WETLAND ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR A PROPOSED PIPELINE IN POMONA, GAUTENG

Prepared for

Eon Consulting

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EXECUTIVE SUMMARY

Based on the findings of the ecological assessment, it is the opinion of the ecologists that from an ecological viewpoint, the proposed project be considered favorably. However, all essential mitigation measures and recommendations presented in this report should be adhered to as to ensure the ecology within the study area along with the surrounding zone of influence is protected or adequately rehabilitated in order to minimise the deviations from the Present Ecological State. Particular attention needs to be paid to the location and extent of the wetland feature in order to ensure development related activities do not encroach unnecessarily into these zones and that ongoing functionality of the wetland is ensured.

Scientific Aquatic Services (SAS) was appointed to conduct a wetland delineation, Present Ecological State (PES) and function assessment as part of the proposed pipeline in Pomona, hereinafter referred to as the "study area" (Figures 1 & 2). The study area is located approximately 4km to the east of the Glen Marais suburb and 3km north- east of the Bredell suburb.

A site visit was conducted in January 2015 and the wetland associated with the study area was investigated and delineated. The study area is characterised by residential areas and open grassland. The ecological assessment was therefore confined to the study area and its immediate surrounds and did not include an ecological assessment of surrounding properties. The surrounding area was however considered as part of the desktop assessment.

The following general background conclusions were drawn upon completion of the study:

- The study area falls within the Carletonville Dolomite Grassland vegetation type (Mucina and Rutherford, 2006);
- According to the National Biodiversity Assessment (2011) the study area is located within a poorly protected area;
- The Freshwater Ecosystem Priority Area (FEPA) database was consulted with regards to wetlands and rivers within or in close proximity to the study area that may be of ecological importance. Aspects applicable to the study area are discussed below:
  - The National Freshwater Ecosystem Priority Areas (NFEPA) database indicates that there is a natural wetland, within the study area and an artificial wetland approximately 70m east of the study area;
  - The NFEPA database indicates no RAMSAR wetlands within the study area;
- The Gauteng Conservation Plan 2014 (C-plan version 3.3) was consulted in order to determine site-specific issues and areas within the study area considered sensitive with regards to the wetland:
  - A portion of the study area is located within a Critical Biodiversity Area (CBA), as well as an Ecological Support Area (ESA) which is a minor portion on the northeastern side of the study area. In addition, the study area falls within an Irreplaceable Area which falls within a wetland buffer and a river buffer.
  - The study area falls outside the Urban Edge and according to GDARD wetland areas outside the urban edge should be allocated a 50m buffer. However, due to the location and the extent of the development, a 32m buffer was prescribed and must be adhered to.

The following conclusions were drawn after completion of the survey of the wetland associated with the study area:

- One Hydrogeomorphic units (HGM units) was identified during the assessment, and classified as an Inland system falling within the Highveld Ecoregion. The HGM unit was classified as unchannelled valley bottom wetland feature;
- The results of the Index of Habitat Integrity (IHI) assessment applied, indicate that the overall PES falls within category C, which implies that the wetland has been moderately modified;

- When the ecosystem function and service provision assessment was applied, the wetland obtained a score that placed the wetland within a moderately low category. It is surmised therefore that the wetland has a moderately low level of service provision and ecological functioning;
- An Ecological Importance and Sensitivity (EIS) assessment was applied to the wetland. The results of this assessment indicates that the wetland falls within category C, which indicates that the wetland is ecologically important and sensitive on a local and possibly a provincial scale;
- Based on the results obtained from the IHI and EIS, the recommended ecological category (REC) assigned to the wetland is category C (Moderately modified); and
- The wetland was delineated using vegetation as a primary indicator as well as soil samples.

Impact Assessment Synthesis and Conclusion

Based on the impact assessment, it is evident that there are three possible impacts on the wetland ecology within the study area. During construction phase the impacts on wetland habitat and ecological structure as well as impacts on the hydrological function and sediment balance are considered to be low level impacts prior to mitigation. However, should mitigation be implemented, the impact on wetland habitat and ecological structure will be remain as a low level impact whereas the impact on wetland hydrological function and sediment balance will be reduced to very-low level impact. The impact on wetland ecological service provision is considered a very-low level impact both prior to mitigation as well as after mitigation.

During operational phase the impacts on the impacts on wetland habitat and ecological structure as well as impacts on the hydrological function and sediment balance are considered to be low level impacts prior to mitigation. However, should mitigation be implemented, both impacts will be reduced to very-low level impacts. The impact on wetland ecological service provision is considered very-low level impact both prior to mitigation as well as after mitigation.

Construction phase		
Impact	**Unmanaged**	**Managed**
1: Impact on the loss of wetland habitat and ecological structure	Low	Low
2: Impact on the changes to wetland ecological service provision	Very-low	Very-low
3: Impact on wetland hydrological function and sediment balance	Low	Very-low
Operational phase		
Impact	**Unmanaged**	**Managed**
1: Impact on the loss of wetland habitat and ecological structure	Low	Very-Low
2: Impact on the changes to wetland ecological service provision	Very-low	Very-Low
3: Impact on wetland hydrological function and sediment balance	Low	Very-Low

MITIGATION MEASURES AND RECOMMENDATIONS

Development footprint

- It must be ensured that, as far as possible, all proposed infrastructure is placed outside the wetland habitat areas. Where this is not possible, suitable mitigation measures as outlined in this report should be adhered to.

- The boundaries of the development footprint and activity areas are to remain as small as possible, be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect the wetland habitat, need to be strictly managed in all areas, particularly within areas of increased ecological sensitivity. Alien species should be eradicated and controlled to prevent their spread beyond the development footprint areas.
- All areas of increased ecological sensitivity beyond the development footprint should be designated as No-Go areas and be off limits to all unauthorised vehicles and personnel. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration. If possible, such roads should be constructed a distance from the wetland habitat and not directly adjacent thereto it must be ensured that construction related waste does not affect the wetland habitat boundaries.

RDL and protected floral species

- Sensitive floral species, if encountered within the development footprint, are to be handled with care and the relocation of sensitive plant species to similar suitable habitat is to be overseen by a botanist.

Alien floral species

- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases.
- Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used.
    - Footprint areas should be kept as small as possible when removing alien plant species.
    - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

Fauna

- Informal fires in the vicinity of development area should be prohibited during all development phases.
- Should any RDL or other threatened or protected faunal species be noted within the development footprint areas, these species should be relocated to similar habitat within the study area with the assistance of a suitably qualified specialist.

Wetland

- Ensure that hydraulic connectivity of the wetland areas is maintained between the areas upstream and downstream of the bridge;
- Ensure that permanent, seasonal and temporary wetland zone functionality is maintained through provision of measures to ensure that soil wetting conditions are maintained;
- Ensure ongoing functioning of the wetland areas in the vicinity of the proposed development;
- Ensure that no incision and canalisation of the wetland feature takes place as a result of the construction activities;

- Ensure that migratory connectivity for more mobile faunal species is facilitated to allow movement of these species between areas upstream and downstream of the development;
- It must be ensured that planning of the development includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible;
- Prevent run-off and seepage from dirty water areas entering wetland habitats;
- No dumping of waste should take place within the adjacent wetland areas;
- An effective waste management plan must be implemented in order to prevent construction related waste from entering the wetland environment;
- Appropriate sanitary facilities must be provided for the duration of the construction activities;
- The wetland must be regularly monitored for erosion and incision. As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils. In this regard special mention is made of the need to use indigenous veldgrasses in areas left bare as a result of road upgrade activities; and
- All wetland areas affected by the proposed development activities are to be rehabilitated to ensure that wetland functions are re-instated after construction. Revegetation must take place by using indigenous wetland species.

Vehicle access

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

Soils

- It must be ensured that construction related waste or spillage and effluent do not affect the immediate and surrounding habitat boundaries.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- All soils compacted as a result of construction activities falling outside of development footprint areas should be ripped and profiled.

Rehabilitation

- It is recommended that as part of the development, rehabilitation measures of the adjacent wetland areas should be implemented;
- Disturbed wetland areas should to be reprofiled where required and adequate vegetation cover on the streambanks must be ensured;
- Wetland areas susceptible to erosion must be reinforced where necessary with gabions, reno mattresses and geotextiles;
- Incorporate adequate erosion management measures in order to prevent erosion and the associated sedimentation of the wetland areas;
- All disturbed habitat areas must be rehabilitated and reseeded with an indigenous seed mixture as soon as possible to ensure that floral ecology is re-instated.

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GLOSSARY OF TERMS

Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Indigenous vegetation	Vegetation occurring naturally within a defined area.
RAMSAR	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species	Organisms that fall into the *Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU)* categories of ecological status.

LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
BGIS	Biodiversity Geographic Information Systems
CSIR	Council for Scientific and Industrial Research
DEMC	Desired Ecological Management Class
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
ESA	Ecological Support Areas
C-Plan	Gauteng Conservation Plan version 3.3.
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
HGM	Hydrogeomorphic
IUCN	International Union for the Conservation of Nature
IWQS	Institute for Water Quality Studies
m	Metres
mm	Millimetre
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy (2008)
NWA	National Water Act (Act 36 of 1998)
PEMC	Present Ecological Management Class
PES	Present Ecological State
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDM	Resource Directed Measures
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services CC

SoER	Gauteng State of the Environment Report (2004)
subWMA	sub-Water Management Area
TSP	Threatened Species Programme
WMA	Water Management Area
WRC	Water Research Council

1. INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a wetland delineation, Present Ecological State (PES) and function assessment as part of the proposed pipeline in Pomona, hereinafter referred to as the "study area" (Figures 1 & 2). The study area is located approximately 4km to the east of the Glen Marais suburb and 3km north- east of the Bredell suburb.

A site visit was conducted in January 2015 and the wetland associated with the study area was investigated and delineated. The study area is characterised by residential areas and open grassland. The ecological assessment was therefore confined to the study area and its immediate surrounds and did not include an ecological assessment of surrounding properties. The surrounding area was however considered as part of the desktop assessment.

This report, after consideration and the description of the ecological integrity of the study area, must guide the Environmental Assessment Practitioner (EAP), regulatory authorities and proponent, by means of the presentation of results and recommendations, as to the ecological viability of the proposed development activities.

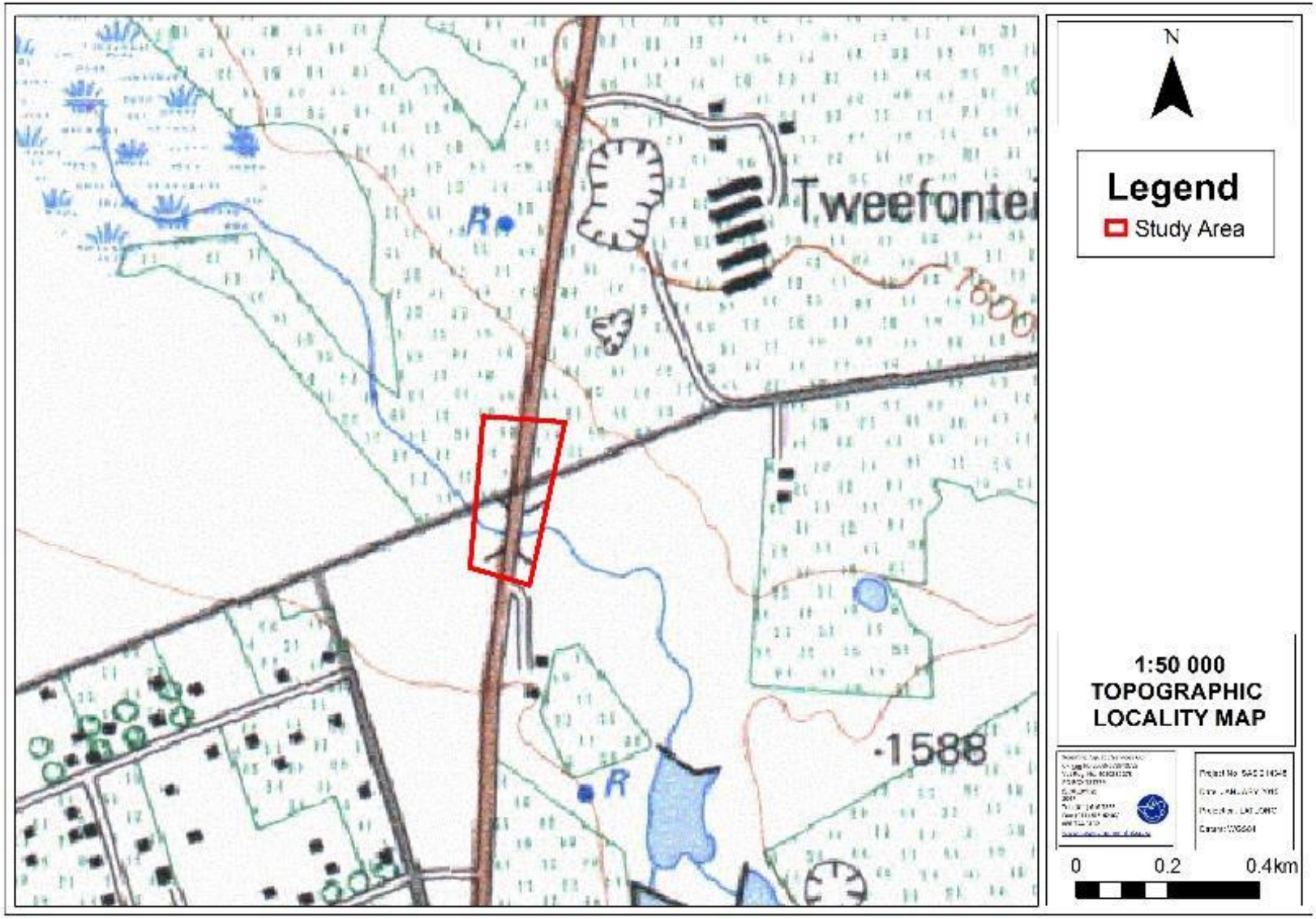

Figure 1: The study area depicted on a 1:50 000 topographical map in relation to its surrounding area.

Figure 2: Digital Satellite image depicting the location of the study area in relation to surrounding areas.

1.2 Project Scope

Specific outcomes in terms of this report are outlined below.

Wetland Assessment:

- To define the PES and EIS of the wetland within the study area;
- To determine the functioning of the system and the environmental and socio-cultural services that the system provide;
- To advocate a Recommended Ecological Category (REC) for the wetland feature;
- To delineate all wetlands zones occurring within the study area; and
- To determine the environmental impacts of the proposed activity on the wetland areas within the study area.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The ecological assessment is confined to the study area and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral communities have been accurately assessed and considered;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa on the study area may therefore been missed during the assessment;
- The wetland assessment is confined to the study area as illustrated in Figures 1 & 2, as well as areas of relevance immediately adjacent to the study area and does not include the neighbouring and adjacent properties. The general surroundings were however considered in the desktop assessment of the study area;
- The wetland delineation as presented in this report is regarded as a best estimate of the wetland boundary based on the site condition present at the time of the assessment and limitations in the accuracy of the delineation due to existing development and historical anthropogenic disturbances are deemed possible; and
- Wetland and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative and obligate wetland species. Within the transition zone some variation of opinion on the wetland boundary may occur, however if the Department of Water Affairs (DWA) (2005) method is followed, all assessors should get largely similar results.

1.4 Indemnity and Terms of use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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2. METHOD OF ASSESSMENT

2.1 Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the wetland and riparian systems present within the study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

2.2 Aquatic Ecoregion

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the study area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment to guide the assessment.

2.3 Ecostatus

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the South African River Health Program (RHP), (currently known as the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP)) are presented in the table below and will be used as the basis of classification of the systems in this desktop study as well as future field studies.

Table 1: Classification of river health assessment classes in line with the RHP.

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

Studies undertaken by the Institute for Water Quality Studies (IWQS) assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments the EIS, Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems prior to assessment or as part of a desktop assessment.

This database was consulted for the quaternary catchment of concern (A21A) in order to define the EIS, PEMC and DEMC. The findings are based on a study undertaken by Kleynhans (1999) as part of “A procedure for the determination of the ecological reserve for the purpose of the national water balance model for South African rivers”.

2.4 National Freshwater Ecosystems Priority Areas (NFEPA)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), the South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity and South African National Parks. The project responds to the reported degradation of freshwater

ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable natural resource, with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present within the study area.

2.5 Classification System for Wetlands and other Aquatic Ecosystems in South Africa

All wetlands or riparian features encountered within the study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems, hereafter referred to as the "classification system" (Ollis *et al*., 2013). A summary of Levels 1 to 4 of the classification system are presented in Table 2 and 3, below.

Table 2: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table 3: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

2.5.1 Level 1: Inland systems

From the classification system, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[1] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had an historical connection to the ocean, which in some cases may have been relatively recent.

[1] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

2.5.2 Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005).

There are a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland (Figure 3 below). DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

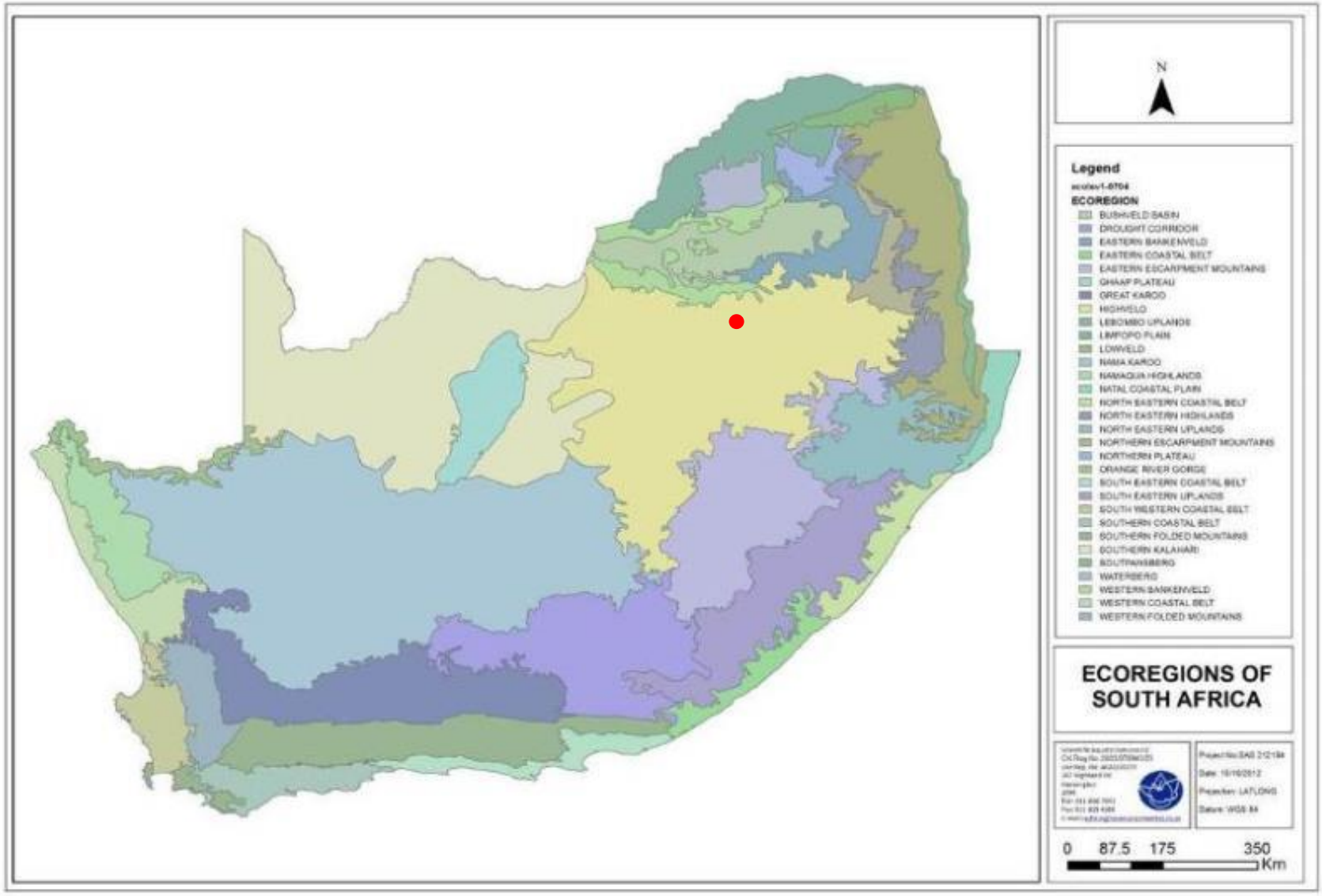

Figure 3: Map of Level 1 Ecoregions of South Africa, with the approximate position of the study area indicated in red.

2.5.3 Level 3: Landscape Setting

At Level 3 of the proposed Classification System, for Inland Systems, a distinction is made between four Landscape Units (Table 3) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes.
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

2.5.4 Level 4: Hydrogeomorphic Units

Eight primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table 4), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it.
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it.
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank.
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope.

Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for “channel”, “flat” and “valleyhead seep”) is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

2.6 Wet-Health Assessment

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever changing landscape. The primary purpose of this assessment is to evaluate the ecophysical health of wetlands, and in so doing promote their conservation and wise management. Within the study area, the WET-Health of the seepage wetland features were assessed.

2.6.1 Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

2.6.2 Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

2.6.3 Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of

water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems in Section 2.4.

2.6.4 Quantification of Present State of a Wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of impact of individual activities and then separately assessing the *intensity* of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores and Present State categories are provided in the table below.

Table 4: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

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

2.6.5 Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (Table 5).

Table 5: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

2.6.6 Overall Health of the Wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provides a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

2.7 Wetland Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[2] The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control

[2] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland (Table 6).

Table 6: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

2.8 Ecological Importance and Sensitivity (EIS)

The method used for the EIS determination was adapted from the method as provided by DWA (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed.

A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 7 below.

Table 7: Descriptions of the EIS Categories.

EIS Category	Range of Mean	Recommended Ecological Management Class[3]
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A

[3] Ed's note: Author to confirm exact wording for version 1.1

EIS Category	Range of Mean	Recommended Ecological Management Class[3]
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

2.9 Recommended Ecological Category

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure." [4]

The REC (Table 8) was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above). Followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A wetland may receive the same class for the PES as the REC if the wetland is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the wetland feature.

Table 8: Description of REC classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

2.10 Wetland Delineation

For the purposes of this investigation, a wetland and a riparian habitat are defined in the national water Act (1998) as stated below:

- A wetland is a 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

[4] Department of Water Affairs and Forestry, South Africa *Version 1.0 of Resource Directed Measures for Protection of Water Resources 1999*

covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

- Riparian habitat is defined as including 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.

The wetland and riparian zone delineation took place according to the method presented in the final draft of "A practical field procedure for identification and delineation of wetlands and riparian areas" published by the Department of Water Affairs (DWA) in February 2005. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils and
- The presence of alluvial soils in stream systems.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

A wetland feature can be divided into three zones (DWA, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

2.11 Ecological Impact Assessment Method

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand

the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[5]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table 9. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the

[5] The definition has been aligned with that used in the ISO 14001 Standard.

impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary[6].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[6] Some risks/impacts that have low significance will however still require mitigation.

Table 9: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear developments affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear developments affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear developments affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear developments affected < 2000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Linear developments affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table 10: Significance Rating Matrix.

	CONSEQUENCE (Severity + Spatial Scope + Duration)														
LIKELIHOOD (Frequency of activity + Frequency of impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 11: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Critically consider the viability of proposed projects Improve current management of existing projects significantly and immediately	Maintain current management
High	101-125	Comprehensively consider the viability of proposed projects Improve current management of existing projects significantly	Maintain current management
Medium-high	76-100	Consider the viability of proposed projects Improve current management of existing projects	Maintain current management
Medium-low	51-75	Actively seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Low	26-50	Where deemed necessary seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Very low	1-25	Maintain current management and/or proposed project criteria and strive for continuous improvement	Maintain current management and/or proposed project criteria and strive for continuous improvement

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;

- Construction; and
- Operation.

- If applicable, transboundary or global effects were assessed.

➢ Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.

➢ Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

2.11.1 Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development:

➢ *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[7] are identified and described in as much detail as possible.

➢ Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.

➢ Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation.*

2.12 Sensitivity Mapping

All the ecological features of the study area were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). In addition identified locations of RDL and SANBI protected species were also marked by means of GPS. A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the proposed development.

3. LAND USE AND CONSERVATION CHARACTERISTICS OF THE STUDY AREA

The following sections contain data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable high quality data, the various databases used not always provide an entirely accurate indication of the study area's actual site characteristics. This information is however considered to be useful as background information to the study. Thus, this data was used as a guideline to

[7] *Mitigation measures should address both positive and negative impacts*

inform the assessment and areas where increased conservation importance is indicated were paid attention to.

3.1 National List of Threatened Terrestrial Ecosystems (2011)

The National Environmental Management Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing of threatened or protected ecosystems, in one of four categories: Critically Endangered, Endangered, Vulnerable or Protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI, BGIS).

According to the National List of Threatened Terrestrial Ecosystems (2011) the study area does not fall a threatened ecosystem.

3.2 National Biodiversity Assessment (NBA; 2011)

The latest National Biodiversity Assessment (2011) provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The NBA (2011) was led by SANBI in partnership with a range of organisations. It follows on from the National Spatial Biodiversity Assessment (2004), broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA (2011) includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial and local levels (SANBI, BGIS).

According to the NBA (2011), the study area is not located within a formally or informally protected area, with the entire study area falling within an area that is not protected.

3.3 Importance According to the Gauteng Conservation Plan version 3.3 (C-Plan v3.3; 2011)

The Gauteng C-Plan v3.3 has indicated the following conservation aspects to be applicable to the study area:

- The study area is situated within an area of conservation importance in the form of a river and wetland buffer (Figure 4);

- The study area falls outside of the Gauteng Urban Edge (2010). Development within the Urban Edge is desirable and encouraged, provided that the development is not detrimental to the receiving environment; and
- The majority of the study area is located within a Critical Biodiversity Area (CBA) and a small portion in the northern section of study area is located within an Ecological Support Area (ESA) (Figure 5). CBAs are areas containing Irreplaceable, Important and Protected Areas and are defined as 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. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses (SANBI; BGIS, 2013). ESAs are landscape features that are essential for the maintenance and generation of biodiversity in sensitive areas that require careful management.

3.4 Ekurhuleni Metropolitan Municipality (EMM) and Gauteng Wetland Forum Google Earth Database (GWFGED).

The EMM in conjunction with GWFGED was consulted to ascertain the presence of wetlands within the linear development. Both datasets indicated the presence of wetlands within the vicinity of the study area (Figure 6)

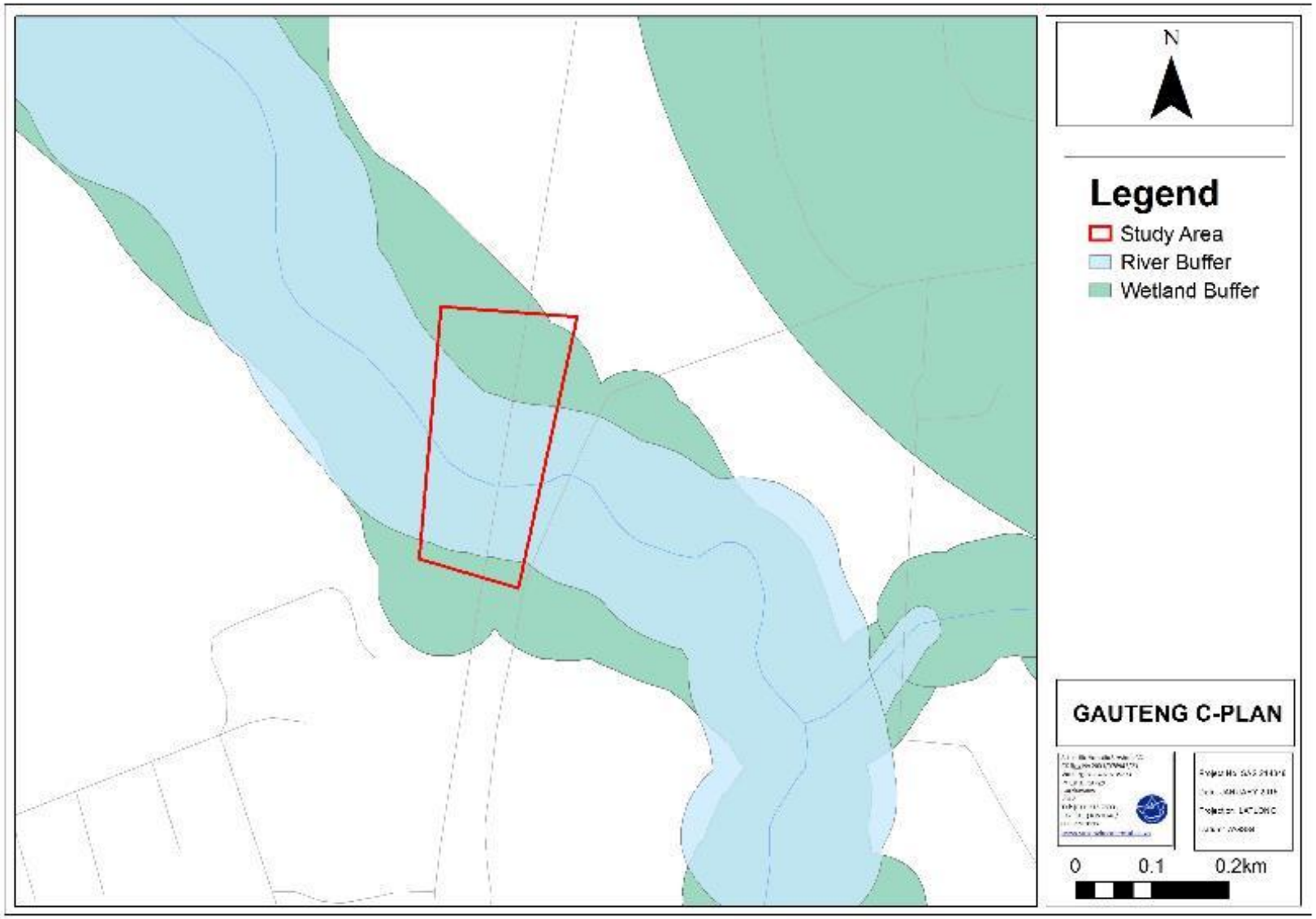

Figure 4: The Gauteng C-Plan 3.3 (2011) layer indicating the river and wetland buffer.

Figure 5: The Gauteng C-Plan 3.3 (2011) layer indicating importance in terms of CBAs and ESAs.

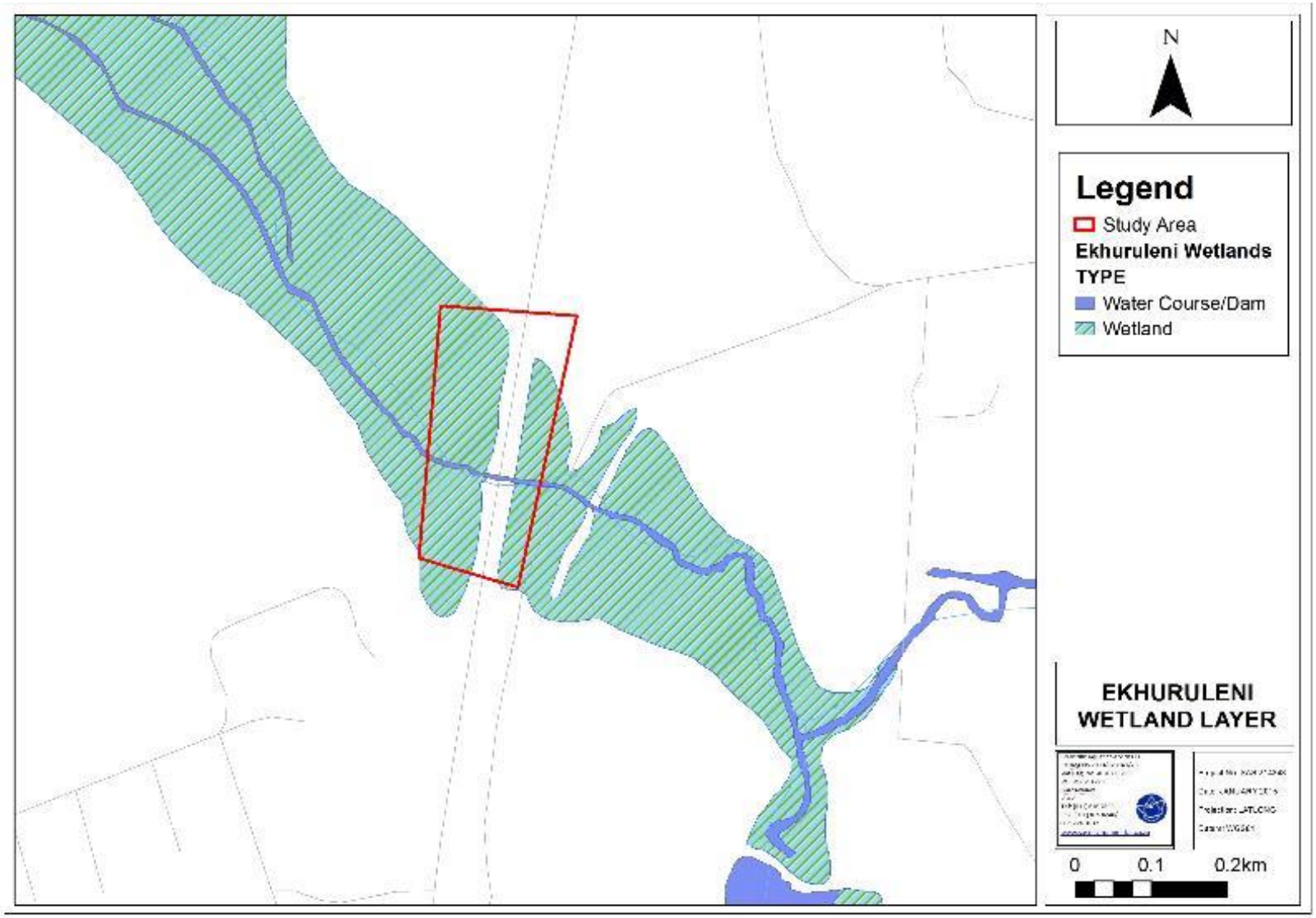

Figure 6: The EMM and GWFGED datasets indicating the presence of a wetland and watercourse associated with the study area.

3.5 Importance according to the National Freshwater Ecosystems Priority Areas database (NFEPA, 2011)

The NFEPA database was consulted with regards to areas in close proximity to the study area that may be of ecological importance. Aspects applicable to the study area and surroundings are discussed below:

- The study area falls within the Crocodile (West) and Marico Water Management Area (WMA). Each WMA is divided into several subWMAs, where catchment or watershed is defined as a topographically defined area which is drained by a stream or river network. The subWMA indicated for the study area is the Upper Crocodile sub-WMA;
- The NFEPA database indicates the presence of one river, traversing the study area, namely the Rietvlei. The river is classified as a PES Class C and its condition is categorised as D. The Rietvlei river is not a flagship river; and
- The NFEPA database identified the presence of one wetland within study area, the aspects applicable to the wetland is discussed below:

    - The wetland identified is considered to be in PES Category C (Figure 7);
    - The wetland is not classified as WETFEPA;
    - The wetland identified within the study area is not considered important with regards to amphibian and crane species;
    - According to the NFEPA database the wetland is classified as a channelled valley bottom wetland; and
    - The WetVeg group identified within the study area is the Dry Highveld Grassland Group 5, classified as “least threatened”.

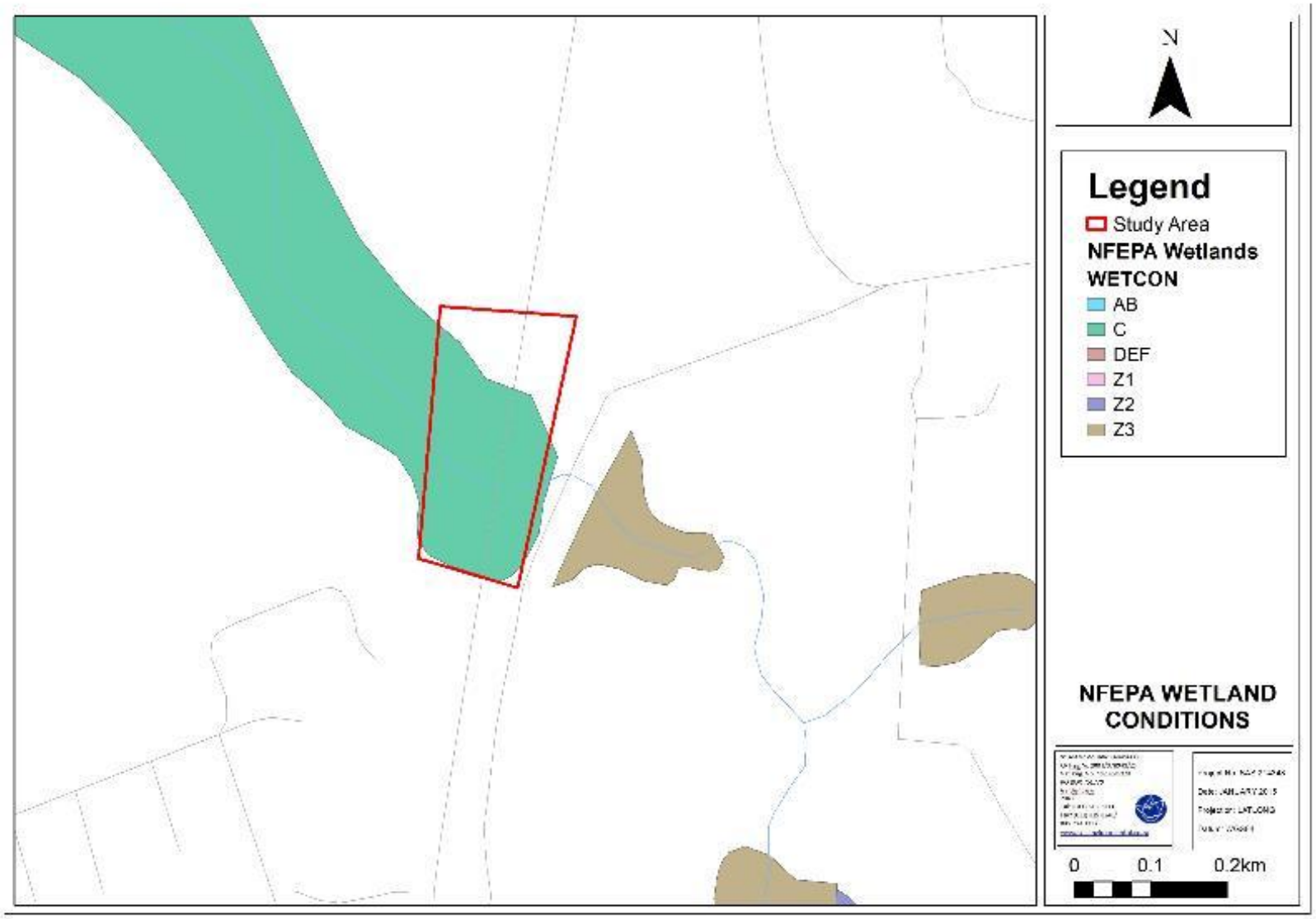

Figure 7: Map illustrating the wetland condition according to the NFEPA database

3.6 Biome and Bioregion

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford, 1997). The study area under assessment falls within the Grassland biome (Mucina and Rutherford, 2006). Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. This study area is situated within the Dry Highveld Grassland Bioregion (Mucina and Rutherford, 2006).

3.7 Vegetation Type and Landscape Characteristics

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area. Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. When the boundary of the assessment site is superimposed on the vegetation types of the surrounding area, it is clear that the study area traverses the Carletonville Dolomite Grassland vegetation type (Mucina and Rutherford, 2006).

4. RESULTS OF THE WETLAND ASSESSMENT

4.1 Aquatic Ecoregions

When assessing the aquatic ecology of any area, it is important to know which aquatic ecoregion the study area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment. The study area falls within the Highveld Aquatic Ecoregion. The main attributes of this Aquatic Ecoregion are presented in the table below. The study area is furthermore located within the A21A quaternary catchment (Figure 8). The attributes of the A21A quaternary catchment is summarised in Table 12 and the section below.

Table 12: Main attributes of the Highveld Aquatic Ecoregion (Kleynhans *et al*., 2005).

MAIN ATTRIBUTES	HIGHVELD
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief**; **Plains; Moderate Relief;** Lowlands; Hills and Mountains: Moderate and High Relief; Open Hills; Lowlands; Mountains: Moderate to High Relief; Closed Hills; Mountains: Moderate and High Relief (limited)
Vegetation types (dominant types in bold) (Primary)	Mixed Bushveld limited)**;** Rocky Highveld Grassland; **Dry Sandy Highveld Grassland**; Dry Clay Highveld Grassland; **Moist Cool Highveld Grassland**; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Clay Highveld Grassland: Patches Afromontane Forest (very limited)
Altitude (m a.m.s.l) (modifying)	1100-2100, 2100-2300 (very limited)
MAP (mm) (Secondary)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	45 to 65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	20 to 32
Mean daily max. temp. (°C): July	14 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	5 to >250

Table 13: Summary of the ecological status of quaternary catchment A21A.

Name	Rivers	EIS	DEMC	PEMC
A21A	Ses Myl Spruit	Low/Marginal	D: Resilent System	CLASS C

The points below summarise the impacts on the aquatic resources in A21A quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been significantly affected by med modification.
- Significant flow modifications have taken place.
- Significant impacts have occurred as a result of introduced instream biota such as *Micropterus salmoides*, *Micropterus dolomieu* and *Cyprinus carpio*.
- Impact due to inundation is significant due to weirs in the system.
- Riparian zones and stream bank conditions are considered to be highly impacted on.
- An impact on the aquatic community, due to altered water quality, is deemed to affect the catchment slightly.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in the A21A catchments:

- The riverine systems in this catchment have a low diversity of habitat types.

- The site has no importance in terms of conservation.
- The riverine resources have no sensitivity to flow requirements.
- The riverine resources have little importance in terms of migration of aquatic species.
- The riverine resources are limited in terms of rare and endemic species conservation.
- The ecology of the riverine resources is considered to be slightly sensitive to changes in water quality.
- The riverine resources are of limited importance as a source of refugia for aquatic species.
- The catchment is considered to be slightly sensitive to water flow changes.
- The catchment has no importance in term of species richness in the area.

Figure 8: The aquatic ecoregion and the quaternary catchment associated with the study area.

4.2 Wetland Characterisation

The wetland occurring within the study area has been classified according to the classification system compiled by SANBI (Ollis *et al*., 2013). The results of the classification, are presented in Table 14 below.

Table 14: Characterisation of the wetland features within close proximity of the study area.

Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: HGM Unit
Inland: An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	**Highveld Aquatic Ecoregion:** The study area falls within the Highveld Aquatic Ecoregion. **NFEPA WetVeg Group:** Dry highveld grassland group 5.	**Valley floor:** The typically gently sloping, lowest surface of a valley.	**Unchannelled valley-bottom:** A valley-bottom wetland with a river channel running through it.

The wetland identified during the field assessment, was situated in a somewhat urbanised area characterised by increased surface hardening which results in increased runoff. In addition, the wetland is traversed by a tar roads as well, which contributed to increased water input within the wetland. There was a sewage treatment plant observed within a residential estate bordering the wetland on the eastern portion of the study area. Treated effluent from this plant might alter the water quality within the wetland. The wetland identified is presented in figure 9 and figure 10 below.

Figure 9: The wetland feature identified during field assessment.

Figure 10: Location of the wetland in relation to the study area

4.3 Wetland Vegetation

The various wetland vegetation components were identified during the assessment, with special attention being paid to both facultative and obligate wetland vegetation associated with soils that are frequently saturated. Dominant species were characterised as either wetland or terrestrial species. The wetland species were then further categorised as temporary, seasonal and permanent zone species. This characterisation is presented and illustrated in the table 15 and figures below, including the terrestrial species identified within the wetland zones. The vegetation cover for the wetland was high as observed during the study area assessment.

A number of alien floral species, such *as Verbena bonariensis* and *Solanum sisymbriifolium* were observed in the terrestrial zone, as well as within temporary and seasonal zones.

Table 15: Vegetation species encountered during the delineation of the wetland.

Terrestrial Species	Temporary zone species	Seasonal zone species	Permanent zone species
**Eragrostis curvula*	**Verbena bonariensis*	**Verbena bonariensis*	*Brachiaria brizantha*
Hyparrhenia hirta	*Digitaria eriantha*	*Imperata cylindrica*	*Imperata cylindrica*
Hyparrhenia tamba	**Bidens pilosa*	*Leersia hexandra*	*Leersia hexandra*
**Bidens pilosa*	*Hyparrhenia tamba*	*Berkheya radula*	*Phragmites australis*
Themeda trianda	*Imperata cylindrica*	*Helichrysum krausii*	*Typha capensis*
**Solanum sisymbriifolium*	*Setaria sphacelata*	*Miscanthus junceus*	
Digitaria eriantha	*Digitaria eriantha*	**Cyperus rotondus*	
**Verbena bonariensis*	*Leersia hexandra*	*Brachiaria brizantha*	
	Berkheya radula		
	Helichrysum krausii		
	Senecio inornatus		
	**Cyperus rotondus*		
	Solanum sisymbriifolium		
	Papaver nudicaule		
	Hypoxis hemerocallidea		

Figure 11: Representative photographs of wetland vegetation.

4.4 Wetland Function Assessment

The wetland functions and service provision of the wetland was assessed utilising the WET-Ecoservices (Kotze *et. al.* 2009) method as previously described. The results of the assessment are tabulated below and in the radar plot that follows.

Table 16: Results of the wetland functions and service provision calculated for the wetland.

Ecosystem services	Unchannelled Valley Bottom
Flood attenuation	1,9
Streamflow regulation	1,6
Sediment trapping	0,8
Phosphate assimilation	1,7
Nitrate assimilation	1,8
Toxicant assimilation	1,6
Erosion control	2,6
Carbon Storage	1,7
Biodiversity maintenance	2,1
Water Supply	0,7
Harvestable resources	0,8
Cultural value	0
Cultivated foods	0
Tourism and recreation	0
Education and research	0
SUM	**17,3**
Average score	**1,2**

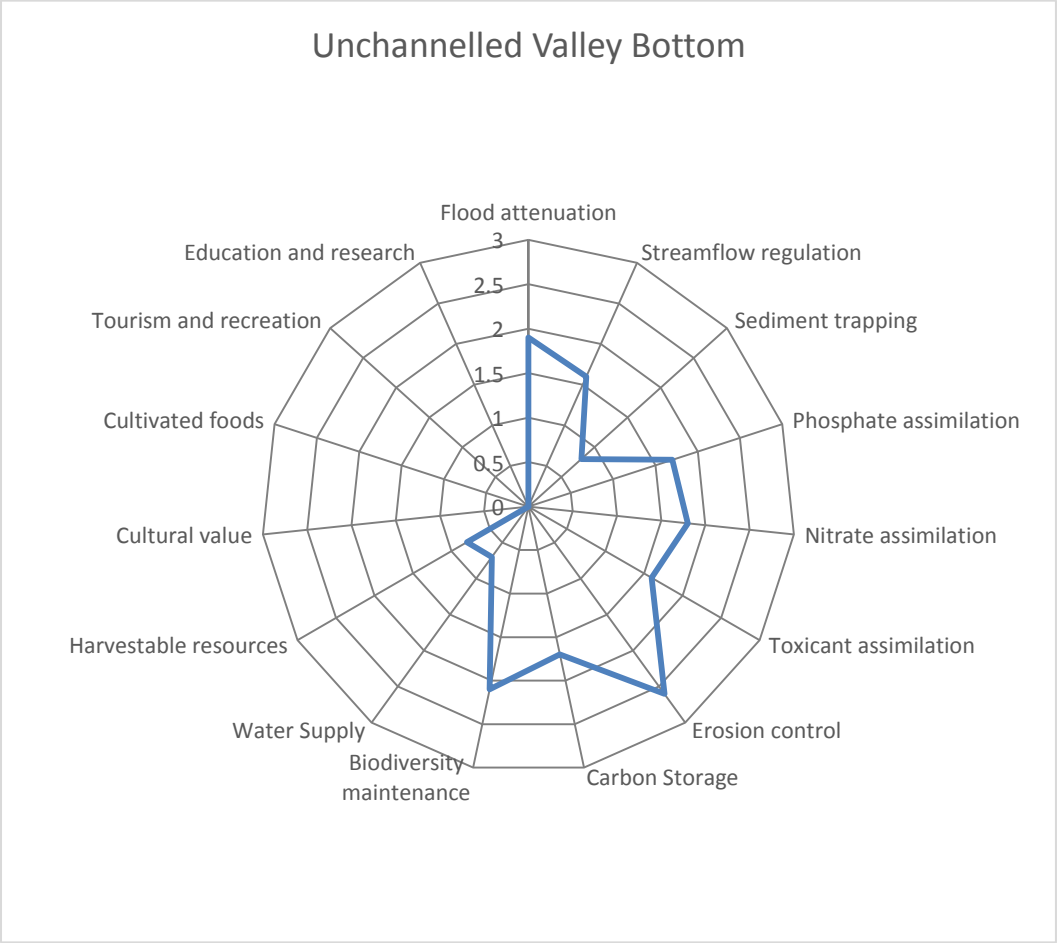

Figure 12: Radar plot of wetland services provided by the wetland.

From the results above, it is evident that an average score of 1.2 was calculated for wetland, placing the wetland within the moderately low category. The wetland is thus considered to have moderately low levels of service provision and ecological functioning.

The catchment has been affected by urbanisation with the construction of tarred roads and residential development, which then reduced sediment deposition into the wetland, hence there was not much evidence of sediment within the wetland. In addition, dense vegetation cover within the wetland, has contributed to the trapping of sediment entering the wetland as well as provision of habitat to faunal species. Due to the hardened surfaces, water input within the wetland.

The score for flood attenuation and stream flow regulation was intermediate, this is mainly due to the connectivity of the wetland with other wetland areas downstream.

Due to the presence of *Hypoxis hemerocallidea*, which is a rare and endangered species the wetland obtained a moderately high score for biodiversity maintenance.

The wetland plays no role in terms of socio-cultural service provision, since there are no households which depend on the wetland for benefits such as crop cultivation, water supply and resource harvesting.

4.5 Wet-Health Assessment

A WET-Health assessment was applied to the wetland identified during the field assessment. Due to the limited time available on site to assess the wetland, a Level 1 WET-Health assessment was used Three modules were assessed, namely hydrology, geomorphology, vegetation and water quality. The results of this assessments are summarised in the table below:

Table 17: Summary of the results of the WET-Health Assessment.

Feature	Hydrology		Geomorphology		Vegetation		Overall PES Category
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
Unchannelled valley bottom	C	↓	B	↓	C	↓	C

The wetland obtained an overall score of 2.8 which is defined as a wetland that is borderline category C/D (largely to moderately modified), indicating that loss of natural habitat, biota and basic ecosystem functions has occurred.

Impacts on the hydrology of the wetland include the increased hardening of the catchment, with impermeable surfaces such as gravel roads and roofs resulting in increased surface water runoff. In addition, the road traversing the wetland contributes to increased water inputs as a result of runoff from the road.

The presence of the road as well as an excavated trench observed in the eastern portion of the wetland, below the road, has resulted in moderate modification of the sediment regime of the wetland. Furthermore, there was evidence of track/dirt road entering the wetland which contributes to the modification of the geomorphology of the wetland.

The vegetation cover within the wetland was high, however the presence of the road and weir, as well as residential development has resulted in loss of vegetation and alien species invasion. Therefore, the vegetation module falls within category C, which implies that the vegetation has been moderately modified.

4.6 Ecological Importance and Sensitivity (EIS)

The results of the wetland function assessment and IHI assessment were used to obtain the EIS assessment, for which the results are presented in table 18.

Table 18: Overall EIS score of the wetland identified within the study area.

Feature	unchannelled Valley bottom	
Determinant	**Score**	**Confidence**
PRIMARY DETERMINANTS		
1.Rare & Endangered Species	2	3
2.Populations of Unique Species	0	2
3.Species/taxon Richness	1	2
4.Diversity of Habitat Types or Features	2	3
5.Migration route/breeding and feeding site for wetland species	2	3
6.PES as determined by IHI assessment	2	3
7.Importance in terms of function and service provision	2	4
MODIFYING DETERMINANTS		
8.Protected Status according to NFEPA Wetveg	0	3
9.Ecological Integrity	2	4
TOTAL	13	
MEAN	1.4	
OVERALL EIS	**C**	

As can be seen from these results, the EIS for wetland falls within Category C (Moderately modified), which indicates that the wetland is ecologically important and sensitive on a local and possibly a provincial scale. The biodiversity of wetlands falling within this category is usually not considered to be sensitive to flow and habitat modifications.

4.7 Recommended Ecological Category (REC)

The REC for the wetland was determined, taking into consideration the results of the wetland functions, IHI and EIS assessments. The wetland was moderately modified and is considered moderately low in terms of ecoservices.

REC Category C was assigned to the wetland in order to ensure that the present levels of ecological services and functioning of the wetland is maintained, and to possibly enhance the PES of the wetland. Therefore, the wetland should not be permitted to deteriorate any further.

5. WETLAND DELINEATION AND SENSITIVITY MAPPING

During the assessment, the boundary of the wetland was delineated utilising the following indicators:

- The soil form indicator was used to determine the presence of soils that are associated with prolonged and frequent saturation and a fluctuating water table which leads to soil mottling.
- The vegetation indicator was used in the identification of hydrophilic vegetation associated with soils that are frequently saturated. This indicator was used to identify the boundary of the temporary zone.

The GDARD Minimum Requirements for Biodiversity Assessments (2014) was consulted to ascertain the minimum buffer zones required for wetlands located in the Gauteng Province. In terms of this document, the following applies:

- A 30m buffer zone for wetlands inside urban areas.
- A 50m buffer zone wetlands outside urban areas.

The study area falls outside the Urban Edge according to the C-Plan 3.3, therefore a 50m buffer must be allocated to the wetland as stipulated in the GDARD Minimum Requirements for Biodiversity Assessments (2014).

Key considerations when making this recommendation include:

- The location of the study area.
- The classification of the area containing a portion of the study area as an Ecological Support Area (ESA) by GDARD.

- The ecological importance and sensitivity of the wetland as determined by the EIS assessment.

The National Environmental Management Act (Act 107 of 1998) stipulate that no activity can take place within 32m of a wetland without the relevant authorisation. In addition the National Water Act (Act 36 of 1998) states that no diversion, alteration of bed and banks or impeding of flow in watercourses (which includes wetlands) may occur without obtaining a water use licence authorising the proponent to do so.

After consideration of findings during the wetland assessment, a suitable buffer zone was considered for the proposed development. Due to the linear nature of the development direct impact on the wetland is inevitable and the pipeline must traverse the wetland. However impacts should be prevented from encroaching into the more natural areas downstream of the wetland crossing. A 32m buffer was prescribed and all non-essential activities should not take place in this area and the development footprint and activity footprint in the wetland and associated buffer should be prevented as far as possible. This buffer zone is deemed sufficient to maintain the Present Ecological State, limit any further impact that the proposed development could have and ultimately support the REC.

The wetland boundaries and their associated buffer zones are conceptually presented in Figure 13 below.

Figure 13: Sensitivity Map for the study area.

6. IMPACT ASSESSMENT

The tables below serve to summarise the significance of potential impacts on the wetland which may be affected by the development. A summary of all potential pre-construction, construction and operational phase impacts is provided. The sections below present the impact assessment according to the method described in Section 2.11.

In addition, it also indicates the required mitigatory and management measures needed to minimise potential ecological impacts and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures, assuming that they are fully implemented.

Latent and general everyday impacts which may impact on local biodiversity will include any activities which takes place within the study area that may impact on the receiving environment.

6.1 Impact identification and analyses

6.1.1 General housekeeping rules:

- Only essential construction activities should occur within the wetland and associated buffer and all support activities should be located outside of the 32m wetland buffer.
- Similarly the construction footprint should be minimised within the wetland and associated buffer.
- No fires whatsoever should be allowed during construction.
- Appropriate sanitary facilities must be provided during construction and all waste removed to an appropriate waste facility.
- All soils compacted as a result of construction activities should be ripped and profiled.
- Special attention should be paid to alien and invasive species within these areas. Alien and invasive vegetation control should take place throughout all development phases to prevent loss of faunal and floral habitat.
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from disturbed areas susceptible to erosion.
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up.

- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced to prevent the ingress of hydrocarbons into the topsoil.
- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.

6.2 Impacts on Wetland Habitat and Ecological Structure

Activities and aspects register

Pre-Construction	Construction	Operational
Inadequate design of infrastructure leading to changes to wetland habitat	Site clearing and the removal of wetland vegetation	Insufficient aftercare and maintenance leading to ongoing erosion and increased sedimentation due to poor management
	Compaction of soils due to construction activities	Continuous introduction and proliferation of alien plant species and further transformation of natural
	Site clearing and the disturbance of soils	
	Movement of construction vehicles as well as access road construction within wetland zones	
	Dumping waste and construction material within the wetland	
	Dumping of material leading to alien plant species proliferation	

Construction related activities that will be undertaken, such as the removal of the topsoil and disturbance of vegetation, will lead to the destruction of habitat and overall loss of biodiversity within the wetland. Impacts on the wetland may lead to a loss of migratory routes for more mobile species. In addition the edge effects from the development could lead to the introduction of alien species.

If left unmitigated, it will lead to significant impact on wetland habitat and ecological structure, however with the implementation of mitigation measures the severity and spatial scale of the impact can be reduced.

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	2	2	2	7	6	42 (Low)
Operational phase	2	3	2	2	2	5	6	30 (Low)

Essential mitigation measures for construction phase:

- Demarcate areas and ensure that vegetation clearing and indiscriminate vehicle driving occurs within demarcated areas.
- It must be ensured that flow connectivity along the wetland features is maintained.
- Reprofiling of the disturbed wetland areas.

Recommended mitigation measures for construction phase:

- As far as possible, all construction activities should occur in the low flow season, during the drier winter months.

Essential mitigation measures for operational phase:

- Any area where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible.
- Implement alien vegetation control program within wetland areas.
- Monitor the wetland for erosion and incision.

Recommended mitigation measures for operational phase:

N/A

Managed	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	2	2	6	6	36 (Low)
Operational phase	1	3	1	1	1	4	3	12 (Very-low)

Probable latent impacts

- Small permanent change in wetland habitat.
- Proliferation of alien and weed species in disturbed areas will lead to altered vegetation communities within the wetland areas.

6.3 Changes to Wetland Ecological and Sociocultural Service Provision

Activities and aspects register

Pre-Construction	Construction	Operational
Inadequate design of the proposed pipeline leading to erosion and sedimentation of the wetland features	Site clearing and further removal of vegetation impacting on the biodiversity maintenance of the wetlands	Insufficient aftercare and maintenance leading to ongoing erosion and increased sedimentation due to poor management
	Contaminating wetland soils and water, further deteriorating the water quality within the wetland	Increased water runoff into wetland areas due to unvegetated areas not rehabilitated after construction
	Movement of construction vehicles within the wetland	

Pre-Construction	Construction	Operational
	Dumping of construction material into the wetland	
	Inability to support biodiversity as a result of changes to water quality, increased sedimentation and alteration of natural hydrological regimes	
	Alteration of natural hydrological regime, impacting on flood attenuation and streamflow regulation capabilities	

Construction related activities may result in the loss of ecosystem services and function such as stream flow regulation and sediment trapping abilities. Furthermore, impacts may result in a decrease in the ability of the wetland to support biodiversity as a result of changes to water quality, increased sedimentation and vegetation.

Due to the fact that there are no households that depend on the wetland, the wetland is considered to be less significant in terms of cultural value and the provision of benefits such as resource harvesting as well as crop cultivation. However, the wetland plays a role in flood attenuation and biodiversity maintenance.

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	3	2	1	2	5	5	25 (Very-low)
Operational phase	1	3	1	1	2	4	4	16 (Very-low)

Essential mitigation measures during the construction phase:

- It must be ensured that flow connectivity throughout the wetland is maintained.
- Reprofiling of disturbed wetland areas.
- During construction, use environmentally sensitive construction techniques which support the nutrient cycling, hydraulic control and sediment control functions of the wetland.

Recommended mitigation measures during the construction phase:

- Restrict construction to the drier winter months if possible to avoid sedimentation of wetland areas in the vicinity of the proposed development and to minimise the severity of disturbance of the wetland habitat and hydraulic function.

Essential mitigation measures during the operational phase:

- Restrict all vehicles to designated roadways. The indiscriminate movement of vehicles through wetland areas must be strictly prohibited at all times.
- Monitor the wetland/drainage areas for erosion and incision.
- Implement an alien vegetation control program within wetland/drainage areas and ensure establishment of indigenous species within areas previously dominated by alien vegetation.

Recommended mitigation measures during the operational phase:
N/A.

Managed	Probability of Impact	Sensitivity of receiving	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance

		environment						
Construction phase	**1**	**3**	**1**	**1**	**1**	**4**	**3**	**12 (Very-low)**
Operational phase	**1**	**3**	**1**	**1**	**1**	**4**	**3**	**12 (Very-low)**

Probable latent impacts

- A small reduction in biodiversity support.

6.4 Impacts on Wetland Hydrological Function and Sediment Balance

Activities and aspect register

Pre-Construction	Construction	Operational
Poor planning with regards to the placement of infrastructure within the wetland that could result in change of the hydrological regime	Site clearing and the removal of vegetation leading to increased runoff	Insufficient aftercare and maintenance leading to on-going erosion and increased sedimentation due to poor management
	Earthworks in the vicinity of the wetland leading to increased runoff and altered runoff patterns	
	Reconstruction within wetland crossings altering base flow patterns and water velocities	
	Sediment deposition and stream bed scouring	

During construction site clearing, the removal of vegetation may result in an increase in runoff from disturbed areas and an increase in the erosion and incision of the wetland features. An increase in runoff from disturbed areas may also alter flow patterns and may result in the severity of floods downstream. In addition, sediment deposition as a result of the disturbance of soils and increased sediment runoff during the construction may result in an impact on the sediment balance of the wetland.

During the operational phase, hardened surfaces and compacted soils will increase surface runoff, which then alters the hydrology of the wetland. In addition, inappropriate rehabilitation may cause erosion as well as alien species proliferation.

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	**3**	**3**	**3**	**2**	**2**	**6**	**7**	**42 (Low)**
Operational phase	**2**	**3**	**2**	**2**	**2**	**5**	**6**	**30 (Low)**

Essential mitigation measures in the construction phase:

- Any construction-related waste must not be placed in the vicinity of any wetland areas.

- During construction, drift fences constructed from hessian sheets should be installed at erodible areas to minimise erosion. Silt traps should also be provided to remove sand/silt particles from runoff.
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise environmental damage.
- Wetland areas that may have been disturbed during construction should be rehabilitated through reprofiling and revegetation upon completion of the construction phase.

Recommended mitigation measures for the construction phase:

- Desilt all wetland areas affected by construction activities if necessary.
- Reinforce banks and drainage features where necessary with gabions, reno mattresses and geotextiles but as far as possible soft rehabilitation techniques should be employed.
- As far as possible, all construction activities should occur in the low flow season, during the drier summer months.

Essential mitigation measures in the operational phase:

N/A

Recommended mitigation measures for the operational phase

- During the operational phase a quarterly assessment should be undertaken for a year, to determine any excessive erosion. Photographic records should be maintained and any necessary maintenance and rehabilitation implemented.

Managed	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	3	2	1	1	5	4	20 (Very-low)
Operational phase	1	3	1	1	1	4	3	15 (Very-low)

Probable latent impacts:

- Erosion and incision of the wetland areas may occur if wetland is not effectively rehabilitated.

6.5 Impact Assessment Conclusion

Based on the above assessment it is evident that there are three possible impacts that may have an effect on the overall integrity of the system. Table 19 summarises the findings indicating the significance of the impacts before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

Table 19: Summary of the wetland impact assessment

Construction phase		
Impact	**Unmanaged**	**Managed**
1: Impact on the loss of wetland habitat and ecological structure	Low	Low
2: Impact on the changes to wetland ecological service provision	Very-low	Very-low
3: Impact on wetland hydrological function and sediment balance	Low	Very-low
Operational phase		
Impact	**Unmanaged**	**Managed**
1: Impact on the loss of wetland habitat and ecological structure	Low	Very-Low
2: Impact on the changes to wetland ecological service provision	Very-low	Very-Low
3: Impact on wetland hydrological function and sediment balance	Low	Very-Low

From the table it is evident that for the duration of the construction phase, the impact on wetland habitat and ecological structure is considered low level impact, prior to mitigation as well as when mitigation takes place. The impact on wetland ecological service provision is considered to be very-low level impact, prior to mitigation as well as when mitigation takes place. The impact on wetland hydrological function and sediment balance is considered low level impact prior to mitigation, however should mitigation measures be implemented the impact will be reduced to very low levels.

For the duration of the operational phase, the impact on wetland habitat and ecological structure as well as the impact on wetland hydrological function and sediment balance are considered to be low level impacts, prior to mitigation. However, if mitigation is implemented impacts will be reduced to very-low level impacts. The impact on wetland ecological service provision is considered to be very-low level impact, prior to mitigation as well as when mitigation takes place.

7. CONCLUSION AND RECOMMENDATIONS

Scientific Aquatic Services (SAS) was appointed to conduct a wetland delineation, Present Ecological State (PES) and function assessment as part of the proposed pipeline in Pomona. Therefore, Based on the findings of the ecological assessment it is the opinion of the ecologists that from an ecological viewpoint, the proposed project be considered favorably. However, all essential mitigation measures and recommendations presented in this report should be adhered to as to ensure the ecology within the proposed construction areas as well as surrounding zone of influence is protected or adequately rehabilitated in order to minimise the deviations from the Present Ecological State. Particular attention needs to be paid to the location and extent of the wetland in order to ensure development related activities do not encroach unnecessarily into these zones and that ongoing functionality of these wetland is maintained.

Development footprint

- It must be ensured that, as far as possible, all proposed infrastructure is placed outside the wetland habitat areas. Where this is not possible, suitable mitigation measures as outlined in this report should be adhered to.
- The boundaries of the development footprint areas are to remain as small as possible, be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect the wetland habitat, need to be strictly managed in all areas, particularly within areas of increased ecological sensitivity. Alien species should be eradicated and controlled to prevent their spread beyond the development footprint areas.
- All areas of increased ecological sensitivity beyond the development footprint should be designated as No-Go areas and be off limits to all unauthorised vehicles and personnel. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration. If possible, such roads should be constructed a distance from the wetland habitat and not directly adjacent thereto it must be ensured that construction related waste does not affect the wetland habitat boundaries.

RDL and protected floral species

- Sensitive floral species, if encountered within the development footprint, are to be handled with care and the relocation of sensitive plant species to similar suitable habitat is to be overseen by a botanist.

Alien floral species

- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases.
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used.
  - Footprint areas should be kept as small as possible when removing alien plant species.
  - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

Fauna

- Informal fires in the vicinity of development area should be prohibited during all development phases.
- Should any RDL or other threatened or protected faunal species be noted within the development footprint areas, these species should be relocated to similar habitat within the study area with the assistance of a suitably qualified specialist.

Wetland

- Ensure that hydraulic connectivity of the wetland areas is maintained between the areas upstream and downstream of the bridge.
- Ensure that permanent, seasonal and temporary wetland zone functionality is maintained through provision of measures to ensure that soil wetting conditions are maintained.
- Ensure ongoing functioning of the wetland areas in the vicinity of the proposed development.
- Ensure that no incision and canalisation of the wetland feature takes place as a result of the construction activities.

- Ensure that migratory connectivity for more mobile faunal species is facilitated to allow movement of these species between areas upstream and downstream of the development.
- It must be ensured that planning of the development includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible.
- Prevent run-off and seepage from dirty water areas entering wetland habitats.
- No dumping of waste should take place within the adjacent wetland areas.
- An effective waste management plan must be implemented in order to prevent construction related waste from entering the wetland environment.
- Appropriate sanitary facilities must be provided for the duration of the construction activities.
- The wetland must be regularly monitored for erosion and incision. As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils. In this regard special mention is made of the need to use indigenous veldgrasses in areas left bare as a result of road upgrade activities.
- All wetland areas affected by the proposed development activities are to be rehabilitated to ensure that wetland functions are re-instated after construction. Revegetation must take place by using indigenous wetland species.

Vehicle access

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

Soils

- It must be ensured that construction related waste or spillage and effluent do not affect the immediate and surrounding habitat boundaries.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- All soils compacted as a result of construction activities falling outside of development footprint areas should be ripped and profiled.

Rehabilitation

- It is recommended that as part of the development, rehabilitation measures of the adjacent wetland areas should be implemented.
- Disturbed wetland areas should to be reprofiled where required and adequate vegetation cover on the streambanks must be ensured.
- Wetland areas susceptible to erosion must be reinforced where necessary with gabions, reno mattresses and geotextiles.

- Incorporate adequate erosion management measures in order to prevent erosion and the associated sedimentation of the wetland areas.
- All disturbed habitat areas must be rehabilitated and reseeded with an indigenous seed mixture as soon as possible to ensure that floral ecology is re-instated.

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