FRESHWATER RESOURCE VERIFICATION FOR THE PROPOSED MIXED-USE DEVELOPMENT ON THE REMAINDER OF PORTION 62 OF THE FARM WITPOORTJIE 117 IR, BRAKPAN, GAUTENG PROVINCE

Prepared for

LEAP Environmental Planners and Landscape Architects

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EXECUTIVE SUMMARY

Based on the findings of the freshwater resource assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed development poses a direct risk to the freshwater resources within the study area. Adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures as provided in this report as well as general good construction practice as well as ongoing management and maintenance as well as monitoring, is essential if the significance of perceived impacts is to be reduced to limit further degradation to the freshwater resources.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource verification of a previous assessment (SAS, 2009) for the proposed mixed-use development on the remainder of Portion 62 of the Farm Witpoortjie 117 IR, located in Brakpan in order to ensure the results obtained in the initial assessment are still valid. The study area is located along the M43 road (Barry Marais Road) within the City of Ekurhuleni Metropolitan Municipality and is bordered on the eastern boundary by an unnamed tributary of the Rietspruit River. The study area lies adjacent to a gold tailings storage facility on the northern border of the property and is bordered to the south and east by a railway line.

The assessment took the following approach:

- A desktop study was conducted, in which the freshwater resources were identified for on-site investigation, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 3 of this report;
- A field assessment took place in September 2018 to verify the delineations presented in SAS (2009); and
- The freshwater resources within the study area were classified according to the classification system (Ollis, *et al.,* 2013) and assessed.

The detailed results of the field assessment are contained in Section 4 of this report and summarised in the table below.

Table A: Summary of results of the field assessment as discussed in Section 4.2.

Freshwater Resource	PES	EIS
Unchannelled Valley Bottom Wetland	C (Moderately modified)	C (Moderate)
Hillslope Seeps	D (Largely modified)	C (Moderate)
Pans	C (Moderately modified)	B (High)

Following the field investigation undertaken in September 2018, it was concluded that the freshwater resource delineations presented in SAS (2009) remain unchanged and are valid. No additional freshwater resources or wetland features were identified within the study area. However, current legislation requires the application of Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998) (NWA) to identify all potential freshwater resources that may potentially be impacted by the proposed development. Therefore, the freshwater resources identified within 500m of the study area were delineated in fulfilment of GN509 of the NWA using desktop methods.

The freshwater resources within the study area have been historically altered through impacts from mining activities (northern section of the study area), residential developments (in the broader catchment) and through the construction of road and railway infrastructure traversing the system.

The reclamation of the tailings storage facility (TSF) located to the north of the study area will result in the loss of hydraulic head and possibly redirect the recharge of the wetland to the catchment to the east of the catchment feeding this wetland. This change in the landscape will lead to the removal of the

primary hydrological driver of the hillslope seep wetland adjacent to the TSF (hillslope seep 1). Thus, the need for future conservation of this wetland is questionable considering the long-term viability of the system functioning in the landscape.

Following the assessment of the freshwater resources within the study area, the Department of Water and Sanitation (DWS) risk assessment matrix was applied to ascertain the significance of possible impacts which may occur as a result of the proposed development. The results of this assessment are presented in Section 5 of this report, and show that, assuming mitigation measures are strictly enforced, impact significance is Low during both construction and operational phases. However, it is considered imperative that suitable mitigation measures, as provided for in Section 5 and Appendix F of this report, are strictly adhered to in order to minimise the impacts associated with the proposed development and decrease the significance of cumulative impacts on the freshwater resources. A summary of the outcome of the DWS Risk Assessment is provided in the table below.

Table B: Summary of the results of the DWS risk assessment applied to the freshwater resources associated with the proposed development.

Phase	Activity	Aspect	Impact	Significance	Risk Rating
Construction Phase	Site clearing prior to commencement of construction activities.	Removal of vegetation and associated disturbances to soils.	Increased runoff and erosion leading to sedimentation of the wetland environment. Increased sedimentation of the wetlands, leading to smothering of wetland vegetation and potentially altering surface water quality. Decreased ecoservice provision.	51.75	L
		Possible indiscriminate driving through the wetlands by construction vehicles.	Damage to wetland vegetation, leading to exposed/compacted soils, in turn leading to increased runoff and erosion. Decreased ecoservice provision. Further decreased ability to support biodiversity.	46	L
	Groundbreaking, excavation of foundations and other earthworks upgradient of and outside of the wetlands and the associated GDARD setback area.	Removal of topsoil and creation of topsoil stockpiles.	Disturbances of soils leading to increased alien vegetation proliferation, and in turn to altered freshwater habitat. Altered runoff patterns, leading to increased erosion and sedimentation of wetlands.	55	L
	Potential indiscriminate waste disposal.	Disposal of construction-related wastes (such as rubble, hazardous chemicals and litter).	Altered flow regime as a result of solid waste within the wetlands. Altered water quality due to chemical waste disposal.	55	L
	Potential spillage from construction vehicles.	Spills / chemical leaks from construction vehicles.	Possible contamination of wetland soils and water, leading to reduced ability to support biodiversity.	52.5	L
Operational Phase	Potential indiscriminate waste disposal.	Potential disposal of hazardous and non-hazardous waste materials into the wetland habitat.	Altered flow regime as a result of solid waste within the wetland habitat. Altered water quality due to waste disposal.	33.75	L

Phase	Activity	Aspect	Impact	Significance	Risk Rating
	Increased impermeable surfaces in the vicinity of the wetlands and the catchment.	Increased impermeable surfaces due to the presence of parking areas, access roads, etc.	Altered runoff patterns and increased water inputs to the wetland environment, resulting in altered flow regime, erosion and incision. Altered flow regime may lead to changed wetland zonation, and possible impacts on vegetation as a result.	55	L
		Potential risk of contaminated runoff from surfaces such as roads and parking areas associated with the proposed development.	Pollution of wetland soils, groundwater and surface water.	51.75	L
	Routine maintenance and operational activities.	Potential disturbances to soils as a result of routine maintenance/operational activities.	Potential for increased proliferation of alien floral species, leading to reduced ability to support biodiversity, and provide ecological services such as flood attenuation.	33.75	L
	Operation and maintenance of planned waste management systems (e.g. sewage infrastructure).	Potential failure of any planned waste management systems (e.g. sewage infrastructure) resulting in leakages and possible contamination of surface and ground water.	Potential contamination of wetland soils, groundwater and surface water.	44	L

Based on the findings of the freshwater ecological assessment, several recommended mitigation measures are made to minimise the impact on the freshwater resources:

- The use of Sustainable Drainage Systems (SUDs) to manage stormwater is considered critical if roads and large paved parking areas are to be planned within close proximity to the freshwater environment, in order to prevent significant impacts on the hydrological functioning of the freshwater area, reduce the risk of flooding during high flow periods and reduce the risk of increased erosion. Furthermore, any discharge of runoff into the freshwater system must be done in such a way as to prevent erosion. In this regard, it is highly recommended that a suitably qualified engineer be consulted with regards to the use of SUDs. Examples of these which may be applicable to this development include permeable paving, rainwater harvesting, soakaways, swales and bio-retention facilities or attenuation ponds to ensure that post-development runoff does not exceed pre-development runoff volumes and lead to altered flood peaks;
- Areas which are to be cleared of vegetation, including contractor laydown areas, must remain as small as possible, particularly in the residential development areas, in order to reduce the risk of proliferation of alien vegetation, and in order to retain a level of protection to the freshwater resources during construction (e.g. sediment trapping, slowing of stormwater runoff etc.). Contractor laydown areas are to remain outside of the delineated wetland and riparian zones and their associated buffers, and as much as feasible no natural/indigenous wetland vegetation is to be cleared;
- It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction;
- A soil management plan must be compiled during planning and implemented when construction commences. It is essential that the following be included in the soil management plan:
    - All exposed soils are to be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) in order to prevent erosion and sedimentation of the freshwater resources. This is considered essential as the soils in the vicinity are highly dispersive;

- No stockpiling of soils is to take place within the freshwater areas or the 50m Gauteng Department of Agriculture and Rural Development (GDARD) setback area, and stockpiles may not exceed 2m in height;
- Any remaining soils following the completion of construction activities are to be levelled and re-seeded with indigenous flora species to minimise the risk of further sedimentation of the freshwater area, and to aid in the natural reclamation process; and
- The residual impacts of the proposed development on the freshwater resources are to be offset.

Based on the findings of the freshwater resource assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed development poses a direct risk to the freshwater resources within the study area. Adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures as provided in this report as well as general good construction practice as well as ongoing management and maintenance as well as monitoring, is essential if the significance of perceived impacts is to be reduced to limit further degradation to the freshwater resources.

It is the opinion of the specialist therefore that the proposed development, from a freshwater resource perspective, be considered favourably, with the proviso that strict adherence to mitigation measures is enforced, in order to ensure that the ecological integrity of the freshwater resources is not further compromised.

DOCUMENT GUIDE

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix G
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix G
b)	A declaration that the specialist is independent	Appendix G
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4.1
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix C
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4.3
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 4.3
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.3
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4, 5, and 6
k)	Any mitigation measures for inclusion in the EMPr	Section 5.1
l)	Any conditions for inclusion in the environmental authorisation	Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section 6
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 6
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
C-Plan	Conservation Plan
CSIR	Council of Scientific and Industrial Research
CVB	Channelled Valley Bottom
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMF	Environmental Management Framework
EMP	Environmental Management Program
EWR	Ecological Water Requirements
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SA RHP	South Africa River Health Programme
SAS	Scientific Aquatic Services
SQR	Sub quaternary catchment reach
SUD	Sustainable Drainage System
subWMA	Sub-Water Management Area
TSF	Tailings Storage Facility

UCVB	Unchannelled Valley Bottom
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WUL	Water Use License

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource verification of a previous assessment (SAS, 2009) for the proposed mixed-use development on the remainder of Portion 62 of the Farm Witpoortjie 117 IR, located in Brakpan, hereafter referred to as the "study area" (Figure 1 and 2) in order to ensure the results obtained in the initial assessment are still valid. The study area is located along the M43 road (Barry Marais Road) within the City of Ekurhuleni Metropolitan Municipality and is bordered on the eastern boundary by an unnamed tributary of the Rietspruit River. The study area lies adjacent to a gold Tailings Storage Facility (TSF) on the northern border of the property and is bordered to the south and east by a railway line.

In order to identify all potential freshwater resources that may potentially be impacted by the proposed development, a 500m "zone of investigation" around the study area, in accordance with Regulation 509 of 2016 as it relates to the National Water Act (NWA), was used as a guide in which to assess possible sensitivities of the receiving environment. This area – i.e. the 500m zone of investigation around the study area - will henceforth be referred to as the "investigation area" (Figure 1 and 2).

The Department of Water and Sanitation (DWS) Risk Assessment Matrix was applied to determine the significance of the perceived impacts associated with the proposed development, and the operational activities impact on the receiving environment. In addition, mitigatory measures were developed which aim to minimise the perceived impacts associated with the proposed activities, followed by an assessment of the significance of the impacts after mitigation, assuming that they are fully implemented.

This report, after consideration and a description of the ecological integrity of the proposed development, must guide the relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed development activities from a watercourse management point of view.

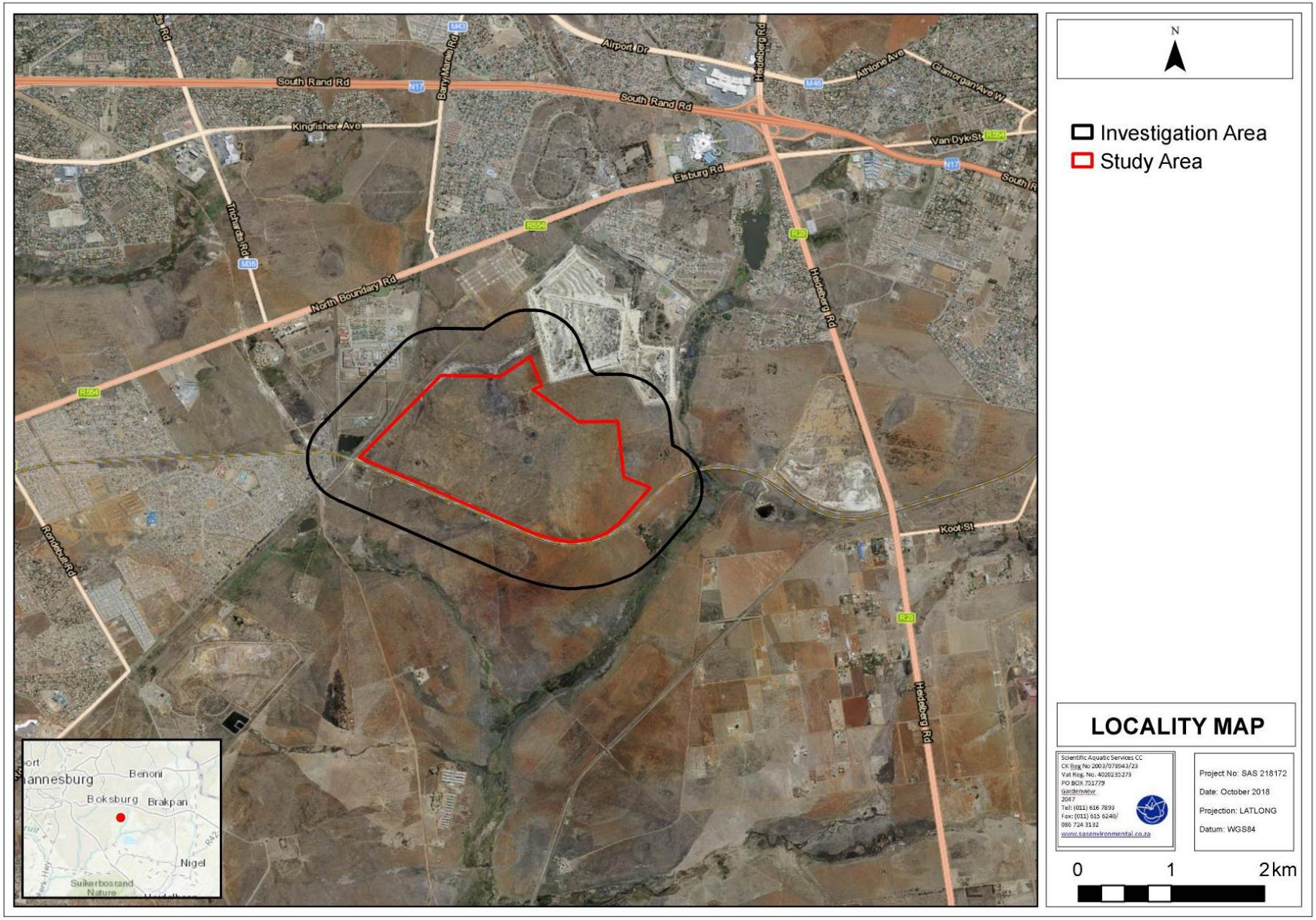

Figure 1: A digital satellite image depicting the location of the study area and investigation area in relation to the surrounding area.

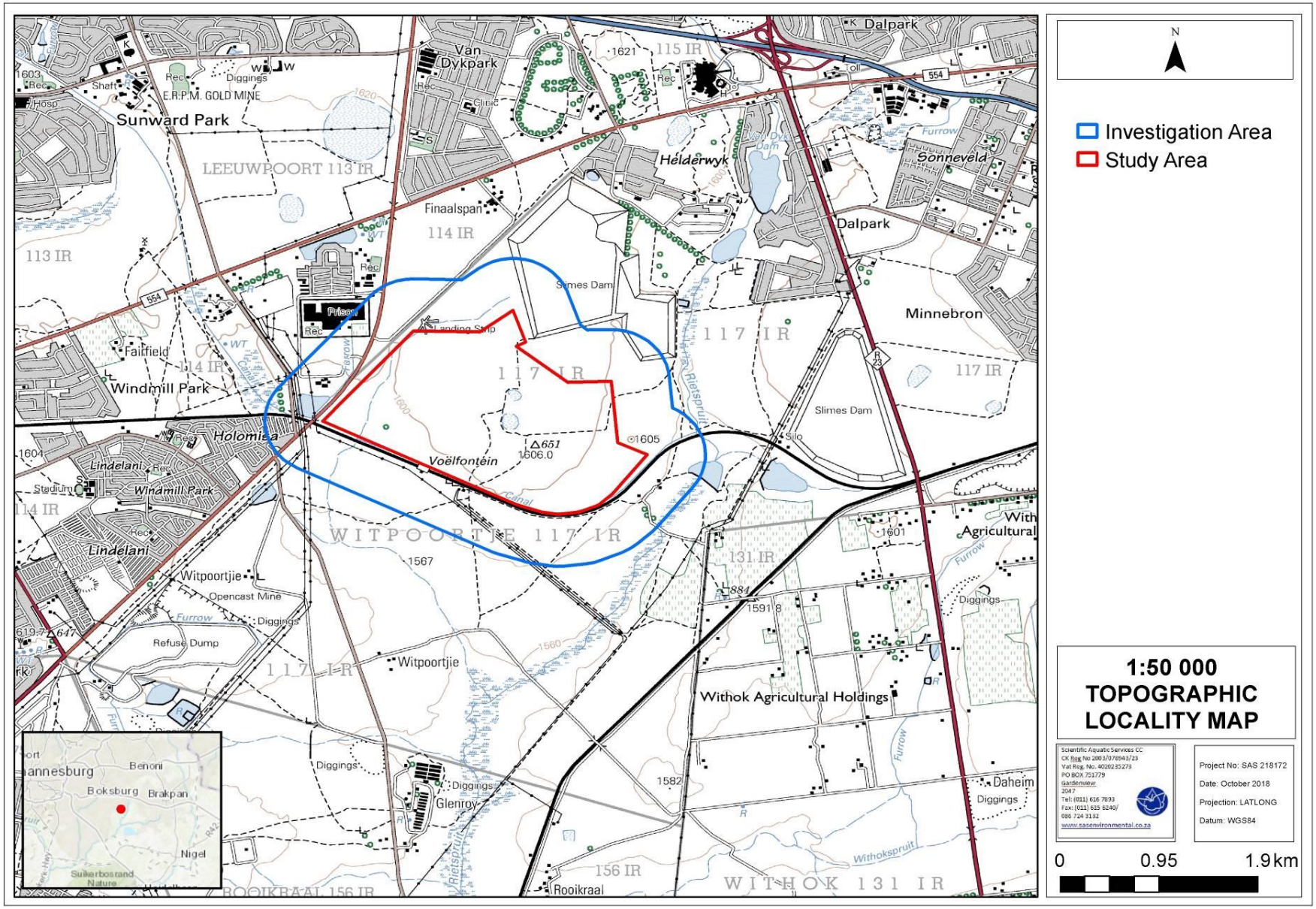

Figure 2: The study area and investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.

1.2 Scope of Work

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database and the Gauteng Conservation Plan V3.3 (2011) was undertaken to aid in defining the PES and EIS of the freshwater resources;
- A site visit was undertaken to verify the presence of watercourses within 500m of the proposed development;
- All freshwater resources identified within 500m of the study area were delineated in fulfilment of Regulation Government Notice (GN) 509 of the NWA using desktop methods;
- The wetland classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the freshwater resources were determined according to the method described by Rountree & Kotze*,* (2013);
- The PES of the freshwater resources was assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.,* (2008);
- Freshwater resources were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the study area. In addition to the freshwater resource boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;
- The DWS Risk Assessment Matrix was applied to identify potential impacts that may affect the freshwater resources as a result of the proposed development, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving environment.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The verification of the freshwater resource boundaries and the assessment thereof, is confined to the freshwater resources within the study area. All freshwater resources identified within 500m of the study area were delineated in fulfilment of Regulation

GN509 of the NWA using desktop methods, however these resources were not assessed individually.;

- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the areas of the freshwater resources where the proposed development will take place have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of freshwater ecology.

1.4 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix B:

- The National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998); and
- The Gauteng Department of Agriculture and Rural Development's (GDARD) Requirements for Biodiversity Assessments, Version 3 (GDARD, 2014).

2 ASSESSMENT APPROACH

2.1 Freshwater Resource Field Verification

Prior to the field survey, the previous assessment conducted by SAS (2009) was reviewed, in addition to digital satellite imagery (current and historical) to identify representative points of interest at which the current conditions of the freshwater resources could be accurately assessed and the accuracy of the delineation verified.

The site assessment was undertaken in September 2018, during which factors influencing the habitat integrity of the freshwater resources were noted, and the functioning, environmental and socio-cultural services provided by the freshwater resources were determined. A detailed explanation of the method of assessment related to the freshwater resource assessment is provided in Appendix C of this report.

For the purposes of this investigation, the definition of wetland habitat was taken as per that in the National Water Act (1998). The definition is as follows:

Wetland habitat is “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

2.2 Sensitivity Mapping

The freshwater resources associated with the study area were verified with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project the features onto digital satellite imagery and topographic maps. A sensitivity map is provided in Section 4.3.

2.3 Risk Assessment and Recommendations

Following the completion of the assessment, a risk assessment was conducted (please refer to Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general ‘best practice’ management measures, which apply to the study area activities as a whole, and which are presented in Appendix F. Mitigation measures have been developed to address issues in all phases throughout the life of the operation including planning, construction and operation. The detailed site-specific mitigation measures are outlined in Section 5 of this report.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 Analyses of Relevant Databases

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard style” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place.

It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate

indication of the study area's actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. However, this information is considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance during the site-specific field verification survey.

Table 1: Desktop data relating to the character of the freshwater resources located within the study area and surrounding region.

Aquatic ecoregion and sub-regions in which the proposed development is located		
Ecoregion	Highveld	
Catchment	Vaal	
Quaternary Catchment	C22C	
WMA	Upper Vaal	
subWMA	Downstream Vaal Dam	
Dominant characteristics of the Highveld Ecoregion Level II (11.01 & 11.03) (Kleynhans *et al.*, 2007)		
Level II Code	11.01	11.03
Dominant primary terrain morphology	Plains; Low Relief	Plains; Low Relief; Moderate Relief
Dominant primary vegetation types	Rocky Highveld Grassland; Mixed Bushveld	Moist Cool Highveld Grassland
Altitude (m a.m.s.l)	1300 – 1900	1300 – 2100
MAP (mm)	500 – 700	400 – 800
Coefficient of Variation (% of MAP)	20 – 34	20 – 34
Rainfall concentration index	55 – 64	45 – 64
Rainfall seasonality	Early to mid-summer	Early to late-summer
Mean annual temp. (°C)	14 – 18	12 – 18
Winter temperature (July)	0 – 20 ºC	-2 – 18 ºC
Summer temperature (Feb)	12 – 30 ºC	10 – 28 ºC
Median annual simulated runoff (mm)	20 – 60	5 – 10 (limited); 10 – 150
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)		
Sub-quaternary reach	C22C – 01381 (Rietspruit River)	
Proximity to study area	The Rietspruit River runs along the eastern boundary of the investigation area.	
Assessed by expert?	Yes	
PES Category Median	Seriously Modified	
Mean Ecological Importance (EI) Class	Low	
Mean Ecological Sensitivity (ES) Class	Moderate	
Stream Order	1	
Default Ecological Class (based on median PES and highest EI or ES mean)	C (Moderate)	

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The proposed development is located within a sub-quaternary catchment currently not considered important in terms of fish or freshwater resource conservation.
NFEPA Wetlands	According to the NFEPA database, a single natural wetland flat and two natural depressions are located within the study area. These wetlands are in a natural/good condition (Class AB) and are classified as wetland FEPAs according to the NFEPA database. A natural and partly artificial channelled valley bottom wetland, a natural seep, depression and a natural wetland flat are located in the investigation area according to the NFEPA database. The wetland flat located in the investigation area is in a natural/good condition (Class AB) and is classified as wetland FEPAs according to the NFEPA database, while the other wetlands located in the investigation area are not wetland FEPAs and are heavily to critically modified (seep and channelled valley bottom) and moderately modified (depression).
Wetland vegetation Type	The study area falls within the Mesic Highveld Grassland Group 2 Wetland Vegetation type, which is considered to be Critically Endangered (Mbona et al., 2014).
NFEPA Rivers	According to the NFEPA database, the Rietspruit River runs along the eastern boundary of the investigation area, however the study area does not traverse the Rietspruit River. The river is seriously to critically modified according to the NFEPA database.
Detail of the study area in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011)	
Critical Biodiversity Area (CBA)	According to the Gauteng C-Plan v3.3 (2011), the entire study area falls within a critical biodiversity area (CBA). A CBA is considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Ecological Support Area (ESA)	According to the Gauteng C-Plan v3.3 (2011), a small portion of the study area located in the western portion of the study area falls within an ecological support area (ESA). An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
Wetland Buffer	According to the Gauteng C-Plan v3.3 (2011), a wetland buffer is located within the western portion of the study area, while a buffer assigned to good quality pans predominantly covers the study area. Therefore, the depression wetlands within the study area (the pan cluster) have been classified by the Gauteng C-Plan v3.3 (2011) as priority pans. Priority pans must be designated as sensitive and thus a 50m buffer is required for these pans.
River Buffer	A river buffer traverses the western portion of the study area from north to south, according to the Gauteng C-plan.
Urban Edge	Although rescinded as a policy document in the Gauteng Spatial Development Framework in 2011, the Urban Edge nevertheless remains a useful indicator of where concentration of development should occur. According to the Gauteng C-Plan v3.3 (2011) and the Gauteng Environmental Management Framework (EMF) the study area is located outside of the Urban Edge and falls within Zone 1 (urban development area) of the EMF.

CBA = Critical Biodiversity Areas; C-Plan = Conservation Plan; DWS = Department of Water and Sanitation; EI = Ecological Importance; EMF = Environmental Management Framework; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Meters Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; WMA = Water Management Area

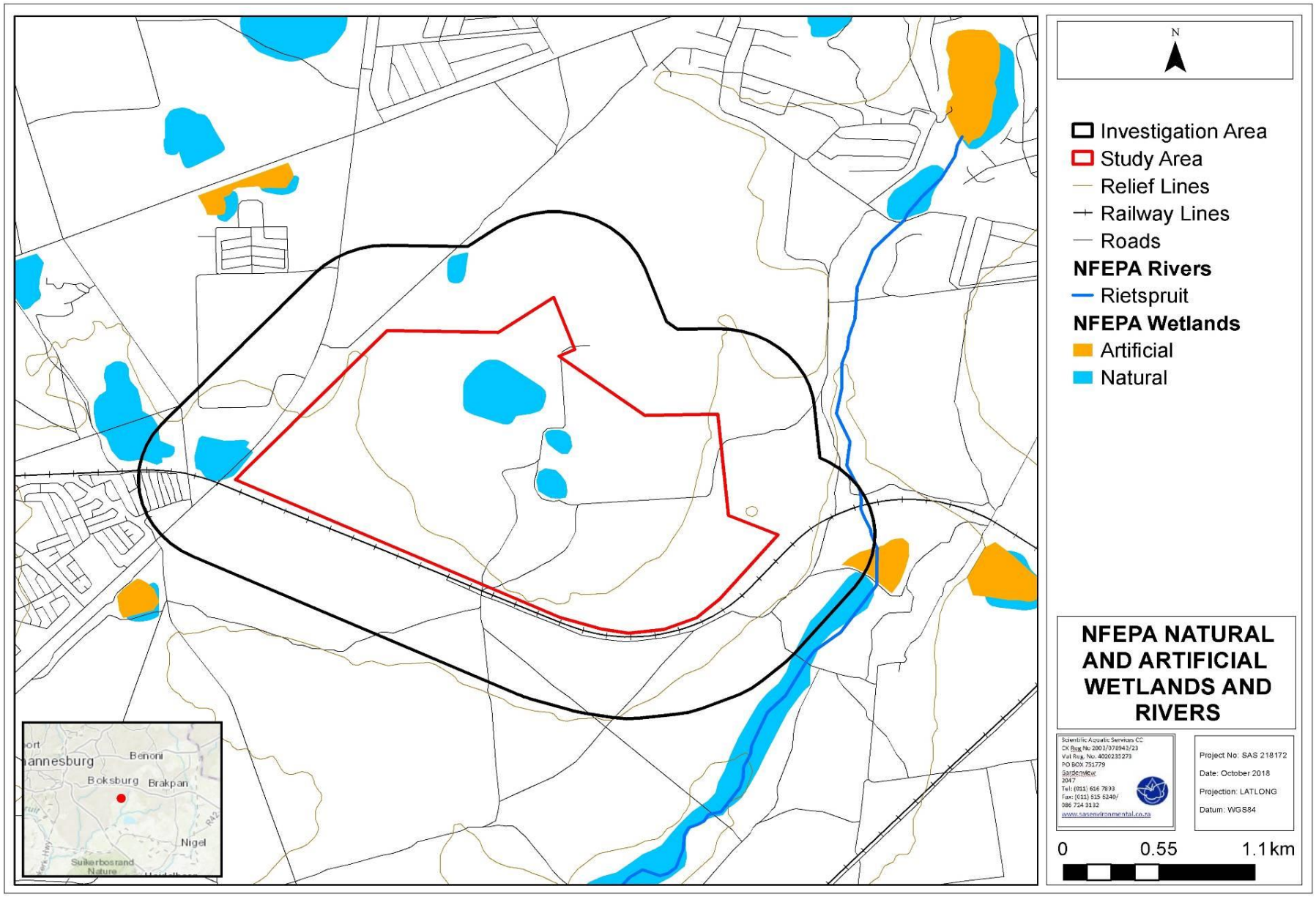

Figure 3: The natural and artificial wetlands and river associated with the study area according to the NFEPA Database (2011).

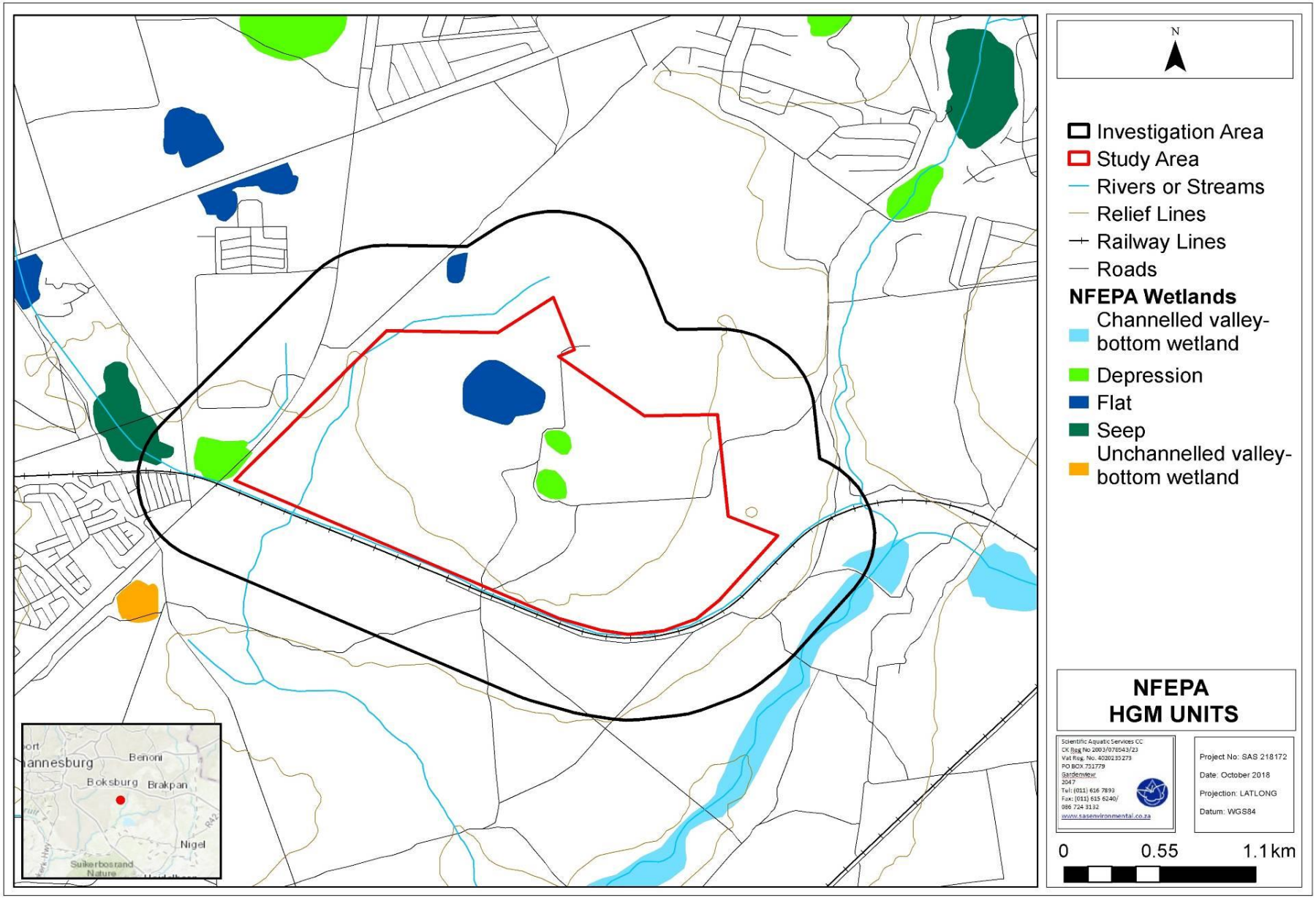

Figure 4: The hydrogeomorphic (HGM) units associated with the study area according to the NFEPA Database (2011).

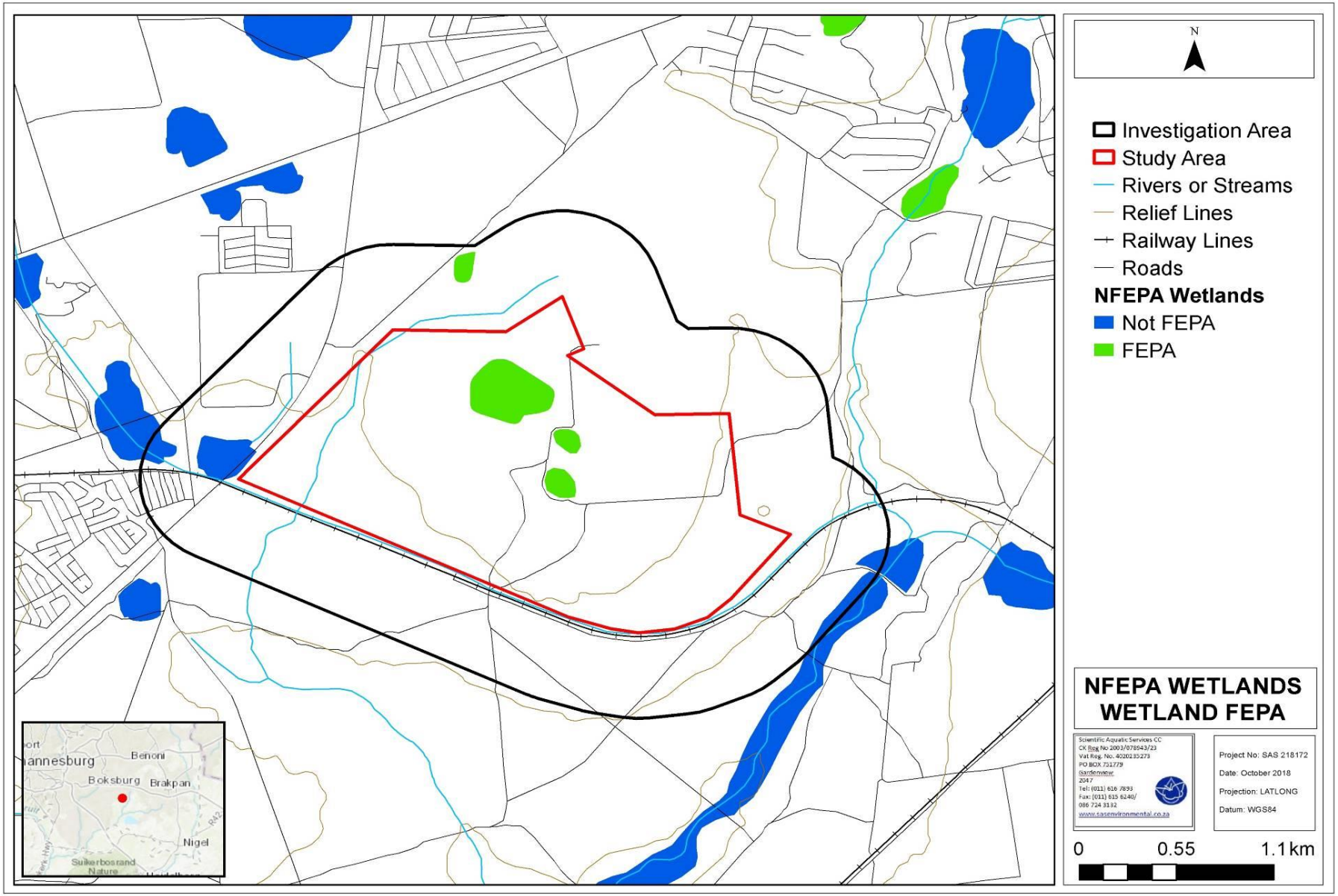

Figure 5: Wetland FEPAs associated with the study area according to the NFEPA Database (2011).

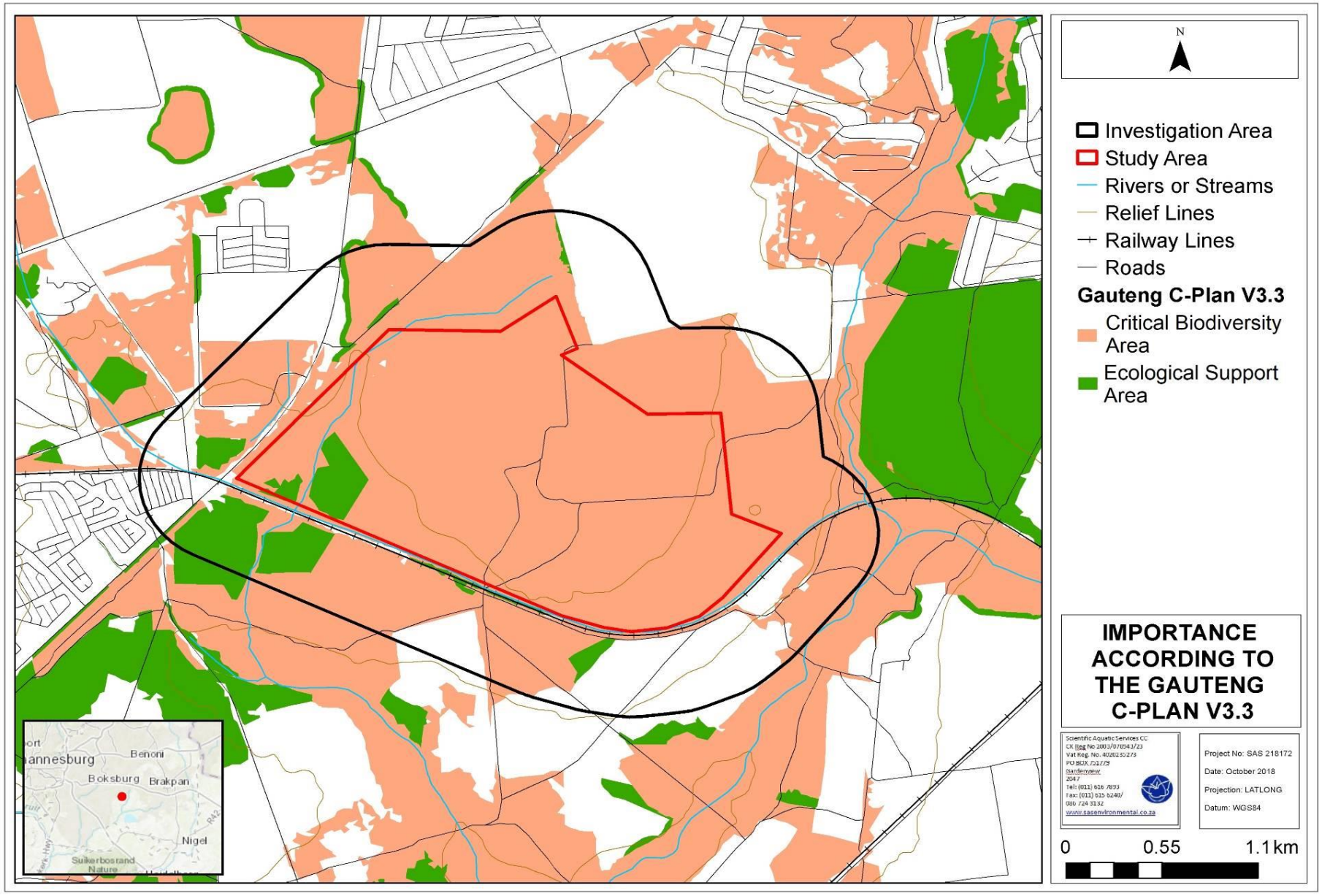

Figure 6: Ecological Support Areas (ESA) and Critical Biodiversity Areas (CBA) associated with the study area (Gauteng C-Plan V3.3, 2011).

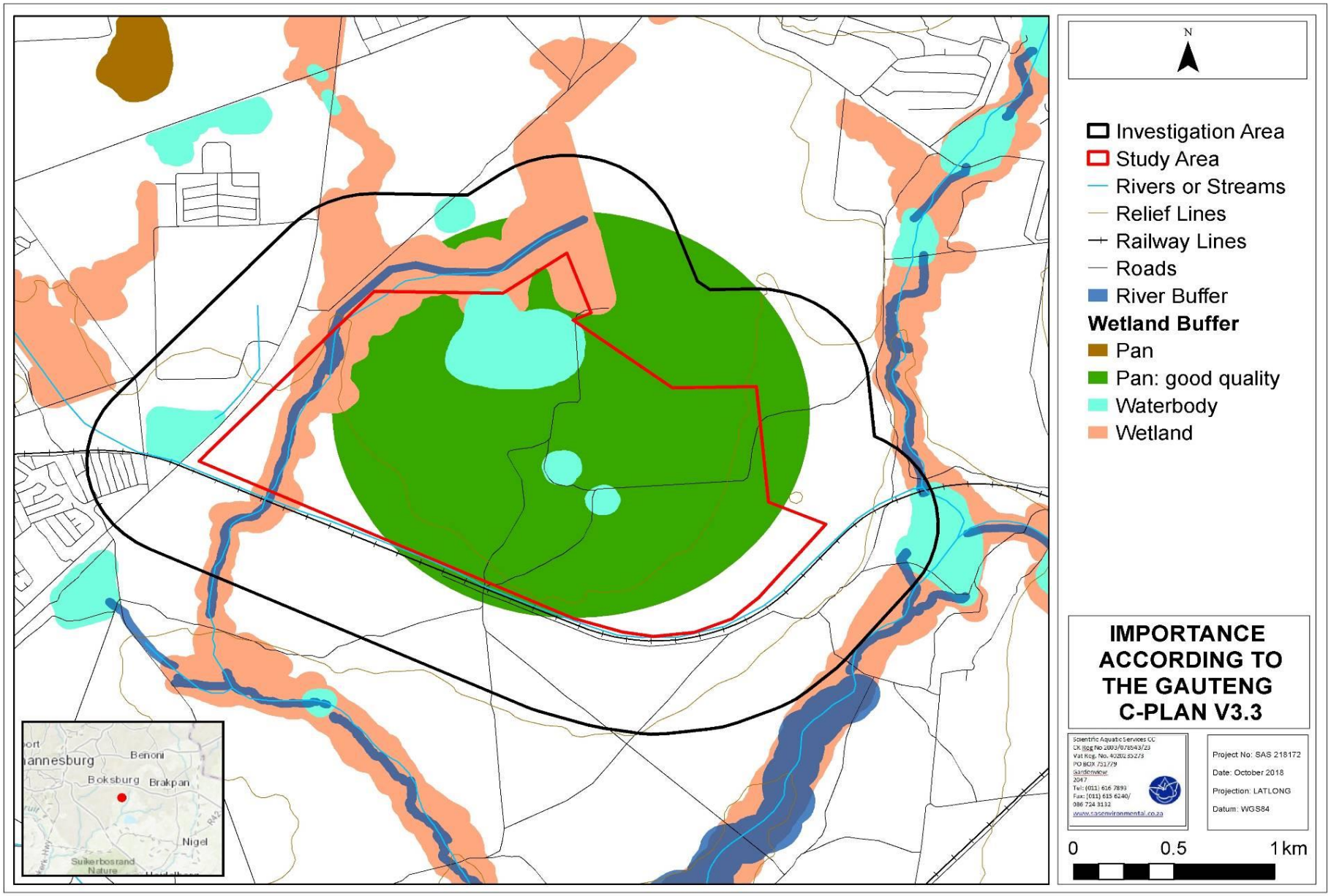

Figure 7: River and wetland buffers associated with the study area, as indicated by the Gauteng C-Plan (2011).

3.2 Ecological Status of Sub-Quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS Database]

The PES/EIS database, as developed by the DWS RQIS department was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology is based on information collated by the DWS RQIS department from available sources of reliable information, such as the South Africa River Health Programme (SA RHP) sites, Ecological Water Requirements (EWR) sites and Hydro Water Management System (WMS) sites.

Key information on background conditions associated with the study area, as contained in this database and pertaining to the PES and EIS for the SQR C22C – 01381 (Retspruit River) are tabulated in Table 2 and 3 and indicated in Figure 8.

The Ecological Importance (EI) data for SQR C22C – 01381 (Retspruit River) indicates that the following fish species may be expected: *Labeobarbus aeneus*; *Enteromius anoplus*; *Enteromius paludinosus*; *Clarias gariepinus*; *Pseudocrenilabrus philander*; *Tilapia sparrmanii*.

Table 2: Invertebrates previously collected from or expected at the SQR C22C – 01381 (Retspruit River) monitoring point associated with the proposed development.

Macro-Invertebrates		
Baetidae 1 Sp	Gomphidae	Notonectidae
Belostomatidae	Gyrinidae	Oligochaeta
Ceratopogonidae	Hydracarina	Psychodidae
Chironomidae	Hydrometridae	Pleidae
Corixidae	Muscidae	Syrphidae
Culicidae	Naucoridae	Veliidae/Mesoveliidae
Gerridae	Nepidae	

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reach SQRs C22C – 01381 (Retspruit River) based on the DWS RQS PES/EIS database.

	C22C – 01381 (Rietspruit River)
Synopsis	
PES Category Median	Seriously Modified
Mean EI class	Low
Mean ES class	Moderate
Length	8.54
Stream order	1
Default EC[4]	C (Moderate)
PES Details	
Instream habitat continuity MOD	Large
RIP/wetland zone continuity MOD	Large
Potential instream habitat MOD activities	Serious
Riparian/wetland zone MOD	Serious
Potential flow MOD activities	Large
Potential physico-chemical MOD activities	Serious
EI Details	
Fish spp/SQ	6
Fish average confidence	1
Fish representivity per secondary class	Moderate
Fish rarity per secondary class	Moderate
Invertebrate taxa/SQ	21
Invertebrate average confidence	1.38
Invertebrate representivity per secondary class	Low
Invertebrate rarity per secondary class	High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Low
Habitat diversity class	Moderate
Habitat size (length) class	Very Low
Instream migration link class	Moderate
Riparian-wetland zone migration link	Moderate
Riparian-wetland zone habitat integrity class	Low
Instream habitat integrity class	Low
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Moderate
Riparian-wetland natural vegetation rating based on expert rating	Low
ES Details	
Fish physical-chemical sensitivity description	Moderate
Fish no-flow sensitivity	High
Invertebrates physical-chemical sensitivity description	Moderate
Invertebrates velocity sensitivity	High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very Low
Stream size sensitivity to modified flow/water level changes description	Low
Riparian-wetland vegetation intolerance to water level changes description	Low

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

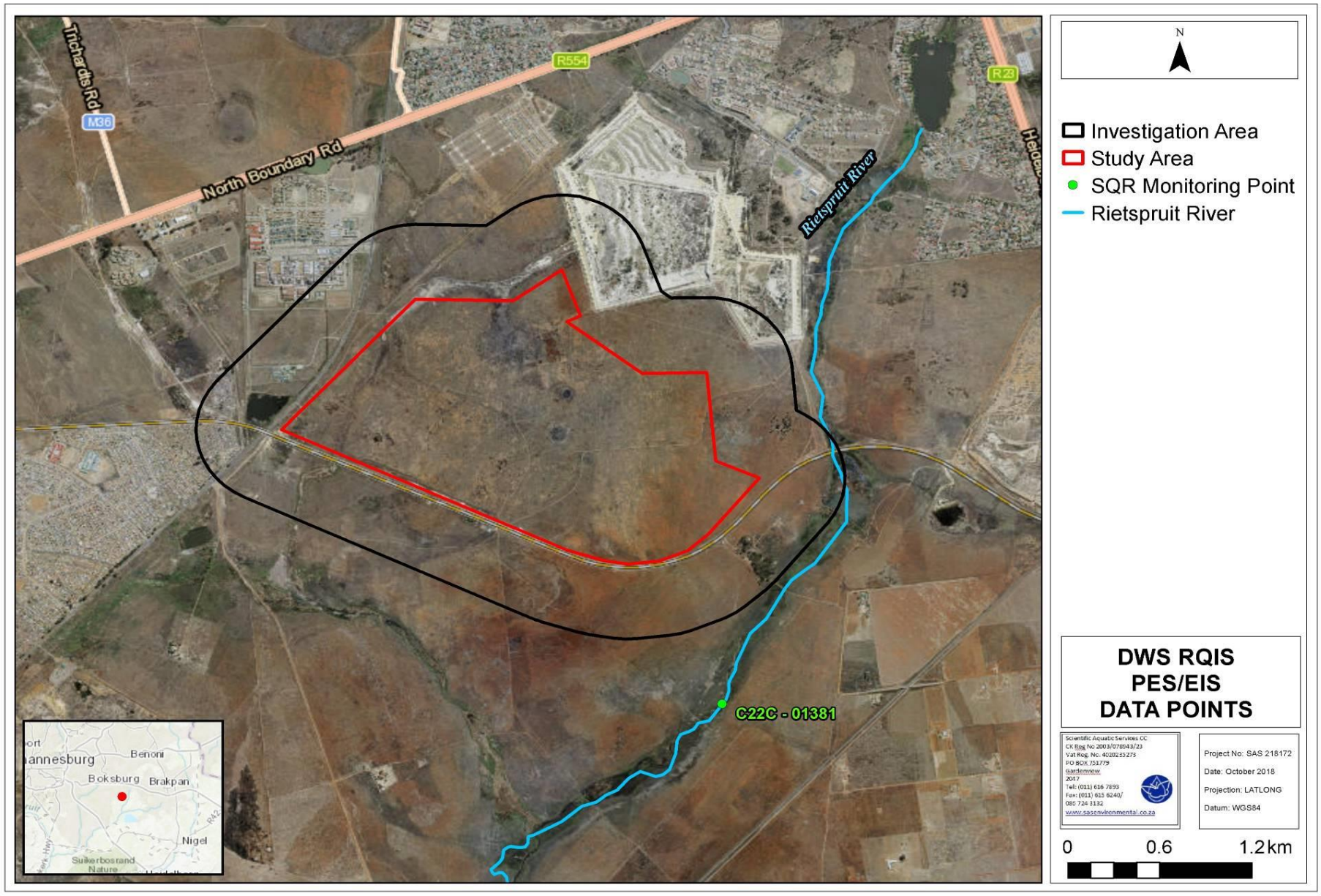

Figure 8: Relevant Sub-Quaternary Catchment Reach (SQR) in the vicinity of the study area

4 RESULTS: FRESHWATER RESOURCE VERIFICATION

4.1 Freshwater Resource System Characterisation

Following the field investigation undertaken in September 2018, it was concluded that the freshwater resource delineations presented in SAS (2009) remain unchanged and are valid. No additional freshwater resources or wetland features were identified within the study area. However, current legislation requires the application of GN509 of 2016 as it relates to the NWA to identify all potential freshwater resources that may potentially be impacted by the proposed development. Therefore, the freshwater resources identified within 500m of the study area were delineated in fulfilment of GN509 of the NWA using desktop methods but were however not assessed further.

The freshwater resources within the study area have been historically altered through mining activities (northern section of the study area), residential developments (in the broader catchment) and through the construction of road and railway infrastructure in the system.

All freshwater resources identified within the study area and investigation area are illustrated in Figure 9.

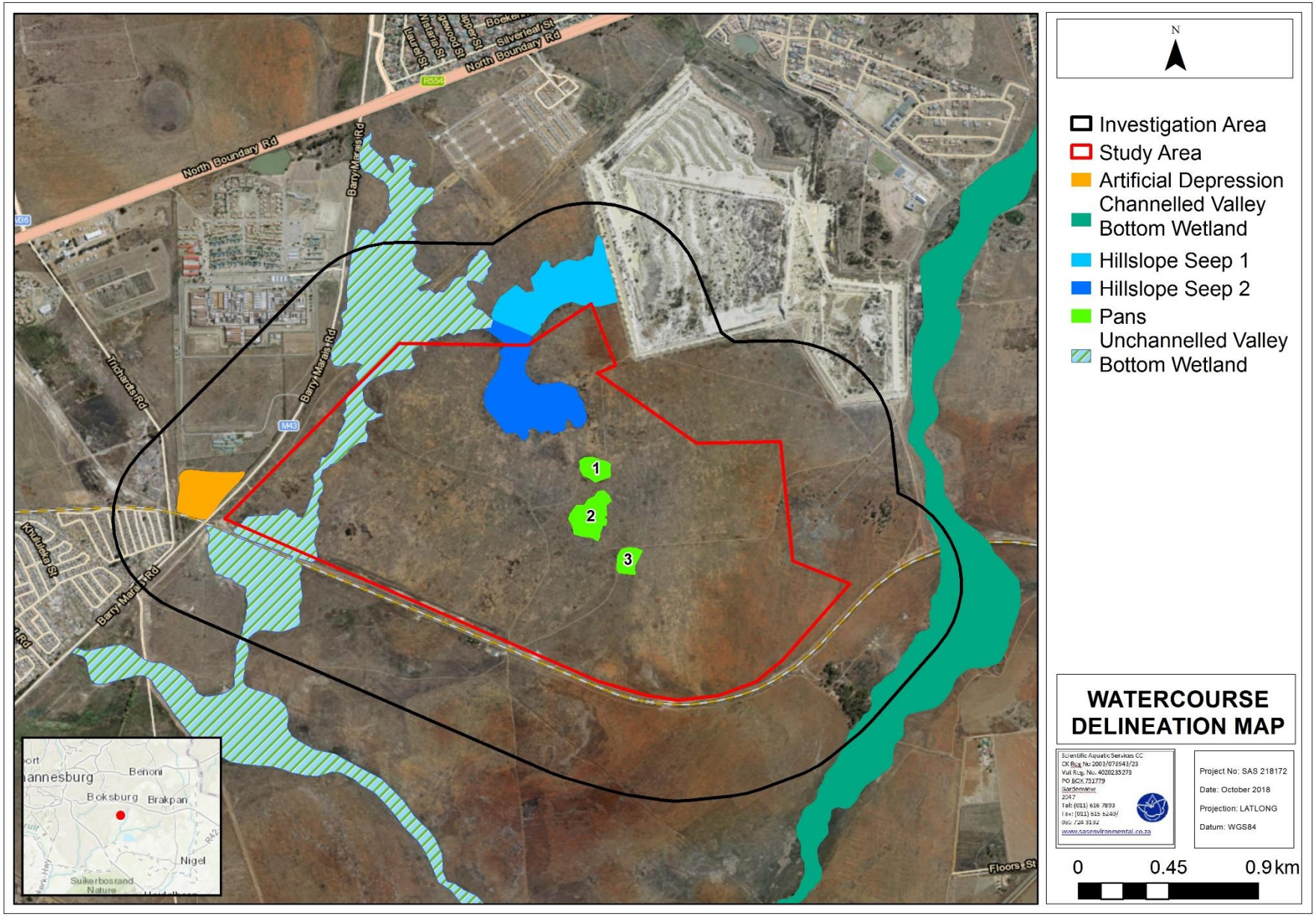

Figure 9: The location of the freshwater resources associated with the study area and investigation area.

During the field assessment, freshwater resources, comprising four hydrogeomorphic (HGM) types, were identified within the investigation area. The freshwater resources were classified according to the classification system (Ollis, *et al*., 2013) as inland systems, falling within the Highveld Aquatic Ecoregion and the Mesic Highveld Grassland Group 2 wetland vegetation (WetVeg) group. The characterisation of the identified freshwater resources is summarised in Table 4 below.

Table 4: Characterisation of the freshwater resources associated with the study area according to the Classification System (Ollis et. al., 2013)

Freshwater Resource	Level 3: Landscape unit	Level 4: HGM Type
Unchannelled Valley Bottom Wetland	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes**.**	**Unchannelled valley bottom:** A valley-bottom wetland without a river channel running through it.
Hillslope Seep	**Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.	**Hillslope Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.
Pan	**Plain:** an extensive area of low relief. These areas are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100.	**Depression:** a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates, including pans.
Channelled Valley Bottom Wetland	**Valley floor:** The typically gently sloping, lowest surface of a valley.	**Channelled Valley-Bottom Wetland:** A valley-bottom wetland with a river channel running through it.

An unchannelled valley bottom (UCVB) wetland, two hillslope seep wetlands and three pans were identified in the study area. The natural extent of both the UCVB wetland and hillslope seeps has been augmented by seepage from the gold Tailings Storage Facility located north of the study area entering these systems. This has resulted in saline soil and surface water conditions leading to a change in the natural wetland vegetation community. Additional anthropogenic activities impacting on the wetlands within the study area include the deposition of sediment, earthworks, proliferation of alien vegetation and the disposal of rubble and rocks.

The reclamation of the tailings storage facility (TSF) located to the north of the study area will result in the loss of hydraulic head and possibly redirect the recharge of the wetland to the catchment to the east of the catchment feeding this wetland. This change in the landscape will lead to the removal of the primary hydrological driver of the hillslope seep wetland adjacent to

the TSF (hillslope seep 1). Thus, the need for future conservation of this wetland is questionable considering the long-term viability of the system functioning in the landscape.

An unnamed tributary of the Rietspruit River passes through the eastern portion of the investigation area in a southerly direction. This tributary of the Rietspruit River was defined as a river within a channelled valley bottom wetland, thus, for the purposes of this investigation, the definition of a wetland was taken as per that in the National Water Act (1998) (see Section 2.1). Runoff from the eastern third portion of the proposed development will drain towards this wetland. However, the railway line located along the south-eastern boundary of the study area acts as a barrier and will limit runoff from the proposed development into the system.

An artificial depression was identified in the western portion of the investigation area. This freshwater resource is best described as an area of artificial ponding formed due to altered topography as a result of the surrounding road and railway infrastructure.

4.2 Field Verification Results

Following the site visit, various assessments were undertaken in order to determine the following:

- PES, incorporating aspects such as hydrology, vegetation and geomorphology;
- The EIS is guided by the results obtained from the assessment of PES and service provision of the wetland; and
- Assessment of impacts of the construction and operation of the proposed development on the freshwater resources.

The results of the assessments are presented in the dashboard report below.

Table 5: Summary of the assessment of the UCVB wetland identified within the study area.

Representative photographs of the unchannelled valley bottom wetland located within the western portion of the study area. Evidence of disposal of rubble can be seen (Left). The area had recently been burned prior to the field verification.

PES discussion	EIS discussion
PES Category: C (Moderately modified) Alterations to the habitat of this wetland have occurred, primarily due to disturbances relating to the gold tailings storage facility (TSF) located to the north of the study area as well as road infrastructure (Barry Marais Road bordering the study area to the west) and railway infrastructure (bordering the study area to the south and east). Transformation of the UCVB wetland habitat has also resulted in the proliferation of alien invasive species and has led to incision within the wetland. The results of the WET-Health assessment indicate that the portion of the wetland located within the study area has undergone moderate changes in ecosystem processes and loss of natural habitat has taken place, but the natural habitat remains predominantly intact. Impacts taken into consideration when assessing the PES included the permanent interruption to natural flow patterns (mainly due to the adjacent road and railway infrastructure) and impacts from the surrounding land-uses.	**EIS Category: C (Moderate).** The EIS of the UCVB falls within Category C, which are resources that are considered to be ecologically important and sensitive on a provincial or local scale, and that the biodiversity of these systems is not usually sensitive to limited flow and habitat modifications. Portions of the wetland are also considered to be a CBA (Gauteng Conservation Plan, 2014), which is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges. Therefore, it is important to conserve the remaining habitat and the connectivity this wetland provides to other natural areas, and to promote the re-establishment of indigenous species.
Watercourse drivers:	
a) Hydrology Increased runoff as a result of catchment hardening in the greater area is a significant modifier of the hydrological functioning of this wetland. The hydrology of the wetland has been modified by the construction of the adjacent road and railway infrastructure. A culvert has been constructed along the railway line that traverses the wetland at the south western border of the study area resulting in the concentration of flow through the culvert. This has led to increased velocity and turbulence of the water passing through the culvert, causing erosion and incision of the active channel downgradient of the culvert.	**c) Topography: Geomorphology and sediment balance** The historical construction of the adjacent road and railway infrastructure has created more concentrated flow into the wetland, thereby altering the geomorphology of the wetland. Windblown dust and surface runoff from the nearby gold TSF are likely to increase the sediment load of the wetland.
b) Water quality The water quality (both surface and groundwater) within the wetland is likely to be impacted upon by runoff and seepage from the gold TSF located to the north of the study area.	**d) Habitat and biota** Alterations to the natural wetland vegetation community have occurred due to seepage from the gold TSF located north of the study area entering the systems. This has resulted in saline soil and surface water conditions allowing the proliferation of vegetation adapted to such conditions, such as the proliferation of *Cynodon dactylon,* leading to a lowered species diversity.

Table 6: Summary of the assessment of the hillslope seeps identified within the study area.

Representative photographs of the hillslope seeps located within the northern portion of the study area. (Left) Gold TSF wall located to the north of the study area; (Middle) Evidence of earthworks within the wetland; (Right) Deposition of sediment likely from the gold TSF.

PES discussion	EIS discussion
PES Category: D (Largely modified) The gold TSF located to the north of the study area and adjacent to the hillslope seep system has caused large alterations to the habitat of this wetland. The historical mining activities have resulted in the deposition of sediment within the wetland as well as changes to the natural wetland vegetation community. Evidence of impacts such as earthworks was present within the wetland. The results of the WET-Health assessment indicate that the hillslope seeps located within the study area and investigation area have undergone large changes in ecosystem processes and loss of natural habitat and biota and has occurred.	**EIS Category: C (Moderate).** The EIS of the hillslope seeps falls within Category C, which are resources that are considered to be ecologically important and sensitive on a provincial or local scale, and that the biodiversity of these systems is not usually sensitive to limited flow and habitat modifications. The system is considered important on a landscape scale rather than for its ecological sensitivity and hydro-functional importance. The Gauteng Conservation Plan, 2014) indicates that the seeps fall within a CBA, which is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges. Therefore, it is important to conserve the remaining habitat that the hillslope seeps provide to other natural areas, and to promote the re-establishment of indigenous species.
Watercourse drivers:	
a) Hydrology The hillslope seeps are most likely hydrologically driven by seepage from the gold TSF situated directly adjacent to the wetlands. Therefore, the hydrology of the system has been modified as the natural extent of these wetlands have been augmented by seepage from the TSF. However, as seepage from the TSF is decreasing as the TSF is unused, the system is drying out and returning to its natural hydrological equilibrium.	**c) Topography: Geomorphology and sediment balance** The geomorphology of the wetland has been altered by earthworks within the wetland. Additionally, suspended solids and sediment introduced from seepage and runoff from the gold TSF are likely to have impacted the sediment load of the system.
b) Water quality The wetlands are non-perennial seeps and the water quality could not be assessed. However, the water quality is likely to be impacted by runoff and seepage from the gold TSF located to the north of the study area.	**d) Habitat and biota** Alterations to the natural wetland vegetation community have occurred due to seepage from the TSF located north of the study area entering the systems. This has resulted in saline soil and surface water conditions allowing the proliferation of vegetation adapted to such conditions, such as the proliferation of *Cynodon dactylon,* leading to a lowered species diversity.

Table 7: Summary of the assessment of the pans identified within the study area.

Representative photographs of pan 1 (left), pan 2 (middle) and pan 3 (right) located within the central portion of the study area. Waste rock dumping was prevalent within all three pans, while evidence of disposal of rubble was observed within pan 3. The area had recently been burned prior to the field verification.

PES discussion	EIS discussion
PES Category: C (Moderately modified) The disposal of waste rock and rubble has altered the habitat of the pans, resulting in the proliferation of alien invasive species. Regular burning of the pans and within the area had led to a decline of the ecological condition of the pans. The results of the WET-Health assessment indicate that the pans have undergone moderate changes in ecosystem processes and loss of natural habitat has taken place, but the natural habitat remains predominantly intact.	**EIS Category: B (High).** The EIS of this wetland falls within Category B, which are freshwater resources considered to be ecologically important and sensitive, and the biodiversity thereof may be sensitive to flow and habitat modifications. The pans are considered important on a landscape scale rather than for their ecological sensitivity and hydro-functional importance. However, the pans are classified as wetland FEPAs according to the NFEPA database and have been classified as priority pans according to the Gauteng C-Plan v3.3 (2011). Priority pans must be designated as sensitive and thus a 50m buffer is required for these pans.
Watercourse drivers:	
a) Hydrology The pans are hydrologically driven by groundwater. However, the hydraulic regime of the pans has been altered to a small degree due to altered runoff patterns from the surrounding disturbed topography, thereby increasing surface water runoff into the pans. A borehole was observed nearby pan 2 which is likely to have impacted upon the hydrology of the pan.	**c) Topography: Geomorphology and sediment balance** The disposal of waste rock and rubble within the pans has altered the geomorphology of the pans. Windblown dust and surface soil runoff from the nearby gold TSF are likely to increase the sediment balance of the pans.
b) Water quality The wetlands are non-perennial pans and the water quality could not be assessed. However, the water quality is likely to be impacted by runoff and seepage from the gold TSF located to the north of the study area.	**d) Habitat and biota** Alterations to the natural wetland vegetation community have occurred due to the disposal of waste rock and rubble within the pans, resulting in the proliferation of alien invasive species leading to a lowered species diversity.

4.3 Sensitivity Mapping

4.3.1 Delineation

Following the field investigation undertaken in September 2018, it was concluded that the freshwater resource delineations presented in SAS (2009) remain unchanged and are valid. No additional freshwater resources or wetland features were identified within the study area. However, current legislation requires the application of GN509 of 2016 as it relates to the NWA to identify all potential freshwater resources that may potentially be impacted by the proposed development. Therefore, the freshwater resources identified within 500m of the study area were delineated in fulfilment of GN509 of the NWA using desktop methods.

4.3.2 Legislative Requirements, national and provincial guidelines pertaining to the application of buffer zones

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered to be important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

Legislative requirements were first taken into consideration when determining a suitable buffer zone for the wetland resources. The definition and motivation for a regulated zone of activity as well as buffer zone for the protection of the freshwater resource can be summarised as follows:

- Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation. This must be determined by the

Environmental Assessment Practitioner (EAP) in consultation with the relevant authorities;

- In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as:
  - the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
  - in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
  - a 500 m radius from the delineated boundary (extent) of any wetland or pan and
- In terms of GDARD Requirements for Biodiversity Assessments (2014), a specific buffer zone is stipulated for wetland resources, depending whether it is located within or outside an Urban Area. According to the Gauteng C-Plan (2011), the study area is located outside of the urban edge. However, the Urban Edge was rescinded as policy document in the Gauteng Spatial Development Framework in 2011. Additionally, the study area falls within Zone 1 of the EMF (urban development zone). Therefore, a 30m GDARD setback area is required for the freshwater resources that fall within the Gauteng Province. However, the Gauteng C-Plan indicates that the pans within the study area are priority pans which must be designated as sensitive and thus a 50m buffer zone is required for these pans.

It is important to note that the proposed development falls predominantly within the 500m GN509 Zone of Regulation and thus relevant authorisation in terms of Section 21 (c) and 21(i) of the National Water Act, 1998 (Act 36 of 1998) from the DWS will be required.

The delineated freshwater resources and their applicable zones of regulation in terms of GN509 2016 as it relates to the NWA and the GDARD Requirements for Biodiversity Assessments are conceptually depicted in Figure 10 below.

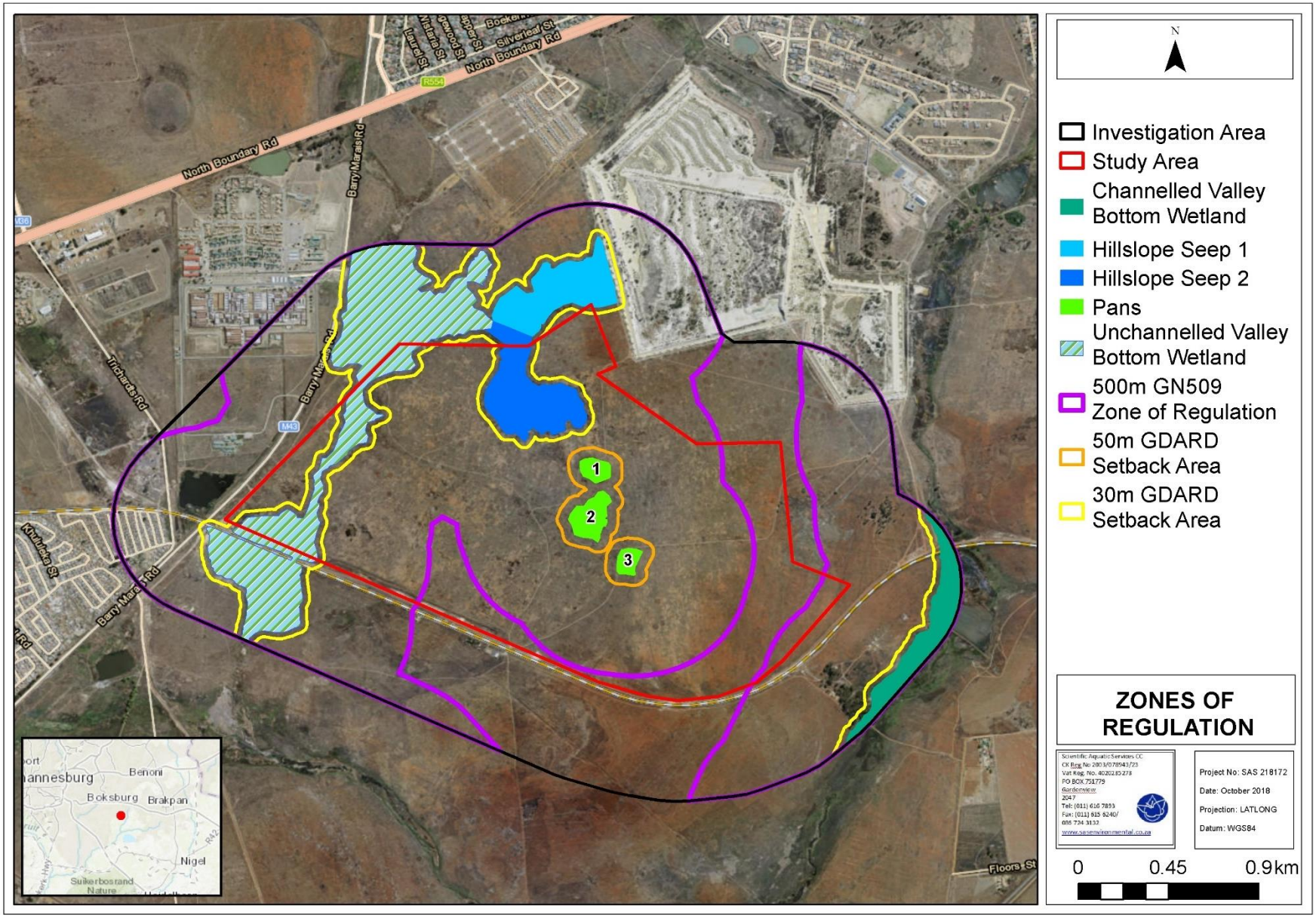

Figure 10: Conceptual presentation of the GDARD Setback areas and the zone of regulation in terms GN509 of 2016 as it relates to the NWA, in relation to the delineated wetlands.

5 RISK ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the identified wetlands associated with the study area. In addition, it also indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed development and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

5.1 Risk Analyses

5.1.1 Consideration of impacts and application of mitigation measures

Following the assessment of the watercourse, the DWS prescribed Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources associated with the study area. These results are summarised in Table 9 presented at the end of Section 5.1.2 of this report.

The risk assessment was undertaken based on the draft layout provided by the proponent. Should further planning take place prior to construction, and (as recommended) no infrastructure is placed within the wetland habitat or the stipulated buffer zones, the perceived impact significance particularly of construction activities may be further reduced. If roads crossing the wetlands can be avoided, this will greatly reduce the impact. Additionally, the design of the crossings will have a significant bearing on the impact to the wetlands.

Following the risk assessment, mitigation measures were compiled to serve as guidance throughout the construction and operational phases. The points below summarise the considerations undertaken:

- The risk assessment was applied assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report presents the perceived impact significance *post-mitigation*;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA *et al* would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- At the time of this assessment, the overall freshwater environment was considered moderately modified, and of moderate ecological importance and sensitivity;

- While the operation of the development will be a permanent activity, the construction thereof is envisioned to take no more than a few years. However, the frequency of the construction impacts may be daily during this time;
- Most impacts are considered to be easily detectable, with the exception of contamination of surface and groundwater (associated with waste disposal and spills) which will require some effort and;
- The considered mitigation measures are easily practicable;
- It is highly recommended that the proponent make provision for small-scale rehabilitation of the areas of the freshwater resources which may be directly impacted upon by construction activities. The area must preferably be rehabilitated to conditions as close as possible to the "natural" state, not the pre-construction state since the state of the wetlands are deemed to be significantly altered from their reference condition. This will ensure that the ecological condition of the freshwater resources within the study area are maintained and where feasible, improved.

5.1.2 Impact discussion and essential mitigation measures

There are four key ecological impacts on watercourses that are anticipated to occur namely,

- Loss of freshwater feature habitat and ecological structure;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the freshwater features; and
- Impacts on water quality.

Various activities and development aspects (tabulated in Appendix E) may lead to these impacts, however, these impacts can be adequately minimized or avoided provided the mitigation measures provided in this report are implemented and adhered to.

The outcome of the Risk Assessment indicated that the proposed development will pose a 'Low' risk to the freshwater environment. However, it is considered imperative that suitable mitigation measures, as provided for in Section 5 and Appendix F of this report are strictly adhered to, to minimise the impacts associated with the proposed development and decrease the significance of cumulative impacts on the freshwater resources.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the impacts arising from the proposed development are likely to be of low significance during the construction and operational phases assuming that a high level of mitigation takes place. It is also recommended that ongoing alien vegetation control is implemented during the operational phase so as to enhance the ecological state of the freshwater environment.

Based on the findings of the freshwater ecological assessment, several recommended mitigation measures are made to minimise the impact on the freshwater resources:

- The use of Sustainable Drainage Systems (SUDs) to manage stormwater is considered critical if roads and large paved parking areas are to be planned within close proximity to the freshwater environment, in order to prevent significant impacts on the hydrological functioning of the freshwater area, reduce the risk of flooding during high flow periods and reduce the risk of increased erosion. Furthermore, any discharge of runoff into the freshwater system must be done in such a way as to prevent erosion. In this regard, it is highly recommended that a suitably qualified engineer be consulted with regards to the use of SUDs. Examples of these which may be applicable to this development include permeable paving, rainwater harvesting, soakaways, swales and bio-retention facilities or attenuation ponds to ensure that post-development runoff does not exceed pre-development runoff volumes and lead to altered flood peaks;
- Areas which are to be cleared of vegetation, including contractor laydown areas, must remain as small as possible, particularly in the residential development areas, in order to reduce the risk of proliferation of alien vegetation, and in order to retain a level of protection to the freshwater resources during construction (e.g. sediment trapping, slowing of stormwater runoff etc.). Contractor laydown areas are to remain outside of the delineated wetland and riparian zones and their associated buffers, and as much as feasible no natural/indigenous wetland vegetation is to be cleared;
- It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction;
- A soil management plan must be compiled during planning and implemented when construction commences. It is essential that the following be included in the soil management plan:
    - All exposed soils are to be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) in order to prevent erosion and sedimentation of the freshwater resources. This is considered essential as the soils in the vicinity are highly dispersive;
    - No stockpiling of soils is to take place within the freshwater areas or its GDARD setback area, and stockpiles may not exceed 2m in height;
    - Any remaining soils following the completion of construction activities are to be levelled and re-seeded with indigenous flora species to minimise the risk of further sedimentation of the freshwater area, and to aid in the natural reclamation process; and

- The residual impacts of the proposed development on the freshwater resources are to be offset.

Additional “good practice” mitigation measures applicable to a project of this nature are provided in Appendix F of this report. A summary of the risk assessment applied to the freshwater resources associated with the study area is provided in Table 8.

Table 8: Summary of the results of the risk assessment applied to the freshwater resources associated with the proposed development.

Phase	No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Mitigation Measures to be implemented
Construction Phase	1	Site clearing prior to commencement of construction activities.	Removal of vegetation and associated disturbances to soils.	Increased runoff and erosion leading to sedimentation of the wetland environment. Increased sedimentation of the wetlands, leading to smothering of wetland vegetation and potentially altering surface water quality. Decreased ecoservice provision.	1.8	5.8	9	**51.8**	**L**	**85**	Limit clearing of vegetation and associated soil disturbances to essential areas only (outside of the GDARD setback area); Protect exposed soils by means of geotextile such as hessian sheeting; and Ensure contractor laydown areas are placed outside of the freshwater environment and the associated GDARD setback area.
	2		Possible indiscriminate driving through the wetlands by construction vehicles.	Damage to wetland vegetation, leading to exposed/compacted soils, in turn leading to increased runoff and erosion. Decreased ecoservice provision. Further decreased ability to support biodiversity.	1.8	5.8	8	**46**	**L**	**85**	The freshwater environment and the associated GDARD setback area are to be clearly demarcated on site, and to remain off-limits to all non-essential personnel; and No vehicles to be permitted within the freshwater habitat unless essential.
	3	Groundbreaking, excavation of foundations and other earthworks upgradient of and outside of the wetlands and the associated GDARD setback area.	Removal of topsoil and creation of topsoil stockpiles.	Disturbances of soils leading to increased alien vegetation proliferation, and in turn to altered freshwater habitat. Altered runoff patterns, leading to increased erosion and sedimentation of wetlands.	1.5	5.5	10	**55**	**L**	**85**	Protect exposed soils and stockpiles by covering with a suitable geotextile such as hessian sheeting; Limit the time in which soils are exposed; No stockpiles to be permitted within freshwater environment and the associated GDARD setback area; and Ensure no stockpiles are higher than 2m.
	4	Potential indiscriminate waste disposal.	Disposal of construction-related wastes (such as rubble, hazardous chemicals and litter).	Altered flow regime as a result of solid waste within the wetlands. Altered water quality due to chemical waste disposal.	1.5	5.5	10	**55**	**L**	**85**	No waste disposal is to be permitted within the freshwater environment and the associated GDARD setback area; and All wastes are to be removed from the site and disposed of at a registered facility.
	5	Potential spillage from construction vehicles.	Spills / chemical leaks from construction vehicles.	Possible contamination of wetland soils and water, leading to reduced ability to support biodiversity.	1.3	5.3	10	**52.5**	**L**	**85**	Vehicles to be regularly inspected for leaks and to be refuelled on sealed surface to prevent ingress into soils; and

Phase	No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Mitigation Measures to be implemented
											All spills are to be immediately cleaned up and treated accordingly.
Operational Phase	6	Potential indiscriminate waste disposal.	Potential disposal of hazardous and non-hazardous waste materials into the wetland habitat.	Altered flow regime as a result of solid waste within the wetland habitat. Altered water quality due to waste disposal.	1.8	3.8	9	**33.8**	**L**	**85**	No waste disposal is to be permitted within freshwater environment and the associated GDARD setback area; and All wastes are to be removed from the site and disposed of at a registered facility.
	7	Increased impermeable surfaces in the vicinity of the wetlands and the catchment.	Increased impermeable surfaces due to the presence of parking areas, access roads, etc.	Altered runoff patterns and increased water inputs to the wetland environment, resulting in altered flow regime, erosion and incision. Altered flow regime may lead to changed wetland zonation, and possible impacts on vegetation as a result.	1.5	5.5	10	**55**	**L**	**85**	Adequate stormwater management plan to be incorporated into the design of the development; Release of stormwater into the freshwater environment must not result in further bank incision or erosion; and It is highly recommended that Sustainable Urban Drainage Systems (SUDs) be implemented.
	8		Potential risk of contaminated runoff from surfaces such as roads and parking areas associated with the proposed development.	Pollution of wetland soils, groundwater and surface water.	1.8	5.8	9	**51.8**	**L**	**85**	Any spills to be immediately cleaned up and treated accordingly; and Ensuring that suitable freshwater vegetation remains post-construction will assist in filtering toxicants from stormwater runoff.
	9	Routine maintenance and operational activities.	Potential disturbances to soils as a result of routine maintenance/operational activities.	Potential for increased proliferation of alien floral species, leading to reduced ability to support biodiversity, and provide ecological services such as flood attenuation.	1.8	3.8	9	**33.8**	**L**	**85**	Alien vegetation management plan to be developed and implemented; and Incorporate indigenous terrestrial and wetland vegetation into landscape plan (if applicable).

Phase	No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Mitigation Measures to be implemented
	10	Operation and maintenance of planned waste management systems (e.g. sewage infrastructure).	Potential failure of any planned waste management systems (e.g. sewage infrastructure) resulting in leakages and possible contamination of surface and ground water.	Potential contamination of wetland soils, groundwater and surface water.	2	4	11	**44**	**L**	**85**	Ensure that regular maintenance takes place to prevent failure; and Develop emergency response plan to be implemented in case of emergency.

6 CONCLUSION

Following the field investigation undertaken in September 2018, it was concluded that the freshwater resource delineations presented in SAS (2009) remain unchanged and are valid. No additional freshwater resources or wetland features were identified within the study area. However, current legislation requires the application of GN509 of 2016 as it relates to the NWA to identify all potential freshwater resources that may potentially be impacted by the proposed development. Therefore, the freshwater resources identified within 500m of the study area were delineated in fulfilment of GN509 of the NWA using desktop methods.

An unchannelled valley bottom (UCVB) wetland, two hillslope seep wetlands and three pans were identified in the study area. Following the assessment of these freshwater resources, the ecological condition thereof could be summarised as below:

Table 9: Summary of results of the field assessment as discussed in Section 4.2.

Freshwater Resource	PES	EIS
Unchannelled Valley Bottom Wetland	C (Moderately modified)	C (Moderate)
Hillslope Seeps	D (Largely modified)	C (Moderate)
Pans	C (Moderately modified)	B (High)

The freshwater resources within the study area have been historically altered through mining activities (northern section of the study area), residential developments (in the broader catchment) and through the construction of road and railway infrastructure in the system.

The reclamation of the tailings storage facility (TSF) located to the north of the study area will result in the loss of hydraulic head and possibly redirect the recharge of the wetland to the catchment to the east of the catchment feeding this wetland. This change in the landscape will lead to the removal of the primary hydrological driver of the hillslope seep wetland adjacent to the TSF (hillslope seep 1). Thus, the need for future conservation of this wetland is questionable considering the long-term viability of the system functioning in the landscape.

Following the assessment of the freshwater resources within the study area, the DWS risk assessment matrix was applied in order to ascertain the significance of possible impacts which may occur as a result of the proposed development. The results of this assessment are presented in Section 5 of this report, and show that, assuming mitigation measures are strictly enforced, impact significance is Low during both construction and operational phases.

However, it is considered imperative that suitable mitigation measures, as provided for in Section 5 and Appendix F of this report, are strictly adhered to in order to minimise the impacts associated with the proposed development and decrease the significance of cumulative impacts on the freshwater resources.

Based on the findings of the watercourse assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed development poses a direct risk to the freshwater resources within the study area. Adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures as provided in this report as well as general good construction practice as well as ongoing management and maintenance as well as monitoring, is essential if the significance of perceived impacts is to be reduced to limit further degradation to the freshwater resources.

It is the opinion of the specialist therefore that the proposed development, from a freshwater resource perspective, be considered favourably, with the proviso that strict adherence to mitigation measures is enforced, in order to ensure that the ecological integrity of the freshwater resources is not further compromised.

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APPENDIX A - Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

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

LEGISLATIVE REQUIREMENTS

National Environmental Management Act (NEMA) (Act No. 107 of 1998)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act (NWA) (Act No. 36 of 1998)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
GDARD Requirements for Biodiversity Assessments Version 3 (GDARD, 2014).	The biodiversity assessment must comply with the minimum requirements as stipulated by GDARD Version 3 of 2014 and must contain the following information: ➢ The wetland delineation procedure must identify the outer edge of the temporary zone of the wetland, which marks the boundary between the wetland and adjacent terrestrial areas; ➢ The delineation must be undertaken according to the DWAF guidelines; ➢ The wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive in a sensitivity map. Rules for buffer zone widths are as follows: • 30m for wetlands occurring inside urban areas; • 50m for wetlands occurring outside urban areas; and • 50m for priority pans.

APPENDIX C - Method of Assessment

FRESHWATER RESOURCE METHOD OF ASSESSMENT

1. Desktop Study

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

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

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

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

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa

The freshwater features encountered within the proposed study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure for Inland Systems, up to Level 3.

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

Table C2: Hydrogeomorphic (HGM) Unit for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

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

Level 1: Inland systems

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

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

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

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

Level 3: Landscape Setting

At Level 3 of the Classification System, for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

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

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the Classification System (Table C2), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

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

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa.

Similar terminology (but excluding categories for “channel”, “flat” and “valleyhead seep”) is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

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

Level of Evaluation
Two levels of assessment are provided by WET-Health:

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

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

Units of Assessment
Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

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

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

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

Impact category	Description	Impact score range	Present State category
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

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

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

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

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

4. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).
In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C8) of the wetland system being assessed.

Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

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

APPENDIX D - Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[2]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[3].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National

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

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

Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

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

- Mitigation and performance improvement measures and actions that address the risks and impacts[4] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and

[4] Mitigation measures should address both positive and negative impacts

- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

APPENDIX E - Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES) AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the WET-Health PES assessment applied to the unchannelled valley bottom wetland.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Overall PES Category
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
1	48	100	3.5	-1	2.2	-1	5.4	-1	
Area weighted impact scores*			**3.5**	**-1.0**	**2.2**	**-1.0**	**5.4**	**-1.0**	**3.7**
PES Category			**C**	↓	**C**	↓	**D**	↓	**C**

Table E2: Presentation of the results of the WET-Health PES assessment applied to the hillslope seeps.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Overall PES Category
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
1	13	100	3.5	-1	2.5	-1	5.9	-1	
Area weighted impact scores*			**3.5**	**-1.0**	**2.5**	**-1.0**	**5.9**	**-1.0**	**4.0**
PES Category			**C**	↓	**C**	↓	**D**	↓	**D**

Table E3: Presentation of the results of the WET-Health PES assessment applied to the pans.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Overall PES Category
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
1	5	100	3.5	-1	2.5	-1	5.9	-1	
Area weighted impact scores*			**3.5**	**-1.0**	**1.9**	**-1.0**	**4.4**	**-1.0**	**3.3**
PES Category			**C**	↓	**B**	↓	**D**	↓	**C**

Table E3: Presentation of the results of the EIS assessment applied to the UVCB wetland, hillslope seeps and pans.

FRESHWATER FEATURE:			Unchannelled Valley Bottom	Hillslope Seeps	Pans
Ecological Importance and Sensitivity			Score (0-4)		
Biodiversity support			**A (average)**		
			1.00	0.67	1.00
Presence of Red Data species			0	0	0
Populations of unique species			1	1	1
Migration/breeding/feeding sites			2	1	2
Landscape scale			**B (average)**		
			2.00	1.40	2.20
Protection status of the wetland			1	1	1
Protection status of the vegetation type			2	2	2
Regional context of the ecological integrity			2	1	2
Size and rarity of the wetland type/s present			3	2	4
Diversity of habitat types			2	1	2
Sensitivity of the wetland			**C (average)**		
			2.00	1.33	1.67
Sensitivity to changes in floods			2	1	1
Sensitivity to changes in low flows/dry season			2	1	1
Sensitivity to changes in water quality			2	2	3
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)			**C**	**C**	**B**
Hydro-Functional Importance			**Score (0-4)**		
Regulating & supporting benefits	**Flood attenuation**		2	2	1
	Streamflow regulation		0	0	0
	Water Quality Enhancement	***Sediment trapping***	1	2	3
		Phosphate assimilation	1	1	2
		Nitrate assimilation	1	1	2
		Toxicant assimilation	1	1	2
		Erosion control	2	2	1
	Carbon storage		1	1	2
HYDRO-FUNCTIONAL IMPORTANCE (average score)			1	1	2
Direct Human Benefits			**Score (0-4)**		
Subsistence benefits	***Water for human use***		0	0	0
	Harvestable resources		0	0	0
	Cultivated foods		0	0	0
Cultural benefits	***Cultural heritage***		1	1	1
	Tourism and recreation		1	1	1
	Education and research		2	2	2
DIRECT HUMAN BENEFITS (average score)			0.67	0.67	0.67

APPENDIX F - Risk Assessment and Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the freshwater ecology and biodiversity, will include any activities which take place in close proximity to the proposed development that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the freshwater system identified in this report:

Development footprint

- All development footprint areas should remain as small as possible and should not encroach into the freshwater areas unless absolutely essential and part of the proposed development. It must be ensured that the freshwater habitat is off-limits to construction vehicles and non-essential personnel;
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes should avoid freshwater areas and be restricted to existing roads where possible;
- Appropriate sanitary facilities must be provided for the life of the construction phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Freshwater habitat

If any infrastructure is to be placed in the freshwater areas the extent of encroachment into the freshwater areas will need to be extremely well controlled and limited.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. Whilst not considered severe at this time, the vegetation component within the freshwater environment is already transformed to an extent as a result of alien plant invasion; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered within the freshwater resources must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, and maintenance phases; and
- Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;

- Footprint areas should be kept as small as possible when removing alien plant species*;* and
- No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

Soils

- Sheet runoff from access roads should be slowed down by the strategic placement of berms;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils;
- No stockpiling of topsoils is to take place within close proximity to the river, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the river;
- All soils compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed.

APPENDIX G - Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Lauren Robson MSc (Zoology) (University of Johannesburg)

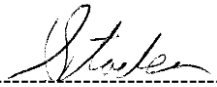
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP);
Accredited River Health practitioner by the South African River Health Program (RHP);
Member of the South African Soil Surveyors Association (SASSO);
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for Wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

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  Tel: 015 291 4015

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF LAUREN ROBSON

PERSONAL DETAILS

Position in Company	Junior Field Ecologist
Date of Birth	20 January 1992
Nationality	South African
Languages	English
Joined SAS	2018

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Candidate Natural Scientist with the South African Council for Natural Scientific Professions

Member of the Gauteng Wetland Forum

EDUCATION

Qualifications

MSc Zoology (University of Johannesburg)	2017
BSc (Hons) Zoology (University of Johannesburg)	2014
BSc Life and Environmental Sciences (University of Johannesburg)	2013

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Western Cape

SELECTED PROJECT EXAMPLES

Freshwater Assessments

- Freshwater Resource Ecological Assessment as part of the environmental assessment and authorisation process for the proposed further development of Erf 35531 and formalisation of the Kuils River adjacent to Erf 35531, Stikland, Western Cape.
- Peer Review of the Basic Assessment with specific focus on Freshwater Resource Impacts and Impact Assessment for the Jewellery Manufacturing Precinct near the OR Tambo Airport, Gauteng to determine adequacy for decision making on the Amendment Application.
- Freshwater ecological assessment as part of the water use license process for the Daybreak Chickens facility in Sundra, near Delmas, Mpumalanga Province.
- Freshwater Resource Ecological Assessment as part of the Environmental Assessment and Authorisation Process for the Proposed Upgrade of Culverts along Protea Road and Waarburgh Road, Western Cape