Proposed 120 ha Residential Development on the Remainder of Portion 12 of the Farm Wemmershuis 379 JT and the Remainder of the Farm Bergendal 981 JT, Belfast, Mpumalanga Province.

Wetland/Riparian Delineation and Functional Assessment
February 2016

Drafted by
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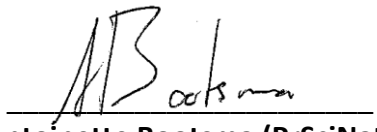
Prepared for:
Labesh Sustainable, Natural Resource management

Declaration of Independence

I, **Antoinette Bootsma**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.



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Ecologist/Botanist
SACNASP Reg. No. 400222-09

2015.12.13
Date

Indemnity

This 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. 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 information available at the time of study. Therefore the author reserves 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.

Although the author exercised due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

Qualification of Specialists

Report writing and review	Antoinette Bootsma Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222-09 Rudi Bezuidenhoudt Wetland specialist / Ecologist SACNASP Reg. No. 500024/13
Field work and data analysis	Rudi Bezuidenhoudt Wetland specialist / Ecologist SACNASP Reg. No. 500024/13

EXECUTIVE SUMMARY

Limosella Consulting (Pty) Ltd was appointed by Labesh sustainable natural resource management to undertake a wetland and/or riparian delineation and functional assessment for the Proposed 120 ha Residential Development on the Remainder of Portion 12 of the Farm Wemmershuis 379 JT and the Remainder of the Farm Bergendal 981 JT, Belfast, Mpumalanga Province.

Fieldwork was conducted on the 1st of April 2016.

The terms of reference for the study were as follows:

- Delineate the wetland/riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake the functional assessment of wetlands and/or riparian areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss potential impacts, mitigation and management procedures relevant to the conserving wetland areas on the site.

Two wetland sections were recorded on the study site as well as two dams. The wetland sections are classified as two sections of headwaters of one large unchannelled valley bottom wetland system the sections of the larger wetland located on the study site is classified as valley head seeps buffer. Only small sections of these two headwater valley head seep wetlands are located on the study site with the majority of the wetland not located on the study site.

The PES scores for both the wetlands on the study site is **a C – Moderately modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.

The EIS score of **2.7** and **2.5** both falls into a category characterised by **High** ecological importance and sensitivity. Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers. The Recommended Ecological Management Class for this wetland is thus a B. Details for the components assessed in the combined EIS score are presented in Appendix B.

Both Quaternary Catchment X11D and X21F is located in the fifth water management area known as the Inkomati water management area. In this WMA the Major rivers include the Nwanedzi River, Sabie River, Crocodile (East) River and Komati River.

Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (Regulation 1199 of 2009 in terms of the National Water Act, 1998).

Development activities close to wetlands are excluded from General Authorisation (GA) for Section 21 (c) and (i) water uses (published in Government Gazette No. 389). In this instance the Department of Water and Sanitation should be contacted regarding the application for a Water Use License.

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1 INTRODUCTION

Limosella Consulting (Pty) Ltd was appointed by Labesh sustainable natural resource management to undertake a wetland and/or riparian delineation and functional assessment for the Proposed 120 ha Residential Development on the Remainder of Portion 12 of the Farm Wemmershuis 379 JT and the Remainder of the Farm Bergendal 981 JT, Belfast, Mpumalanga Province.

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1.1 Terms of Reference

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1.2 Assumptions and Limitations

The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

Furthermore, the assessment of wetlands is based on environmental indicators such as vegetation, that are subjected to seasonal variation as well as factors such as fire and drought. Although background information was gathered, the information provided in this report was mainly derived from what was observed on the study site at the time of the field survey. A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study. Description of the depth of the regional water table and geohydrological processes falls outside the scope of the current assessment. During the sit visit large areas of the wetland and surroundings was grazed very short and not all vegetation could be identified. It should also be noted that although the study was conducted during the summer, it was during an extreme drought period and some seasonal and temporary wetlands could have been missed during the study visit.

1.3 Definitions and Legal Framework

This section outlines the definitions, key legislative requirements and guiding principles of the wetland study and the Water Use Authorisation process.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the Department of Water Affairs (DWA). The NWA sets out a range of water use related principles that are to be applied by DWA when taking decisions that significantly affect a water resource. The NWA defines a water resource as including a watercourse, surface water, estuary or aquifer. A watercourse includes a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake, pan or dam, into which or from which water flows; any collection of water that the Minister may declare to be a watercourse; and were relevant its beds and banks.

The NWA defines a wetland as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat often perform important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). It is defined by the NWA as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas".

Water uses for which authorisation must be obtained from DWA are indicated in Section 21 of the NWA. Section 21 (c) and (i) is applicable to any activity related to a wetland:
Section 21(c): Impeding or diverting the flow of water in a watercourse; and
Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

Authorisations related to wetlands are regulated by Government Notices R.1198 and R.1199 of 18 December 2009. GN 1198 and 1199 of 2009 grants General Authorisation (GA) for the above water uses on certain conditions:
GN R.1198: Any activity in a wetland for the rehabilitation of a wetland for conservation purposes.
GN R.1199: Any activity more than 500 m from the boundary of a wetland.

These regulations also stipulate that these water uses must the registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a

wetland are excluded from a GA under either of these regulations. Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (GN 1199). Such an activity requires a Water Use Licence (WUL) from the relevant authority.

In addition to the above, the proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA].
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003).
- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA.
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA.
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).

1.4 Locality of the study site

The study site is located south east of the town of Belfast in the Mpumalanga Proivince and is bordered by the national road, the N4, in the north and by the regional road, the R33, in the west. The approximate central coordinates of the channel is 25°42'59.81"S and 30° 4'0.35"E (Figure 1).

Furthermore the layout of the study area is predominantly residential with some areas of mixed use (Figure 2).

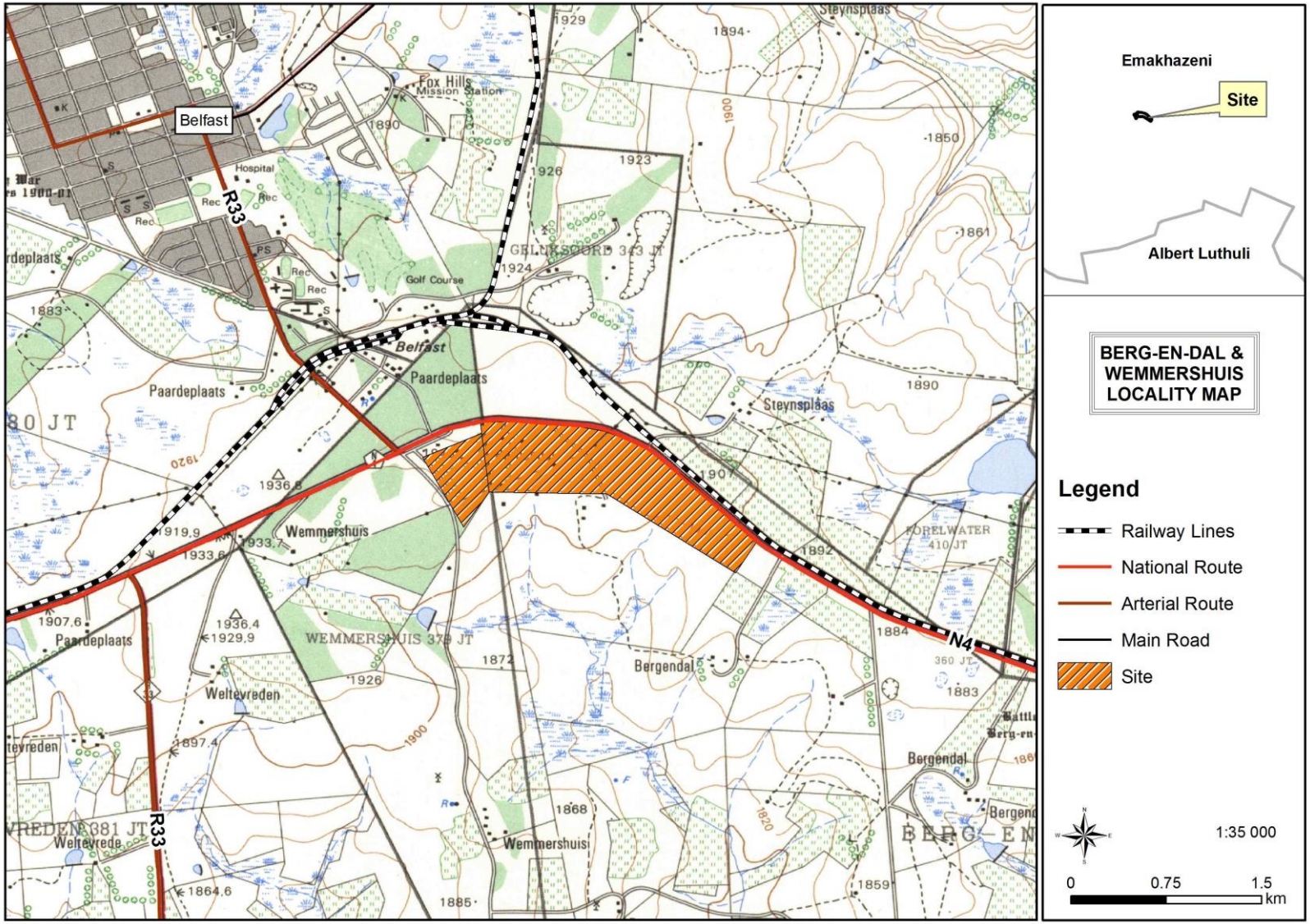
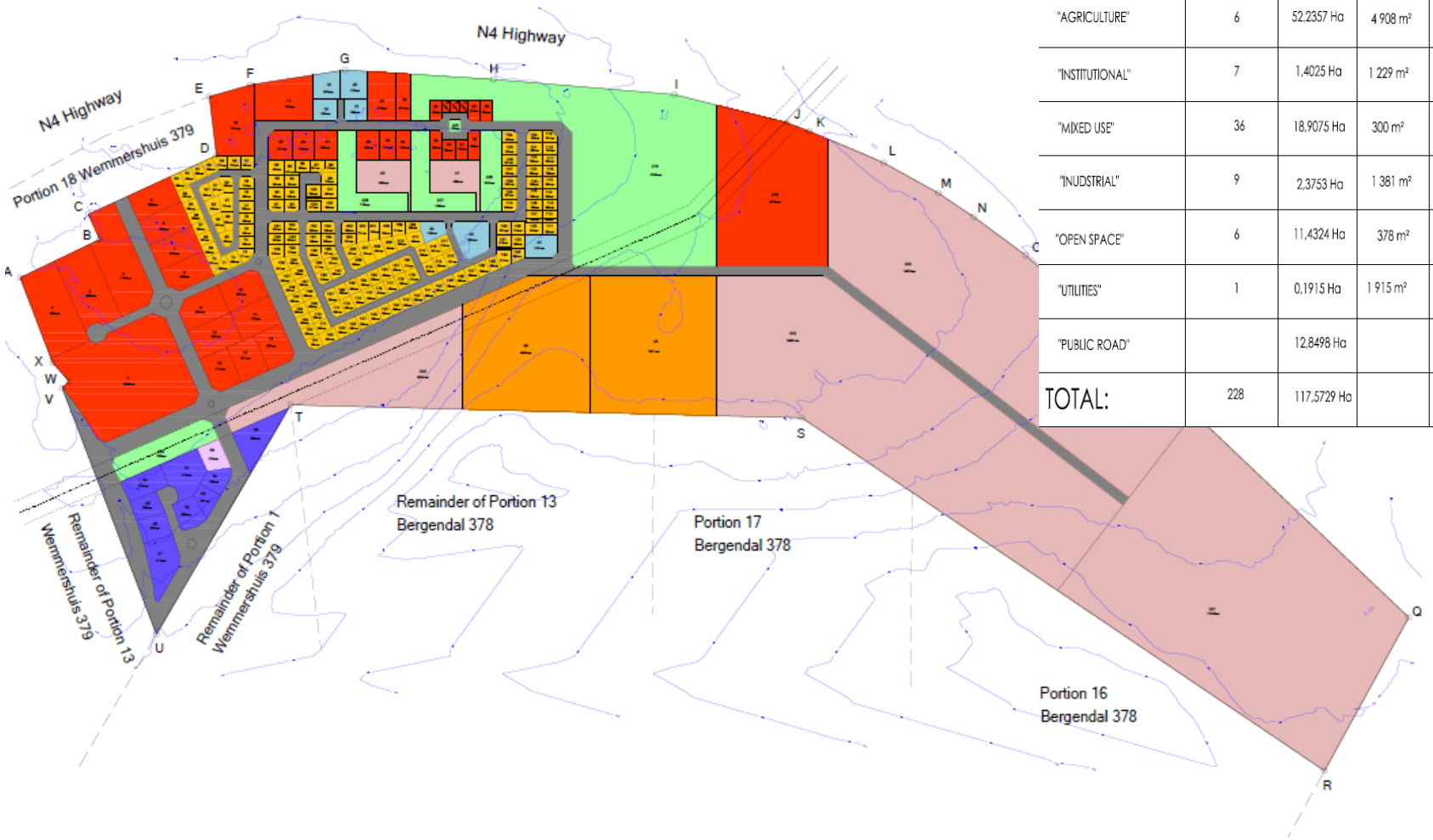


Figure 1: Locality Map



ZONINGS:	TOTAL ERVEN	AREA Ha	MIN Area	MAX Area	AVE. Area	% OF TOWN	Colour NOT.
" RESIDENTIAL MEDIUM"	161	8,5008 Ha	500 m²	785 m²	528 m²	7.23	
"RESIDENTIAL HIGH"	2	9,6774 Ha	46 463 m²	50 311 m²	48 387 m²	8.23	
"AGRICULTURE"	6	52,2357 Ha	4 908 m²	174 985 m²	87 060 m²	44.43	
"INSTITUTIONAL"	7	1,4025 Ha	1 229 m²	3 282 m²	2 004 m²	1.19	
"MIXED USE"	36	18,9075 Ha	300 m²	46 733 m²	5 252m²	16.08	
"INUDSTRIAL"	9	2,3753 Ha	1 381 m²	4 123 m²	2 639 m²	2.02	
"OPEN SPACE"	6	11,4324 Ha	378 m²	87 345 m²	19 054 m²	9.72	
"UTILITIES"	1	0,1915 Ha	1 915 m²	1 915 m²	1 915 m²	0.16	
"PUBLIC ROAD"		12,8498 Ha				10.93	
TOTAL:	228	117,5729 Ha				100 %	

Figure 2: Layout of the proposed development

1.5 Description of the Receiving Environment

A review of available literature and spatial data formed the basis of a characterisation of the biophysical environment in its theoretically undisturbed state and consequently an analysis of the degree of impact to the ecology of the study site in its current state.

Quaternary Catchments and Water Management Area (WMA):

As per Macfarlane *et al*, (2009) one of the most important aspects of climate affecting a wetland's vulnerability to altered water inputs is the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) (i.e. the average rainfall compared to the water lost due to the evapotranspiration that would potentially take place if sufficient water was available). The study site is located predominantly in the X11D quaternary catchment with only a small section of the study site located in the X21F quaternary catchment. In both these Quaternary Catchments X11D and X21F the precipitation rate is lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.41 and 0.43 respectively. Consequently, watercourses in these areas are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

19 Water Management areas (WMA) were established by, and their boundaries defined in, Government Notice No. 1160 on 1st October 1999. Both Quaternary Catchment X11D and X21F is located in the fifth water management area known as the Inkomati water management area. In this WMA the Major rivers include the Nwanedzi River, Sabie River, Crocodile (East) River and Komati River.

Geology and soils:

The study site is underlain by the Madzaringwe Fm, Karoo Spgrp and Vaalian Erathem (AGIS 2015; ENPAT 2015).

Furthermore the soil of the area is classified as Ac2 and the soil class is S23. The soil classified as Ac2 is characterised by Red-yellow apedal, freely drained soils; red and yellow, dystrophic and/or mesotrophic as well as Quartzite, shale, hornfels, limestone, andesite, tuff and conglomerate of the upper formations of the Pretoria Group (Previously the Smelterskop Stage); tillite, sandstone and shale of the Dwyka Formation; shale, sandstone and grit of the Ecca Group. Furthermore the soil class S23 is characterised as Structure less and textural contrast soils which may have favourable physical properties, somewhat high natural fertility; relative wetness favourable in dry areas including restricted depth, imperfect drainage, high erodibility; slow water infiltration and seasonal wetness.

Hydrology:

Surface water spatial layers such as the National Freshwater Ecosystems Priority Areas (NFEPA) Wetland Types for South Africa (SANBI, 2010) were consulted for the presence of wetlands, perennial and non-perennial rivers on or in proximity to the site. Based on these spatial layers no watercourses are located on the study site while some perennial rivers, non-perennial rivers and wetlands are located in close

association to the study site (Figure 3). However, based on the NFEPA layers the study site is located on an area characterised by wetland clusters and is classified as mesic Highveld grassland group 6 (Figure 4).

Regional Vegetation:

The regional vegetation classification (sensu Mucina & Rutherford, 2006) indicated that the vegetation unit could potentially be influenced by the development.

Lydenburg Montane Grassland is characterised by forb rich grasslands high-altitude plateaus, undulating plains, mountain peaks and slopes including hills and deep valleys which supports predominantly low grasslands on the high-lying areas with the height of the grasses increasing on lower slopes. This vegetation type is considered vulnerable with a conservation target of 27% with only 2.4% formally protected.

Mpumalanga Conservation Plan

Critical Biodiversity Areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision making. CBA's are therefore 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 (Desmet *et al,* 2009).

In addition, the assessment also made provision for Ecological Support Areas (ESA's), which are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas (Desmet *et al,* 2009).

On the study site the western side of the study site associated with current infrastructure the area is classified as "no natural habitat remaining" while the rest of the site classified as part of a 'least concern' (Figure 5).

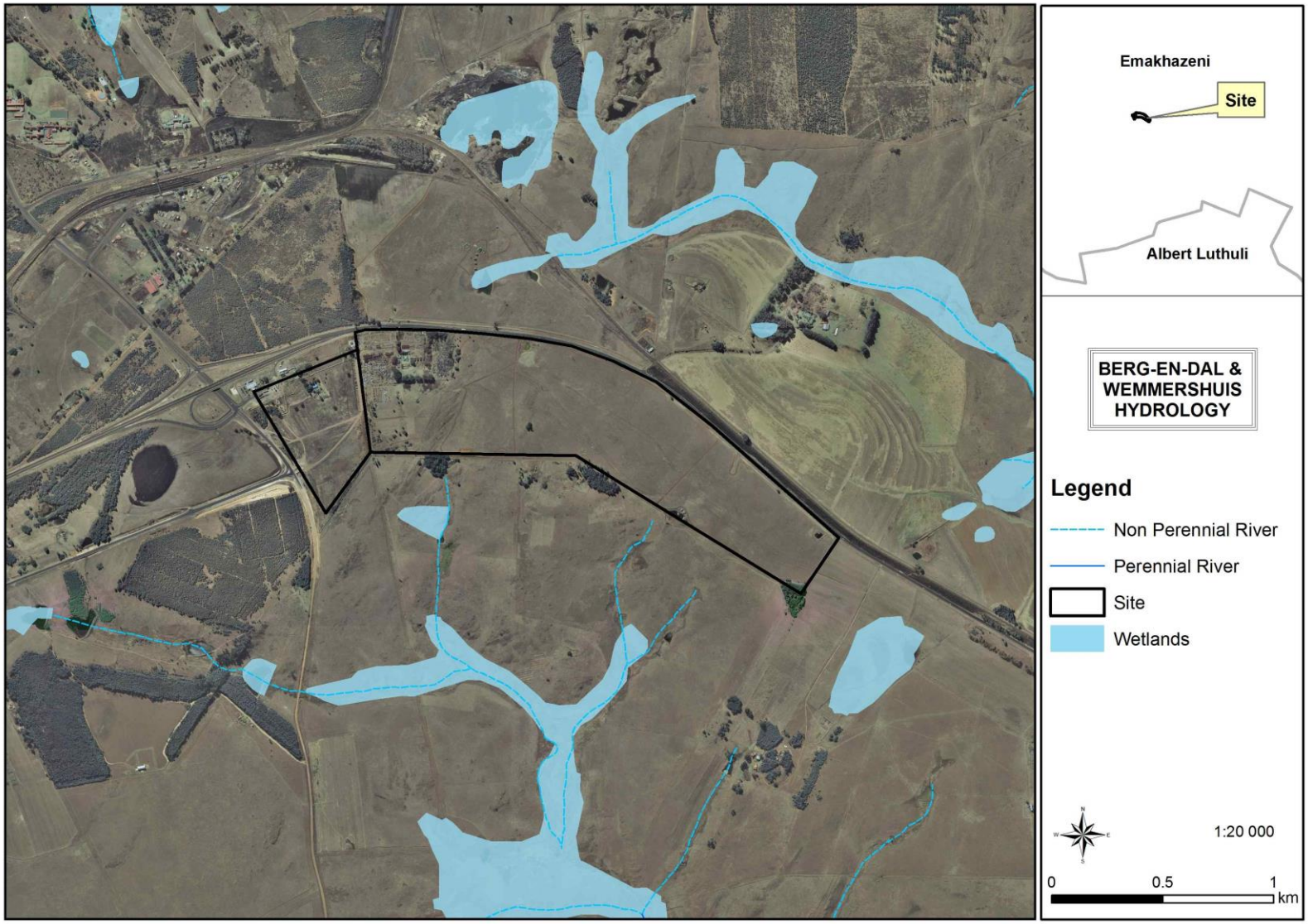


Figure 3: Regional hydrology

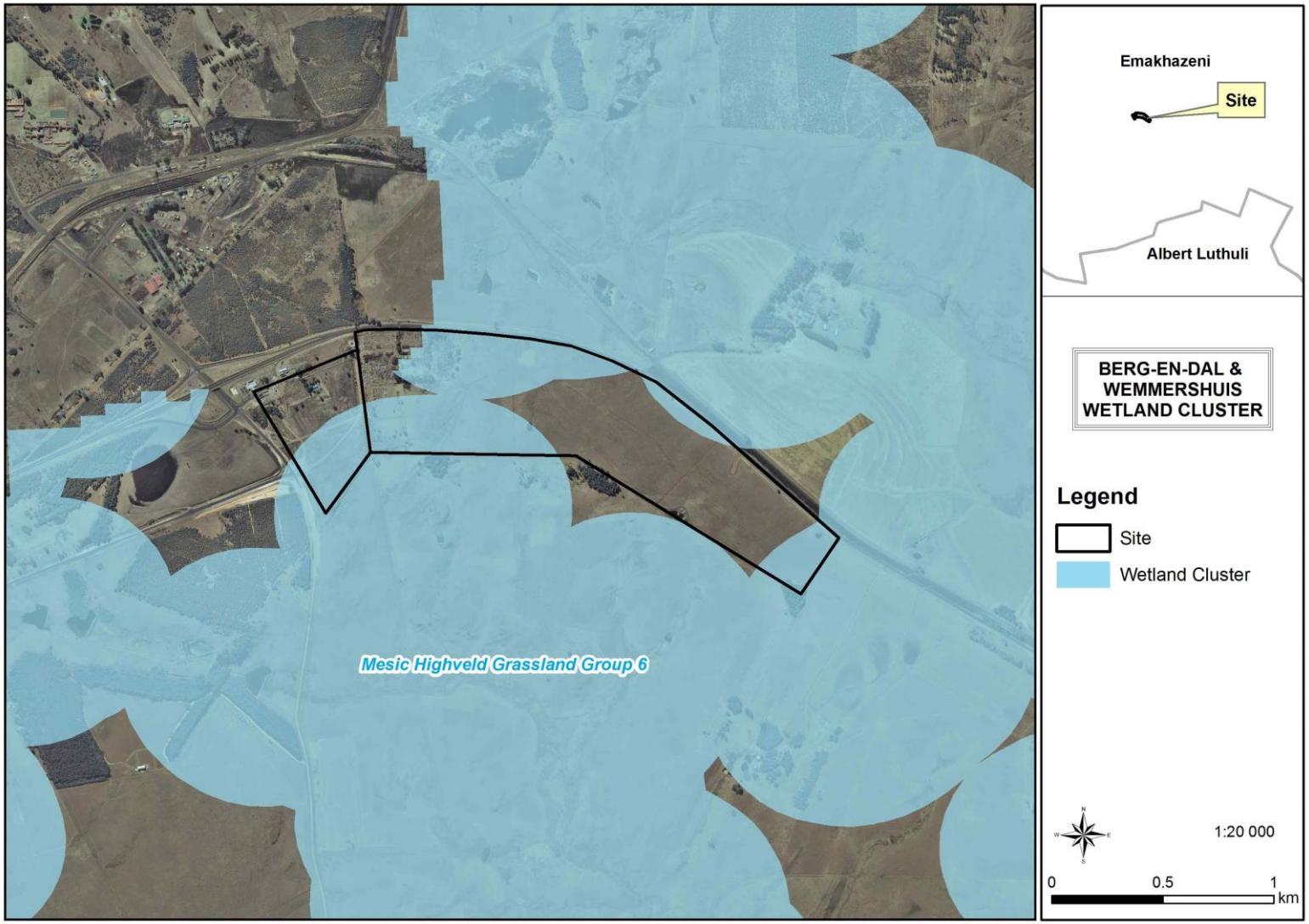


Figure 4: Wetland Clusters of the study site.

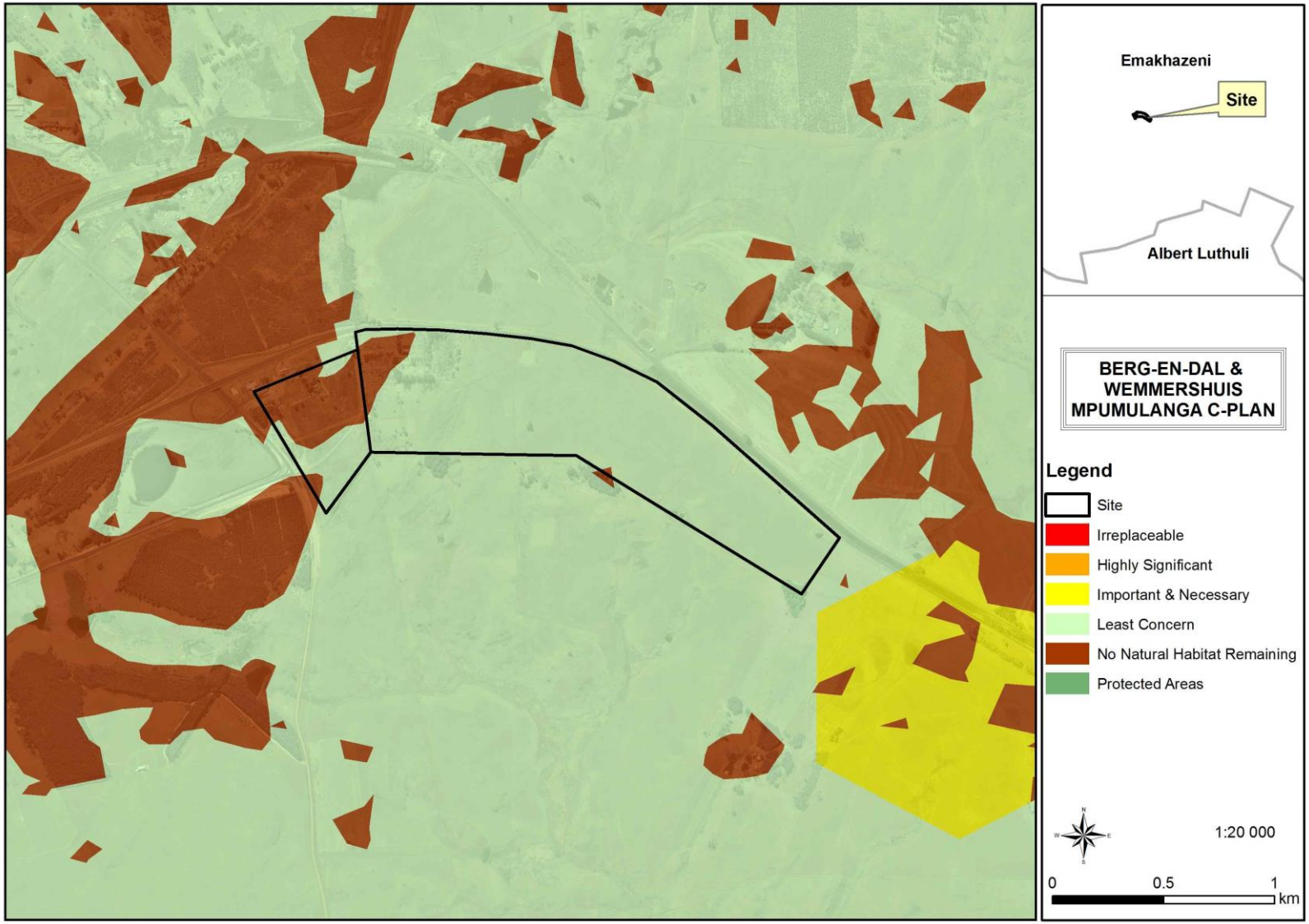


Figure 5: Gauteng Conservation Plan.

2 METHODOLOGY

The delineation method documented by the Department of Water affairs and Forestry in their document "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008), and the Minimum Requirements for Biodiversity Assessments (GDACE, 2009) as well as the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al,* 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms as well as the terrain unit indicator.

A hand held Garmin Montana 650 was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field survey.

2.1 Wetland and Riparian Delineation

Wetlands are identified based on the following characteristic attributes (DWAF, 2005) (Figure 6):

- The presence of plants adapted to or tolerant of saturated soils (hydrophytes);
- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation; and
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing within 50cm of the soil surface.

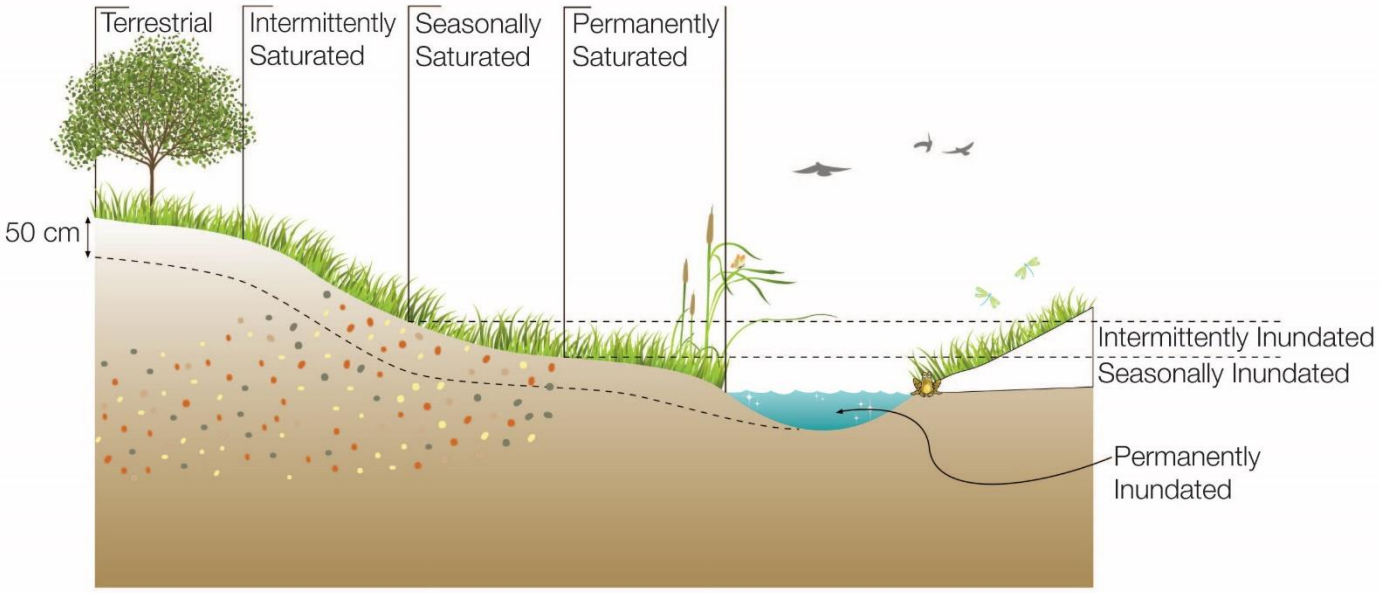


Figure 6: Typical cross section of a wetland (Ollis, 2013)

The Terrain Unit Indicator

The terrain unit indicator (Figure 7) is an important guide for identifying the parts of the landscape where wetlands might possibly occur. Some wetlands occur on slopes higher up in the catchment where groundwater discharge is taking place through seeps. An area with soil wetness and/or vegetation indicators, but not displaying any of the topographical indicators should therefore not be excluded from

being classified as a wetland. The type of wetland which occurs on a specific topographical area in the landscape is described using the Hydrogeomorphic classification which separates wetlands into 'HGM' units. The classification of Ollis, *et al*. (2013) is used, where wetlands are classified on Level 4 as either Rivers, Floodplain wetlands, Valley-bottom wetlands, Depressions, Seeps, or Flats (Figure 8).

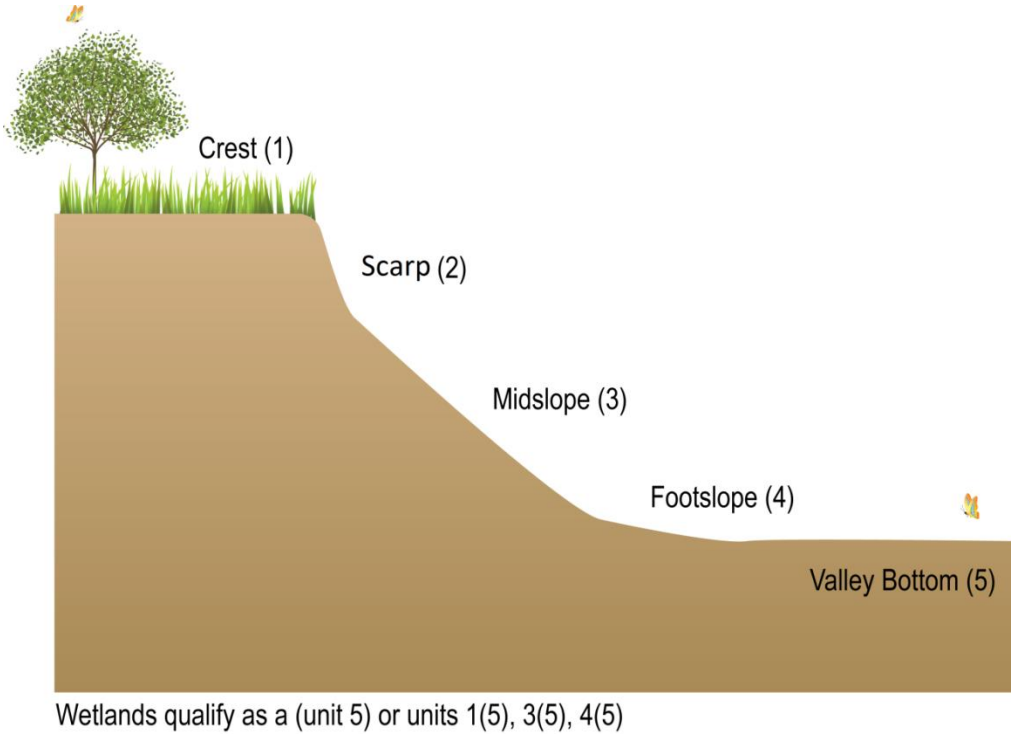


Figure 7. Terrain units (DWAF, 2005).

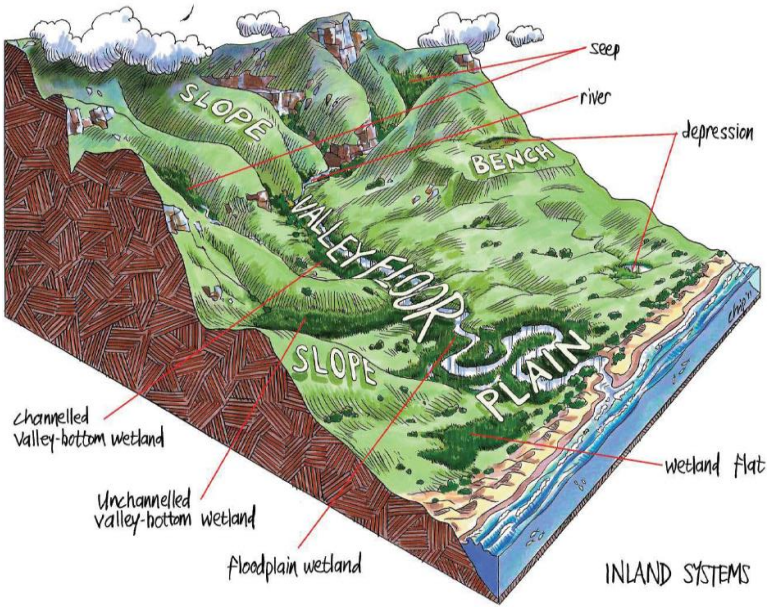


Figure 8: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

Riparian Indicators

Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. The macro stream channel is defined as the outer bank of a compound channel and should not be confused with the active river bank. The macro channel bank often represents a dramatic change in the energy with which water passes through the system. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008). The marginal zone includes the area from the water level at low flow, to those features that are hydrologically activated for the greater part of the Year (WRC Report No TT 333/08 April, 2008). The non-marginal zone is the combination of the upper and lower zones (Figure 9).

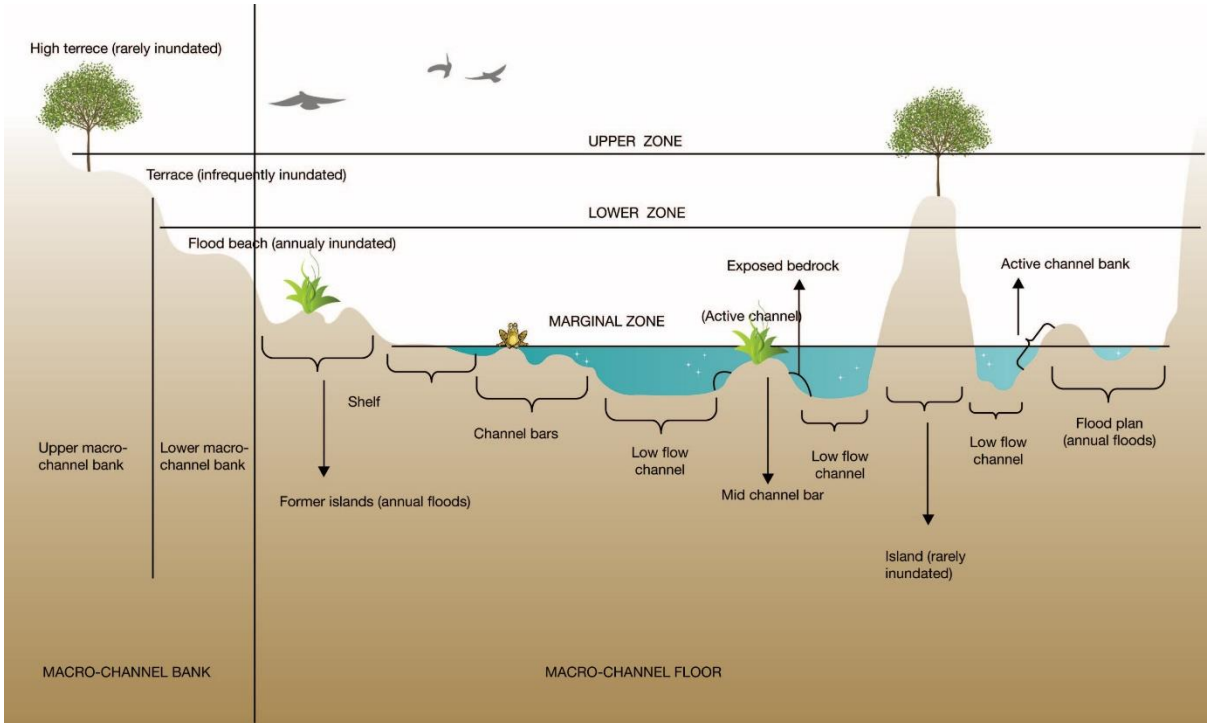


Figure 9: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans *et al*, 2007)

The vegetation of riparian areas is divided into three zones, the marginal zone, lower non-marginal zone and the upper non-marginal zone (Table 1). The different zones have different vegetation growth.

Table 1: Description of riparian vegetation zones (Kleynhans *et al*, 2007).

	Marginal	(Non-marginal) Lower	(Non-marginal) Upper
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or	Usually a marked increase in lateral Elevation.	Usually a marked decrease in lateral elevation

	Marginal	(Non-marginal) Lower	(Non-marginal) Upper
	moistened) for the Greater part of the year.		
Characterized by	See above ; Moist substrates next to water's edge; water loving- species usually vigorous due to near permanent access to soil moisture	Geomorphic features that are hydrologically activated (inundated or moistened) on a Seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated (inundated or moistened) on an Ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

Riparian Area:

A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Figure 10) (Kotze, 1999).

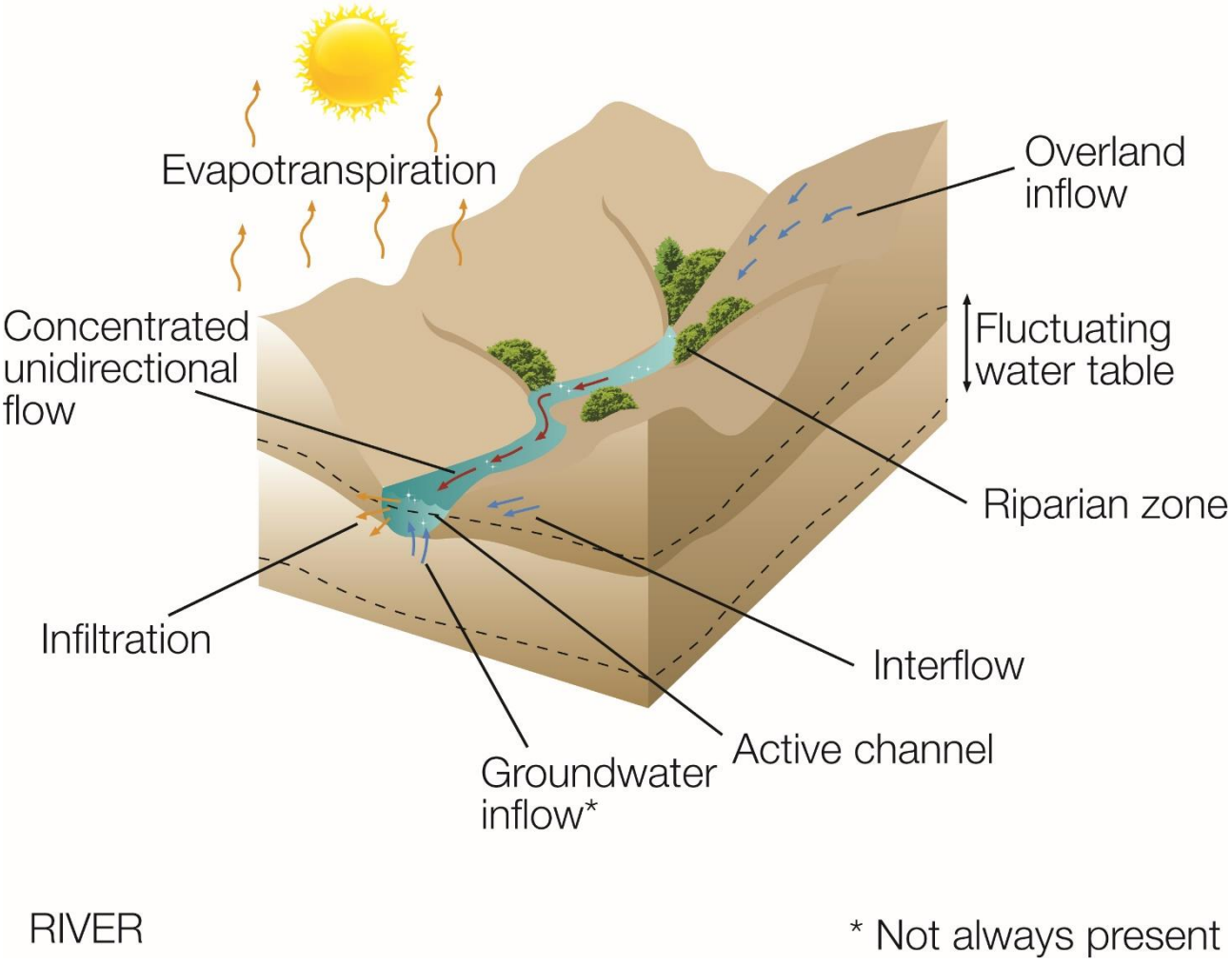


Figure 10: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel (Figure 11). Two types of temporary rivers are recognized, namely "ephemeral" rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and "episodic" rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman *et al*, 2010). The riparian areas recorded on site are thus classified as episodic streams due to the high elevation of these streams.

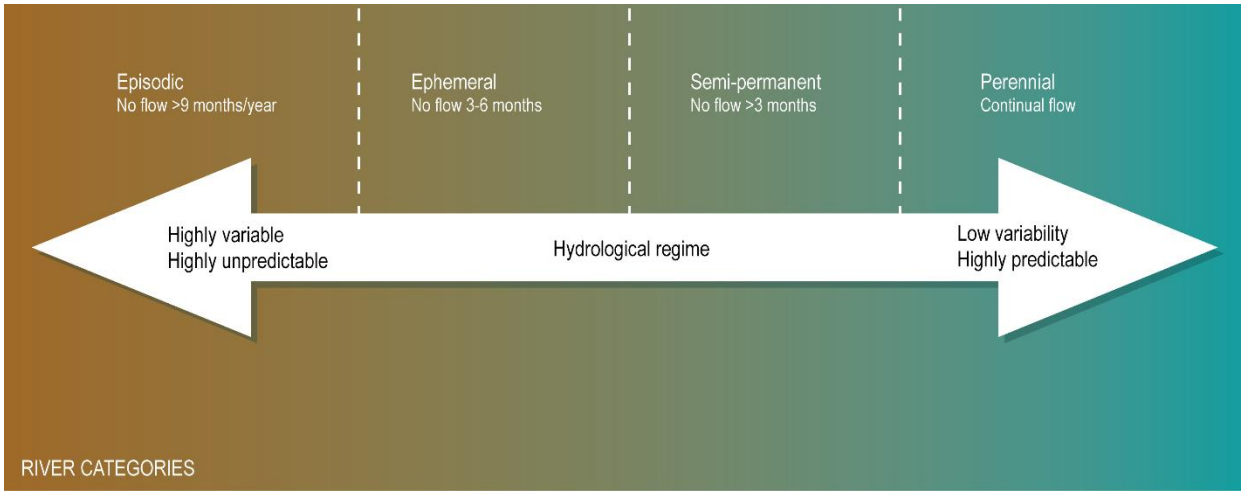


Figure 11: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

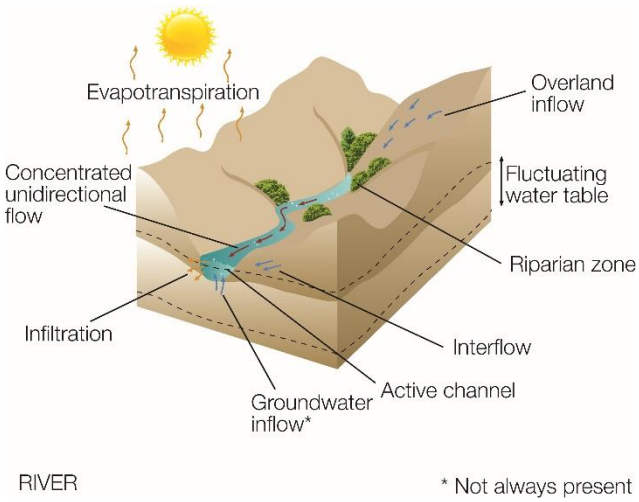
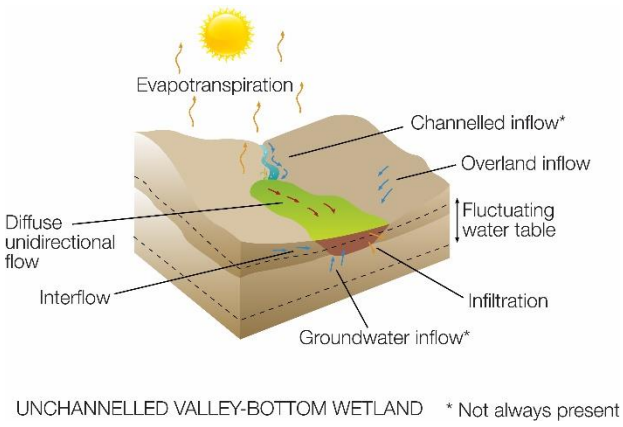
2.2 Wetland Classification and Delineation

The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (SANBI, 2009). The current wetland study follows the same approach by classifying wetlands in terms of a functional unit in line with a level three category recognised in the classification system proposed in SANBI (2009). HGM units take into consideration factors that determine the nature of water movement into, through and out of the wetland system. In general HGM units encompass three key elements (Kotze *et al*, 2005):

- Geomorphic setting - This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
- Water source - There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
- Hydrodynamics - This refers to how water moves through the wetland.

The Classification of hydrologically functional areas recorded on the study site and/or within 500 m of the study site (adapted from Brinson, 1993; Kotze, 1999, Marneweck and Batchelor, 2002 and DWAF, 2005) are as follows (Table 2):

Table 2: Hydrogeomorphic Types and descriptions

Wetland Type:	Description:
Riparian Habitat  	Linear fluvial, eroded landforms which carry channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone.
Unchannelled Valley Bottom  	Linear fluvial, net depositional valley bottom surfaces which do not have a channel. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas, or at tributary junctions where the sediment from the tributary smothers the main drainage line.

2.3 Buffer Zones

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development has several impacts on the surrounding environment and on a wetland. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments. The buffer zone identified in this report serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream

activities and adjoining landuses; (iii) providing habitat for various aspects of biodiversity. A brief description of each of the functions and associated services is outlined in Table 3 below.

Table 3: Generic functions of buffer zones relevant to the study site (adapted from Macfarlane *et al*, 2010)

Primary Role	Buffer Functions
Maintaining basic aquatic processes, services and values.	• Groundwater recharge: Seasonal flooding into wetland areas allows infiltration to the water table and replenishment of groundwater. This groundwater will often discharge during the dry season providing the base flow for streams, rivers, and wetlands.
Reducing impacts from upstream activities and adjoining land uses	• Sediment removal: Surface roughness provided by vegetation, or litter, reduces the velocity of overland flow, enhancing settling of particles. Buffer zones can therefore act as effective sediment traps, removing sediment from runoff water from adjoining lands thus reducing the sediment load of surface waters. • Removal of toxics: Buffer zones can remove toxic pollutants, such hydrocarbons that would otherwise affect the quality of water resources and thus their suitability for aquatic biota and for human use. • Nutrient removal: Wetland vegetation and vegetation in terrestrial buffer zones may significantly reduce the amount of nutrients (N & P), entering a water body reducing the potential for excessive outbreaks of microalgae that can have an adverse effect on both freshwater and estuarine environments. • Removal of pathogens: By slowing water contaminated with faecal material, buffer zones encourage deposition of pathogens, which soon die when exposed to the elements.

Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts of land uses / activities planned adjacent to water resources. These must however be considered in conjunction with other mitigation measures.

New buffer tools have been developed and been published as “Prelimanary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Consolidated Report” by the WRC (Macfarlane *et al* 2015). This new buffer tool aims to calculate the best suited buffer for each wetland or section of a wetland based on numerous on-site observations. The resulting buffer area can thus have large differences depending on the current state of the wetland as well as the nature of the proposed development. Developments with a high risk factor such as mining are likely to have a larger buffer area compared to a residential development with a lower risk factor. The minimum accepted buffer for low risk developments are however 15 meters from the edge of the wetland (Macfarlane, *et al* 2015) as opposed to the generic recommendation of 30 m for wetlands inside the urban edge and 50 m outside the urban edge (GDARD, 2012). For the proposed residential development a buffer zone of 44 meters was calculated.

2.4 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions. In the current assessment the hydrological, geomorphological and vegetation integrity was assessed for the wetland unit associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane *et al*, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999). The impacts observed for the affected wetlands on the study site are summarised for each wetland under section 3.2. These impacts are based on evidence observed during the field survey and land-use changes visible on aerial imagery.

The allocations of scores in the functional and integrity assessment are subjective and are thus vulnerable to the interpretation of the specialist. Collection of empirical data is precluded at this level of investigation due to project constraints including time and budget. Water quality values, species richness and abundance indices, surface and groundwater volumes, amongst others, should ideally be used rather than a subjective scoring system such as is presented here.

The functional assessment methodologies presented below take into consideration subjective recorded impacts to determine the scores attributed to each functional Hydrogeomorphic (HGM) wetland unit. The aspect of wetland functionality and integrity that are predominantly addressed include hydrological and geomorphological function (subjective observations) and the integrity of the biodiversity component (mainly based on the theoretical intactness of natural vegetation) as directed by the assessment methodology.

In the current study the wetland was assessed using, WET-Health (Macfarlane *et al*, 2007) and EIS (DWAF, 1999).

2.4.1 Present Ecological Status (PES) – WET-Health

A summary of the three components of the WET-Health namely Hydrological; Geomorphological and Vegetation Health assessment for the wetlands found on site is described in Table 4. A Level 1 assessment was used in this report. Level 1 assessment is used in situations where limited time and/or resources are available.

Table 4: Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007)

Description	Impact Score Range	PES Score	Summary
Unmodified, natural.	0.0.9	A	Very High
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural	1-1.9	B	High

Description	Impact Score Range	PES Score	Summary
habitats and biota may have taken place.			
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	Moderate
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D	Moderate
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	Low
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	Very Low

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 5.

Table 5: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health (Macfarlane *et al*, 2007)

Change Class	Description	Symbol
Improve	Condition is likely to improve over the over the next 5 years	(↑)
Remain stable	Condition is likely to remain stable over the next 5 years	(→)
Slowly deteriorate	Condition is likely to deteriorate slightly over the next 5 years	(↓)
Rapidly deteriorate	Substantial deterioration of condition is expected over the next 5 years	(↓↓)

2.4.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Wetland Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits relevant to a HGM unit. Both PES and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This

classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The Ecological Importance and Sensitivity of the seepage wetland is represented are described in the results section. Explanations of the scores are given in Table 6.

Table 6: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores (DWAF, 1999)

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
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. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <=3	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. They play a small role in moderating the quantity and quality of water in major rivers	>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. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1	D

2.4.3 Present Ecological Category (EC): Riparian

In the current study, the Ecological Category of the riparian areas was assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans et al, 2007) (Appendix B; Appendix C). Appendix B lists the VEGRAI calculations that determine the Ecological Category (EC) for the riparian area. Table 7 below provides a description of each EC category.

Table 7: Generic ecological categories for EcoStatus components (modified from Kleynhans, 1996 & Kleynhans, 1999)

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

2.4.4 Quick Habitat Integrity Model

To accommodate a less-detailed process, a desktop habitat integrity assessment (using the Quick Habitat Integrity model) that allows for a coarse assessment was developed. This assessment rates the habitat according to a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics (Seaman *et al*, 2010):

- Bed modification.
- Flow modification.
- Introduced Instream biota.
- Inundation.
- Riparian / bank condition.
- Water quality modification.

3 RESULTS

3.1 Land Use, Cover and Ecological State

The study site is predominantly open land currently used for small scale cattle farming. Sections of the study area is characterised by farming infrastructure. Numerous dirt roads are located on the study area. The area is likely to have been used historically for cattle farming. The study site is bordered in the north by the N4 highway.

3.1.1 Soil and Vegetation Indicators

Soil

The soil of the study site was predominantly red to brown loam soils with many rocky outcrops throughout the study site. The farm dam located in the north east corner was also characterised by bedrock. The headwaters of the south eastern valley head seep wetland was characterised by grey clay soils with distinct mottling, gelying and root oxidation. The south western wetland was characterised by laom red soil. Both the sections of the wetlands located on the study site has been excavated to create dams in the headwaters of the wetland system and the excavated soil is stored in heaps adjacent to the dams and thus some sections of the soil profile has been disturbed.

The soil characteristics are summarised in the table below (Table 8) and visually by the figures below (Figure 12).

Table 8: Summary of the wetland soil conditions on site (Adapted from Job, 2010).

Site Conditions:	
Do normal circumstances exist on the site?	Yes
Is the site significantly disturbed (difficult site)?	No
Indicators of soil wetness within 50 cm of soil surface:	
Sulfidic odour (a slight sulfidic odour was noted in permanent zone)	No
Mineral and Texture	Clay and loam
Gley	Yes
Mottles or concretions	Yes
Organic streaking or oxidised rhizopheres	Yes
High organic content in surface layer	No
Setting (In bold):	
crest (1) scarp (2) midslope (3) footslope (4) **valley bottom (5)**	
Additional indicators of wetland presence:	
Concave	Yes
Bedrock	No
Dense clay	Yes
Flat	No
Associated with a river	No

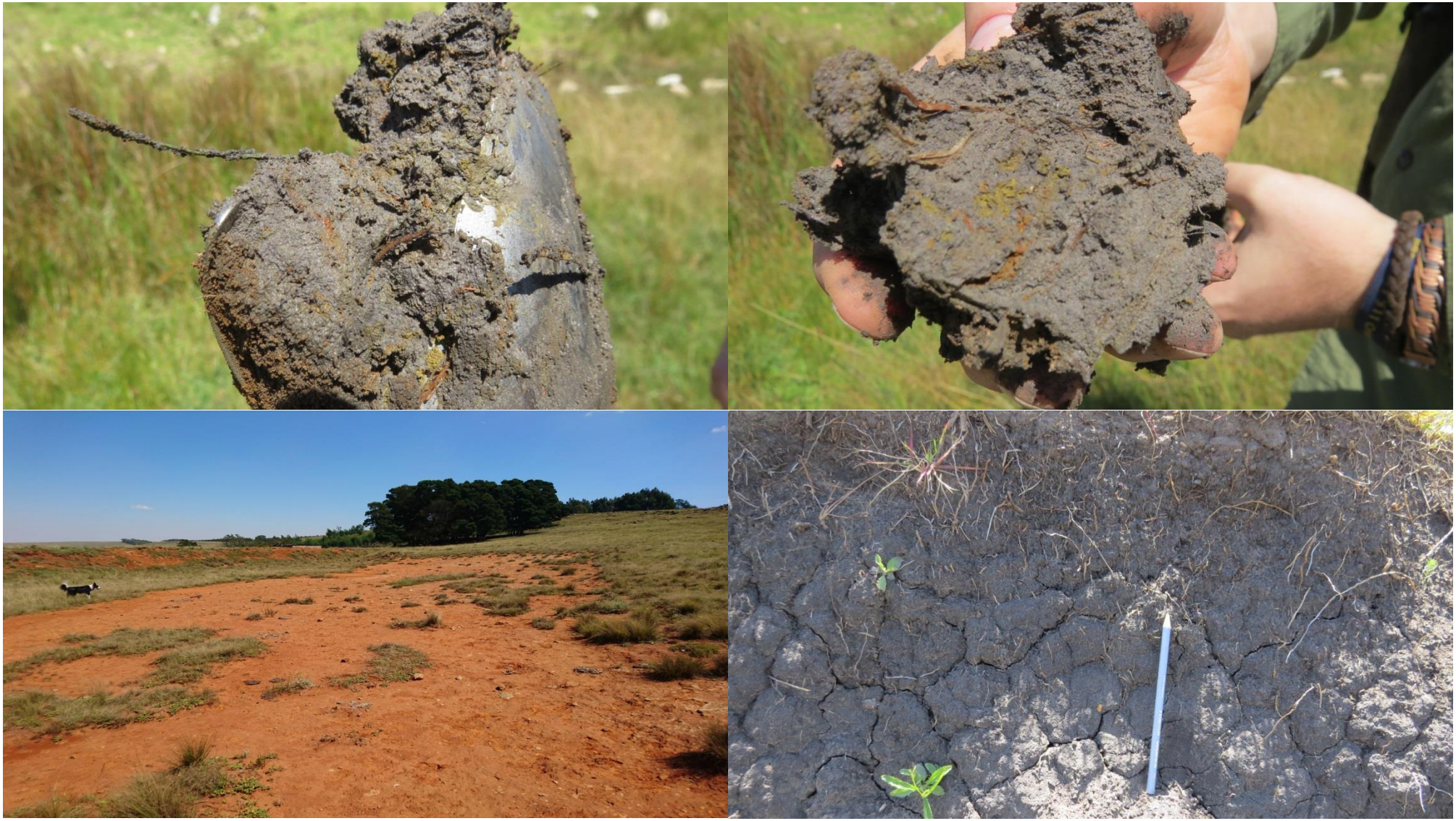


Figure 12: Disturbed soil profile of the area and alluvial deposits in the channel.

Vegetation

The vegetation of the wetland areas on the study site is characterised by predominantly indigenous species consisting of mainly sedges and grasses. The south eastern valley head seep wetland was characterised by more hygrophilous plant species than the valley head seep located in the south western section of the study site which was dominated by grass cover and is likely episodic in nature. The plants used in the delineation process as well as other species in or around the wetland areas are recorded in the table below (Table 9) and visually in figures 13 - 14.

Table 9: Species composition of the wetland areas on site (Highlighted areas used in the delinieation)

Plant Species	Exotic	Wetland Indicator	Recorded in Wetland Area	Recorded on Study Site (Not wetland)
Monopsis decipiens		Y	**Y**	
Pennisetum clandestinum	Y	Y	**Y**	**Y**
Plantego major	Y	Y	**Y**	
Typha capensis		Y	**Y**	
Schoenoplectus corymbosus		Y	**Y**	
Persicaria lapathofofia	Y	Y	**Y**	
Isolepis fluitans		Y	**Y**	
Limosella major		Y	**Y**	
Hibiscus trionum			**Y**	**Y**
Fuirena pubescens		Y	**Y**	
Eragrostis curvula			**Y**	**Y**
Eragrostis plana			**Y**	**Y**
Andropogon schirensis			**Y**	**Y**
Lobelia erinus		Y	**Y**	**Y**
Pelargonium luridum			**Y**	**Y**
Ranunculus multifidus		Y	**Y**	**Y**
Watsonia latifolia			**Y**	**Y**
Lagarosiphon major		Y	**Y**	
Scirpus dioecus		Y	**Y**	

Figure 13: Wetland vegetation of the south eastern valley head seep wetland.

Figure 14: Wetland vegetation of the south western valley head seep wetland.

3.2 Wetland/Riparian Classification and Delineation

Two wetland sections were recorded on the study site as well as two dams. The wetland sections are classified as two sections of headwaters of one large unchannelled valley bottom wetland system and is thus classified as valley head seepsbuffer. Only small sections of these two headwater valley head seep wetlands are located on the study site with the majority of the wetland not located on the study site (Figure 15).

The wetland recorded on the study area is classified up to level 6 according to the SANBI guidelines (Ollis *et al,* 2013) and summarised in the tables below (Table 10-12):

Table 10: Level 1- 4 classification of the wetlands recorded on the study site (adapted from Ollis *et al*, 2013).

Level 1: System Type	**Level 2: Regional Setting**	**Level 3: Landscape Setting**	**Level 4: HGM Unit**		
System	**DWA Ecoregion**	**Landscape Unit**	**Level 4A:Wetland Type**	**Level 4B: Longtitudinal zonation**	**Level 4C: Inflow drainage**
Inland	Highveld	Valley Floor	Valley head seep	n/a	n/a
		Valley Floor	Valley head seep	n/a	n/a

Table 11: Level 5 classification of the wetlands recorded on the study site (adapted from Ollis *et al*, 2013).

Level5: Hydroperiod and depth of inundation		
Level 5A	**Proportional Rating (0-6) for wetlands on site**	
Inundation Peroid		
	Valley head seep (East)	Valley head seep (West)
Permanently Inandated	4	3
Seasonally Inandated	3	4
Intermittently Inandated	3	3
Never/Rarely Inandated	2	2

Level5: Hydroperiod and depth of inundation		
Unknown		
Level 5B	**Proportional Rating (0-6) for wetlands on site**	
Saturartion periodicity (within 50 cm of the soil surface)		
Permanently Inandated	4	3
Seasonally Inandated	4	3
Intermittently Inandated	3	4
Never/Rarely Inandated	1	2
Unknown		
Level 5C: Inundation depth-class		
Limnetic or Littoral	**n/a**	**n/a**

Table 12: Level 6 classification of the wetlands recorded on the study site (adapted from Ollis *et al*, 2013).

Component	Dominant categories for selected descriptorss (Level 6)							
	Natural vs Artificial		Substratum Type	Vegetation Cover, Form and Status				
						Detailed Vagetation From		
	6A: NAtural vs Artificial	6B: Artificial Categories	6A: Primary Categories	6A: Vegetation Cover	6B: Primary Vegetation Cover	6C: Herbaceous Vegetation	6D: Forest Vegetation	6E: Vegetation Status
Valley head seep (East)	Natural	N/A	Clay	Vegetated	Herbaceous	Grasses & sedges	n/a	Indigenous
Valley head seep (West)	Natural	N/A	Loam	Vegetated	Herbaceous	Grasses	n/a	Indigenous

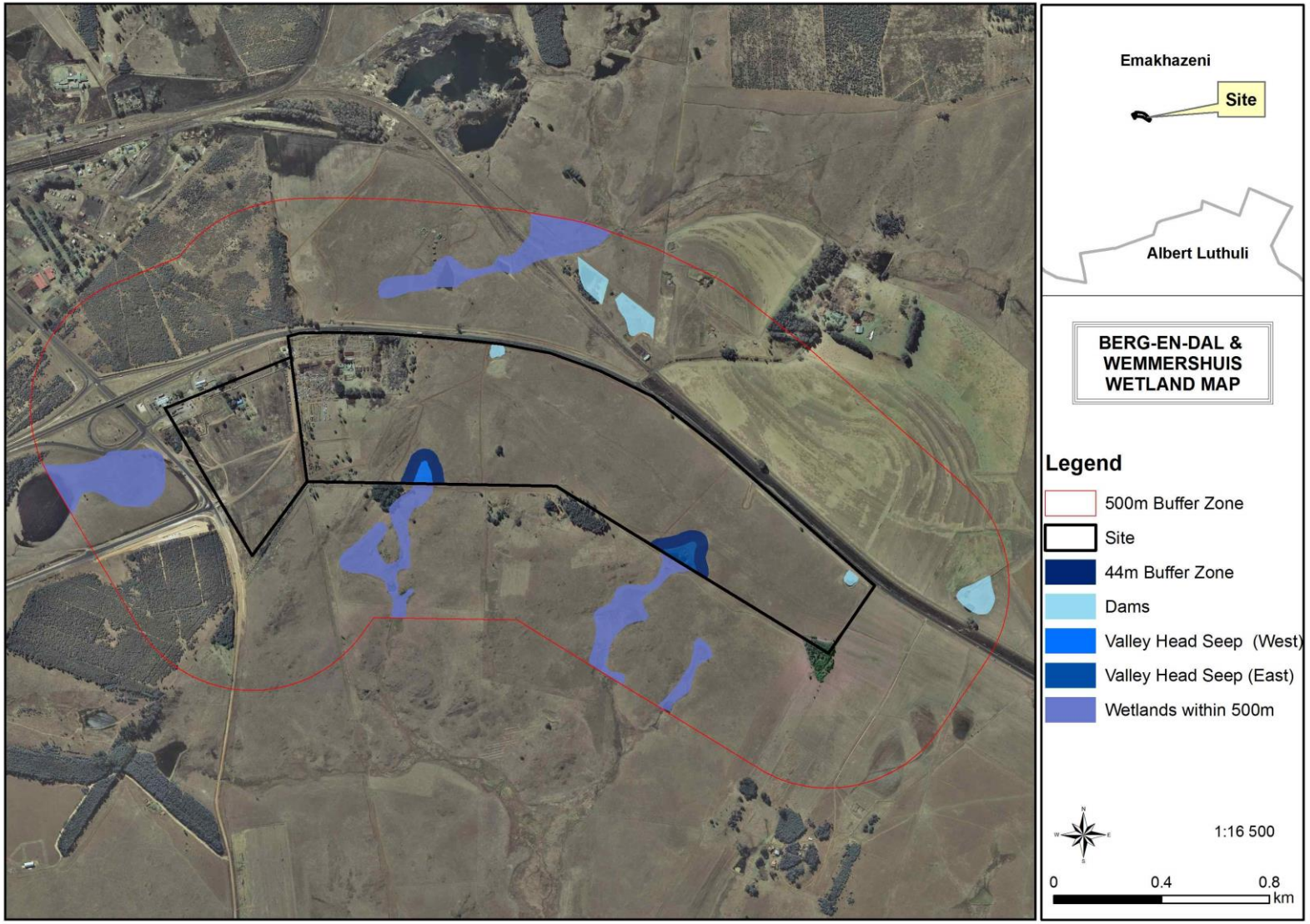


Figure 15: Wetland associated with the study site.

Present Ecological Status (PES)

The PES was calculated for the wetlands on the study site and not for the wetlands within 500 m which are unlikely to be impacted by the proposed activities.

The wetlands on the study site are only slightly disturbed with the main impacts including impacts such as dams within the wetland and some grazing animals (Table 13).

The PES scores for both the wetlands on the study site is **a C – Moderately modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact (Tables 13):

Table 13: Summary of hydrology, geomorphology and vegetation health assessment for the channelled valley bottom wetland on the study site (Macfarlane *et al*, 2009).

Wetland Unit	Hectare (Ha)	Hydrology		Geomorphology		Vegetation		Overall Health Score for the Wetland	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
Valley head seep (East)	0.6	3.8	0	1.8	0	1.7	0	2.6	0
PES Category and Projected Trajectory		**C**	**→**	**B**	**→**	**B**	**→**	**C**	**→**
Valley head seep (West)	0.4	2.7	0	1.8	0	1.7	0	2.1	0
PES Category and Projected Trajectory		**C**	**→**	**B**	**→**	**B**	**→**	**C**	**→**

Ecological Importance and Sensitivity (EIS)

The EIS score of **2.7** and **2.5** both falls into a category characterised by **High** ecological importance and sensitivity. Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers (DWAF, 1999) (Table 14 and Table 15). The Recommended Ecological Management Class for this wetland is thus a B. Details for the components assessed in the combined EIS score are presented in Appendix B.

Table 14: Combined EIS scores obtained for the wetland system on the study site. (DWAF, 1999).

WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Ecological importance & sensitivity	3.3	3.0
Hydro-functional importance	2.6	2.5
Direct human benefits	2.2	3.0
Overall EIS score	**2.7**	

Table 15: Combined EIS scores obtained for the wetland system on the study site. (DWAF, 1999).

WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Ecological importance & sensitivity	3.0	3.0
Hydro-functional importance	2.4	2.5
Direct human benefits	2.0	3.0
Overall EIS score		**2.5**

3.3 Impacts and Mitigations

A development has several impacts on the surrounding environment and particularly on a wetland. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater run-off, and therefore the hydrological regime of the site. Site specific mitigation measures should be included in an Environmental Management Plan.

The proposed development aims to rehabilitate the stream and will thus likely improve the overall health of the stream although some impacts may occur in the short term such as sedimentation and erosion it is likely that these impacts will be rectified during rehabilitation.

In accordance with the requirements from the EIA Regulations 2014 GN 982, Regulation 19 (3) and as set out in Appendix 1, the following impacts of the issues identified through the basic assessment phase was assessed in terms of the following criteria and summarized in Tables 16-20:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **probability (P)** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **duration (D)**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **extent (E)**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

- The **magnitude (M)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- the **significance (S)**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
    - the significance rating is calculated by the following formula:

      S (significance) = (D + E + M) x (P)
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

Suggested primary management procedures are summarised in Table 16 – 20 and the Aspects And Impact Register/Risk Asssessment For Watercourses Including Rivers, Pans, Wetlands, Springs,Drainage Lines

Are summarised in table 16 – 20.

Table 16: Changes in water flow regime impact ratings

Nature: Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow		
ACTIVITY: Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow. The sources of this impacts include: • Development within watercourse, thereby diverting or impeding flow • Vehicles driving in / through the watercourse • Lack of adequate rehabilitation resulting in invasion by invasive plants		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Definite (5)	Highly probable (4)
Duration	Permanent (5)	Long term (4)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	High (8)	Moderate (6)
Significance	**75 (High)**	**48 (Moderate)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Highly probable (4)	Probable (30)
Duration	Permanent (5)	Permanent (5)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	High (8)	Low (4)
Significance	**60 (high)**	**30 (moderate)**

Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	No	

Mitigation:

- No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable, only the construction footprint and no access roads can be considered. This is subjected to authorization by means of a water use license.
- Construction must be restricted to the dryer winter months.
- A temporary fence or demarcation must be erected around the works area to prevent access to the adjacent portions of the watercourse. The works areas generally include the servitude, construction camps, areas where material is stored and the actual footprint of proposed development.
- Prevent pedestrian and vehicular access into the watercourse and buffer areas.

Cumulative impacts: Expected to be moderate. The upgrade of the wetland system is likely to improve some aspects of the wetland system.

Residual Risks: Permanent changes, including positive impacts, are likely to be permanent.

Table 17: Changes in sediment entering and exiting the system impact ratings

Nature: Changes in sediment entering and exiting the system.

Activity: Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). Construction, operational and decommissioning activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the wetland and increase the turbidity of the water. Possible sources of the impacts include:

- Earthwork activities when constructing
- Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil.
- Disturbance of soil surface
- Disturbance of slopes through creation of roads and tracks adjacent to the watercourse
- Erosion (e.g. gully formation, bank collapse)

	Without mitigation	**With mitigation**

CONSTRUCTION PHASE		
Probability	Definite (5)	Highly probable (4)
Duration	Medium-term (3)	Medium-term (3)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	High (8)	Moderate (6)
Significance	**65 (high)**	**44 (moderate)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Highly probable (4)	Probable (30)
Duration	Permanent (5)	Permanent (5)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	High (8)	Low (4)
Significance	**60 (high)**	**30 (moderate)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Water is expected to seep into any area of trenching and earthworks. It is likely that water will be contaminated within these earthworks and should thus be cleaned or dissipated into a structure that allows for additional sediment input and slows down the velocity of the water thus reducing the risk of erosion. Structures such as boulder weirs should be considered for its ability to absorb excess sediment as well as dissipating the water over a larger area.
- Construction in and around watercourses must be restricted to the dryer winter months.
- A temporary fence or demarcation must be erected around the works area to prevent water runoff and erosion of the disturbed or heaped soils into watercourse areas.
- Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas.
- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- A vegetation rehabilitation plan should be implemented. Grassland can be removed as sods and stored within transformed vegetation. The sods must preferably be removed during the winter months and be replanted by latest springtime. The sods should not be stacked on top of each other or within sensitive environs. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks.
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover.
- Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction and that plan must be implemented immediately upon completion of construction.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and

livestock access.

- During the construction phase measures must be put in place to control the flow of excess water so that it does not impact on the surface vegetation.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
- Runoff from the construction area must be managed to avoid erosion and pollution problems.
- Implementation of best management practices
- Source-directed controls
- Buffer zones to trap sediments
- Active rehabilitation

Cumulative impacts: Expected to be moderate, should mitigation measure not be implemented as changes made to the bed or banks of watercourse channels will cause unstable channel conditions causing erosion, meandering, increased potential for flooding and movement of bed material, which will result in property damage adjacent to and downstream of the site.

Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 18: Introduction and spread of exotic vegetation impact ratings.

Nature: Introduction and spread of exotic vegetation

Activity: Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a wetland, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plans can easily colonise and impact on downstream users.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Definite (5)	Probable (3)
Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Moderate (6)
Significance	**55 (Moderate)**	**30 (moderate)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Highly probable (4)	Probable (3)
Duration	Medium-term (3)	Medium-term (3)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	High (6)	Low (4)
Significance	**36 (Moderate)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation: • Weed control • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area and returning it where possible afterwards. • Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish. • Rehabilitate or revegetate disturbed areas
Cumulative impacts: Expected to be minimal. The vegetation on the site is disturbed as a result of human activities and no highly sensitive habitat was identified.
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 19: Loss and disturbance of wetland habitat and fringe vegetation

Nature: Loss and disturbance of wetland habitat and fringe vegetation/Changing physical structure of wetland.		
Activity: Loss and disturbance of wetland habitat and fringe vegetation due to direct development on the wetland as well as changes in management, fire regime and habitat fragmentation.		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Definite (5)	Probable (4)
Duration	Long-term (4)	Medium-term (3)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Moderate (6)
Significance	**60 (High)**	**36 (moderate)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Highly probable (4)	Probable (3)
Duration	Medium-term (3)	Medium-term (3)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	High (6)	Low (4)
Significance	**36 (Moderate)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Moderate	Moderate
Can impacts be mitigated?	Yes	

Mitigation:

- The development footprint should be designed around current wetland and wetland buffers.
- Where construction occurs in the demarcated wetland and buffer, extra precautions should be implemented to so as to minimise wetland loss.
- Where wetlands are lost, compensation should be made to protect the remaining wetlands and their catchments, increase their buffers and rehabilitate their condition and functionality.
- Other than approved and authorized structure, no other development or maintenance infrastructure is allowed within the delineated watercourse or associated buffer zones.
- Demarcate the watercourse areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas
- Weed control in buffer zone
- Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed.
- Monitor the establishment of alien invasive species within the areas affected by the construction and take immediate corrective action where invasive species are observed to establish.
- Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas
- Operational activities should not impact on rehabilitated or naturally vegetated areas
- Rehabilitate of function of disturbed wetlands

Cumulative impacts: Expected to be minimal. The habitat is however already largely transformed and fragmented due to the adjacent mining activities and the site is not a unique habitat within the landscape. It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction and operation of the proposed development.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 20: Changes in water quality due to foreign materials and increased nutrients impact ratings.

Nature: Changes in water quality due to toxic contaminants and increased nutrient levels

Activity: Construction, operational and decommissioning activities will result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands and a reduction in wetland function as well as human and animal waste. Could possibly impact on groundwater

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (4)	Probable (3)
Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Moderate (6)
Significance	**44 (High)**	**30 (moderate)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Probable (4)	Probable (3)

Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Moderate (6)
Significance	**44 (High)**	**30 (moderate)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Moderate	Moderate
Can impacts be mitigated?	Yes	

Mitigation:

- The development footprint should be designed around current wetland and wetland buffers.
- Where construction occurs in the demarcated wetland and buffer, extra precautions should be implemented to so as to minimise wetland loss.
- Where wetlands are lost, compensation should be made to protect the remaining wetlands and their catchments, increase their buffers and rehabilitate their condition and functionality.
- Other than approved and authorized structure, no other development or maintenance infrastructure is allowed within the delineated watercourse or associated buffer zones.
- Demarcate the watercourse areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas
- Weed control in buffer zone
- Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed.
- Monitor the establishment of alien invasive species within the areas affected by the construction and take immediate corrective action where invasive species are observed to establish.
- Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas
- Operational activities should not impact on rehabilitated or naturally vegetated areas
- Rehabilitate of function of disturbed wetlands

Cumulative impacts: Expected to be minimal. The habitat is however already largely transformed and fragmented due to the adjacent mining activities and the site is not a unique habitat within the landscape. It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction and operation of the proposed development.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

4 CONCLUSION

Two wetland sections were recorded on the study site as well as two dams. The wetland sections are classified as two sections of headwaters of one large unchannelled valley bottom wetland system the sections of the larger wetland located on the study site is classified as valley head seeps buffer. Only small sections of these two headwater valley head seep wetlands are located on the study site with the majority of the wetland not located on the study site.

The proposed development is likely to lead to increased hardened surfaces and is thus likely to have negative effects such as sedimentation, erosion, increased flooding, increased flow peaks and the input of foreign material into the wetland areas.

The wetland is summarised in the table below:

	Wetland Types	**Quaternary Catchment and WMA area**	**Linked to an important River System**	**Coordinates and Relation to study area**	**Present Ecological Score (PES)**	**Recommended Ecological Management Class (EIS/REMC)**	**Buffers**
	Valley Head Seeps	X11D and X21F Inkomati WMA	No	25°43'6.11"S and 30° 3'59.30"E & 25°43'15.27"S and 30° 4'30.69"E	**C**	**B**	**44 Meters**
Does the specialist support the development?	Yes – From a wetland point of view only small sections of the wetlands are located on the study site and a suggested 44 meter buffer is likely enough (together with the mitigations in this report) to minimise any potential impacts on the wetlands. However from an ecological point of view the study area and surrounding wetlands are very sensitive and should be protected and development is thus not supported.						
Major concerns	Increased hardened surfaces thus increasing sedimentation, erosion, increased flooding, increased flow peaks and the input of foreign material into the wetland areas.						
Recommendations	Wetland buffers should be respected as well as adhere to the mitigations.						
Vegetation Type and Importance	Lydenburg Montane Grassland. This vegetation type is considered vulnerable with a conservation target of 27% with only 2.4% formally protected.						
CBA and other Important area	Majority of the site is classified as “least concern”						

Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (Regulation 1199 of 2009 in terms of the National Water Act, 1998). Development activities close to wetlands are excluded from General Authorisation (GA) for Section 21 (c) and (i) water uses (published in Government Gazette No. 389). In this instance the Department of Water and Sanitation should be contacted regarding the application for a Water Use License.

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APPENDIX A: GLOSSARY OF TERMS

Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area
Hydrophyte	any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats
Hydromorphic soil	soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils)
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Soil profile	the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991)
Wetland:	"*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." (National Water Act; Act 36 of 1998).
Wetland delineation	the determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures are included in impact assessment tables

APPENDIX B: Functional Assessment Data

Table 21: Ecological Importance and Sensitivity Calculations of the valley head seep (East)

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Biodiversity support		3.00		
Presence of Red Data species	4	3.00	Numerous vulnerable plant species recorded on the study site	Endangered or rare Red Data species presence
Populations of unique species	3	3.00	Numerous vulnerable and rare plant species and communities recorded on the study site	Uncommonly large populations of wetland species
Migration/breeding/feeding sites	3	3.00	Yes – numerous birds recorded as well as signs of smaller animals	Importance of the unit for migration, breeding site and/or a feeding.
Landscape scale		3.00		
Protection status of the wetland	2	3.00	All wetlands are protected under the NWA	National (4), Provincial, private (3), municipal (1 or 2), public area (0-1)
Protection status of the vegetation type	3	3.00	Untransformed vegetation is protected and the vegetation cover is good	SANBI guidance on the protection status of the surrounding vegetation
Regional context of the ecological integrity	3	3.00	Majority of wetland in this region is only slightly disturbed	Assessment of the PES (habitat integrity), especially in light of regional utilisation
Size and rareity of the wetland type/s present	3	3.00	Only a small section on the study site but large system overall	Identification and rareity assessment of the wetland types
Diversity of habitat types	3	3.00	Numerous habitats recorded.	Assessment of the variety of wetland types present within a site.
Sensitivity of the wetland		2.33		
Sensitivity to changes in floods	2	2.00	Valley head seep	floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1.
Sensitivity to changes in low flows/dry season	2	3.00	Valley head seep	Unchannelled VB's probably most sensitive
Sensitivity to changes in water quality	2	2.00	Valley head seep	Esp naturally low nutrient waters - lower nutients likely to be more sensitive

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
ECOLOGICAL IMPORTANCE & SENSITIVITY	3.3	2.8		

Table 22: Hydrological Functional Importance Calculations **of the valley head seep (East)**

HYDRO-FUNCTIONAL IMPORTANCE			Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Regulating & supporting benefits	Flood attenuation		3	2	Large wetland system	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
	Streamflow regulation		3	2		Sustaining streamflow during low flow periods
	Water Quality Enhancement	Sediment trapping	3	2		The trapping and retention in the wetland of sediment carried by runoff waters
		Phosphate assimilation	3	2	Robust vegetation cover with large numbers of cattle	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality
		Nitrate assimilation	3	2		Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality
		Toxicant assimilation	3	2		Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality
		Erosion control	2	2	Robust vegetation cover with large numbers of cattle	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
	Carbon storage		1	3	Clay and loam soils contributes slightly	The trapping of carbon by the wetland, principally as soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE			**2.6**			

Table 23: Direct Human Benefits Calculations **of the valley head seep (East)**

DIRECT HUMAN BENEFITS		Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Subsistence benefits	Water for human use	3	3	Used for cattle	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
	Harvestable resources	3	3	Grazing	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
	Cultivated foods	0	3	None recorded	Areas in the wetland used for the cultivation of foods
Cultural benefits	Cultural heritage	2	3	Possible	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
	Tourism and recreation	3	3	Adjacent a tourist route	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
	Education and research	2	3	Suitable site	Sites of value in the wetland for education or research
DIRECT HUMAN BENEFITS		**2.2**	**3**		

Table 24: Ecological Importance and Sensitivity Calculations of the valley head seep (East)

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Biodiversity support		3.00		

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Presence of Red Data species	4	3.00	Numerous vulnerable plant species recorded on the study site	Endangered or rare Red Data species presence
Populations of unique species	3	3.00	Numerous vulnerable and rare plant species and communities recorded on the study site	Uncommonly large populations of wetland species
Migration/breeding/feeding sites	3	3.00	Yes – numerous birds recorded as well as signs of smaller animals	Importance of the unit for migration, breeding site and/or a feeding.
Landscape scale		3.00		
Protection status of the wetland	2	3.00	All wetlands are protected under the NWA	National (4), Provincial, private (3), municipal (1 or 2), public area (0-1)
Protection status of the vegetation type	3	3.00	Untransformed vegetation is protected and the vegetation cover is good	SANBI guidance on the protection status of the surrounding vegetation
Regional context of the ecological integrity	3	3.00	Majority of wetland in this region is only slightly disturbed	Assessment of the PES (habitat integrity), especially in light of regional utilisation
Size and rareity of the wetland type/s present	3	3.00	Only a small section on the study site but large system overall	Identification and rareity assessment of the wetland types
Diversity of habitat types	3	3.00	Numerous habitats recorded.	Assessment of the variety of wetland types present within a site.
Sensitivity of the wetland		2.33		
Sensitivity to changes in floods	2	2.00	Valley head seep	floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1.
Sensitivity to changes in low flows/dry season	2	3.00	Valley head seep	Unchannelled VB's probably most sensitive
Sensitivity to changes in water quality	2	2.00	Valley head seep	Esp naturally low nutrient waters - lower nutients likely to be more sensitive
ECOLOGICAL IMPORTANCE & SENSITIVITY	3.3	2.8		

Table 25: Hydrological Functional Importance Calculations **of the valley head seep (East)**

HYDRO-FUNCTIONAL IMPORTANCE			Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Regulating & supporting benefits		Flood attenuation	3	2	Large wetland system	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
		Streamflow regulation	3	2		Sustaining streamflow during low flow periods
	Water Quality Enhancement	Sediment trapping	3	2		The trapping and retention in the wetland of sediment carried by runoff waters
		Phosphate assimilation	3	2	Robust vegetation cover with large numbers of cattle	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality
		Nitrate assimilation	3	2		Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality
		Toxicant assimilation	3	2		Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality
		Erosion control	2	2	Robust vegetation cover with large numbers of cattle	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
		Carbon storage	1	3	Clay and loam soils contributes slightly	The trapping of carbon by the wetland, principally as soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE			**2.6**			

Table 26: Direct Human Benefits Calculations **of the valley head seep (East)**

DIRECT HUMAN BENEFITS		Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Subsistence benefits	Water for human use	3	3	Used for cattle	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes

	Harvestable resources	3	3	Grazing	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
	Cultivated foods	0	3	None recorded	Areas in the wetland used for the cultivation of foods
Cultural benefits	Cultural heritage	2	3	Possible	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
	Tourism and recreation	3	3	Adjacent a tourist route	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
	Education and research	2	3	Suitable site	Sites of value in the wetland for education or research
DIRECT HUMAN BENEFITS		**2.2**	**3**		

Appendix C: Abbreviated CVs of participating specialists

Name:	**ANTOINETTE BOOTSMA nee van Wyk**
ID Number	7604250013088
Name of Firm:	Limosella Consulting
Position:	Director - Principal Specialist
SACNASP Status:	Professional Natural Scientist # 400222-09 Botany and Ecology
Nationality:	South African
Marital Status:	Married
Languages:	Afrikaans (mother tongue), English, basic French

EDUCATIONAL QUALIFICATIONS

- B. Sc (Botany & Zoology), University of South Africa (1997 - 2001)
- B. Sc (Hons) Botany, University of Pretoria (2003-2005). Project Title: A phytosociological Assessment of the Wetland Pans of Lake Chrissie
- Short course in wetland delineation, legislation and rehabilitation, University of Pretoria (2007)
- Short course in wetland soils, Terrasoil Science (2009)
- MSc Ecology, University of South Africa (2010 - ongoing). Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management

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- P.L. Grundling, A Lindstrom., M.L. Pretorius, A. Bootsma, N. Job, L. Delport, S. Elshahawi, A.P Grootjans, A. Grundling, S. Mitchell. 2015. Investigation of Peatland Characteristics and Processes as well as Understanding of their Contribution to the South African Wetland Ecological Infrastructure Water Research Comission KSA 2: K5/2346
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KEY EXPERIENCE

The following projects provide an example of the application of wetland ecology on strategic as well as fine scale as well as its implementation into policies and guidelines. (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- More than 250 fine scale wetland and ecological assessments in Gauteng, Mpumalanga, KwaZulu Natal, Limpopo and the Western Cape. 2007, ongoing.
- Scoping level assessment to inform a proposed railway line between Swaziland and Richards Bay. April 2013.
- Environmental Control Officer. Management of onsite audit of compliance during the construction of a pedestrian bridge in Zola Park, Soweto, Phase 1 and Phase 2. Commenced in 2010, ongoing.
- Fine scale wetland delineation and functional assessments in Lesotho and Kenya. 2008 and 2009;
- Analysis of wetland/riparian conditions potentially affected by 14 powerline rebuilds in Midrand, Gauteng, as well submission of a General Rehabilitation and Monitoring Plan. May 2013.
- Wetland specialist input into the Environmental Management Plan for the upgrade of the Firgrove Substation, Western Cape. April 2013
- An audit of the wetlands in the City of Johannesburg. Specialist studies as well as project management and integration of independent datasets into a final report. Commenced in August 2007
- Input into the wetland component of the Green Star SA rating system. April 2009;
- A strategic assessment of wetlands in Gauteng to inform the GDACE Regional Environmental Management Framework. June 2008.
- As assessment of wetlands in southern Mozambique. This involved a detailed analysis of the vegetation composition and sensitivity associated with wetlands and swamp forest in order to inform the development layout of a proposed resort. May 2008.
- An assessment of three wetlands in the Highlands of Lesotho. This involved a detailed assessment of the value of the study sites in terms of functionality and rehabilitation opportunities. Integration of the specialist reports socio economic, aquatic, terrestrial and wetland ecology studies into a final synthesis. May 2007.
- Ecological studies on a strategic scale to inform an Environmental Management Framework for the Emakazeni Municipality and an Integrated Environmental Management Program for the Emalahleni Municipality. May and June 2007

Name:	**RUDI BEZUIDENHOUDT**
ID Number	880831 5038 081
Name of Firm:	Limosella Consulting
Position:	Wetland Specialist
SACNASP Status:	
Nationality:	South African
Marital Status:	Single
Languages:	Afrikaans (mother tongue), English

EDUCATIONAL QUALIFICATIONS

- BSc Hons (Environmental Science), University of South Africa (ongoing)
- B. Sc (Botany & Zoology), University of South Africa (2008 - 2012)
- Short course in Wetland Rehabilitation Principles, University of the Free State (2012)
- Short course in Tools for Wetland Assessment, Rhodes University (2011)
- Short course in Understanding Environmental Impact Assessment, WESSA (2011)
- Short course in SASS 5, Groundtruth (2012)
- Wetland Seminar, ARC-ISCW & IMCG (2011)
- Introduction to Wetlands Seminar, Gauteng Wetland Forum (2010)
- Biomimicry and Constructed Wetlands Workshop, Golder Associates & Water Research Commission (2011)

KEY EXPERIENCE

- **Assistant Wetland Specialist**

  This entails all aspects of scientific investigation associated with a consultancy that focuses on wetland specialist investigations. This includes the following:

  - Approximately 70 specialist investigations into wetland and riparian conditions on strategic, as well as fine scale levels in Gauteng, Limpopo,North-West Province Mpumalanga KwaZulu Natal,Western Cape, Eastern Cape & Northern Cape
  - Ensuring the scientific integrity of wetland reports including peer review and publications.

- **Assistant – Wetland and Rehabilitation**

This entailed the management of wetland vegetation and rehabilitation related projects in terms of developing proposals, project management, technical investigation and quality control through the following:

- **Wetland Ecology**

Experience in the delineation and functional assessment of wetlands and riparian areas in order to advise proposed development layouts, project management, report writing and quality control.

- **Environmental Controlling Officer**:

Routine inspection of construction sites to ensure compliance with the City's environmental ordinances, the Environmental Management Program and other laws and by- laws associated with development at or near wetland or riparian areas.

  - Soweto Zola Park 2011-ongoing

MEMBERSHIPS IN SOCIETIES

- Botanical Society of South African
- SAWS (South African Wetland Society) Founding member
- SACNASP (Certified Natural Scientist – Pending)

EMPLOYMENT EXPERIENCE

Wetland Specialist – Limosella Consulting (September 2010 - Ongoing)