SCIENTIFIC AQUATIC SERVICES

FRESHWATER ECOSYSTEM ASSESSMENT

AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR THE PROPOSED URBAN DEVELOPMENT ON PORTION 268 RIETFONTEIN 189 IQ, GAUTENG PROVINCE

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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed urban development on Ptn 268/189 Rietfontein IQ (hereafter referred to as the "study area"). The study area measures approx. 9.2 hectares (ha) in extent and is located approx. one kilometre (km) east of the town of Muldersdrift and approximately 0.3 km south of the R114 regional roadway. It falls within the Mogale City Local Municipality which is an administrative district of West Rand District Municipality, Gauteng Province.

Following on from desk-based investigation of possible freshwater features in the study area and investigation area (defined as a 500 m radius around the study area, in line with Government Notice (GN) 4167 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended) (NWA), a field assessment was undertaken on the 29th of November 2023 to verify the presence of freshwater ecosystems. An unchanneled valley bottom (UCVB) wetland, which intersects a southern portion of the study area, was identified as the main drainage feature of concern. Two hillslope seep (HSS) wetlands were also identified within the study area, both of which drain directly into the UCVB wetland. The results of the field assessment of the identified wetlands within the study area is summarised in the table below:

Freshwater ecosystem	PES	Ecoservices importance	EIS	REC / RMO / BAS
Unchanneled Valley Bottom (UCVB) wetland	D (largely modified)	Moderate	High	C/ Improve/D
Hillslope Seep (HSS) wetland 1	D (largely modified)	Low	Low/Marginal	D/Maintain/D
Hillslope Seep (HSS) wetland 2	D (largely modified)	Low	Low/Marginal	D/Maintain/D

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2023) was applied to determine the significance of potential risks arising from the proposed urban development on the receiving freshwater environment. No layout was provided at the time of the survey, but should the development footprint remain outside the delineated freshwater ecosystems and their associated 50m GDARD non-development buffer areas, development activities within the study area are not anticipated to result in loss of, or alteration to, the functionality of the identified wetlands, and the impacts are considered to be 'Low' (given that the mitigation measures as provided in Section 6 are implemented). However, if the final proposed development layout encroaches on the freshwater habitat and associated 50m GDARD buffer, medium to high direct or indirect impacts to the freshwater ecosystems may be anticipated. For the purposes of this report, it was assumed that the first (preferred) option in the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. the impacts would be avoided as opposed to minimised, rehabilitated or offset.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed development activities are likely to be reduced during the construction and operational phases. It is, therefore, the opinion of the freshwater ecologist that the proposed project may be granted environmental authorisation provided that all mitigation measures as set-out in this report are implemented and the development can be considered for authorisation. This opinion is however subject to revision after the final infrastructure layout and description of activities for the project is made available.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed urban development on Ptn 268/189 Rietfontein IQ (hereafter referred to as the "study area"). The study area measures approx. 9.2 hectares (ha) in extent and is located approx. one kilometre (km) east of the town of Muldersdrift and approximately 0.3 km south of the R114 regional roadway. It falls within the Mogale City Local Municipality which is an administrative district of West Rand District Municipality, Gauteng Province.

The purpose of this report is to define the ecology of the freshwater ecosystems associated with the study and associated investigation area (defined as a 500 m radius around the various components that form part of the study area, in line with GN 4167 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended in terms of freshwater characteristics, including mapping of the freshwater ecosystems, defining areas of increased Ecological Importance and Sensitivity (EIS) and defining the Present Ecological State (PES) of the freshwater ecosystems associated with the study area. The report also aims to define the socio-cultural and ecological service provision of the freshwater ecosystems and additionally outlines the Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) for the freshwater ecosystems. The assessment took the following approach:

- A desktop study was conducted, in which possible freshwater ecosystems were identified for on-site investigation, and relevant national and provincial databases were consulted; and
- The field assessment took place on the 29th of November 2023 during which an unchanneled valley bottom wetland and two hillslope seep wetlands were identified within the study area.

The results of the field assessment of the abovementioned wetland are presented in Section 4 of this report, and are summarised in the table below:

Table A: Summary of results of the field assessment as discussed in Section 4.

Freshwater ecosystem	PES	Ecoservices importance	EIS	REC / RMO / BAS
Unchanneled Valley Bottom (UCVB) wetland	D (largely modified)	Moderate	High	C/ Improve/D
Hillslope Seep (HSS) wetland 1	D (largely modified)	Low	Low/Marginal	D/Maintain/D
Hillslope Seep (HSS) wetland 2	D (largely modified)	Low	Low/Marginal	D/Maintain/D

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2023) was applied to determine the significance of potential risks arising from the proposed urban development on the receiving freshwater environment. The outcome of the DWS Risk Assessment is summarised in the table below.

Table B: Summary of DWS Risk Assessment applied to the proposed development.

Phase	Activity	Impact	Potentially affected watercourses			Risk Rating
			Name/s	PES	Ecological Importance	
PRE-CONSTRUCTION (DESIGN)	Planning of all construction activities, including schedules (timing) of activities and design of infrastructure (e.g. stormwater management systems)	*Potential concentrated flow and increased flow velocity into the receiving environment. *Increased risk of erosion. *Unattenuated discharge of stormwater into the freshwater ecosystems, leading to sedimentation and erosion of wetland habitat. *Potential decreased ability of the freshwater ecosystems to provide ecosystem services. *Potential degradation of wetland habitat.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L
CONSTRUCTION	Vegetation clearing and earthworks outside the delineated extent of the freshwater ecosystems and associated 50m GDARD non development buffer area.	*Disturbance of soil leading to increased AIP proliferation, which may spread to the adjacent wetlands. *Reduced vegetation cover, potentially providing opportunity for AIP establishment. *Alteration of runoff patterns and a risk of increased sediment loads being transported into downgradient freshwater ecosystems. *Potential soil and stormwater contamination from oils as well as hydrocarbons from construction machinery.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L
	Construction of infrastructure, including buildings, paved areas and support infrastructure (e.g. access roads, cables, and pipelines).	*Removal of vegetation in close proximity to the freshwater ecosystems, but outside the 50m GDARD buffer. *Altered runoff patterns as a result of excavation and hardened surfaces, potentially leading to increased erosion and sedimentation thereof. *Disturbances of soil, leading to increased AIP proliferation and potentially altered freshwater habitat. *Potential for deteriorated water quality.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L
OPERATIONAL	Operation of the development, roads, and associated open space areas (if applicable).	*Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems. *Proliferation of alien and invasive plant species within the freshwater ecosystems.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L
	Operation of the stormwater infrastructure within the study area	*Potential altered runoff patterns and increased water inputs to the freshwater ecosystems, altering the flow regime, and potentially leading to erosion and incision. *Increased catchment yield (due to increased runoff) and altered flow regime may lead to changed freshwater ecosystem zonation. *Increased water contamination due to hydrocarbons in stormwater from the internal road network. *Flow concentration and potentially erosion at concentration points i.e. culverts, swales and other stormwater infrastructure.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L
	Operation of any sewerage treatment plants (if applicable) within the study area outside the 50m GDARD non development buffer but inside the 500m GN 4167 Zone of Regulation.	*Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems. *Potential eutrophication of the freshwater ecosystems as a result of increased nitrates and phosphate loads from untreated effluent (from the sewer infrastructure) due to potential leakage of the pipelines. Potential fragmentation of the freshwater ecosystems	UCVB wetland	D	High	L

Phase	Activity	Impact	Potentially affected watercourses			Risk Rating
			Name/s	PES	Ecological Importance	
	Operation of sewer infrastructure (including pump stations), fences and site walls, if applicable.	caused by property fences. *Proliferation of alien and invasive plant species within the freshwater ecosystems.	Hillslope Seep wetlands	D	Low	L
	Maintenance of any sewer infrastructure, fence and site walls.	*Potential eutrophication of the freshwater ecosystems as a result of increased nitrates and phosphate loads from untreated effluent (from the sewer infrastructure) due to potential leakage of the pipelines in the event of a leak of damage to the pipeline infrastructure. *Proliferation of alien and invasive plant species within the freshwater ecosystems. *Potential loss of indigenous vegetation as a result of maintenance works.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L
	Monitoring of structural integrity of the service infrastructure, swales and other stormwater and linear infrastructure associated with the development (cables, powerlines and pipelines).	*Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances. *Disturbance to and compaction of soil resulting in erosion.	UCVB wetland	D	High	L
			Hillslope Seep wetlands	D	Low	L

No layout was provided at the time of the survey, but should the development footprint remain outside the delineated freshwater ecosystems and their associated 50m GDARD non development buffer areas, development activities within the study area are not anticipated to result in loss of, or alteration to, the functionality of the identified wetlands, and the impacts are considered to be 'Low' (given that the mitigation measures as provided in Section 6 are implemented). However, if the final proposed development layout encroaches on the freshwater habitat and associated 50m GDARD buffer, medium to high direct or indirect impacts to the freshwater ecosystems may be anticipated. For the purposes of this report, it was assumed that the first (preferred) option in the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. the impacts would be avoided as opposed to minimised, rehabilitated or offset.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed development activities are likely to be reduced during the construction and operational phases. It is, therefore, the opinion of the freshwater ecologist that the proposed project may be granted environmental authorisation provided that all mitigation measures as set-out in this report are implemented and the development can be considered for authorisation. This opinion is however subject to revision after the final infrastructure layout and description of activities for the project is made available.

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Appendix I
2.2	Description of the preferred development site, including the following aspects-	Section 1
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Sections 4 & 5
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 3
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 3
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 4
2.3	Identify any alternative development footprints within the preferred development site which would be of a "low" sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	Section 6 and 7; Appendix H
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 7
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 4 and Section 7
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Section 7
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). d. Assessment of the risks associated with water use/s and related activities.	Section 4
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river);	Section 4

	c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); and e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).	
2.4.5	How will the development impact on the functionality of the aquatic feature including: a. water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river) b. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland). c. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); d. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); e. The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc.) associated with or within the aquatic ecosystem.	Section 4
2.4.6	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 4
2.4.7	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 4
2.4.9	A motivation must be provided if there were development footprints identified as per paragraph 2.3 above that were identified as having a “low” biodiversity sensitivity and were not considered appropriate.	NA
3.	The report must contain as a minimum the following information:	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Appendix I
3.2	A signed statement of independence by the specialist;	Appendix I
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 1 and 4
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Appendix C and D
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 5 and 6
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 6
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 5
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 6
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Section 7
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 7

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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, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area 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.
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 soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
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.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil 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 occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
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 according to the International Union for Conservation of Nature (IUCN) Classification.

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 50 cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50 cm 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 soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

AC	Alternating Current
BAS	Best Attainable State
BESS	Battery Energy Storage System
BGIS	Biodiversity Geographic Information Systems
CVB	Channelled Valley Bottom
DC	Direct Current
DWA	Department of Water Affairs
DFFE	Department of Environment Forestry and Fisheries
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EI	Ecological Importance
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EPL	Ecosystem Protection Level
ES	Ecological Sensitivity
ESA	Ecological Support Area
ETS	Ecosystem Threat Status
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
ha	hectares
HGM	Hydrogeomorphic
IFC	International Finance Corporations
IPP	Independent Power Producer
km	kilometres
kV	Kilovolt
m	Metres
mm	Millimetre
m.a.m.s.l	Metres above mean sea level
MAP	Mean Annual Precipitation
MW	Megawatt
MWh	Megawatt-hours
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
OHPL	Overhead Powerline
O & M	Operation and Maintenance
PES	Present Ecological State
PS	Performance Standard
PV	Photovoltaic
REC	Recommended Ecological Category
REDZ	Renewable Energy Development Zone
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
SEF	Solar Energy Facility
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas

WUA	Water Use Authorisation
ZoR	Zone of Regulation

1 INTRODUCTION

1.1 *Background*

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed urban development on Ptn 268/189 Rietfontein IQ (hereafter referred to as the "study area"). The study area measures approx. 9.2 hectares (ha) in extent and is located approx. one kilometre (km) east of the town of Muldersdrift and approximately 0.3 km south of the R114 regional roadway. It falls within the Mogale City Local Municipality which is an administrative district of West Rand District Municipality, Gauteng Province. The location and extent of the proposed project is depicted in Figures 1 and 2 below.

To identify all freshwater ecosystems that may potentially be impacted by the development, a 500 m "zone of investigation" was implemented around the proposed development site, in accordance with Government Notice (GN) 4167 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA), to assess possible sensitivities of the receiving freshwater environment. This area – i.e., the 500 m zone of investigation around the proposed project- will henceforth be referred to as the 'investigation area'.

This report aims to define the freshwater ecology of the area in terms of characteristics, assessing key ecological drivers, and to define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), as well as the socio-cultural and ecological service provision of the freshwater ecosystems utilising current industry "best practice" assessment methods. Additionally, this report aims to define the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) for the freshwater ecosystems associated with the proposed project. Lastly, the potential impact of the proposed development on the freshwater ecosystems has been assessed through the application of the DWS Risk Assessment (2023). Suitable mitigation measures have been specified.

This report, after consideration of the above, must guide the Environmental Assessment Practitioner (EAP) and proponent on the proposed project activities from a freshwater management perspective and indicate any development constraints that must be considered in line with the principles of sustainable development and Integrated Environmental Management.

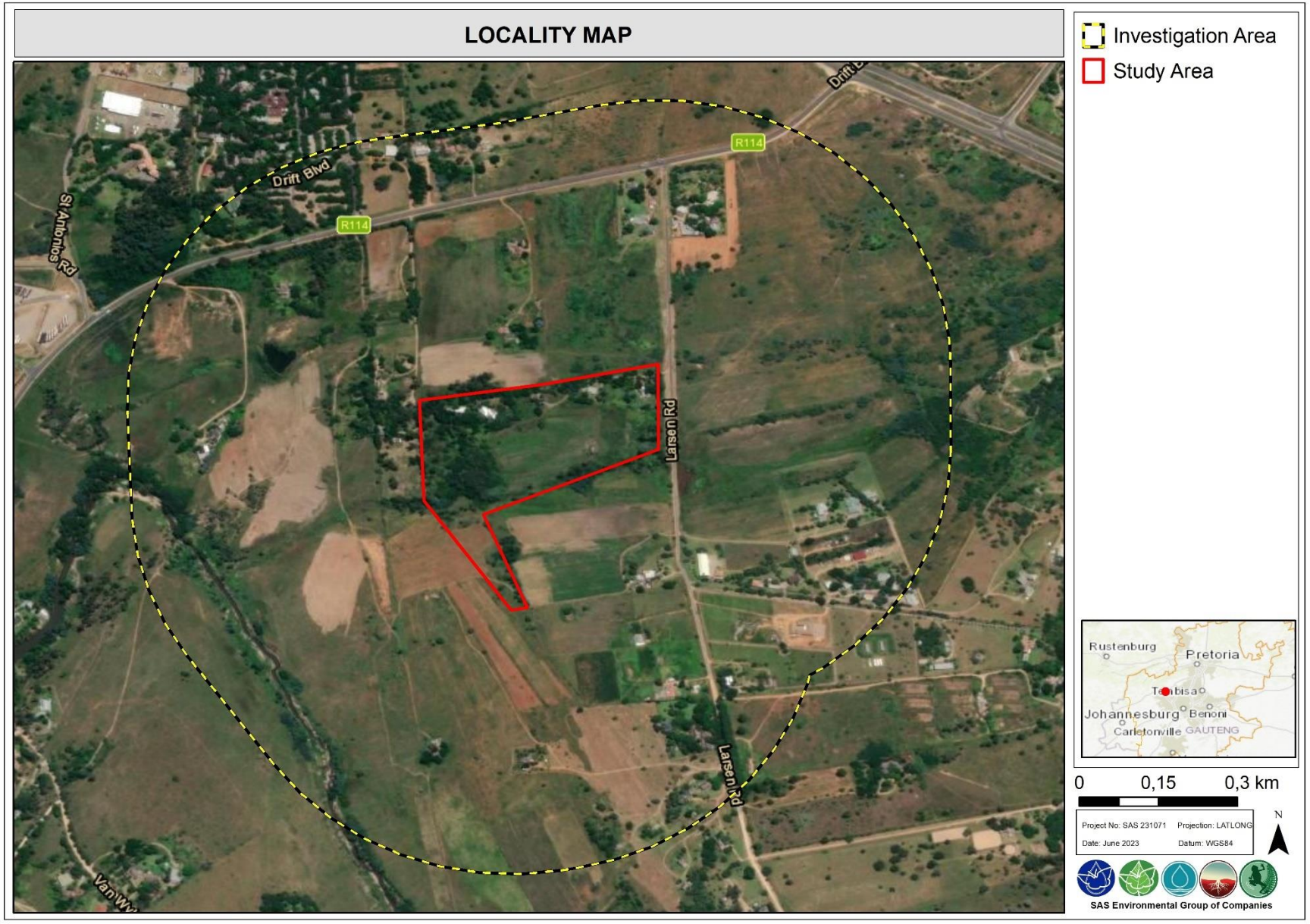


Figure 1: A digital satellite image depicting the general location of the proposed urban development (i.e. study area) and associated investigation area in relation to the surrounding area.

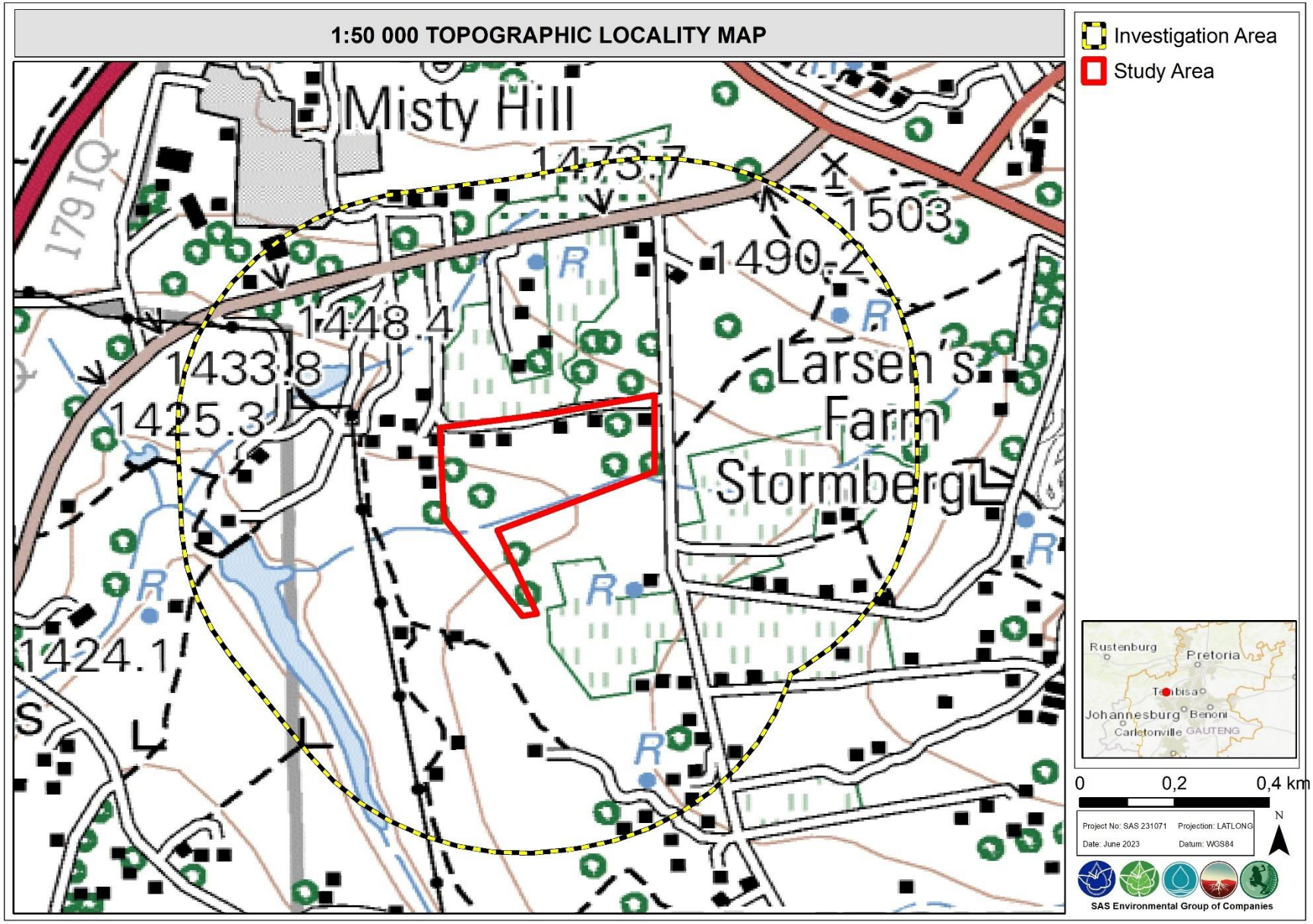


Figure 2: The proposed urban development area (i.e. study area) and associated investigation area depicted on a 1:50 000 topographic map in relation to the surrounding area.

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, National Biodiversity Assessment (NBA) (2018), and the Gauteng Conservation Plan (C-Plan V3.3, 2011) were undertaken to aid in defining the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems;
- All freshwater ecosystems associated with the proposed development were delineated using desktop methods in accordance with GN 4167 of 2023 as it relates to activities as stipulated in the National Water Act, 1998 (Act No. 36 of 1998), as amended, and verified according to the "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2]: A practical field procedure for identification of wetlands and riparian areas". Aspects such as soil morphological characteristics and wetness along with vegetation types were used to verify the freshwater ecosystems;
- The freshwater ecosystem 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 Present Ecological State (PES) of the freshwater ecosystems were assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.* (2008);
- The Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems were determined according to the method described by Rountree and Kotze, (2013);
- The Ecoservices of the freshwater ecosystems were assessed according to "A technique for rapidly assessing ecosystem services supplied by wetlands" (Kotze *et al.,* 2020);
- The freshwater ecosystem boundaries, and legislated zones of regulation were depicted for the freshwater ecosystems, where applicable;
- Allocation of a suitable Recommended Management Objective (RMO), Recommended Ecological Category (REC) and Best Attainable State (BAS) of the freshwater

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA) and subsequently as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.
[2] Even though an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas), this is still considered a draft document currently under review.

ecosystems were assigned based on the results obtained from the PES and EIS assessments; and

- Management and mitigation measures were presented which must be implemented during the various development phases to assist in minimising the impact of the proposed development on the receiving environment.

1.3 *Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- The freshwater ecosystems associated with the study area were ground-truthed, however, the freshwater ecosystems within 500 m of the study area were delineated using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs. The delineations of freshwater ecosystems outside the study area must not be utilised for any purpose, other than planning within the study area the data in this report pertains to. Any areas outside of the study area that may have additionally been mapped will require field-based delineation and ground-truthing as directed by applicable legislation and best practice methods;
- Various areas within the study area displayed transformed topography, soil profiles and runoff patterns within the landscape. Large portions of the study area are for example historically or currently transformed by agriculture (crop cultivation). As such, these disturbances have likely resulted in alterations to the hydroperiod of the freshwater ecosystems over time and have resulted in a complex mosaic of wet response areas interspersed between patches of terrestrial habitat. This is particularly true for the seep wetlands identified in the study area. This placed a limitation on the precision with which delineations could be done in the field, and in these cases, current and historical satellite imagery was used in conjunction with field-verified points to delineate the wetlands as accurately as possible;
- Some areas of the proposed project are underlain by Vertic and melanic soils which are dark brown/black or red coloured and strongly to very strongly structured. These soils have high clay content, display a high water-holding capacity and mostly contain a high percentage of swelling clay minerals. This is important in a freshwater (wetland) delineation context as the presence of vertic soils poses difficulties for delineation of wetlands as due to their high (alkaline) pH status ≥8; typical signs of wetness (such as mottling) are not typically present in these soils and the standard delineation procedure for wetlands in South Africa that relies mostly on soil wetness indicators cannot be applied where these soils were found. Accordingly, an adapted delineation

methodology which was based on vegetation, terrain, hydrological indicators and historical aerial photography, was applied in these areas;

- 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 actual site characteristics within the study area at the scale required to inform the EA process. However, this information is considered useful as background information to the study;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the freshwater ecosystems will need to be surveyed and pegged according to surveying principles and with surveying equipment;
- Wetland, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundaries may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results;
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. It is, however, expected that the freshwater ecosystem that may be affected by the proposed activities have been accurately assessed and considered, based on the site observations undertaken in terms of freshwater ecosystem ecology; and
- No project layout was available at the time this report was compiled, and the DWS Risk Assessment Matrix (2023) was therefore applied, assuming that the first (preferred) option in the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. the impacts would be avoided as opposed to minimised, rehabilitated or offset. As such, it was assumed that any development activities would remain outside of the delineated wetlands and their associated 50m GDARD buffer areas.

2 ASSESSMENT APPROACH

2.1 *Freshwater Ecosystem definition*

The NWA is aimed at the protection of the country's water resources, defined in the Act as:

> *"a watercourse, surface water, estuary or aquifer"*

According to the NWA a watercourse means:

> *(a) a river or spring;*
>
> *(b) a natural channel in which water flows regularly or intermittently;*
>
> *(c) a wetland, lake or dam into which, or from which, water flows; and*
>
> *(d) any collection of water which the Minister may, by notice in the Gazette, declare a watercourse.*

A 'Watercourse' as per the definition of the NWA, is referred to in this report as a "freshwater ecosystem"

The NWA further provides definitions of wetland and riparian habitats 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."

Another widely used definition of wetlands is the one used under the **Ramsar Convention**; wetlands are defined as:

> *"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"*

However, the presence / absence of hydric soils is the primary determining factor used to define a freshwater feature as a wetland.

This determining factor has been utilised in this assessment. Wetland soils can be termed hydric or hydromorphic soils. **Hydric soils** are defined by the United States Department of Agriculture's Natural Resources Conservation Service as being:

> *"soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part".*

These anaerobic conditions would typically support the growth of hydrophytic vegetation (vegetation adapted to grow in soils that are saturated and starved of oxygen) and are typified by the presence of redoximorphic features.

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent area.

2.2 *Freshwater Ecosystem Field verification*

Where limitations to on-site delineations were experienced, use was made of historical and current digital satellite imagery, topographic maps and available provincial and national databases to aid in the delineation of the freshwater ecosystem following the site assessment. The following were taken into consideration when utilising the above desktop methods:

- **Linear features:** since water flows/moves through the landscape, freshwater ecosystems often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- **Vegetation associated with freshwater ecosystems:** a distinct increase in density as well as shrub size near flow paths;
- **Hue:** with water flow paths often showing as white/grey or black and outcrops or bare soils displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation, with freshwater ecosystem vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery, these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas, where there is less soil moisture or surface water present; and
- **Texture:** with areas displaying various textures which are distinct from the adjacent terrestrial areas, created by varying vegetation cover and soil conditions within the freshwater ecosystems.

The site assessment was undertaken in November 2023 (mid-summer, wet season), to delineate and undertake a detailed freshwater ecosystem assessment of any freshwater ecosystems that may be affected by the proposed development. The delineation of the freshwater ecosystems took place as far as possible, according to the method presented in the “Updated manual for the identification and delineation of wetland and riparian resources” (DWAF, 2008). The foundation of the method is based on the fact that freshwater ecosystems have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soil; and
- Vegetation adapted to saturated soil.

In addition to the delineation process, a detailed assessment of the delineated freshwater ecosystems was undertaken. Factors affecting the integrity of the freshwater ecosystems were taken into consideration and aided in the determination of the functioning and the ecological

and socio-cultural services provided by the freshwater ecosystems. A detailed explanation of the methods of assessment undertaken is provided in **Appendix C** 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” 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. Where required, further discussion and interpretation is provided.

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 areas actual site characteristics at the scale required to inform the EA/ WUA processes. Nevertheless, this information is considered useful as background information to the study, is important in legislative contextualisation of risk and impact, and was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance. It must, however, be noted that site assessment of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. The information contained in the dashboard report below is intended to provide background to the landscape of the proposed development. Actual site conditions at the time of the assessment may differ to the background information provided by various datasets. Please refer to Section 4 for details pertaining to the site investigation.

Table 1: Desktop data indicating the characteristics of the freshwater ecosystems associated with the study area and associated investigation area [Quarter Degree Square (2627BB)].

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	Highveld
Catchment	Limpopo
Quaternary Catchment	A21E
WMA	Crocodile West and Marico
subWMA	Upper Crocodile
Dominant characteristics of the Highveld Ecoregion Level II (11.01) (Kleynhans *et al.*, 2007)	
Level II Code	11.01
Dominant primary terrain morphology	Plains
Dominant primary vegetation types	Rocky Highveld Grassland; Mixed Bushveld
Altitude (m a.m.s.l)	1300 to 1900
MAP (mm)	500 to 700
The coefficient of Variation	20 to 34
Rainfall concentration index	55 to 64
Rainfall seasonality	Early to mid-summer
Mean annual temp. (°C)	14 to 18
Winter temperature (July)	0 to 20
Summer temperature (Feb)	12 to 30
Median simulated runoff (mm)	20 to 60
ES of the most proximal sub-quaternary reach (DWS, 2014)	
Sub-quaternary reach	A21E-01224 (Crocodile River)
Distance from the study area	± 2.00 km south-east of the study area
Assessed by an expert?	Yes
PES Category Median	Seriously Modified (Class E)
Mean EI Class	Moderate
Mean ES Class	High
Stream Order	1
Default Ecological Class	B (High)
National web-based Environmental Screening Tool (2020) (Accessed 2023) (Figure 5).	
The screening tool is intended for the pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the migration hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	
The study area is in an area considered to be of **very high** aquatic biodiversity sensitivity, due to the study area being located in **proximity to wetlands.**	
Gauteng Environmental Management Framework (GEMF, 2014) (Figure 7).	

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) Database	
FEPACODE	The study and investigation areas fall within a sub-quaternary catchment classed as a FEPA **CODE 2** (**Fish Support Areas**). These sub-quaternary catchments are fish sanctuaries in a lower than an A or B ecological condition, an include sub-quaternary catchments that are important for the migration of threatened fish species. This catchment is important for the migration of one fish species of *Enteromius (Barbus) motebensis* which is indicated as vulnerable by NFEPA.
NFEPA Wetlands (Figure 3)	According to the NFEPA Database, no wetlands are located within the study area. A channelled valley bottom wetland is indicated west of the investigation area and is shown by the database to be in a Heavily to Critically Modified (WETCON Z3) ecological condition.
Wetland Vegetation Type	The study area is situated within the Mesic Highveld Grassland Group 3 Vegetation Type, indicated as Least Threatened (LT) by Mbona *et al.* (2015).
NFEPA Rivers (Figure 3)	As per the NFEPA Rivers Database, the Crocodile River is located within the investigation area west of the study area. The river is indicated by the database to be in a Heavily Modified (RIVCON = D) ecological condition.
Strategic Water Source Areas (SWSA, 2017)	
Surface water SWSAs are defined as areas of land that supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The sub-national Water Source Areas (WSAs) are not nationally strategic as defined in the report but were included to provide complete coverage.	
The study area and its associated investigation area are not indicated to be within a surface Strategic Water Source Area.	
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA) (Figure 4).	
According to the NBA 2018: SAIIAE Database, five natural wetlands are indicated by the database to be within the investigation area, including an unchanneled Valley Bottom (UCVB) with an associated seep wetland that also traverses the study area. Two other seep wetlands and a CVB wetland along the Crocodile River are indicated to be within the investigation area by the database. All wetlands are indicated by the database as Largely to Critically Modified (WETCON D/E/F) and Critically Endangered (ETS2018). The UCVB wetlands are indicated as Not Protected while the seep wetlands are indicated as Poorly Protected (EPL2018). The Artificial Wetlands Database indicates dams along the UCVB wetland and the seep wetlands in the investigation area to the west of the study area. The rivers database indicates the Crocodile River is indicated within the investigation area. The NBA Rivers Database indicates the Crocodile River flows west of the study area. The river is indicated by the database to be in a Seriously Modified (RIVCON = E) ecological condition and is indicated by the database as Critically Endangered (ETS2018) AND Poorly Protected (EPL2018).	
Detail of the Assessment area in terms of the Land Type Data (Figure 6).	
The study area falls within the Bb2 land type, and its associated investigation area falls within both the Bb2 and the Bb1 land types. Soil. In Bb Land Types dystrophic yellow-brown and grey soils are widespread. Ba and Bb Land Types are generally located in the eastern and central interior basins. A very large part of the South African interior is occupied by a catena in its perfect form represented by Hutton, Avalon, Bainsvlei, and Longlands soil forms. Glencoe, Wasbank, Westleigh and occasionally Tambankulu and Mispah (Hillside and Klipfontein series; or Dresden 1991 classification) plinthic soils are also present. Plinthic soils occupy at least 10% of the landscape. Where sedimentary rocks dominate the underlying geology, Pinedene and Kroonstad occupy lower slope positions, while Katspruit soil forms and streambeds are present in stable bottomland terrain positions. Duplex soils of the Valsrivier and Sterkspruit forms and alluvium (Dundee and Oakleaf forms) are dominant in many less stable bottomland sites. In addition, where basic igneous rocks are widespread,	

<table>
<tr><td rowspan="5">The study and investigation area are mostly indicated as an Urban Development Zone (Zone 1) except for portions shown as High Control Zone (Zone 2) where the wetlands and the Crocodile River are indicated. A small section in the south of the investigation area is indicated to be within the Normal Control Zone (Zone 4).
<u>Zone 1 (Urban Development Zone):</u> The intention with this zone is to streamline urban development activities in it and to promote development infill, densification, and concentration of urban development in order to establish a more effective and efficient city region that will minimise urban sprawl into rural areas.
<u>Zone 2 High Control Zone (Within Zone 1: the Urban Development Zone):</u> This zone is sensitive to development activities. Only conservation should be allowed in this zone. Related tourism and recreational activities must be accommodated in areas surrounding this zone.
Zone 3 Normal Control Zone: This zone is dominated by agricultural uses outside the urban development zone. Agricultural and rural development that support agriculture should be promoted.</td><td colspan="2">black clay soils of the Rensburg, Willowbrook and Bonheim soils also occupy bottomland positions. Mispah, Glenrosa and rock land are also common features of the landscape.</td></tr>
<tr><td colspan="2">Detail of the study area in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011) (Figure 8 -9).</td></tr>
<tr><td>Critical Biodiversity Area (CBA)</td><td>Portions of the study area and investigation area associated with the Crocodile River and wetlands are indicated as Critical Biodiversity Areas: Irreplaceable Areas, which are essential in meeting targets set for conservation of biodiversity by providing habitat for Red Listed plant habitat, Orange Listed plant habitat, Red Listed bird habitat, primary vegetation, and a bioclimate zone.</td></tr>
<tr><td>Ecological Support Area (ESA)</td><td>Portions of the investigation area along the CBA areas and in a large portion of the UCVB wetland in the study area are indicated by the database as ESAs. No ESAs are indicated to be within the study area. Ecological Support Areas (ESAs) are natural, near natural, degraded or heavily modified areas required to be maintained in an ecologically functional state to support CBAs and/or Protected Areas.</td></tr>
<tr><td>Wetland and River Buffers</td><td>The database indicates a non-perennial river buffer along the Crocodile River and within the study area where the UCVB wetland is indicated east of the study area. No wetland buffers are indicated to be within the study area or investigation area by the database.</td></tr>
<tr><td>DWS 1:50 000 Rivers Database for Gauteng (2022) (Figure 10).
According to the Gauteng Rivers Database, a non-perennial, unnamed tributary of the Crocodile River traverses the study area. The tributary is indicated to be in a developed landscape. This is where the river passes through a landscape that is generally transformed. This type is important if understanding is needed on the impacts of hard surfaces or agriculture on water quantity and quality.</td><td>Ridges (C-Plan Ridges V81_2020)</td><td>The north of the study area within the investigation area is indicated to have a Class 3 ridge. The ridge is indicated to be transformed by cultivation and urbanization. No ridge features are associated with the study area.
Class 3 ridges are ridges that have been transformed by 35% or more, but less than 65% because of human activity.</td></tr>
</table>

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; EPL = Ecosystem Protection Level; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area.

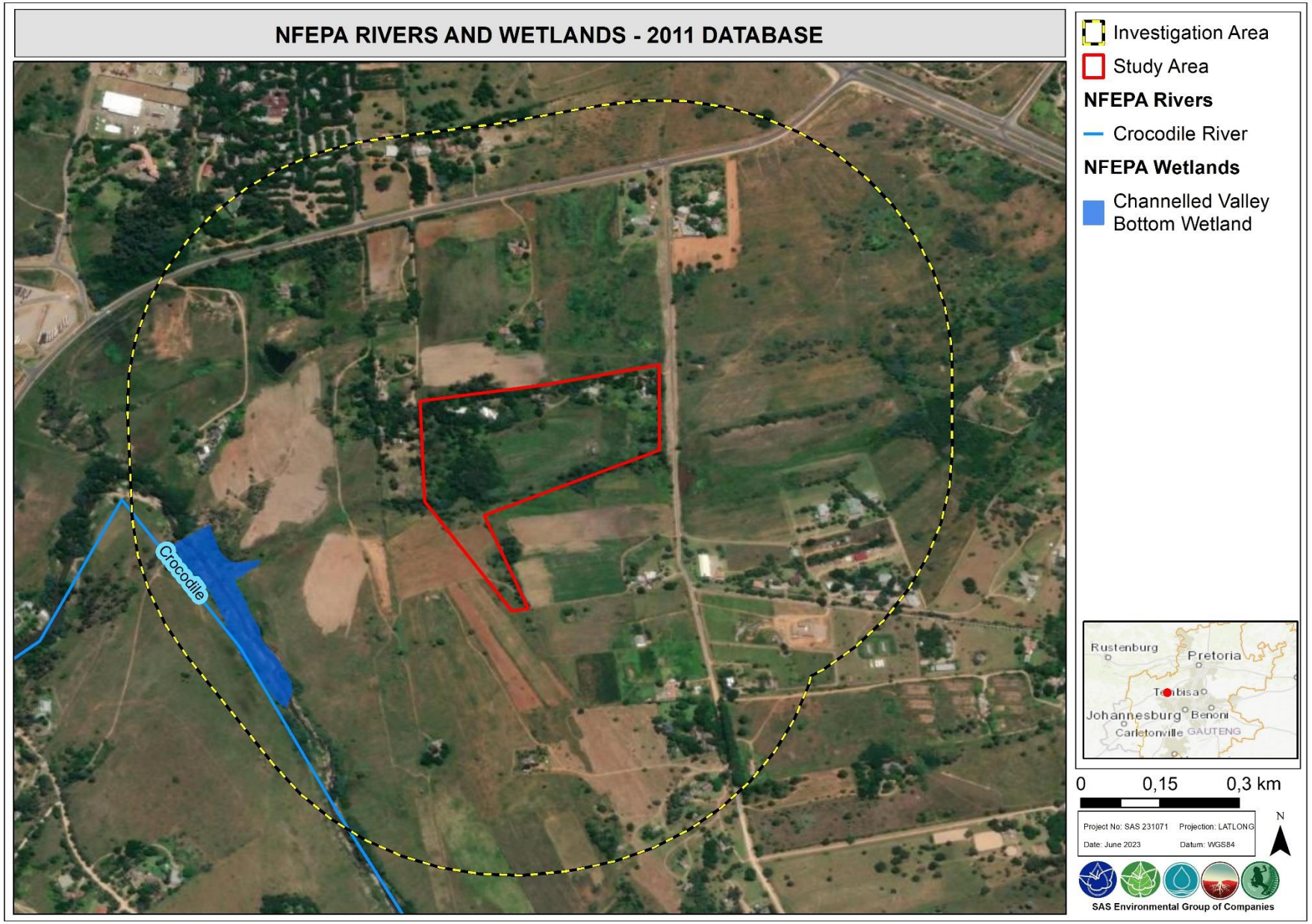


Figure 3: Wetlands and rivers associated with the study and investigation areas according to the NFEPA database (2011).

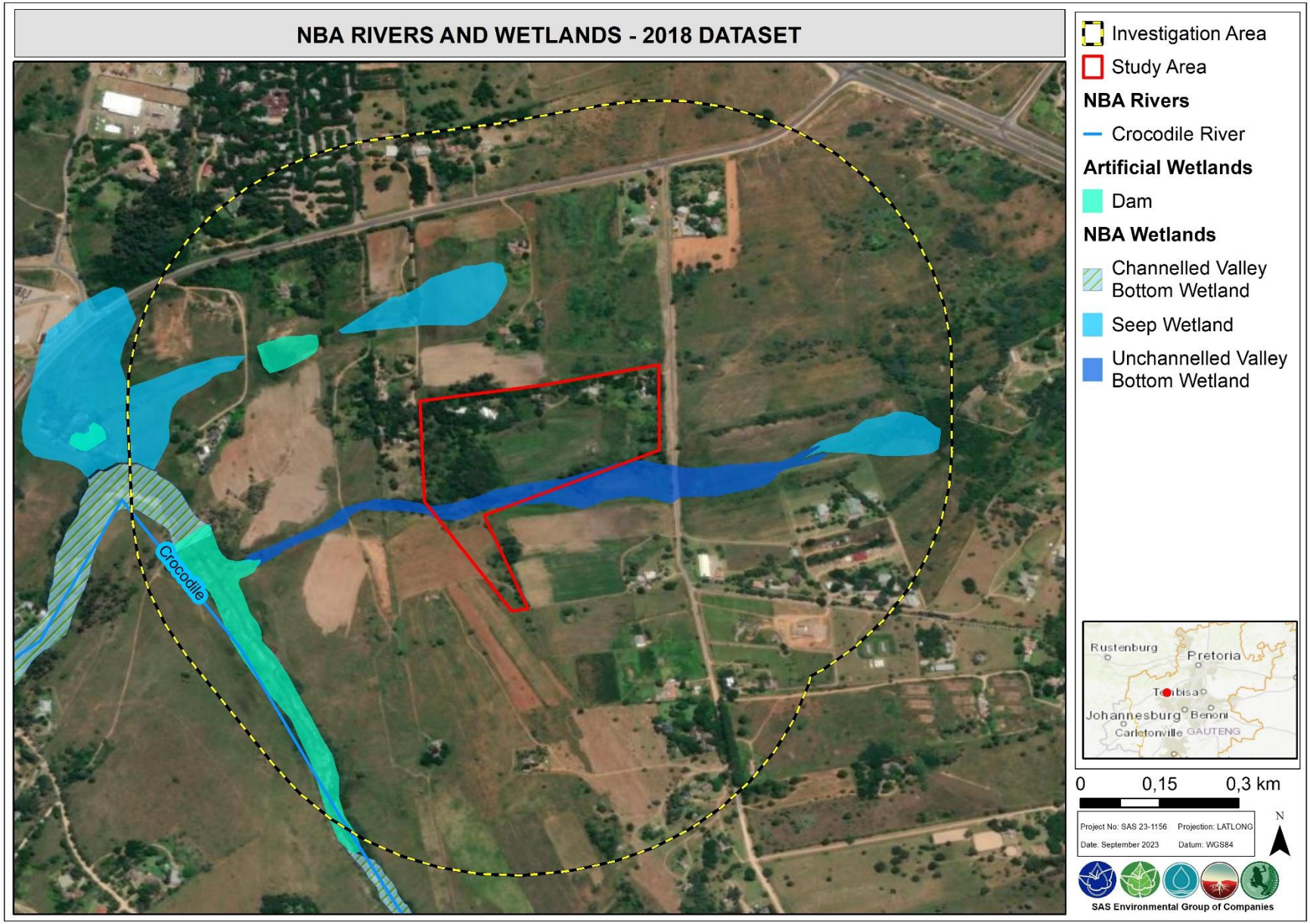


Figure 4: Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment database (2018).

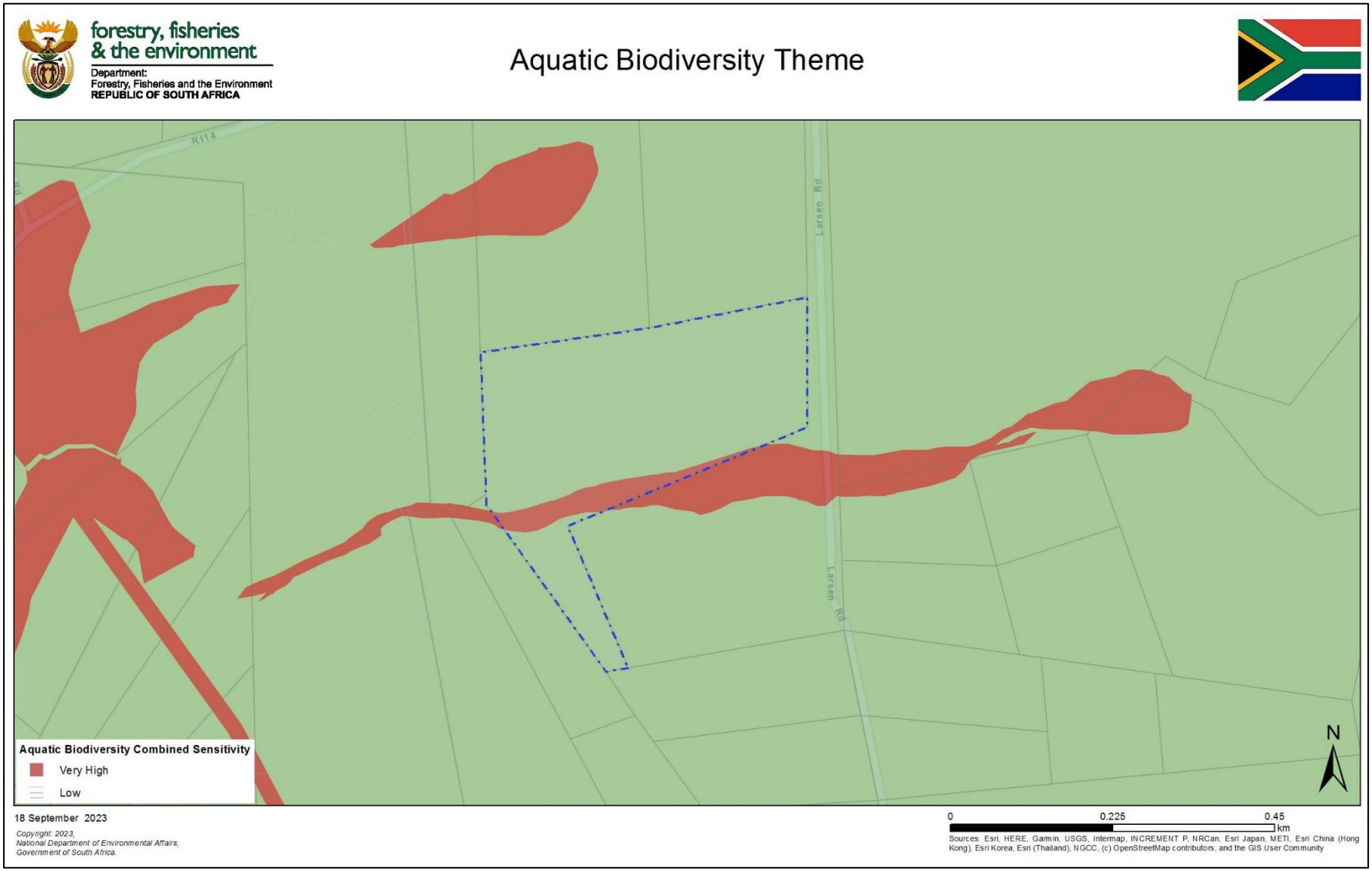


Figure 5: The sensitivity associated with the study area according to the National Web Based Environmental Screening Tool (Accessed 2024).

Figure 6: The land types associated with the study and investigation area.

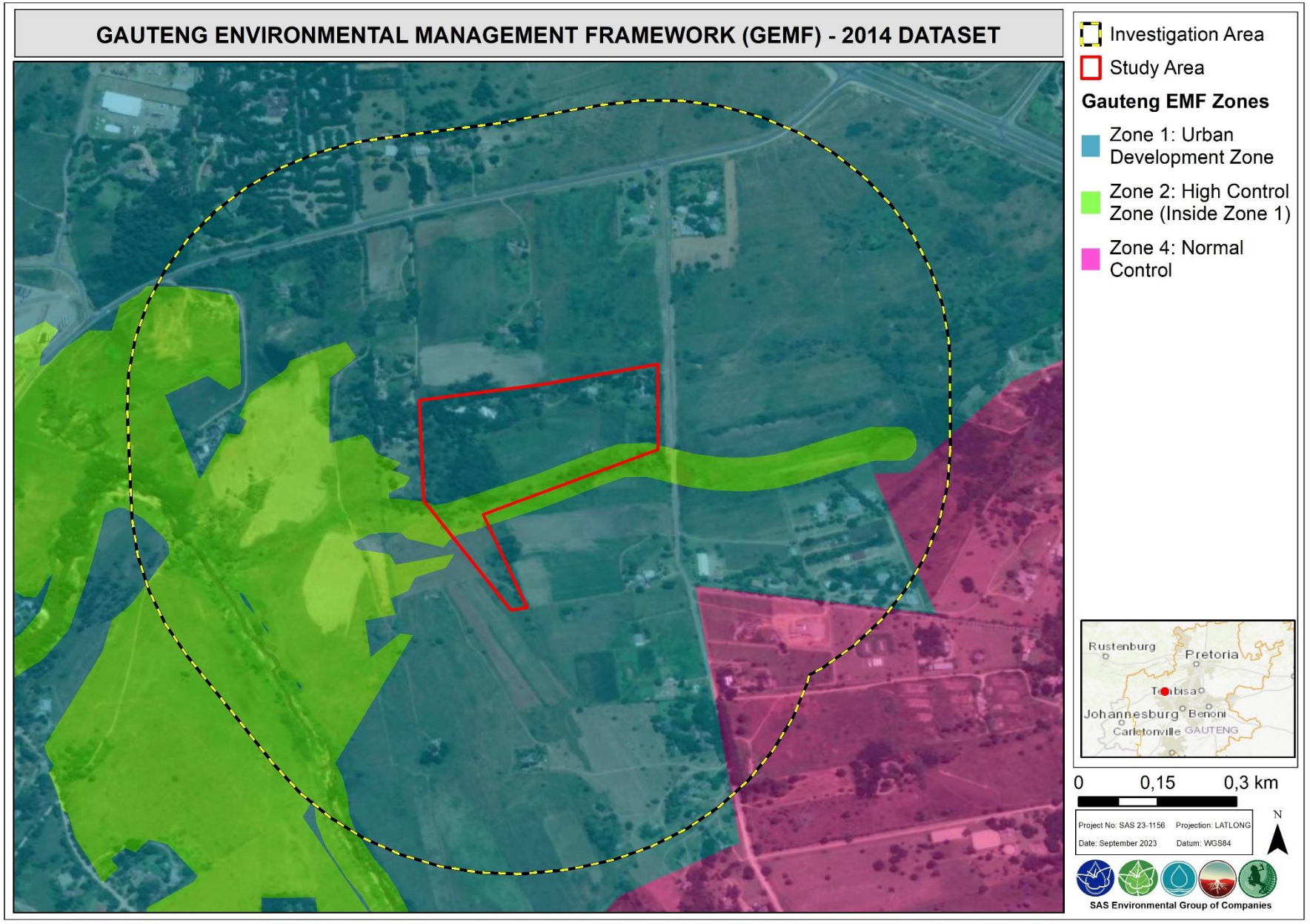


Figure 7: Detail of the study and investigation area in terms of the Gauteng Environmental Management Framework (GEMF, 2014).

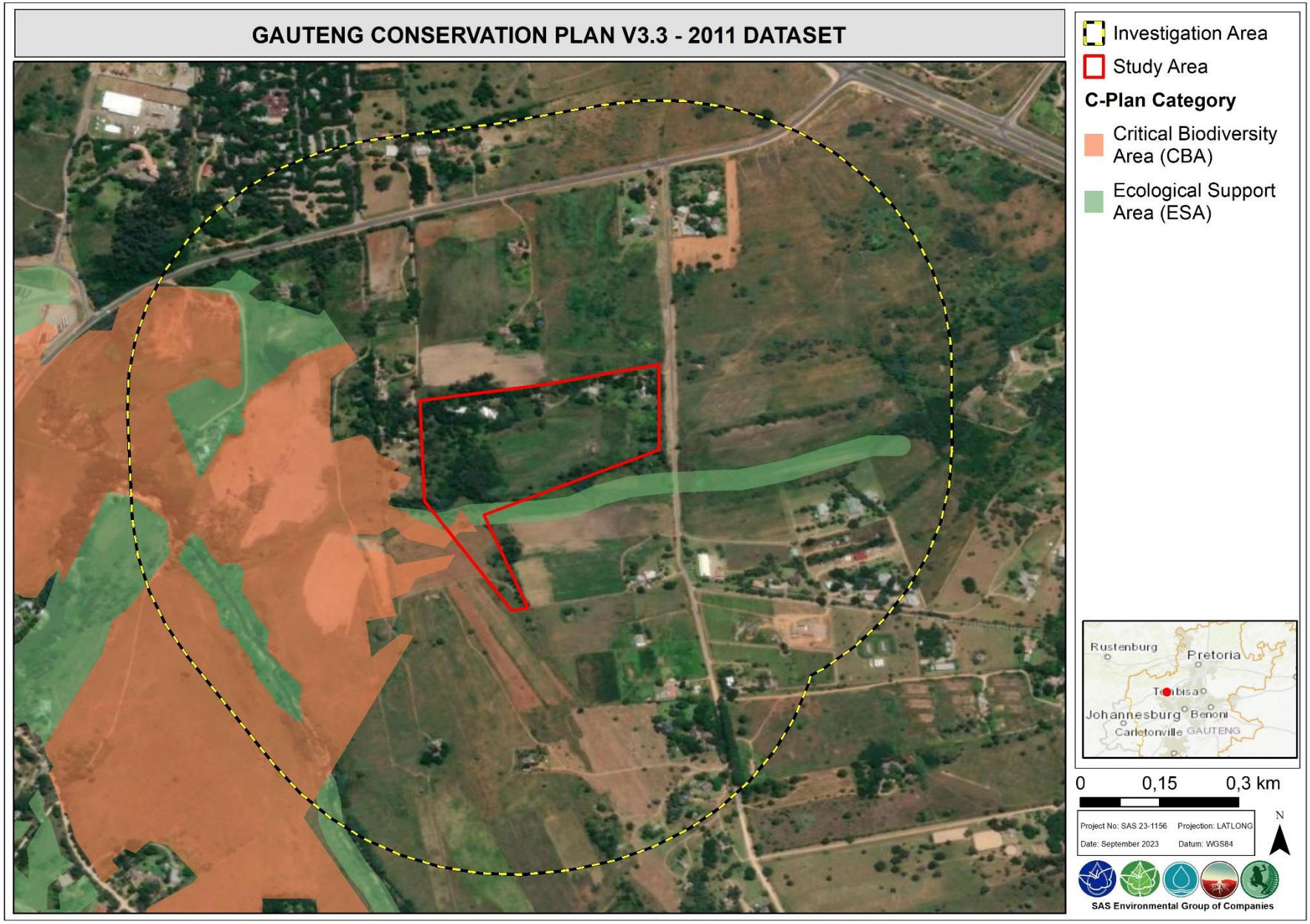


Figure 8: Detail of the study and investigation area in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011).

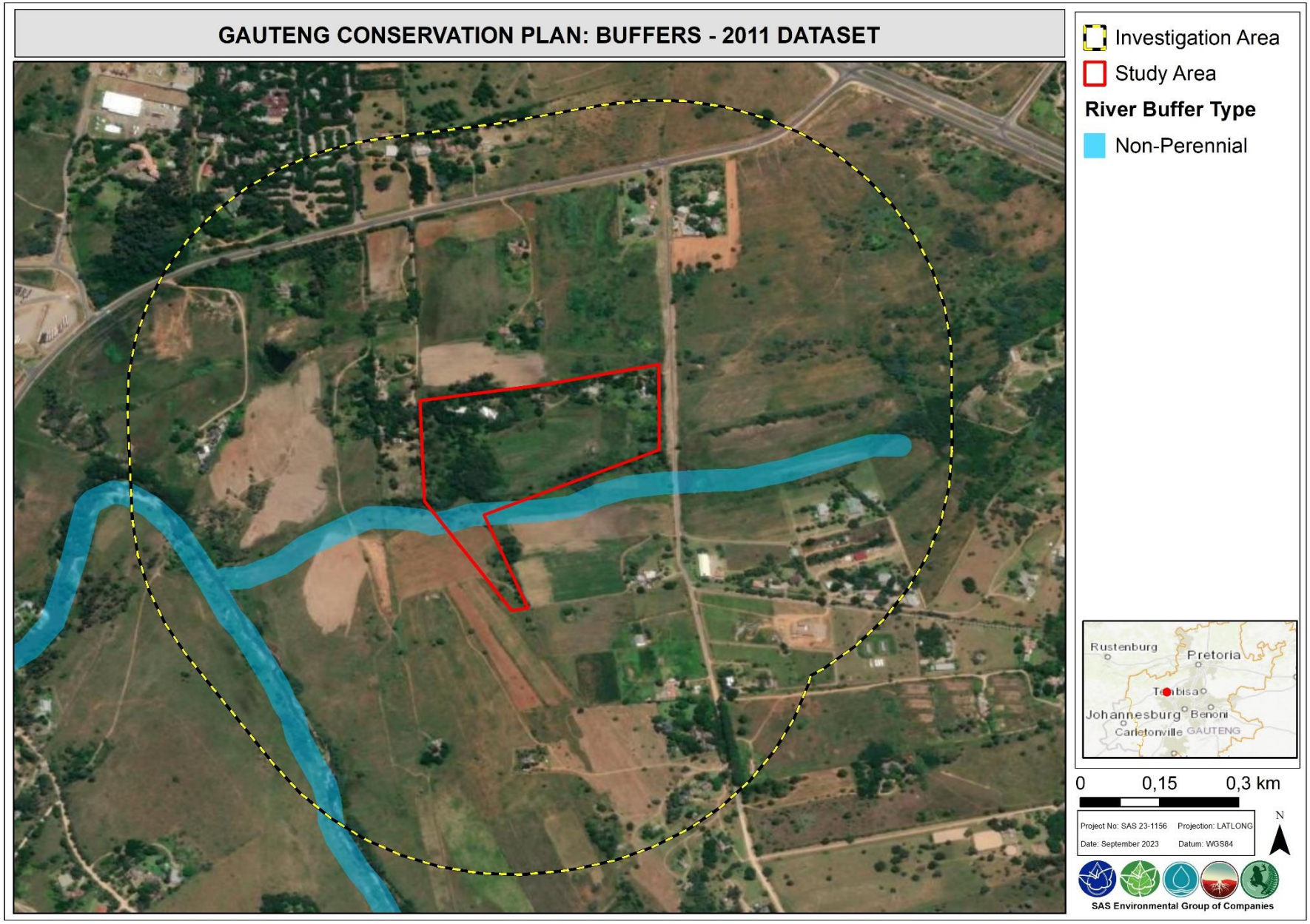


Figure 9: Wetland and river buffers according to the Gauteng Conservation Plan (C-Plan V3.3, 2011).

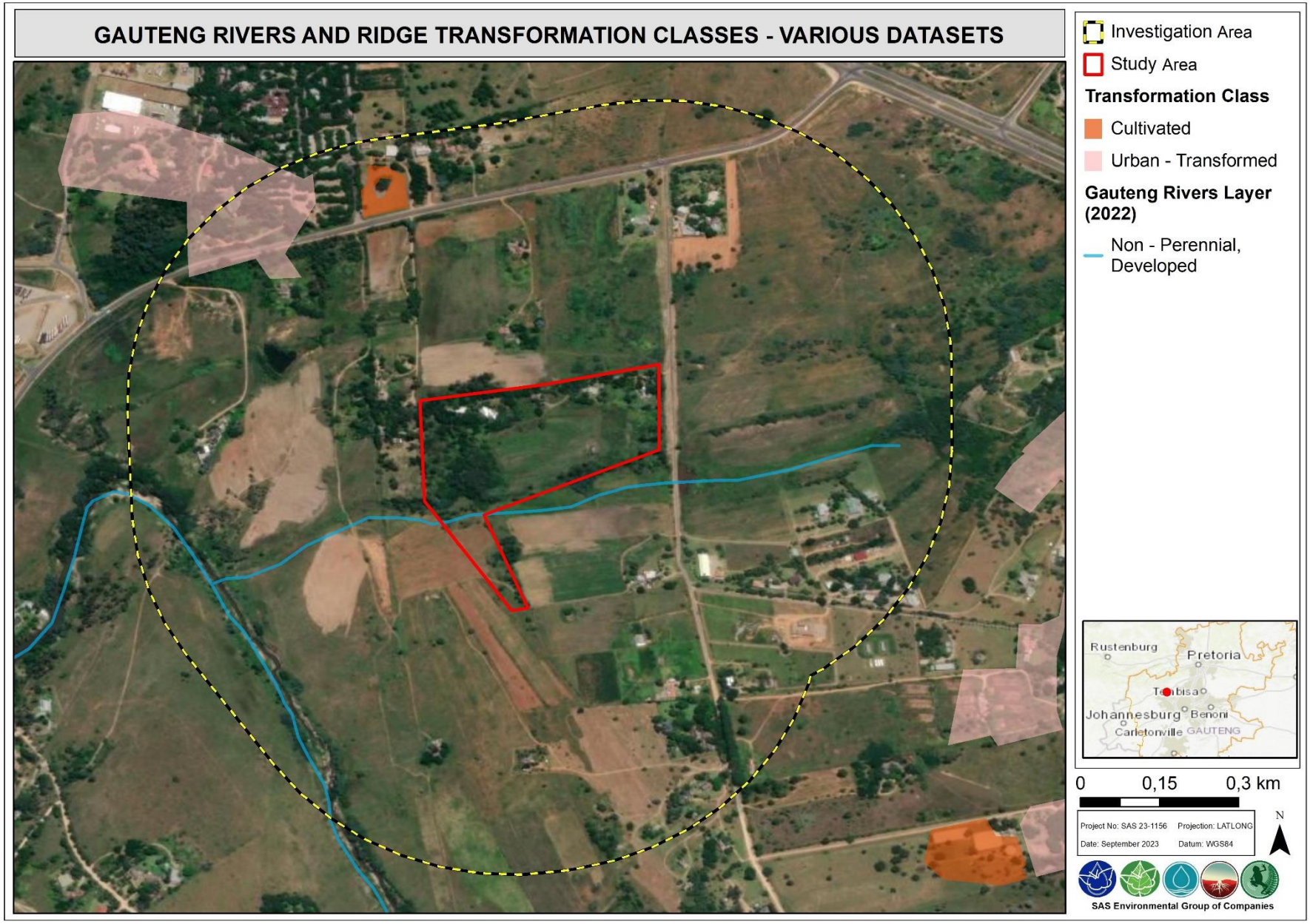


Figure 10: The rivers associated with the study and investigation areas according to the DWS 1:50 000 Rivers Database for Gauteng (2022).

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.

The study area falls within the Highveld Ecoregion and is within the A21E - 01224 (Crocodile River) quaternary catchment. According to the PES/EIS database, as developed by the DWS RQIS department, the Sub-Quaternary Catchment Reach (SQR) for the A21E - 01224 (Figure 11) is applicable, with the SQR monitoring point located approximately 2.00 km south-east of the study area. Key information on background conditions associated with the study area as contained in this database and pertaining to the PES and EIS for the reach is indicated in the tables below.

The following macro-invertebrate taxa have previously been reported from SQR A21E - 01224 (Crocodile River):

Aeshnidae	*Aeshnidae*	*Aeshnidae*	*Aeshnidae*
Baetidae 2 Sp	*Baetidae 2 Sp*	*Baetidae 2 Sp*	*Baetidae 2 Sp*
Belostomatidae	*Belostomatidae*	*Belostomatidae*	*Belostomatidae*
Caenidae	*Caenidae*	*Caenidae*	*Caenidae*
Ceratopogonidae	*Ceratopogonidae*	*Ceratopogonidae*	*Ceratopogonidae*
Chironomidae Culicidae	*Chironomidae Culicidae*	*Chironomidae Culicidae*	*Chironomidae Culicidae*
Coenagrionidae	*Coenagrionidae*	*Coenagrionidae*	*Coenagrionidae*

The following fish species has previously been reported from SQR A21E - 01224 (Crocodile River):

Clarias gariepinus	*Enteromius motebensis*	*Labeobarbus marequensis*	*Tilapia sparrmanii*
Enteromius anoplus	*Enteromius paludinosus*	*Pseudocrenilabrus philander*	

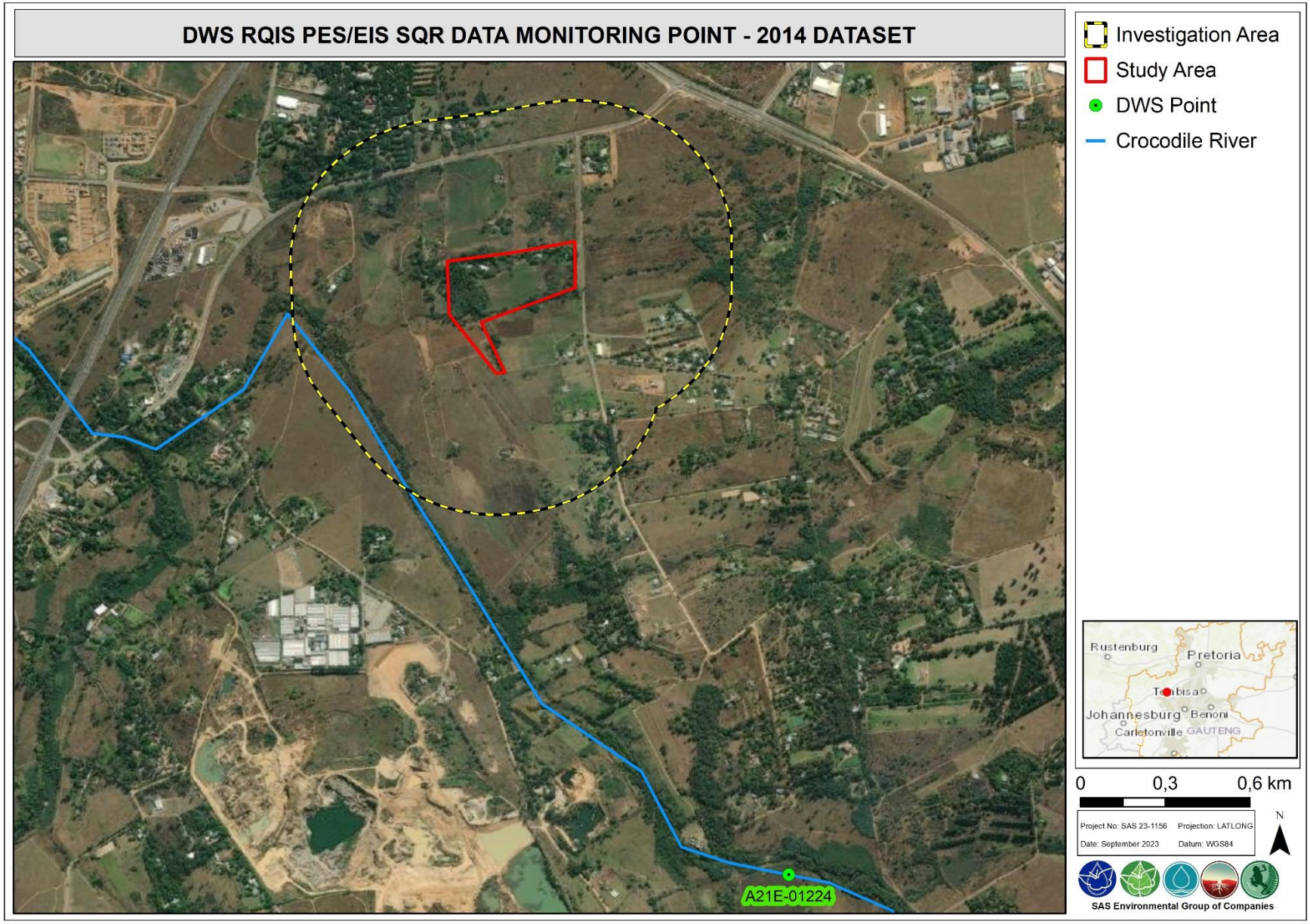


Figure 11: Relevant sub-quaternary catchment reach (SQR) monitoring point associated with the study area and associated investigation area according to the DWS database (2014).

Table 2: Summary of the ecological status of the sub-quaternary catchment (SQ) reach A21E - 01224 (Crocodile River) on the DWS RQS PES/EIS database.

Synopsis SQ reach A21E - 01224 (Crocodile River):					
PES[1] category median	**Mean EI[2] class**	**Mean ES[3] class**	**Length**	**Stream order**	**Default EC[4]**
E (Seriously Modified)	Moderate	High	23.73 km	1	B
PES details					
Instream habitat continuity MOD		Large	**Riparian/wetland zone MOD**		Large
RIP/wetland zone continuity MOD		Serious	**Potential flow MOD activities**		Serious
Potential instream habitat MOD activities		Serious	**Potential physico-chemical MOD activities**		Serious
EI details					
Fish spp/SQ		7.00	**Fish average confidence**		1.29
Fish representativity per secondary class		Low	**Fish rarity per secondary class**		Very High
Invertebrate taxa/SQ		30.00	**Invertebrate average confidence**		4.40
Invertebrate representativity per secondary class		Moderate	**Invertebrate rarity per secondary class**		High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating		High	**Habitat diversity class**		High
Habitat size (length) class		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 500 m**		Moderate
Riparian-wetland natural vegetation rating based on expert rating					High
ES details					
Fish physical-chemical sensitivity description		High	**Fish no-flow sensitivity**		High
Invertebrates physical-chemical sensitivity description		High	**Invertebrate velocity sensitivity**		Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description					Very High
Stream size sensitivity to modified flow/water level changes description					High
Riparian-wetland vegetation intolerance to water level changes description					High

[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.

4 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

4.1 *Freshwater Ecosystem Characterisation*

The site assessment confirmed the presence of an unchanneled valley bottom (UCVB) wetland, which intersects a southern portion of the study area. The UCVB wetland flows in a south-westerly direction and drains into the Crocodile River approximately 0.4 km downstream of the study area. Two hillslope seep (HSS) wetlands were also identified within the study area, both of which drain directly into the UCVB wetland. Two more freshwater ecosystems (another UCVB wetland and a channelled valley bottom wetland associated with the Crocodile River) were identified within the investigation area, but were not considered further for the purposes of this report as the potential risks associated with the proposed development on these two systems are considered negligible.

The identified freshwater ecosystems within the proposed development area were classified according to the Classification System (Ollis *et al.*, 2013) as Inland Systems. The freshwater ecosystems fall within the Mesic Highveld Grassland Group 3 Vegetation Type, indicated as Least Threatened (LT) by Mbona et al. (2015). At Levels 3 (Landscape Unit) and 4 (HGM Type) of the Classification System, the systems were classified as per the summary in Table 3, below.

Table 3: Characterisation at Levels 3 and 4 of the Classification System (Ollis *et al*., 2013) of the freshwater ecosystem associated with the proposed development area (i.e. study area).

Freshwater ecosystems	Level 3: Landscape unit	Level 4: HGM Type
One **Unchanneled Valley Bottom** wetland was identified which traverses the southern portion of the study area.	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes.	**Unchanneled valley bottom:** A valley bottom wetland without a river channel running through it.
Two **Hillslope Seep** wetlands were identified within the study area.	**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.	**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 delineated freshwater ecosystems in relation to the study area are conceptually depicted in Figure 12 below.

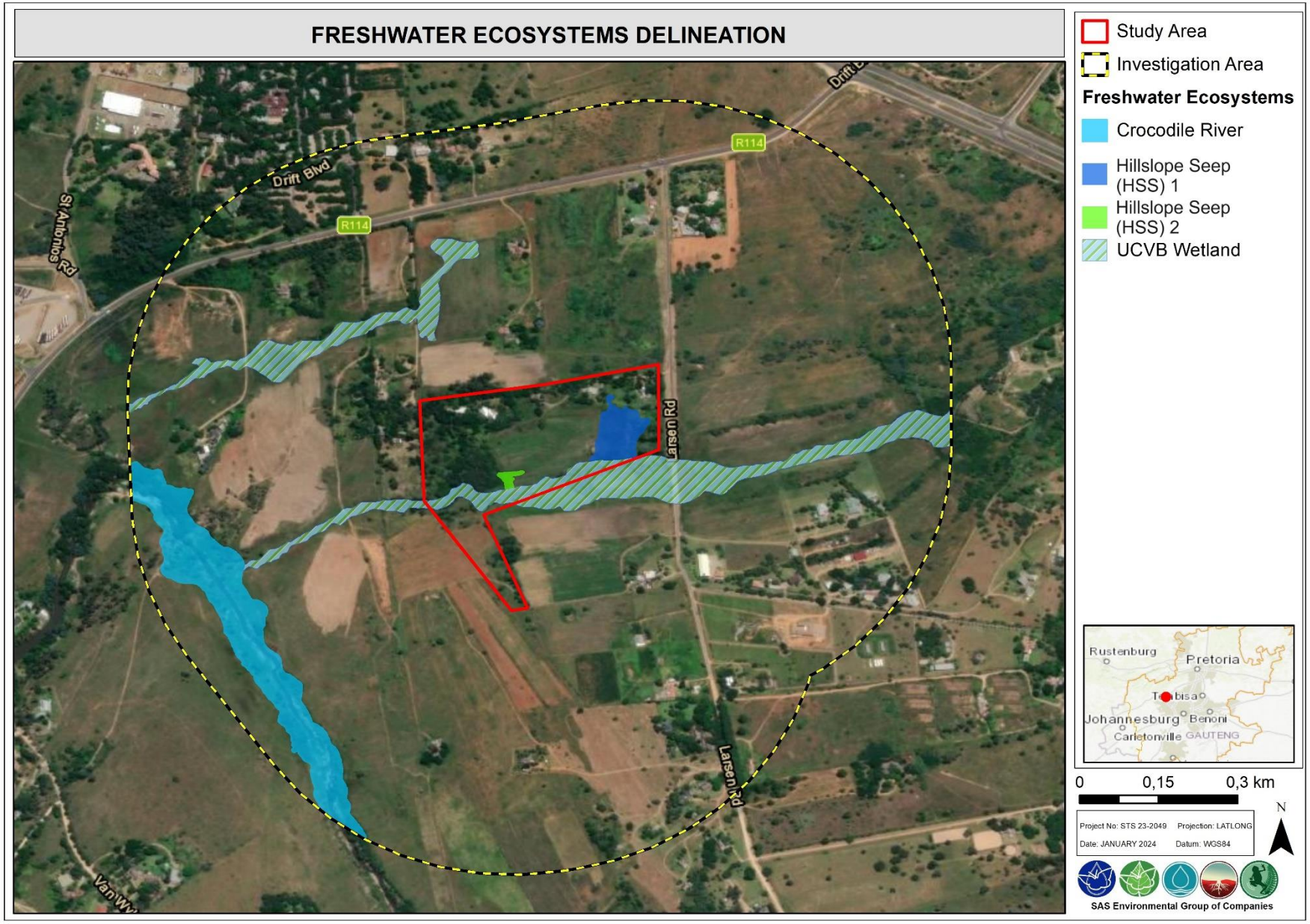


Figure 12: Location of the freshwater ecosystem associated with the proposed development within the study and investigation area.

4.2 *Freshwater Ecosystem Delineation*

As noted in Section 1.2, the freshwater ecosystem assessment was limited to the freshwater ecosystems within the study area as provided by the proponent. It was noted during the site assessment that historical and ongoing agricultural activities have occurred within the investigation area and immediate surrounds. The delineations as presented in this report, are nevertheless deemed the best estimate of the freshwater ecosystem boundaries based on site conditions present at the time of the assessment and are considered adequate to allow for informed decision-making.

During the site assessment, the following indicators were used to delineate the boundaries of the freshwater ecosystem:

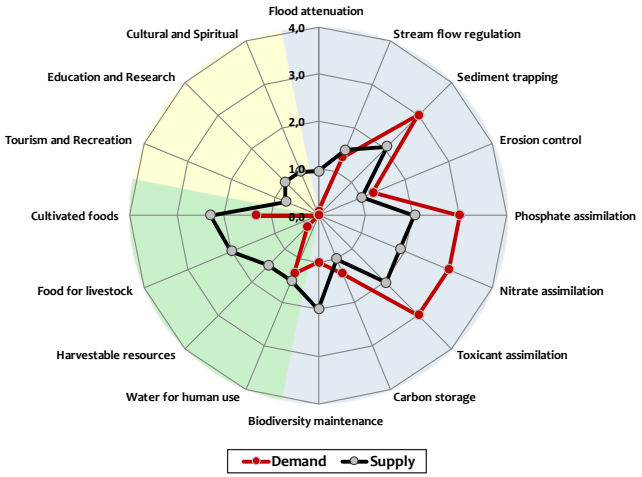
- **Soil wetness indicator**, duration and frequency of saturation in the soil profile is a diagnostic indicator since it influences the colour change in the soil. Low chroma (grey and muted colours) as well as mottles are more prominent in soil which have higher saturation frequency. Soils displaying signs of hydromorphism also indicates an increased hydroperiod and thus the potential presence of hydromorphic characteristics. These soil characteristics were found in some areas within the assessed site, however, the majority of the proposed project is underlain by Vertic and melanic soils which are dark brown/black or red coloured and strongly to very strongly structured (topsoil and subsoil). These soils have high clay content, display a high water-holding capacity and mostly contain a high percentage of swelling clay minerals. This is important in a freshwater (wetland) delineation context as the presence of vertic soils poses difficulties for delineation of wetlands due to their high (alkaline) pH status ≥8; typical signs of wetness (such as mottling) are therefore not typically present in these soils and the standard delineation procedure for wetlands in South Africa that relies mostly on soil wetness indicators could not be applied in these areas. Accordingly, an adapted delineation methodology which was based on vegetation, terrain, hydrological indicators and historical aerial photography was applied in these areas;
- **Vegetation** was utilised as the primary indicator to identify and define the freshwater ecosystems. The distinction between obligate, facultative, and terrestrial vegetation was mostly discernible. Vegetation species composition and structure was utilised to determine wetland boundaries, except in those areas where recent soil tilling occurred or in areas where woody AIPs were proliferating.

- **Terrain setting** indicators were used as a secondary, confirmatory indicator. Terrain was utilised to provide an indication of low-lying areas where water is likely to collect and/or move through the landscape; and
- The **presence of moisture** and evidence of water movement in the landscape was utilised as a further confirmatory indicator.

4.3 *Site Verification Results*

Following the site assessment, the assessments outlined in Section 1.2 were applied. The results of the assessments are discussed in the dashboard style reports which follow (Table 4 and 5) and the details thereof are presented in Appendix E. In addition, a freshwater ecosystem site sensitivity verification report was compiled for the proposed project according to the “Protocols for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes (“the Protocols”) published in Government Gazette No. 43110 on 20 March 2020 and Government Gazette No. 43855 on 30 October 2020. The Protocols must be complied with for every new application for Environmental Authorisation that is submitted after 9 May 2020. The site sensitivity verification report is presented in Appendix H.

Table 4: Summary of the assessment of the Unchanneled Valley Bottom (UCVB) wetland within the study area.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph (present state):
 
</td><td colspan="2">  
Photographic notes: Representation of the UCVB wetland system located within the study area. Left: An upstream portion of the UCVB wetland, which is characterised by open herbaceous wetland vegetation Right: A downstream section of the UCVB wetland which is heavily invaded by woody AIPs (e.g. Acacia mearnsii and Eucalyptus) along the stream channel margins.</td></tr>
<tr><td>PES Discussion</td><td>Present Ecological Condition (PES): Largely modified (PES D)
The UCVB wetland within the study area was considered largely modified from its expected reference state. The largest identified impacts on the system include extensive agricultural activities within the marginal (temporary zone) areas of the wetland) as well as woody Alien Invasive Plant (AIP) proliferation within the wetland habitat.</td><td>Ecoservice provision</td><td>Ecoservices category: Moderate
Various portions of the wetland are prominently utilised for crop production. The system also provides some grazing of moderate quality for livestock, although the assessed unit it does not appear to be utilised as such at present. Some reeds and sedges are also present for harvesting. Overall, the system supports good herbaceous vegetation cover, which provides resistance to flow and it is expected that the system contributes to sediment trapping as well as nutrient and toxicant assimilation to some degree, although the system's performance in this regard is lessened by its modified state, and it is therefore expected that the high demand for these services cannot be fully met by the system. The system also supports a moderate diversity of flora and fauna, despite its transformed nature. The eastern portion of the UCVB wetland is characterised by a prominent permanent zone with waterlogged soils that slow down organic matter decomposition, and it is therefore expected that it contributes to carbon sequestration, albeit on a local scale.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category: High
Despite extensive transformation and deteriorated Ecostatus of the system, the Ecological Importance and Sensitivity of the UCVB wetland is considered high. Within a regional context, the wetland is classified as an Ecological Support Area, and as such is considered important to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. In terms of its sensitivity to changes in flow regime, the UCVB wetland is also scored high. Changes in flow regime for example will likely reduce flows within the marginal areas of the wetland, and in an extreme situation, may lead in the transformation of the system from a wetland to a</td><td>REC, RMO & BAS Category</td><td>Recommended Ecological Category (REC): Category C
Best Attainable State (BAS): Category D
Recommended Management Objective (RMO): C/D (Improve)
Based on the PES and EIS of the wetland, the RMO is ideally to improve the ecostatus of the wetland system at a BAS and REC of C (Moderately modified). It is acknowledged that the current disturbances associated with agriculture and AIP proliferation within the larger system and catchment is beyond the control of the proponent, and achieving the ideal RMO would require input from multiple parties and institutions. However, any future activities planned within the vicinity of the wetland system and its catchment must be managed to mitigate impacts (in-line with the mitigation hierarchy) to ensure that at a minimum the PES status of the UCVB wetland is at the very least not allowed to deteriorate further from its current state. In addition, an AIP control plan must be developed and implemented in an effort to remediate the encroached areas of the UCVB wetland to prevent ongoing cumulative effects.</td></tr>
</table>

	riparian feature or a more predominantly channelised feature, resulting in the loss of wetland habitat.		

Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):

The UCVB wetland is located within a valley bottom position in the landscape and the majority of the assessed reach within the study area is characterised by very indistinct channel banks, and the prevalence of diffuse flows, hence the classification of the system as a UCVB wetland. However, channelised flows within incised banks become increasingly prominent towards the western portion of the assessed unit, where the slope in the landscape starts to fall more rapidly towards the Crocodile River. The system contained very little open water besides some scattered pools along the permanent zone band, and the channels of the western (downstream) portion with incised banks contained no surface water at the time of the site visit in November 2023.

The most significant impacts to the hydrology of the system are considered to be the upstream dam on the opposite side of Lanseria Road, as well as the densification of alien invasive tree copses along sections of the channel. It is expected that these factors have caused significant decreases in the overall flow volumes (including peak flows) in the system. Catchment wide agriculture and development of buildings associated with smallholdings are also expected to contribute to the altered flow regimes of the wetland.

The geomorphology of the UCVB wetland is affected by activities related to current and historic crop agriculture. Sections along the margins (temporary zone) of the wetland have been ploughed and are actively cultivated at present. It is expected that these activities represent a significant source of sediment in the system. On the whole, the wetland itself displayed little active erosion, although the channels within the areas encroached by alien tree copses were moderately incised.

Since very little to no surface water (besides standing pools) was present due to the non-perennial nature of the wetland, water quality parameters were not taken at the time of the site visit. It is however expected that the water quality in the system is affected at least to some degree by increased sediment loads resulting from the disturbance activities discussed above, along with increased nutrient and toxicant loads which may be expected from agricultural runoff.

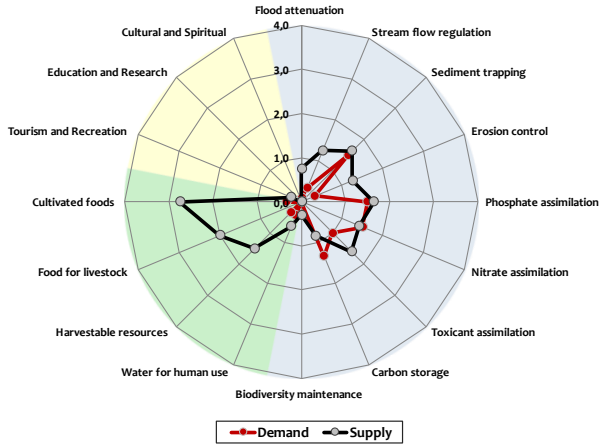
The vegetation cover throughout the majority of the wetland was found to be good, and the wetland is dominated by a community of dense reeds and sedges of moderate height (e.g. C*yperaceae (Sedge Family)* and *Schoenoplectus* (bulrush Family). Other wetland species observed included *Imperata cylindrica*, *Sporobolus africanus*, *Berkheya radula*, *Denekia capensis*, *Lobelia erinus*, and *Tulbaghia leucantha.* The encroachment of *Acacia mearnsii, Eucalyptus cf. camaldulensis* and *Populus* × *canescens* were however significant in some sections of the wetland, with the resultant loss of herbaceous vegetation underneath the tree cover. This loss of herbaceous vegetation and the resultant bare soil along the flow channels was perceived as the most likely cause of the increased bank incision that has taken place in the tree invaded areas. However, the system as a whole remains functional in terms of providing breeding and feeding habitats to a reasonable diversity of fauna. Small mammal species within the area are also expected to benefit from the seasonal supply of water within the system, and foraging habitat that are sustained by sub-surface flows during dry periods.

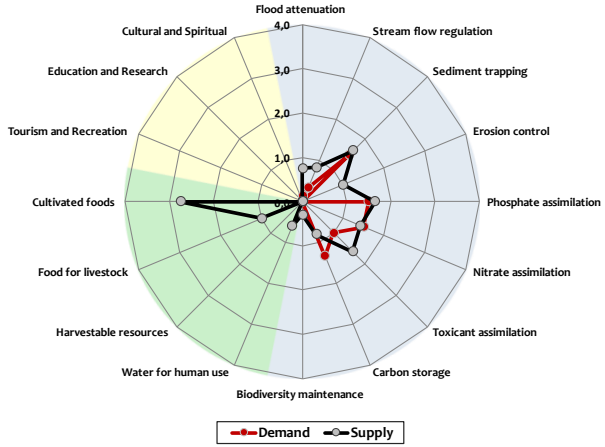
Extent of modification anticipated.	**Low** A low degree of modification is anticipated from the construction and operation of the development, with the assumption that development will stay clear of the delineated extent of the wetland and its 50m GDARD non development buffer area. However, cognisance must be given to mitigation measures required to achieve this low level of impact, as discussed in Section 6 below.

Risk Assessment Outcome & Business Case:

Low	If it is assumed that no freshwater ecosystem habitats will be present within the proposed project footprint, no direct risk is anticipated by the proposed urban development on the freshwater ecosystems in the area. Typical disturbance activities that are likely to occur with any mixed use/urban development type were considered, and which may result in indirect impacts, if not mitigated correctly. In this regard, general key mitigation measures that are likely applicable to the proposed urban development are given below (please refer to Section 6 for a complete list of mitigation measures): ➢ The clearing of vegetation increases the vulnerability of the site to erosion, which may in a worst-case scenario lead to sediment laden runoff into the wetlands, and result in sedimentation of the wetland habitat. Strict implementation of erosion prevention and control measures must therefore be developed and implemented throughout the entire development process (construction and operational phases). These measures must form part of a watercourse rehabilitation and management plan (WRMP), which must be developed for the site by an appropriately qualified freshwater specialist. Monitoring of sites identified as hotspots for erosion is considered an important aspect related to the WRMP. ➢ The increase in hardened surfaces associated with developed areas will result in lower permeability within the wetland catchments, concentrated flows and increased flow velocity of stormwater during rainfall events. This necessitates an appropriate design for the stormwater management structures to mitigate the operational impacts of the release of stormwater into the surrounding landscape and potentially the wetland habitat. As such, a formal Stormwater Management Plan (SWMP) must be designed by a suitably qualified engineer/hydrologist which must consider the increased runoff potential and increased sedimentation potential of the areas permanently kept clear of vegetation. As part of the SWMP, it must be ensured that all stormwater discharge is done in an attenuated manner (e.g. by implementing Sustainable Drainage Systems (SuDs) such as swales or detention ponds). ➢ Strict measures must be implemented to correctly manage construction and operational related waste throughout the footprint area to avoid contamination of soil that may result in contaminated runoff.

Table 5: Summary of the assessment of the Hillslope Seep (HSS) wetlands within the study area.





Ecological & socio-cultural service provision graphs of HSS 1 (Top) and HSS 2 (bottom):

Photographic notes: Representation of HSS 1 within the eastern portion of the study area (left) and HSS 2 within the western portion of the study area (right).

PES Discussion	**Present Ecological Condition (PES): Largely modified (Category D)** The seep wetlands have been extensively modified by historical and ongoing crop agriculture (mainly *Glycine max* (soybean) and *Zea mays* (maize)). From historical aerial photography circa 1938, it is apparent that the seep wetlands considered in this study are remnants of much more extensive wetland systems are now mostly transformed by the crop agriculture activities. The remaining extents of the seep wetlands are however hydrologically functional and support some diversity of wetland vegetation, although AIP proliferation was prominent throughout the seep wetland extents.
Ecoservice provision	**Ecoservices category: Low** In terms of ecosystem service provision, the seep wetlands were considered to be of low value overall, in light of their reduced size, and transformed ecostatus. The ecosystem service scored highest for the seep wetlands is supporting crop cultivation by providing water supply in shallow sub-surface interflows. This function is prominently fulfilled by HSS 1, which contained several small vegetable gardens at the time of the site visit. The expected value of HSS2 in providing this service however lies in its potential to do so, rather than its current provision thereof, since it is not actively cultivated at present. HHS1 also offers a moderate food supply for livestock, although it is likely not utilised as grazing at present. Despite their connectivity to the UCVB wetland, the seeps cannot be expected to contribute to water quality improvement or stream flow regulation on a landscape scale due to their small size. Similarly, their contribution to carbon storage is likely minimal due to their lack of permanently waterlogged soils that slow down organic matter decomposition.
EIS discussion	**EIS Category: Low/Marginal** The seep wetlands were assessed to be of low/marginal Ecological Importance and Sensitivity based on their largely transformed ecological condition. Due to their small size, these systems provide very little habitat for wetland related biodiversity. It is also expected that the systems have low sensitivity to changes in floods or to changes in low flows during the dry season, due to the nature of their hydraulic recharge mechanisms (seep wetlands are not primarily driven by overbank flooding, as is the case with valley bottom systems such as floodplains, but receive recharge via interflow from upslope catchment areas). Also, it is apparent that the seep wetlands within the study area are characterised by sub-surface flows (no surface water was present during the site visit during the wet season, and this is expected to be the case throughout much of the year). The seep wetlands therefore support very little aquatic life, which may be sensitive to changes in water quality.

REC, RMO & BAS Category	**Recommended Ecological Category (REC): Category D** **Best Attainable State (BAS): Category D** **Recommended Management Objective (RMO): D (Maintain)** Relating to the current largely modified ecostatus of the seep wetlands, combined with their relatively low EIS, the RMO for the seep wetlands is to maintain their current PES at a category D. As for the UCVB wetland discussed above, the implementation of an AIP control plan and encouraging the re-establishment of natural vegetation within cultivated areas must be priority to ensure that the seep systems do not deteriorate further. With the exclusion of cultivation activities and access restrictions that may be implemented following the development of the site, it is expected that the abovementioned disturbances may be reduced. This, together with the appropriate implementation of the recommended rehabilitation activities after construction of the proposed development, may ensure that the RMO is achieved.
Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
Typical water inputs for hillslope seeps are primarily via subsurface flows from an up-slope direction, where the vadose zone intersects the land surface, resulting in groundwater discharge directly to the land surface, and with diffuse overland flow (sheetwash) after rainfall events. It is expected that the hillslope seeps associated with the study area are characterised by these hydrogeomorphic processes, although the link these systems may have with groundwater tables were not determined as part of this assessment. As discussed above, the seep wetlands within the study area are characterised predominantly by shallow sub-surface interflows and no surface water was present during the site visit. In terms of the hydrological impacts to the seep wetlands, the overland recharge of the seep wetlands is expected to be affected by the agricultural activities and infrastructure (buildings and roads) within the immediate catchments of the systems, and which have encroached on large portions of the original extents of the seep wetlands. In addition, woody AIP proliferation within the seep catchments are expected to affect flow volumes. All these disturbances are expected to cause an overall reduction in flow volume. The seep wetlands do not appear to be the main receiving environment of stormwater runoff from the currently developed areas, but concentrated runoff volumes are in any case low at present due to the general lack of hardened surfaces within the vicinity of the wetlands. The geomorphological processes and balance of the seep wetlands are affected by activities related to current and historic crop agriculture. Significant encroachment of agricultural activities into the original extents of the wetlands have taken place. Some moderate erosion was noted within tilled areas inside the wetland boundaries, particularly within HSS 2. Since surface water was absent at the time of assessment, no onsite specific water quality testing was undertaken for the seep wetlands. It is expected however that catchment wide anthropogenic activities with specific mention of the agricultural activities inside the wetlands and runoff from built-up areas and roads directly into the HHS wetland, have the potential to significantly alter the natural water quality of the wetlands. The vegetation component of the HHS wetlands consist of a relatively short grassy layer of sedges and grasses. Wetland species commonly found within temporarily saturated soils were found, including *Miscanthus junceus*, *Imperata cylindrica*, *Sporobolus africanus* and several species of the Cyperaceae (Sedge Family). Vegetation losses due to crop cultivation have occurred and the proliferation of AIPs was prominent (e.g. *Conyza bonariensis*, *Oenothera rosea*, *Tagetes minuta*, and *Verbena bonariensis*). The seep wetlands are expected to support minimal aquatic or wetland fauna due to their small size and lack of surface water, although they are likely to provide sustained forage to a selection of small mammals and avifauna during drier periods.	
Extent of modification anticipated.	**Low** A low degree of modification is anticipated from the construction and operation of the development, with the assumption that development will stay clear of the delineated extent of the wetlands and their 50m GDARD non development buffer areas. However, cognisance must be given to mitigation measures required to achieve this low level of impact, as discussed in Section 6 below.
Risk Assessment Outcome & Business Case:	
Low	If it is assumed that no freshwater ecosystem habitats will be present within the proposed project footprint, no direct risk is anticipated posed by the proposed urban development on the freshwater ecosystems in the area. Typical disturbance activities that are likely to occur with any mixed use/urban development type were considered, and which may result in indirect impacts, if not mitigated correctly. In this regard, general key mitigation measures that are likely applicable to the proposed urban development are given in Table 4 (please refer to Section 6 for a complete list of mitigation measures).

5 LEGISLATIVE REQUIREMENTS AND APPLICATION OF BUFFER ZONES

The following legislative requirements were considered during the assessment. A detailed description of these legislative requirements is presented in **Appendix B** of this report:

- The Constitution of the Republic of South Africa, 1996[3];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) (as amended);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA) (as amended); and
- Government Notice 4167 as published in the Government Gazette 49833 of 2023 as it relates to the NWA, as amended).

Certain articles of legislation related to the above Acts and legislation impose potential zones of regulation on freshwater ecosystems in both a national and provincial context. The Zones of Regulation (ZoR) are not necessarily development exclusion zones, rather areas in which EIA and Water Use Authorisation legislative tools have been introduced for the protection and sustainable use of freshwater resources by requiring that certain types of activities within a freshwater ecosystem, or within a certain distance of a freshwater ecosystem require authorisation. The definition and motivation for a regulated zone of activity for the protection of freshwater ecosystems can be summarised as follows:

Table 6: Articles of Legislation and the relevant zones of regulation applicable to each article.

Legislation / Guideline	Zone of applicability
Water Use Authorisation. Application for water uses as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) as amended. **Department of Water and Sanitation (DWS)**	**Government Notice 4167 as published in the Government Gazette 49833 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended))** In accordance with GN4167 of 2023 as it relates to the NWA, a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i 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 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.**

[3] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 1996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

Legislation / Guideline	Zone of applicability
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended in 2017.	**Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended in 2017)** The development of— (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs—; a) within a watercourse; b) in front of a development setback; or c) if no development setback exists, **within 32 metres of a watercourse, measured from the edge of a watercourse.** excluding— (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (ee) where such development occurs within existing roads, road reserves or railway line reserves; or (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared. **Activity 14** of Listing Notice 3 of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) states that: The development of: (xii) Infrastructure or structures with a physical footprint of 10 square meters or more. Where such development occurs— a) Within a watercourse; b) In front of a development setback; or c) If no development setback has been adopted, **within 32 meters of a watercourse**, measured from the edge of a watercourse. **c. Gauteng:** iv. Sites identified as Critical Biodiversity Areas (CBAs) or Ecological Support Areas (ESAs) in the Gauteng Conservation Plan or in bioregional plans.

Since no layout or description of specific planned activities was available at the time this report was compiled, the list of potential trigger activities above may not be representative of the full list of activities relevant to the project. The following relevant Zones of Regulation (ZoR) are most likely applicable (Figure 13 below) but will need to be revised based on the final layout for the project:

- NEMA 32m ZoR as it relates to the National Water Act, 1998 (Act No. 107 of 1998) as amended;
- GN 4167 500m ZoR as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended.

The following buffer zone is applicable:

- 50 m for wetlands occurring outside urban areas, according to the Gauteng Department of Agriculture and Rural Development (GDARD) 2014. In terms of GDARD Requirements for Biodiversity Assessments (2014), a specific buffer zone is stipulated for wetland resources, depending on whether it is located within or outside an Urban Area. The freshwater specialist interpreted the study area as being outside the urban edge, and therefore a 50m GDARD exclusion zone is required for the wetlands identified within the study area.

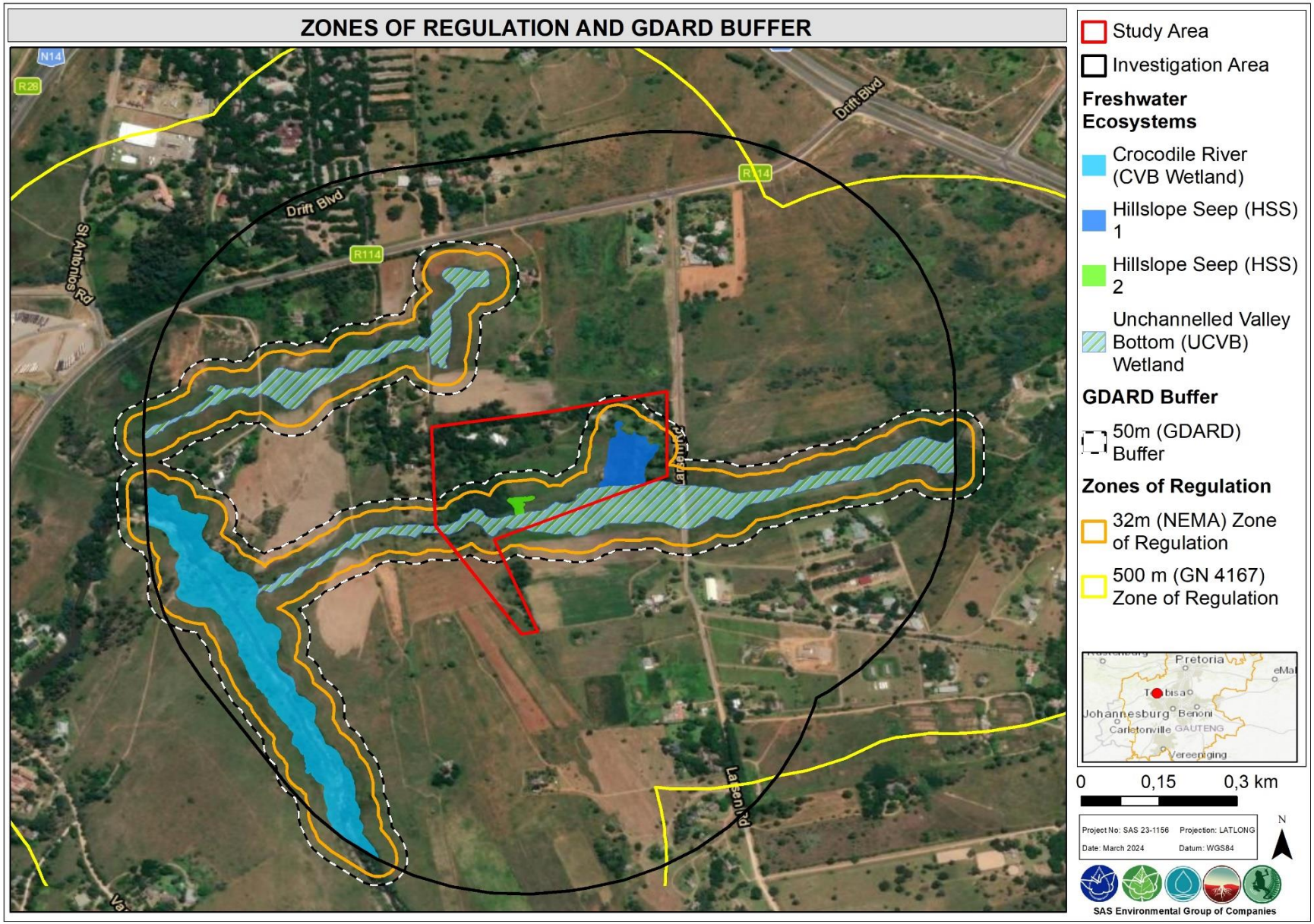


Figure 13: Conceptual representation of the zones of regulation in terms of NEMA and GN 4167 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended, and GDARD buffer associated with the proposed development.

6 RISK ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the wetlands associated with the study area. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of the activities likely to take place and presents an assessment of the significance of the potential impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented. The impact significances were determined using the method provided by the DWS Risk Assessment Matrix (2023).

The points below summarise the considerations taken when applying the DWS Risk Assessment Matrix (2023):

- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. the impacts would be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- No project layout was available at the time this report was compiled, and the DWS Risk Assessment Matrix (2023) was therefore applied, assuming that the first (preferred) option in the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. the impacts would be avoided as opposed to minimised, rehabilitated or offset. As such, it was assumed that any development activities would remain outside of the delineated wetlands and their associated 50m GDARD non development buffer areas.
- 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;**
- The ecological state of the wetlands was considered in the determination of the risk significance, since the anticipated significance of impact is likely linked to the ecological integrity and overall ecological importance and sensitivity of the wetlands;
- The frequency of the activities associated with operational phase is likely to be long-term (ceases with operational life) and as such the impacts associated with these activities are also considered to be long-term; and
- With the provision of the detailed footprint layout, the risk assessment may need to be revised according to the specified footprint areas.

6.1 *Risk Assessment Discussion*

There are four key ecological impacts on the wetlands within the study area that could potentially occur namely,

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

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, impacts can likely be avoided or adequately minimised. The mitigation measures provided in this report have been developed with the mitigation hierarchy in mind, and the implementation and strict adherence to these measures will assist in minimising the significance of impacts on the receiving environment.

A summary of the DWS Risk Assessment Matrix applied to the study area, is provided in the table below, whilst a comprehensive outcome of the risk assessment is presented in **Appendix F**.

Based on the findings of the freshwater ecosystem assessment, several recommendations are made to minimise the impact on the freshwater ecology of the area, should the proposed project proceed, as outlined in Table 7 below.

Table 7: Summary of the results of the DWS risk assessment matrix applied to the wetlands associated with the study area.

Phase	Activity	Impact	Potentially affected watercourses			Risk Rating	Confidence level
			Name/s	PES	Ecological Importance		
PRE-CONSTRUCTION (DESIGN)	Planning of all construction activities, including schedules (timing) of activities and design of infrastructure (e.g. stormwater management systems)	*Potential concentrated flow and increased flow velocity into the receiving environment. *Increased risk of erosion. *Unattenuated discharge of stormwater into the freshwater ecosystems, leading to sedimentation and erosion of wetland habitat. *Potential decreased ability of the freshwater ecosystems to provide ecosystem services. *Potential degradation of wetland habitat.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium
CONSTRUCTION	Vegetation clearing and earthworks outside the delineated extent of the freshwater ecosystems and associated 50m GDARD non development buffer area.	*Disturbance of soil leading to increased AIP proliferation, which may spread to the adjacent wetlands. *Reduced vegetation cover, potentially providing opportunity for AIP establishment. *Alteration of runoff patterns and a risk of increased sediment loads being transported into downgradient freshwater ecosystems. *Potential soil and stormwater contamination from oils as well as hydrocarbons from construction machinery.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium
	Construction of infrastructure, including buildings, paved areas and support infrastructure (e.g. access roads, cables, and pipelines).	*Removal of vegetation in close proximity to the freshwater ecosystems, but outside the 50m GDARD buffer. *Altered runoff patterns as a result of excavation and hardened surfaces, potentially leading to increased erosion and sedimentation thereof. *Disturbances of soil, leading to increased AIP proliferation and potentially altered freshwater habitat. *Potential for deteriorated water quality.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium
OPERATIONAL	Operation of the development, roads, and associated open space areas (if applicable).	*Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems. *Proliferation of alien and invasive plant species within the freshwater ecosystems.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium

Phase	Activity	Impact	Potentially affected watercourses			Risk Rating	Confidence level
			Name/s	PES	Ecological Importance		
	Operation of the stormwater infrastructure within the study area	*Potential altered runoff patterns and increased water inputs to the freshwater ecosystems, altering the flow regime, and potentially leading to erosion and incision. *Increased catchment yield (due to increased runoff) and altered flow regime may lead to changed freshwater ecosystem zonation. *Increased water contamination due to hydrocarbons in stormwater from the internal road network. *Flow concentration and potentially erosion at concentration points i.e. culverts, swales and other stormwater infrastructure.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium
	Operation of any sewerage treatment plants (if applicable) within the study area outside the 50m GDARD non development buffer but inside the 500m GN 4167 Zone of Regulation.	*Potential eutrophication of the freshwater ecosystems as a result of increased nitrates and phosphate loads from untreated effluent (from the sewer infrastructure) due to potential leakage of the pipelines in the event of a leak of damage to the pipeline infrastructure. *Proliferation of alien and invasive plant species within the freshwater ecosystems. *Potential loss of indigenous vegetation as a result of maintenance works.	UCVB wetland	D	High	L	Medium
	Operation of sewer infrastructure (including pump stations), fences and site walls, if applicable.		Hillslope Seep wetlands	D	Low	L	Medium
	Maintenance of any sewer infrastructure, fence and site walls.	*Potential eutrophication of the freshwater ecosystems as a result of increased nitrates and phosphate loads from untreated effluent (from the sewer infrastructure) due to potential leakage of the pipelines. *Proliferation of alien and invasive plant species within the freshwater ecosystems. *Potential loss of indigenous vegetation as a result of maintenance works.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium
	Monitoring of structural integrity of the service infrastructure, swales and other stormwater and linear infrastructure associated with the development (cables, powerlines and pipelines).	*Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances. *Disturbance to and compaction of soil resulting in erosion.	UCVB wetland	D	High	L	Medium
			Hillslope Seep wetlands	D	Low	L	Medium

Table 8: General mitigation measures developed for the project.

Aspect	Mitigation measures
1. Pre-construction (planning/design)	➢ Construction works must preferably be undertaken during the driest period of the year when there is reduced risk of significant stormwater runoff from the construction site to the receiving environment. ➢ In terms of planning of construction phase activities and vegetation restoration, cognisance must be given to the best time for construction (winter months) and the best time for re-vegetation (spring/early summer). Preferably, construction must be timed to finish at the end of the winter dry season, so that re-vegetation can commence soon after to minimise the time that soils are exposed. ➢ The design of linear infrastructure (e.g. roads, powerlines, cables or pipelines) must avoid the freshwater ecosystem habitat as far as possible. If crossings over the freshwater ecosystems are unavoidable, free-spanning aboveground structures must be preferred to trenching, unless infrastructure can be installed by means of directional drilling or pipe-jacking (whilst considering the depth of interflow and groundwater tables). ➢ The design of any wetland crossings (if applicable) must ensure that the linear infrastructure crosses the wetland at a right angle (perpendicularly) and avoid running parallel to the wetland as this increases the risks of edge effects on the wetland. ➢ Appropriate design of the stormwater management structures are essential to mitigate the operational impacts of the release of stormwater into the surrounding landscape and potentially the adjacent wetlands. As such, a formal Stormwater Management Plan (SWMP) must be designed by a suitably qualified engineer/hydrologist which must consider the increased runoff potential and increased sedimentation potential of the areas permanently kept clear of vegetation. ➢ As part of the SWMP, it must be ensured that all stormwater discharge is done in an attenuated manner. The stormwater infrastructure and outlets must therefore be appropriately designed to achieve this (also refer to construction phase mitigation measures below).
2. Construction phase	**Erosion control:** The increased risk of erosion associated with the clearing or trampling of vegetation and the potential contamination of freshwater ecosystems with sediment laden runoff is a significant concern, especially for development activities within close proximity to freshwater ecosystems. The following measures are recommended to mitigate against the onset of erosion: ➢ The entire construction area (development site) must be fenced prior to the commencement of construction and vegetation clearing to ensure that no vehicle or other construction personnel access occurs off the site and within the 50m GDARD buffers of the freshwater ecosystems. ➢ Vegetation clearing must be restricted to the approved development footprint, done in a phased manner as the development progresses and, as much indigenous vegetation as possible is to be retained. ➢ Drifts fences/silt curtains (as part of construction-phase stormwater control system) must be placed along the footprint perimeter as an erosion prevention and control measure. ➢ Construction footprint areas must remain within the authorised footprint and vegetation clearing must be limited to the development footprint area. ➢ Excavation for foundations and support structures may result in loose sediments within the landscape, specifically if works are undertaken during a period of rainfall (if applicable). As such, sediment traps must also be installed downstream/downgradient of the construction area. Sediment traps can be created by pegging an appropriate geotextile across the entire width of the work area at the specified support structure, held down by cobbles/boulders or by geotextile wrapped hay bales spanning the width of the work area and staked into position. ➢ With regard to stockpile management: ▪ Stockpiles must be placed on the upgradient side of trenches to prevent soil from washing down into the freshwater ecosystems during rainfall events.

Aspect	Mitigation measures
	▪ Excavated materials (from the trenches) must not be contaminated, and it must be ensured that the minimum surface area is taken up, however the stockpiles may not exceed 2m in height. ▪ Mixture of the lower and upper layers of the excavated soil must be kept to a minimum. ▪ All exposed soil must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent erosion and sedimentation of the freshwater ecosystems. **Stormwater management:** Buildings and paved areas will result in increased hardened surfaces, which is associated with increased runoff velocity during stormflows. To mitigate this, the following mitigation measures are proposed: ➢ It is highly recommended that a suitably qualified engineer be consulted with regards to the use of the Sustainable Urban Drainage Systems (SuDs) to polish stormwater by trapping sediments and by removing pollutants that could contaminate downgradient freshwater ecosystems, and to allow the gradual discharge of stormwater into the catchments of the downgradient drainage lines following rainfall events. ➢ As such the use of 'soft' engineering features such as bioswales that are vegetated with suitable vegetation that is tolerant of both wet and dry conditions is strongly recommended. ➢ The use of stone pitching to reduce velocity of stormwater is strongly recommended. ➢ The proposed stormwater infrastructure must also be incorporated into a suitable and site-specific SWMP. ➢ The implementation of detention ponds and infiltration strips to manage stormwater may 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. ➢ Other examples of these which may be applicable to this development include permeable paving, rainwater harvesting, soakaways and swales to ensure that post-development runoff does not exceed pre-development runoff volumes and lead to altered flood peaks. **Pollution control:** ➢ A formal waste management and disposal system must be implemented. ➢ Any excessive mud and silt generated from the rehabilitation activities must be removed from the area. Silt traps should be erected downgradient of all activities (as per above examples) prior to commencing with the rehabilitation activities to minimise the risk of excess sedimentation of the system. ➢ Suitable ablution facilities need to be provided for all personnel. ➢ Waste and litter must be cleared and be disposed of at a registered and approved disposal site. ➢ Suitable general waste receptacles must be provided. ➢ Disposal of waste or litter must be prohibited within the wetland systems and associated buffer areas. Any waste noted must be cleared immediately. ➢ Litter traps should be installed at the stormwater outlets to further prevent any litter or debris from entering the wetlands. These structures must be properly maintained/cleaned on a regular basis, particularly after heavy rainfall events. ➢ Contractor laydown areas, vehicle re-fuelling areas, material storage and ablution facilities must remain within the approved footprint area, and must not be allowed to encroach on to the 50m GDARD buffer of the freshwater ecosystems. ➢ Dust suppression measures must be implemented (such as spray watering on gravel access roads) throughout the proposed development activities to prevent excessive dust and suppress the potential for runoff of sediment. ➢ With regard to concrete mixing on site: o No mixed concrete may be deposited outside of the designated construction footprint;

Aspect	Mitigation measures
	○ As far as possible, concrete mixing must be restricted to a designated batching plant that is located in the construction camp. Additionally, batter / dagga board mixing trays and impermeable sumps must be provided, onto which any mixed concrete can be deposited while it awaits placing; and ○ Concrete spilled outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site. **AIP control:** ➢ An Alien Invasive Plant management plan must be compiled for the site by a suitably qualified specialist, to be strictly implemented throughout the construction and operational phases of the proposed development to control AIP proliferation. ➢ As part of the AIP control plan, monitoring for the establishment of AIPs within the development footprint and along access roads must be undertaken. This also includes topsoil stockpiles, which must be kept clear of AIPs. ➢ Should AIPs be identified, they must be removed and disposed of as per the development's alien and invasive species control plan, and the area must be revegetated with suitable indigenous vegetation.
3. Operational activities	**Erosion control:** ➢ Regular inspection of the stormwater outlet structures and areas devoid of vegetation must be undertaken (specifically after large storm events) to monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of embankments and revegetation. ➢ Only indigenous vegetation species may be used as part of the rehabilitation process. ➢ Any area where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible. ➢ Exposed areas along the edge of the rehabilitated wetlands will likely be highly prone to erosion. Drainage control features such as earth berms or perimeter berm/swales must be used to intercept and convey runoff from above disturbed areas to suitable dispersal areas or drainage systems. This helps to reduce the sedimentation from exposed areas. Walker, D. 1999 et al. and USEPA. 2005 have identified the following methods: ○ Brush layering is when branches are placed perpendicular to the slope contour. This method is effective for earth reinforcement and mass stability. Brush layers break up the slope length, preventing surface erosion, and reinforce the soil with branch stems and roots, providing resistance to sliding or shear displacement. Brush layers also trap debris, aid infiltration on dry slopes, dry excessively wet sites, and mitigate slope seepage by acting as horizontal drains. Brush layers facilitate vegetation establishment by providing a stable slope and a favourable microclimate for growth of vegetation. USEPA 2005 ○ Live gully repair is a technique that is similar to branch packing but is used to repair rills and gullies. Live gully repairs offer immediate reinforcement and reduce the velocity of concentrated flows. They also provide a filter barrier that reduces further rill and gully erosion and must be used where gully erosion is taking place on the project footprint. USEPA 2005. ○ Ensure that no further incision or canalisation occurs within the wetlands, particularly the unchanneled valley-bottom wetland along the north-western boundary of the proposed development site. If incision is identified, remediation must commence immediately, and the surrounding area is to be reprofiled to a slope not greater than a 3:1 slope (a 5:1 is however, considered preferable), covered with a commercially available geotextile as described above, which is to be staked to the surface of the slopes until indigenous wetland vegetation can be re-instated. **Stormwater and pollution management:**

Aspect	Mitigation measures
	➢ Any swales and litter traps must be inspected regularly to ensure proper functioning, monitoring of erosion and clearing of any debris or litter in the swales and stormwater outlets. ➢ The quality of the stormwater discharged into wetlands must regularly be monitored to prevent the pollution originating from the proposed development areas to enter the system. ➢ Release of stormwater into the wetlands must not result in further erosion and increased sedimentation of the system. ➢ The proposed development area layout must be considered in the design of the stormwater management systems to maintain the natural flow patterns and movement of water in the landscape. **AIP control:** ➢ An Alien Invasive Plant management plan must be compiled for the site by a suitably qualified specialist, to be strictly implemented throughout the construction and operational phases of the proposed development to control AIP proliferation. ➢ Before and after AIP clearing, a report must be compiled. A quarterly monitoring report should ideally be produced during the first year post AIP clearing and annually during each growing season, for at least 3 years post rehabilitation. The report must include information from before and after mobilisation of follow-up clearing teams.

In summary, the activities associated with the construction, operation and decommissioning of the proposed urban development are likely to pose a ‘Low’ risk significance to the identified wetlands, provided that all mitigation measures as detailed in the above table are implemented.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed solar energy facility are likely to be reduced during the construction and operational phases. Additional “good practice” mitigation measures applicable to a project of this nature are provided in **Appendix G** of this report.

6.2 *Cumulative and Residual Impacts*

Cumulative impacts are not limited to the construction or operational phase of the proposed activities but may add to the impacts identified above. The wetlands within the study area, and wider investigation area are under continued threat due to intensive agricultural activities and urbanisation in the surrounding landscape. Impacts identified within freshwater ecosystems bordering these disturbance areas include an increase in alien and invasive species entering the system due to regular disturbance of soil and removal of indigenous vegetation. Increased erosion due to vegetation removal also results in greater inputs of sediment and nutrients from runoff that are of higher concentrations within these disturbed areas. The impacts of the proposed urban development on the reaches of the identified wetlands are however unlikely to significantly add to the cumulative impacts on the system, so long as the proposed activities are located outside the delineated boundaries of the freshwater ecosystems and the associated 50m GDARD buffer area. To ensure avoidance of cumulative impacts, the recommended mitigation measures, as set out in this report must be however be implemented.

Residual impacts arise from activities of which the effects persist long after the activity has ceased due to the self-perpetuating nature of such impacts (e.g. erosion). Residual impacts may cease with human remediation or when the trajectory of ecosystem imbalance caused by such an impact is complete. Due to the disturbance of soil and removal of vegetation that will commence with construction of infrastructure, there may be an increase in the establishment of alien and invasive species, and which may then persist long after construction activities have been completed. In addition, the possible onset of erosion associated with construction activities may potentially result in sediment laden runoff into the adjacent wetlands if stormwater management is not appropriately implemented, and which, in a worst case scenario, may result in greater inputs of sediment and toxicants into the wetlands over time. With rehabilitation of areas cleared of vegetation during construction activities, including the removal of invasive vegetation species and implementing appropriate erosion control measures, the PES and ecoservice provision of the freshwater ecosystems will likely be maintained, if not improved, as per the REC and RMO.

7 CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed urban development on Ptn 268/189 Rietfontein IQ (hereafter referred to as the "study area"). The study area measures approx. 9.2 hectares (ha) in extent and is located approx. one kilometre (km) east of the town of Muldersdrift and approximately 0.3 km south of the R114 regional roadway. It falls within the Mogale City Local Municipality which is an administrative district of West Rand District Municipality, Gauteng Province.

Following on from desk-based investigation of possible freshwater features in the study area and investigation area (defined as a 500 m radius around the study area, in line with Government Notice (GN) 4167 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended) (NWA), a field assessment was undertaken on the 29th of November 2023 to verify the presence of freshwater features. An unchanneled valley bottom (UCVB) wetland, which intersects a southern portion of the study area, was identified as the main drainage feature of concern. Two hillslope seep (HSS) wetlands were also identified within the study area, both of which drain directly into the UCVB wetland. The results of the field assessment of the identified wetlands within the study area is summarised in the table below:

Table C: Summary of results of the field assessment as discussed in Section 4.

Freshwater ecosystem	PES	Ecoservices importance	EIS	REC / RMO / BAS
Unchanneled Valley Bottom (UCVB) wetland	D (largely modified)	Moderate	High	C/ Improve/D
Hillslope Seep (HSS) wetland 1	D (largely modified)	Low	Low/Marginal	D/Maintain/D
Hillslope Seep (HSS) wetland 2	D (largely modified)	Low	Low/Marginal	D/Maintain/D

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2023) was applied to determine the significance of potential risks arising from the proposed urban development on the receiving freshwater environment. No layout was provided at the time of the survey, but should the development footprint remain outside the delineated freshwater ecosystems and their associated 50m GDARD buffer areas, development activities within the study area are not anticipated to result in loss of, or alteration to, the functionality of the identified wetlands, and the impacts are considered to be 'Low' (given that the mitigation measures as provided in Section 6 are implemented). However, if the final proposed development layout encroaches on the freshwater habitat and associated 50m GDARD buffer, medium to high direct or indirect impacts to the freshwater ecosystems may be anticipated. For the purposes of this report, it was assumed that the first (preferred) option in the mitigation

hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. the impacts would be avoided as opposed to minimised, rehabilitated or offset.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed development activities are likely to be reduced during the construction and operational phases. It is, therefore, the opinion of the freshwater ecologist that the proposed project may be granted environmental authorisation provided that all mitigation measures as set-out in this report are implemented and the development can be considered for authorisation. This opinion is however subject to revision after the final infrastructure layout and description of activities for the project is made available.

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APPENDIX A – Terms of Use and Indemnity

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APPENDIX B – Legislation

LEGISLATIVE CONSIDERATIONS

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act (Act No. 107 of 1998) (NEMA)	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 Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
The National Water Act 1998 (Act No. 36 of 1998) (NWA) as amended	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 4167 as published in the Government Gazette 49833 of 08 December 2023 as it relates to the NWA (Act 36 of 1998) as amended	GN 4167 outlines the parameters and process of a General Authorisation (GA), which replaces the need to apply for a licence in terms of Section 40 of the NWA, provided that the water use is within the limits and conditions of the GA. The notice **replaces GN 509 of 2016.** The GA sets out the need to determine the regulated area of a watercourse, as well as the degree of risk posed by an activity/ies related to a particular water use. In accordance with GN 4167 of December 2023, the 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 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 distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench; or

	c) In respect of a wetland, a 500 m radius around the delineated boundary (extent) of any wetland, including pans. The GA only applies to the use of water in terms of Section 21(c) and (i) of the NWA where the risk class is **LOW** as determined through the application of the Risk Matrix as prescribed in the Notice. The GA also does not apply where other Section 21 water uses are triggered, does not apply for most sewage infrastructure and pipelines carrying hazardous materials, water uses associated with hazardous materials, water uses associated with water and wastewater treatment works, and for most mining-related water uses. The GA may be exercised as follows: i) Section 21(c) or (i) water use activities that are determined to pose a LOW Risk as determined through the application of the Risk Matrix as prescribed in the Notice can be undertaken subject to the general conditions of the GA; ii) Section 21(c) or (i) water use activities set out in Appendix D1 of the Notice can be undertaken *without* being subject to the requirement of a risk assessment and subject to the general conditions of the GA. Such water use activities in Appendix D1 include *inter alia* emergency river crossings, fence erection, solar renewable infrastructure that has no direct impact on watercourses and mini-scale hydropower developments; iii) Prescribed water use activities undertaken by certain State Owned Entities as detailed in Appendix D2 of the Notice can be undertaken *without* being subject to the requirement of a risk assessment and subject to the general conditions of the GA; iv) Maintenance work associated with an 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 can be undertaken ; v) River and stormwater management activities including maintenance of infrastructure as contained in a river management plan or similar management plan, may be conducted subject to the approval of such a plan by the relevant DWS regional office or catchment management agency; vi) Rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix can be conducted; and vii) Emergency work arising from an emergency situation and or incident associated with the persons' existing lawful water use entitlement can be undertaken, provided that all work is executed and reported in the manner prescribed in the Emergency protocol contained in Appendix C of the Notice. A 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 with the water use as contemplated in the GA

APPENDIX C – 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[4] (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.

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

[4] 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.

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
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. General Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans *et al.* 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C5 below.

Table C5: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans *et al.*2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

5. WET-Health

The Riparian Vegetation Response Assessment Index (VEGRAI)

VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans *et al.*, 2007a). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Riparian vegetation is described in the National Water Act (Act No. 36 of 1998) as amended as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soil, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Table C6: Descriptions of the A-F ecological categories.

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

6. Watercourse Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[5] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate assimilation;
- Nitrate assimilation;
- Toxicant assimilation;
- Erosion control;
- Carbon storage;
- Biodiversity maintenance;
- Provision of water for human use;
- Provision of harvestable resources;
- Food for livestock;
- Provision of cultivated foods;
- Cultural and spiritual experience;
- Tourism and recreation; and
- Education and research.

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

Table C7: Integrating scores for supply and demand to obtain and overall importance score

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0,0	0,0	0,5	1,5	2,5
Low	1	0,0	0,0	1,0	2,0	3,0
Moderate	2	0,0	0,5	1,5	2,5	3,5
High	3	0,0	1,0	2,0	3,0	4,0
Very High	4	0,5	1,5	2,5	3,5	4,0

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

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

Table C8: Classes for determining the likely extent to which a benefit is being supplied.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

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

The purpose 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 C9: 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

8. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the freshwater resource (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C10: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

PES			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a freshwater resource fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

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

Table C11: Description of Recommended Ecological Category (REC) classes.

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

9. WET-Ecoservices

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[6] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate assimilation;
- Nitrate assimilation;
- Toxicant assimilation;
- Erosion control;
- Carbon storage;
- Biodiversity maintenance;
- Provision of water for human use;
- Provision of harvestable resources;
- Food for livestock;
- Provision of cultivated foods;
- Cultural and spiritual experience;
- Tourism and recreation; and
- Education and research.

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.
*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

Table C12: Integrating scores for supply and demand to obtain and overall importance score

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0.0	0.0	0.5	1.5	2.5
Low	1	0.0	0.0	1.0	2.0	3.0
Moderate	2	0.0	0.5	1.5	2.5	3.5
High	3	0.0	1.0	2.0	3.0	4.0
Very High	4	0.5	1.5	2.5	3.5	4.0

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than

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

demand, with the supply score acting as the starting score for a “moderate” demand scenario. The importance score is, however, adjusted by up to one class up where demand is “very high” and by up to one class down where demand is “very low”. The overall importance score can then be used to derive an importance category for reporting purposes.

Table C13: Classes for determining the likely extent to which a benefit is being supplied.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

APPENDIX D – Risk Assessment Methodology

For the proponent 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 are possessed by an organisation;
- **Environmental impacts** are the consequences of these impacts on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is;
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Intensity** 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 scale** refers to the geographical scale of the impact; and
- **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 intensity, spatial scale and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 75. The likelihood of the impact occurring is determined by assigning a likelihood score of between 20% and 100%. 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[7].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (Act No. 107 of 1998) 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 2023 publication: Section 21 c and i water use Risk Assessment Protocol) GN4167 of December 2023 published in Government Gazette 49833 of 8 December 2023) (p208).

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

Table D1: Intensity (What is the intensity of the impact on the resource quality - hydrology, water quality, geomorphology, biota?)

Negative impacts	
Negligible / non-harmful; no change in PES	0
Very low / potentially harmful; negligible deterioration in PES (<5% change)	+1
Low / slightly harmful; minor deterioration in PES (<10% change)	+2
Medium / moderately harmful; moderate deterioration in PES (>10% change)	+3
High / severely harmful; large deterioration in PES (by one class or more)	+4
Very high / critically harmful; critical deterioration in PES (to E/F or F class)	+5
Positive impacts	
Negligible; no change in PES	0
Very low / potentially beneficial; negligible improvement in PES (<5% change)	-1
Low / slightly beneficial; minor improvement in PES (<10% change)	-2
Medium / moderately beneficial; moderate improvement in PES (>10% change)	-3
Highly beneficial; large improvement in PES (by one class or more) and/or increase in protection status	-4
Very highly beneficial; improvement to near-natural state (A or A/B class) and/or major increase in protection status	-5

*PES of affected watercourses must be considered when scoring Impact Intensity

Table D2: Spatial Scale (How big is the area that the activity is impacting on, relative to the size of the impacted watercourses?)

Very small portion of watercourse/s impacted (<10% of extent)	1
Moderate portion of watercourse/s impacted (10-60% of extent)	2
Large portion of watercourse/s impacted (60-80%)	3
Most or all of watercourse/s impacted (>80%)	4
Impacts extend into watercourses located well beyond the footprint of the activities	5

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

Transient (One day to one month)	1
Short-term (a few months to 5 years) OR repeated infrequently (e.g. annually) for one day to one month	2
Medium-term (5 – 15 years)	3
Long-term (ceases with operational life)	4
Permanent	5

Table D4: Likelihood of impact (What is the probability that the activity will impact on the resource quality?)

Improbable / Unlikely	20%
Low probability	40%
Medium probability	60%
Highly probable	80%
Definite / Unknown	100%

Table D5: Rating Classes.

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 29	(L) Low Risk	Acceptable as is or with proposed mitigation measures. Impact to watercourses and resource quality small and easily mitigated, or positive.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notable 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.

NOTE: A Low Risk class must be obtained for all activities to be considered for a GA

Table D6: Calculations.

Intensity = Maximum Intensity Score (negative value for positive impact)	MAX = 5
Severity = Intensity + Spatial Scale + Duration (<Intensity - Spatial Scale - Duration> for positive impact)	MAX = 15 (MIN = -15 for +ve impacts)
Consequence = Severity X Importance rating	MAX = 75
Significance\Risk = (Consequence X Likelihood) X (100/75)	MAX = 100

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 freshwater ecosystems associated with the study area.

Freshwater Ecosystems	Hydrology		Geomorphology		Vegetation		Overall score
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
UCVB wetland	6,5	0,0	3,4	0,0	6,6	0,0	6,5
	E	→	C	→	E	→	E
Hillslope Seep (HSS) 1	3,5	0,0	3,4	0,0	5,7	0,0	3,5
	C	→	C	→	D	→	C
Hillslope Seep (HSS) 2	6,5	0,0	3,4	-1,0	5,7	-1,0	6,5
	E	↓	C	↓	D	↓	E

Table E2: Presentation of the results of the EIS assessment applied to the freshwater ecosystems associated with the study area, namely the unchanneled valley bottom (UCVB) and hillslope seep (HSS) wetlands.

Freshwater Ecosystems			UCVB wetland	HSS 1	HSS 2	
Ecological Importance and Sensitivity			Score (0-4)	Score (0-4)	Score (0-4)	*Confidence (1-5)*
Biodiversity support			A (average)	A (average)	A (average)	(average)
			1,00	0,33	0,33	3,00
Presence of Red Data species			0	0	0	3
Populations of unique species			1	0	0	3
Migration/breeding/feeding sites			2	1	1	3
Landscape scale			B (average)	B (average)	B (average)	(average)
			1,20	0,60	0,20	5,00
Protection status of the wetland			0	0	0	5
Protection status of the vegetation type			0	0	0	5
Regional context of the ecological integrity			1	1	0	5
Size and rarity of the wetland type/s present			2	1	0	5
Diversity of habitat types			3	1	1	5
Sensitivity of the wetland			C (average)	C (average)	C (average)	(average)
			2,33	1,00	1,00	2,00
Sensitivity to changes in floods			3	1	1	2
Sensitivity to changes in low flows/dry season			3	1	1	2
Sensitivity to changes in water quality			1	1	1	2
ECOLOGICAL IMPORTANCE & SENSITIVITY			C (2.33) High	C (1.00) Low	C (1.00) Low	
Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)	*Confidence (1-5)*
Regulating & supporting	Flood attenuation		2	1	0	4
	Streamflow regulation		1	0	0	4
	Water Quality	*Sediment trapping*	2	1	1	4
		Phosphate assimilation	2	1	1	4
		Nitrate assimilation	2	1	1	4
		Toxicant assimilation	2	1	1	4

Freshwater Ecosystems		UCVB wetland	HSS 1	HSS 2	
	Erosion control	2	1	1	4
	Carbon storage	1	1	0	3
HYDRO-FUNCTIONAL IMPORTANCE		**2**	**1**		**4**
Direct Human Benefits		Score (0-4)	Score (0-4)	Score (0-4)	*Confidence (1-5)*
Subsistence benefits	*Water for human use*	0	0	0	5
	Harvestable resources	2	1	0	5
	Cultivated foods	4	2	1	5
Cultural benefits	*Cultural heritage*	0	0	0	3
	Tourism and recreation	0	0	0	5
	Education and research	0	0	0	5
DIRECT HUMAN BENEFITS		**1.00**	**0.50**	**0.17**	**5**

Table E3: Presentation of the results of the Ecoservices assessment applied to the UCVB wetland associated with the study area.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,9	0,1	0,0	Very Low
	Stream flow regulation	1,5	1,3	0,7	Very Low
	Sediment trapping	2,1	3,0	2,1	Moderate
	Erosion control	1,0	1,3	0,1	Very Low
	Phosphate assimilation	2,0	3,0	2,0	Moderate
	Nitrate assimilation	1,9	3,0	1,9	Moderate
	Toxicant assimilation	2,0	3,0	2,0	Moderate
	Carbon storage	1,0	1,3	0,2	Very Low
	Biodiversity maintenance	2,0	1,0	1,0	Low
PROVISIONING SERVICES	Water for human use	1,5	1,3	0,7	Very Low
	Harvestable resources	1,5	0,3	0,2	Very Low
	Food for livestock	2,0	0,0	0,5	Very Low
	Cultivated foods	2,3	1,3	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0,8	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Table E4: Presentation of the results of the Ecoservices assessment applied to Hillslope Seep (HHS) 1 associated with the study area.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,8	0,1	0,0	Very Low
	Stream flow regulation	1,3	0,3	0,0	Very Low
	Sediment trapping	1,6	1,5	0,9	Low
	Erosion control	1,3	0,3	0,0	Very Low
	Phosphate assimilation	1,6	1,5	0,9	Low
	Nitrate assimilation	1,4	1,5	0,7	Very Low
	Toxicant assimilation	1,6	1,0	0,6	Very Low
	Carbon storage	0,8	1,3	0,0	Very Low
	Biodiversity maintenance	0,3	0,0	0,0	Very Low
PROVISIONING SERVICES	Water for human use	0,6	0,3	0,0	Very Low
	Harvestable resources	1,5	0,3	0,2	Very Low
	Food for livestock	2,0	0,0	0,5	Very Low
	Cultivated foods	2,8	0,3	1,4	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0,3	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

Table E5: Presentation of the results of the Ecoservices assessment applied to Hillslope Seep (HHS) 2 associated with the study area.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,8	0,1	0,0	Very Low
	Stream flow regulation	0,8	0,3	0,0	Very Low
	Sediment trapping	1,6	1,5	0,9	Low
	Erosion control	1,0	0,0	0,0	Very Low
	Phosphate assimilation	1,6	1,5	0,9	Low
	Nitrate assimilation	1,4	1,5	0,7	Very Low
	Toxicant assimilation	1,6	1,0	0,6	Very Low
	Carbon storage	0,8	1,3	0,0	Very Low
	Biodiversity maintenance	0,3	0,0	0,0	Very Low
PROVISIONING SERVICES	Water for human use	0,6	0,0	0,0	Very Low
	Harvestable resources	0,0	0,0	0,0	Very Low
	Food for livestock	1,0	0,0	0,0	Very Low
	Cultivated foods	2,8	0,0	1,3	Low
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

APPENDIX F – Risk Assessment Outcome

Table F1: Presentation of the results of the DWS Risk Assessment.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
PRE-CONSTRUCTION (DESIGN)	Planning of all construction activities, including schedules (timing) of activities and design of infrastructure (e.g. stormwater management systems)	*Potential concentrated flow and increased flow velocity into the receiving environment. *Increased risk of erosion. *Unattenuated discharge of stormwater into the freshwater ecosystems, leading to sedimentation and erosion of wetland habitat. *Potential decreased ability of the freshwater ecosystems to provide ecosystem services. *Potential degradation of wetland habitat.	UCVB wetland	D	High	3	3	3	3	3	**6**	2	4	**12**	**4**	**48**	40%	**19,2**	**L**	Medium
			Hillslope Seep wetlands	D	Low	3	3	3	3	1	**6**	2	4	**12**	**2**	**24**	40%	**9,6**	**L**	Medium
CONSTRUCTION	Vegetation clearing and earthworks outside the delineated extent of the freshwater ecosystems and associated 50m GDARD non development buffer area.	*Disturbance of soil leading to increased AIP proliferation, which may spread to the adjacent wetlands. *Reduced vegetation cover, potentially providing opportunity for AIP establishment. *Alteration of runoff patterns and a risk of increased sediment loads being transported into downgradient freshwater ecosystems. *Potential soil and stormwater	UCVB wetland	D	High	4	3	4	4	3	**8**	2	2	**12**	**4**	**48**	40%	**19,2**	**L**	Medium
			Hillslope Seep wetlands	D	Low	4	1	4	3	1	**8**	2	2	**12**	**2**	**24**	40%	**9,6**	**L**	Medium

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
			Name/s	PES	Ecological Importance	Abiotic Habitat (Drivers)			Biota (Responses)											
						Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
		contamination from oils as well as hydrocarbons from construction machinery.																		
	Construction of infrastructure, including buildings, paved areas and support infrastructure (e.g. access roads, cables, and pipelines).	*Removal of vegetation in close proximity to the freshwater ecosystems, but outside the 50m GDARD buffer. *Altered runoff patterns as a result of excavation and hardened surfaces, potentially leading to increased erosion and sedimentation thereof. *Disturbances of soil, leading to increased AIP proliferation and potentially altered freshwater habitat. *Potential for deteriorated water quality.	UCVB wetland	D	High	4	3	4	4	3	**8**	2	2	**12**	**4**	**48**	40%	**19,2**	**L**	Medium
			Hillslope Seep wetlands	D	Low	4	1	4	3	1	**8**	2	2	**12**	**2**	**24**	40%	**9,6**	**L**	Medium
OPERATIONAL	Operation of the development, roads, and associated open space areas (if applicable).	*Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems. *Proliferation of alien and invasive plant species within the freshwater ecosystems.	UCVB wetland	D	High	2	3	2	2	2	**6**	2	5	**13**	**4**	**52**	20%	**10,4**	**L**	Medium
			Hillslope Seep wetlands	D	Low	2	1	2	2	1	**4**	2	5	**11**	**2**	**22**	20%	**4,4**	**L**	Medium

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
			Name/s	PES	Ecological Importance	Abiotic Habitat (Drivers)			Biota (Responses)											
						Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	Operation of the stormwater infrastructure within the study area	*Potential altered runoff patterns and increased water inputs to the freshwater ecosystems, altering the flow regime, and potentially leading to erosion and incision. *Increased catchment yield (due to increased runoff) and altered flow regime may lead to changed freshwater ecosystem zonation. *Increased water contamination due to hydrocarbons in stormwater from the internal road network. *Flow concentration and potentially erosion at concentration points i.e. culverts, swales and other stormwater infrastructure.	UCVB wetland	D	High	2	3	2	2	2	**6**	2	5	**13**	**4**	**52**	20%	**10,4**	**L**	Medium
			Hillslope Seep wetlands	D	Low	2	1	2	2	1	**4**	2	5	**11**	**2**	**22**	20%	**4,4**	**L**	Medium
	Operation of any sewerage treatment plants (if applicable) within the study area outside the 50m GDARD non development buffer but inside the 500m GN 4167 Zone of Regulation.	*Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems. *Potential eutrophication of the freshwater ecosystems as a result of increased nitrates and phosphate loads from untreated effluent (from the sewer infrastructure) due to potential leakage of the pipelines. Potential fragmentation of the freshwater ecosystems caused by property fences. *Proliferation of alien and invasive plant species within the freshwater ecosystems.	UCVB wetland	D	High	1	2	1	1	1	**4**	2	5	**11**	**4**	**44**	20%	**8,8**	**L**	Medium
	Operation of sewer infrastructure (including pump stations), fences and site walls, if applicable.		Hillslope Seep wetlands	D	Low	1	2	1	1	0	**4**	2	5	**11**	**2**	**22**	20%	**4,4**	**L**	Medium

Phase	Activity	Impact	Potentially affected watercourses				Intensity of Impact on Resource Quality						Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)		Severity (max = 20)	Importance rating (max = 5)		Consequence (max = 100)		Likelihood (Probability) of impact		Significance (max = 100)	Risk Rating	Confidence level
			Name/s	PES	Ecological Importance		Abiotic Habitat (Drivers)			Biota (Responses)																	
							Hydrology	Water Quality	Geomorph	Vegetation	Fauna																
	Maintenance of any sewer infrastructure, fence and site walls.	*Potential eutrophication of the freshwater ecosystems as a result of increased nitrates and phosphate loads from untreated effluent (from the sewer infrastructure) due to potential leakage of the pipelines in the event of a leak of damage to the pipeline infrastructure. *Proliferation of alien and invasive plant species within the freshwater ecosystems. *Potential loss of indigenous vegetation as a result of maintenance works.	UCVB wetland	D	High		1	2	1	1	1		**4**	2	5		**11**	**4**		**44**		20%		**8,8**	**L**	Medium
			Hillslope Seep wetlands	D	Low		1	2	1	1	0		**4**	2	5		**11**	**2**		**22**		20%		**4,4**	**L**	Medium
	Monitoring of structural integrity of the service infrastructure, swales and other stormwater and linear infrastructure associated with the development (cables, powerlines and pipelines).	*Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances. *Disturbance to and compaction of soil resulting in erosion.	UCVB wetland	D	High		1	0	1	2	2		**4**	2	5		**11**	**4**		**44**		20%		**8,8**	**L**	Medium
			Hillslope Seep wetlands	D	Low		1	0	1	1	0		**2**	2	5		**9**	**2**		**18**		20%		**3,6**	**L**	Medium

APPENDIX G – General "Good Housekeeping" 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 watercourse identified in this report:

Development footprint

- All development footprint areas must remain as small as possible and must 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, must be clearly defined and all activities must remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes must avoid freshwater ecosystems 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 must be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- All hazardous storage containers and storage areas must comply with the relevant SABS standards to prevent leakage;
- No fires must 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 offsite 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 spillage must be p prevented 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. Contaminated soil must be bagged and disposed of in hazardous waste receptacles.

Vegetation

- Removal of the alien and weed species encountered within the wetlands 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 must be kept as small as possible when removing alien plant species; and

- No vehicles must be allowed to drive through designated sensitive watercourse areas during the eradication of alien and weed species.

Soil

- Sheet runoff from access roads and the walk ways must be slowed down by the strategic placement of berms;
- As far as possible, all construction activities must 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 soil;
- No stockpiling of topsoil must take place within close proximity to the watercourse, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the watercourse;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas must be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence must be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site;
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development must be removed. Alien vegetation control must take place for a minimum period of two growing seasons after rehabilitation is completed; and
- Side slope and embankment vegetation cover must be monitored to ensure that sufficient vegetation is present to bind these soil and prevent further erosion.

Scientific Aquatic Services
Applying science to the real world
29 Arterial Road West, Oriel, Bedfordview, 2007
Tel 011 616 7893
Fax 011 615-6240
admin@sasenvgroup.co.za
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APPENDIX H – Site Sensitivity Verification

FRESHWATER ECOSYSTEM SITE SENSITIVITY VERIFICATION REPORT FOR THE PROPOSED URBAN DEVELOPMENT ON PORTION 268 RIETFONTEIN 189 IQ, GAUTENG PROVINCE

Introduction

According to the "Protocols for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes ("the Protocols") published in Government Gazette No. 43110 on 20 March 2020 and Government Gazette No. 43855 on 30 October 2020, the Environmental Assessment Practitioner (EAP) must verify the current use of the site in question and its environmental sensitivity as identified by the Screening Tool to determine the need for specialist inputs in relation to the themes included in the Protocols. The Protocols are allowed for in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"). The Protocols must be complied with for every new application for Environmental Authorisation that is submitted after 9 May 2020. This document serves as the Freshwater Ecosystem Site Sensitivity Verification Report for the proposed urban development on Ptn 268/189 Rietfontein IQ (hereafter referred to as the "study area").

Study Area

The study area measures approx. 9.2 hectares (ha) in extent and is located approx. one kilometre (km) east of the town of Muldersdrift and approximately 0.3 km south of the R114 regional roadway. It falls within the Mogale City Local Municipality which is an administrative district of West Rand District Municipality, Gauteng Province (Figure H1).

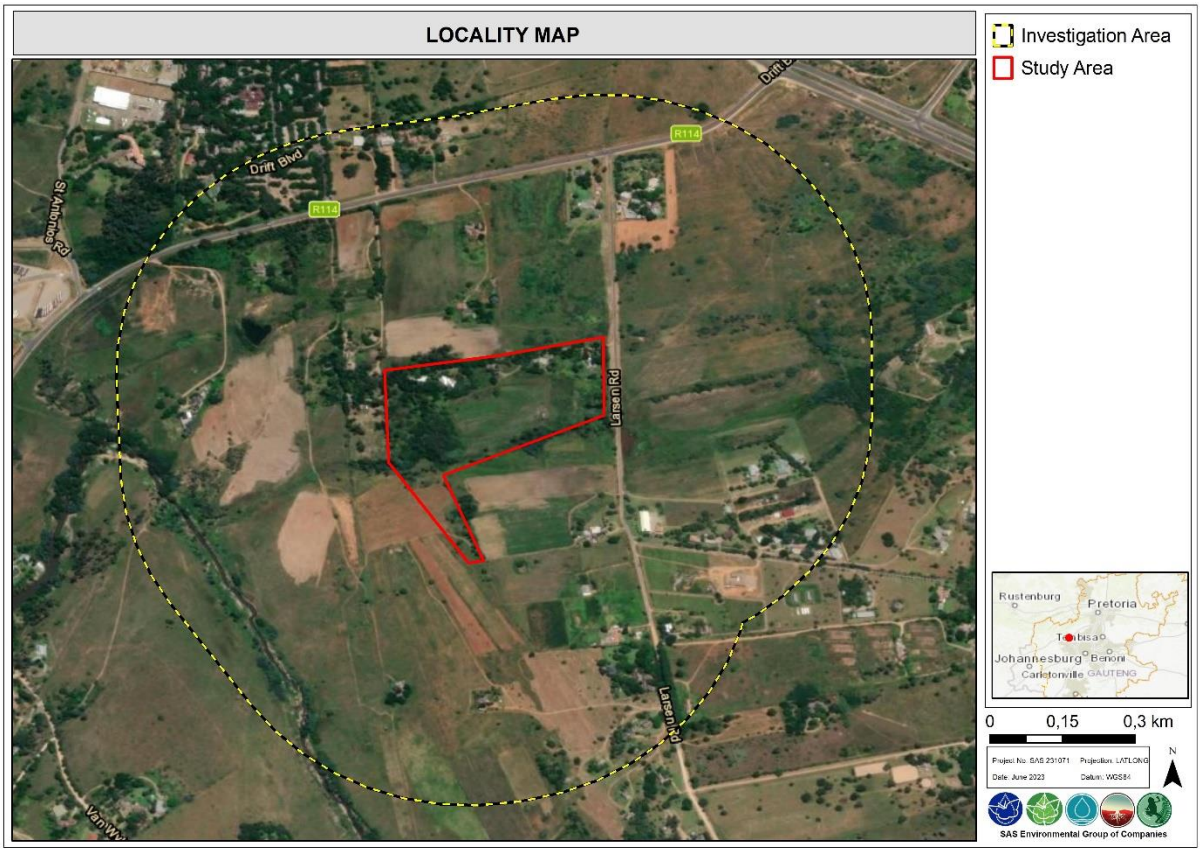


Figure H1: Digital satellite image depicting the location of the study area and associated investigation area in relation to the surrounding area.

This Freshwater Ecosystem site sensitivity verification report relates to a Screening Tool Report (STR) completed for the site in February 2024.

Site Verification Methodology

A site visit was conducted by the specialist to inform the specialist reports required for the proposed project.

Aquatic Biodiversity Site Verification

The table below provides information regarding the outcome of the Screening Tool in terms of the aquatic biodiversity theme sensitivity associated with the proposed project as well as a brief summary of the outcome of the freshwater ecosystem specialist report in response.

Table H1: Aquatic Biodiversity Theme Sensitivity analysis for the proposed project.

Environmental Theme	Applicable Protocol	Response
Aquatic Biodiversity Sensitivity Rating: The majority of the study area shows a very low aquatic biodiversity sensitivity except for a small southern portion, which is indicated to be of **very high aquatic biodiversity sensitivity due to the presence of a wetland.** **Actual Sensitivity:** The presence of the wetland indicated by the screening tool (the UCVB wetland) was confirmed on site, along with two additional seep wetlands that are located directly north of the UCVB wetland, and therefore the very low aquatic sensitivity indicated by the screening tool within the majority of the study area is disputed. **Due to the presence of several freshwater ecosystems within the study area, there is a potential quantum of risk associated with the development, since activities are likely to occur within close proximity to the identified wetlands.** Requiring a Freshwater Ecosystem Assessment.	3(b) Protocol for the assessment and reporting of environmental impacts on aquatic biodiversity (GG 43110 of 10/03/2020).	A Freshwater Ecosystem Assessment was conducted by Scientific Aquatic Services (SAS, 2023). During the assessment and associated field verification it was determined that the development site (study area) is of low sensitivity whilst the identified freshwater ecosystems within the study area is of high aquatic biodiversity sensitivity. A detailed study was required to support both the authorisation process required in terms of NEMA as well as the NWA. The study and associated comprehensive report from a site visit in November 2023 provide a detailed description of the freshwater ecosystem associated with the proposed project and considered the potential impacts applicable to the freshwater ecosystem and provided suitable mitigation measures to best minimise the potential impact on the freshwater ecosystems.

APPENDIX I – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Paul Da Cruz	BA (Hons) (Geography and Environmental Studies) (WITS)
Stephen van Staden	MSc (Environmental Management) (UJ)
Monique Botha	PhD Environnemental Science (NWU)

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

Company of Specialist:	Scientific Aquatic Services (Pty) Ltd		
Name / Contact person:	Monique Botha		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	0727670435
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	monique@sasenvgroup.co.za		
Qualifications	Ph. D Environmental Science		
Registration / Associations	Registered Candidate Member of the South African Council for Natural Scientific Professions (SACNASP)		

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

I, Paul da Cruz, 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.

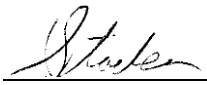
Signature of the Specialist

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

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

I, Monique Botha, 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

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF PAUL DA CRUZ

PERSONAL DETAILS

Position in Company	Senior Ecologist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Certificated Scientist at South African Council for Natural Scientific Professions (SACNASP)

Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA)

Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

BA (Hons) (Geography and Environmental Studies) (University of the Witwatersrand)	1998
BA (Geography) (University of the Witwatersrand)	1997

Short Courses

Taxonomy of Wetland Plants (Water Research Commission)	2017
Advanced Grass Identification (Frits van Outshoorn)	2010
Grass Identification (Frits van Outshoorn),	2009
Soil Form Classification and Wetland Delineation; (TerraSoil Science)	2008

AREAS OF WORK EXPERIENCE

South Africa – All Provinces

Southern Africa – Lesotho, Botswana

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy (Wind and solar)
2. Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
3. Nature Conservation and Ecotourism Development
4. Commercial development
5. Residential development
6. Environmental and Development Planning and Strategic Assessment

7. Industrial/chemical; Non-renewable power Generation

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- EIA / BA Applications
- Environmental Authorisation Amendments
- EMPr Compilation
- Environmental Compliance Monitoring (Environmental Auditing)
- Environmental Screening Assessments and Listing Notice 3 Trigger Identification / Mapping
- Strategic Environmental Assessments and Environmental Management Frameworks
- EIA / Specialist Study Peer Review

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Assessments in support of Environmental Screening Assessments, Precinct Planning & SEA
- Wetland Construction (Compliance) Monitoring

Biodiversity Assessments

- Avifaunal Assessments
- Strategic Biodiversity Assessment

Visual Impact Assessment

- Visual Impact Assessments

GIS / Spatial Analysis

- GIS Spatial Analysis and Listing Notice 3 mapping

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

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 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

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS 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 Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)

5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use License Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF MONIQUE BOTHA

PERSONAL DETAILS

Position in Company	Junior Freshwater Specialist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

SACNASP Candidate Natural Scientist (Environmental Sciences) **#126160**

EDUCATION

Qualifications

B.Sc. Environmental and Biological Sciences (North-West University)	2010
Hons. B.Sc. Environmental Sciences (North-West University)	2011
M.Sc. Environmental Sciences (North-West University)	2014
Ph.D. Environmental Sciences (North-West University)	2016

Training Courses

Basic Soil Properties: Analysis and Interpretation of Results (ARC-SCW)	2022
Wetland Legislation Course (WETREST)	2023

DEVELOPMENT SECTORS OF EXPERIENCE

1. Linear developments (energy transmission, pipelines, roads)
2. Renewable energy (wind and solar)
3. Commercial development
4. Residential development
5. Landfills

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North-West, Northern Cape

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation, Maintenance and Management Plans