The increase in surface roughness throughout the surrounding parkland area, but particularly in the less formal areas where denser fynbos shrublands are established, and the implementation of a stormwater retention pond would serve as inherent mitigation within the proposed plan. Therefore without mitigation the overall impact on the flow regime is low (negative) and with the additional mitigation provided below, is very low (negative).

*Essential Mitigation Measures*

The following mitigation measures are considered essential:

- Maintain the 15m buffer around each wetland and the drainage line that is to be rehabilitated in accordance with a detailed FRMMP.
- Retain storm water and runoff from hardened infrastructure in the stormwater retention pond as far as possible and use for irrigation of the proposed parkland area, outside of the buffer zones as planned. Ensure that indigenous wetland vegetation is established within the stormwater pond. Ensure that the portion of stormwater from the eastern parts of the site that cannot drain into the proposed stormwater pond drains into the drainage line through a swale of at least 4m in width and 30m in length vegetated with indigenous wetland vegetation (as per the FRMMP).
- Maintain the aforementioned swale and stormwater retention pond as per the FRMMP.
- Install the grass blocks for the drift crossing at an elevation of no more than 20mm above the bed of the drainage line, such that no significant barrier to flow is presented by the grass blocks.
- Undertake all rehabilitation, maintenance and management measures contained in the FRMMP.
- Check and clear the portion of the fence that crosses the drainage line on a daily basis once it is constructed.

#### *4.2.1.3 Results*

| **Impact I: Impact on the Flow Regime** | | | | | |
|---|---|---|---|---|---|
| | **Intensity** | **Extent** | **Duration** | **Probability of impact occurring** | **Significance** |
| **Construction Phase** | | | | | |
| Without mitigation | Medium | Local | Short term | Medium | Low (-ve) |
| With mitigation | Low | Local | Short term | Medium | Very Low (-ve) |
| **Operational Phase** | | | | | |
| Without mitigation | Medium | Local | Medium term | Medium | Low (-ve) |
| With mitigation | Very Low | Local | Medium term | Low | Very Low (-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. The potential impact of cement on renosterveld rivers and drainage lines where pH is alkaline is extremely limited however.

The construction of wooden infrastructure may involve the use of Copper Chrome Arsenate (CCA) which is toxic, thereby impairing water quality. These impacts are not likely to be significant, except

from the pedestrian bridges and vehicle crossing within the drainage line, and these are therefore addressed in mitigation.

Reduced surface roughness and soil compaction associated with 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 wetlands and the drainage line downslope. Excavation within the bed and banks of the drainage line may also loosen soil and cause sedimentation to occur.

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 wetlands (if in high volume) and herbicide used in alien clearing of the site may also impact runoff quality.

Without mitigation the impact on water quality is low (negative), with mitigation the impact is very low (negative).

*Essential Mitigation Measures*

- Demarcate (by means of danger tape, fencing or a similar barrier) and rehabilitate buffer zones prior to initial site clearing in accordance with an approved Freshwater Rehabilitation Maintenance and Management Plan (FRMMP).
- Undertake site clearing and initiate construction and landscaping during the dry, summer months (November – March). Also initiate and complete construction of the drift and pedestrian bridges through this period.
- 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 or at an appropriate location offsite;
- Install sediment fences at the boundary of all cleared areas to sediment;
- Place compost and fertilizer within the holes dug for planting when landscaping;
- Use herbicide only for direct stump treatment of acacias and other woody alien invasive species. Control invasive annuals by hand-pulling.
- 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);
- No products containing Copper Chrome Arsenate (CCA) may be used during any construction, and specifically during the construction of pedestrian bridges should wood be used in their construction;
- Ensure that the banks are not destabilised in construction of the bridge by setting the bridge supports back from banks of the drainage line such that no excavation is necessary within 1m of the banks. This will prevent bank collapse, erosion and the subsequent localised increase in turbidity.

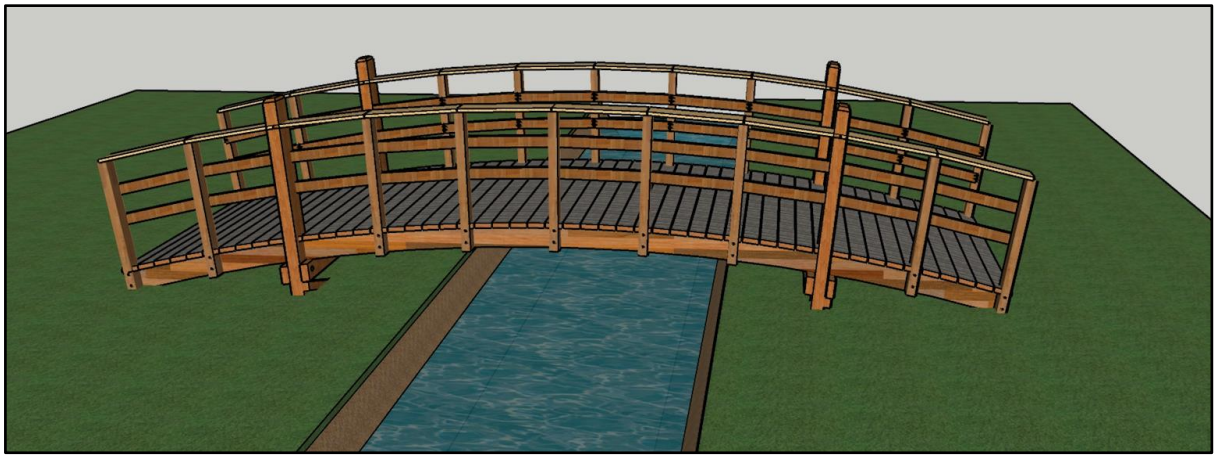

**Figure 19: Example of the design for the pedestrian crossings.**

#### *4.2.2.2 Operational Phase*

Routine use of compost and fertilizer in the more formal landscaped areas and the presence of laterite roads and pathways (if used) would result in increased nutrient load (particularly phosphates and nitrates) in runoff. Laterite roads and pathways would also increase the nutrient load in runoff. Graves tend to increase nutrient load in the soil immediately adjacent for a period of time after burial but are in the opinion of the specialist, unlikely to impact on the nutrient load of the watercourses within the site to a measurable or significant degree.

Herbicides used for continued control of alien invasive species may enter the wetlands via runoff. Runoff from roads and parking lots will likely contain limited volumes of oil and 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 adjacent wetlands. There is however little concrete construction planned that is in close proximity to the wetlands and this impact is expected to be minor.

The essential mitigation measures described below will mitigate both pre-existing and development-related water quality impacts. The likely impact on water quality without mitigation during the operational phase is medium (negative), however with the implementation of the essential mitigation measures and the proposed stormwater retention pond and swales, the impact will be reduced to low (positive).

*Essential Mitigation Measures*

- Ensure that all fertilizer, compost, herbicides and pesticides are stored on a bunded surface that drains to a sump and not into a watercourse;
- Ensure that all plants within the nursery area are grown on a bunded surface;
- Dig fertilizer and compost into the soil whenever used to minimised nutrient load in runoff;
- 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. Control invasive annuals by hand-pulling;
- Construct a swale at the northern entrance to the retention pond and one northeast of the southern-most wooden pedestrian bridge. This will further improve the water quality of runoff entering the wetlands and the drainage line;
- Vegetate the artificial wetland (swale) with hardy indigenous vegetation known to assimilate nutrients such as *Juncus krausii, Juncus acutus* and *Typha capensis*.

#### *4.2.2.3 Results*

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

### 4.2.3 Impact 3 – Wetland and Riparian Habitat

#### *4.2.3.1 Construction Phase*

The impact on aquatic habitat is negligible given the proposed development plan. The proposed development incorporates the delineated watercourses and buffer zones within the parkland area, and no construction is earmarked within the watercourses or buffer zone, except for the three crossings. The majority of aquatic habitat has been lost historically and function has been severely impacted through alien invasion. With the implementation of alien clearing and the essential mitigation measures,

aquatic habitat would likely recover to a large degree and the proposed development would have a net positive impact on wetland habitat.

Additional impacts would be in the form of wind-blown litter from the construction site that may smother plants and entangle or be ingested by wildlife.

Therefore, without mitigation the impact on aquatic habitat is very low (negative) and with the implementation of mitigation measures is very low (positive).

*Essential Mitigation Measures*

- Rehabilitate the watercourses and buffer zone as indicated in the FRMMP. Ensure that the FRMMP is drafted by a SACNASP registered and properly qualified and experienced freshwater specialist.
- Eradicate alien invasive vegetation throughout the proposed site, as per the FRMMP;
- Demarcate (by means of fencing or danger tape) and rehabilitate the 15m buffer, wetland mosaic and drainage line. Do not allow entry to this area during the construction phase except for rehabilitation purposes and for the purpose of construction of the three crossings and the fence line on the boundary.
- Demarcate the areas within the watercourses and buffer where the three crossings and fence are to be constructed and restrict all related construction activities to these demarcated areas.
- Do not allow any concrete to be used within the watercourse during construction of the fence crossing on the southern boundary.
- Ensure that the vehicle crossing is no wider than 3m and that the two pedestrian crossings are no wider than 1.8m.

Windblown litter can be mitigated against by implementing the following:

- Ensure that all contractors are aware of a ‘no-littering’ policy while on the construction site;
- Inspect the proposed development site weekly and remove all litter;
- Inspect wetlands within the property monthly and remove all litter.

#### *4.2.3.2 Operational Phase*

The impact of changes in water quality and hydrology on wetland habitat would be largely similar in the operational phase to that of the construction phase assessed above. The only significant exception would be the large number of graves present within proposed development area, but these are likely to be hydrologically divorced from the wetlands due to their depth and are therefore unlikely to impact wetland or drainage line water quality. Windblown litter may also be a concern in the operational phase given the public nature of the memorial park.

Without mitigation the impact on wetland habitat is low (negative) and with mitigation measures in place is medium (positive) due to the extensive nature of the planned rehabilitation.

*Essential Mitigation*

- Manage and maintain the watercourses and buffer such that the gains in PES made through rehabilitation are retained over time, as per the FRMMP.
- Use herbicide only for direct stump treatment of acacias and other woody alien invasive species. Control invasive annuals by hand-pulling;
- Implement a “no bins” policy within the proposed site and do not provide bins;
- 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 memorial park weekly and remove all litter;
- Inspect wetlands within the property monthly and remove all litter.

#### *4.2.3.3 Results*

| Impact 3: Impact on Wetland Habitat | | | | | |
|---|---|---|---|---|---|
| **Alternatives** | **Intensity** | **Extent** | **Duration** | **Probability of impact occurring** | **Significance** |
| **Construction Phase** | | | | | |
| Without mitigation | Low | Local | Short term | Medium | Very low (-ve) |
| With mitigation | Low | Local | Short term | Medium | Very Low (+ve) |
| **Operational Phase** | | | | | |
| Without mitigation | Low | Local | Long term | Medium | Low (-ve) |
| With mitigation | Medium | Local | Long term | Medium | Medium (+ve) |

### 4.2.4 Impact 4 – Impact on Biota

#### *4.2.4.1 Construction Phase*

The construction of the wooden pedestrian bridge crossings over and within portions of the drainage line may involve the use of Copper Chrome Arsenate (CCA) to preserve the wooden infrastructure. CCA is toxic and would specifically negatively affect invertebrates, amphibians and fish (where they occur downstream). Open pits in construction areas adjacent to wetlands may also lead to substantial amphibian deaths, particularly in winter. Rehabilitation within open areas on site would likely have a positive impact on all wetland biota.

The only other possible impact would be in the form of illegal harvesting, trapping and hunting often associated with natural areas adjacent to construction site. The risk of this impact occurring increases with proximity to the construction area. No huntable wetland fauna was noted however during the site visit and the rarity or absence of wetland fauna would further reduce the likelihood of this impact occurring.

Therefore, without mitigation the impact on biota is medium (negative) and with the implementation of mitigation measures is very low (positive).

*Essential Mitigation Measures*

- No products containing Copper Chrome Arsenate (CCA) may be used during any construction, specifically during the construction of the wooden pedestrian bridges;
- Clearly demarcate the boundary of all wetland areas and buffer zones and ensure that all contractors remain out of these areas, except where activities are to be undertaken in terms of the Environmental and Water Use Authorisations;
- It is recommended that digging and filling foundations of buildings be done during summer as far as possible, and that all pits and trenches are covered during winter to limit the potential amphibian deaths;
- 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*

The potential impact on biota during the operational phase would be limited to the secondary impact of changes in water quality and habitat. Both are likely to improve over the current situation, with the exception of the potential increase in pH, the likely impact of which is limited however, as no pH sensitive species were encountered on site and the degree of transformation of the site makes their presence unlikely. Return of such species is likely after rehabilitation of the site. Applicable mitigation is limited to those measures already included under Water Quality and Habitat above.

The impact on biota without mitigation measures in place is very low (negative) and with the implementation of mitigation measures is very low (positive).

#### *4.2.4.3 Results*

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

## 4.3 'No Go' Scenario

The 'No Go' scenario would likely result in further degradation of the drainage line and the mosaic of wetlands, due to the maturing of alien vegetation and soil erosion. It is the municipality's responsibility to clear alien invasive vegetation on municipal land, which would have a long-term positive impact. However, given that an alien eradication plan has not been implemented within Farm 29 to date, and that municipal resources are not likely to improve in the foreseeable future, it is in the opinion of the specialist, unlikely that this will happen in the long-term.

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

## 4.4 Indirect Impacts

No indirect impacts were identified.

## 4.5 Cumulative Impacts

Many sources of nitrates and phosphates are present within the broader catchment and nutrient loading is cumulative when all sources of nutrients considered enter the system thereby exacerbating the impact. This in turn may lead to eutrophication of watercourses. In addition, any use of CCA products would accumulate within the broader catchment and exacerbate the impact on Water Quality and Biota. With the implementation of the proposed mitigation measures under Section 4.2.2 for Water Quality and Section 4.2.4 for Biota, associated impacts would be minimal.

No wetland habitat will be lost through the proposed development, and habitat is expected to improve with the implementation of a vegetated buffer and alien clearing (see mitigation measures discussed above). Therefore, the cumulative impact on vegetation will be positive.

# 5 Conclusion and Recommendation

A mosaic of depression wetlands and a non-perennial drainage line were identified and delineated within Farm 29. Given the high degree of transformation within the farm however, it is possible that the wetland boundaries determined may change after the alien invasive forests have been removed and hydrology has returned to more natural conditions. It is therefore proposed that it be made a condition of any approval granted based on the findings of this report that the site be revisited for verification of the wetland delineation during the wet season (Jul/August) after site clearing is completed, so that reports can be updated and plans adjusted to accommodate post clearing wetland boundaries.

The non-perennial drainage line and the depression wetlands identified were therefore assessed in terms of PES, EIS and Eco-services. The drainage line fell within the IHIA Category D, while the mosaic of depression wetlands had an overall PES score of Category E. Given the opportunity for rehabilitation, a realistic REC category of C is advocated for all watercourses within the proposed site. Application of the best practice method for determination of an appropriate minimum buffer found that a buffer of 15m

during the construction and operational phases would be appropriate for the freshwater features delineated on Farm 29.

Following the Impact Assessment, it was found that the significance of the majority of the impacts associated with the proposed development can be reduced substantially with the implementation of the essential mitigation measures provided. After mitigation, the significance of the impacts was either very low or low (negative) with the impact on wetland habitat and biota being very low or low (positive). Therefore, with the implementation of the essential mitigation measures and 15m buffer around each freshwater feature, the project would represent a significant positive improvement over present conditions. It is therefore the opinion of the specialist that Environmental and Water Use Authorisations be granted for this project.

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# Appendix 1 – Impact Assessment Criteria

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 or spatial influence of the impact** | SITE SPECIFIC | Site specific/Local:<br>Extends only as far as the activity |
| | LOCAL | Limited to the site and its immediate surroundings |
| | REGIONAL | Regional/Provincial:<br>Will have an impact on the region/province |
| | | |
| **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 |
| | High | National | Short Term |

| SIGNIFICANCE RATING | LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC SIGNIFICANCE RATING | | |
|---|---|---|---|
| | **INTENSITY** | **EXTENT** | **DURATION** |
| | 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 |