Appendix G.2

AQUATIC REPORT

Confidential

Name: Paul da Cruz
Date: 05 June 2025
Project Nr: SAS 23-1138

WSP
Building 1
Maxwell Office Park,
Magwa Crescent West
Waterfall City
Midrand
1685
Email: Aslea.Strong@wsp.com

Attention: Ashlea Strong

MEMORANDUM: FRESHWATER ASSESSMENT OF THE PHEFUMULA-EMOYENI WIND ENERGY FACILITY (WEF) LAYOUT CHANGE – JUNE 2025.

1. INTRODUCTION

Scientific Aquatic Services (SAS) (Pty) Ltd was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment (EIA) for the proposed Phefumula Emoyeni One Wind Energy Facility (WEF) in the Ermelo area of the Mpumalanga Province. The freshwater report was submitted to WSP in March 2025 following changes to the layout of the proposed WEF. SAS has been requested by WSP to consider a further change to the layout of the WEF and the potential implications for impacts on the freshwater environment, especially in the context of the findings and recommendations of EIA-phase freshwater report that was updated in March 2025. This memo outlines the assessment of the new layout.

2. DISCUSSION

The potential impacts to the freshwater environment associated with the proposed WEF were assessed through the application of the Department of Water and Sanitation (DWS) Risk Assessment Matrix (RAM) and the WSP impact assessment matrix in the EIA-phase freshwater report. The DWS RAM assessed that certain activities associated with the development of the WEF would result in impacts of low risk significance but certain activities would be associated with impacts of medium risk significance. Such medium risk activities are associated with the development of infrastructure that is located within, or within close proximity to a freshwater ecosystem, in particular new roads and turbine hardstands located in wetlands.

The EIA-phase freshwater report (revised in March 2025) highlighted that activities associated with a medium risk relate to the single turbine and hardstand located within a wetland (Turbine WTG 5), as well as Turbine WTG 42 which is located immediately adjacent to a wetland. The report also highlighted a number of proposed internal road crossings that are not located along existing roads / farm tracks as being associated with a medium risk. The report stated that the potential re-alignment / relocation of certain infrastructure is highly important in the context of mitigating such impacts and reducing their spatial footprint. The report made the recommendation that Turbine WTG 42 be slightly relocated to the north or east to be located outside of the delineated extent of and associated 15 m non-development buffer of the seep wetland in which it has been located and that Turbine WTG 5 be relocated outside of the seep wetland in which it has been located. Lastly the report stated that all other new road crossings of wetlands cross the wetland unit perpendicularly and provided the suitable design measures in the crossing structures are implemented, these crossings are considered acceptable and would be unlikely to significantly adversely affect the wetland unit.

3. ANALYSIS OF THE LATEST LAYOUT

Under the latest layout WTG 42 would still be associated with potentially significant impacts on the wetland unit in which, it has been located. Part of the WTG 42 hardstand is located in the wetland, and the access road into the wetland has now been realigned to run through the upper part of the seep wetland, thereby increasing the area of wetland that would be transformed (Figure 1).

WTG 5 has however been relocated to lie outside of the wetland's 15 non-development buffer in line with the recommendations of the freshwater report.

Figure 1 Google Earth image showing WTG 42 and the associated access road within a seep wetland

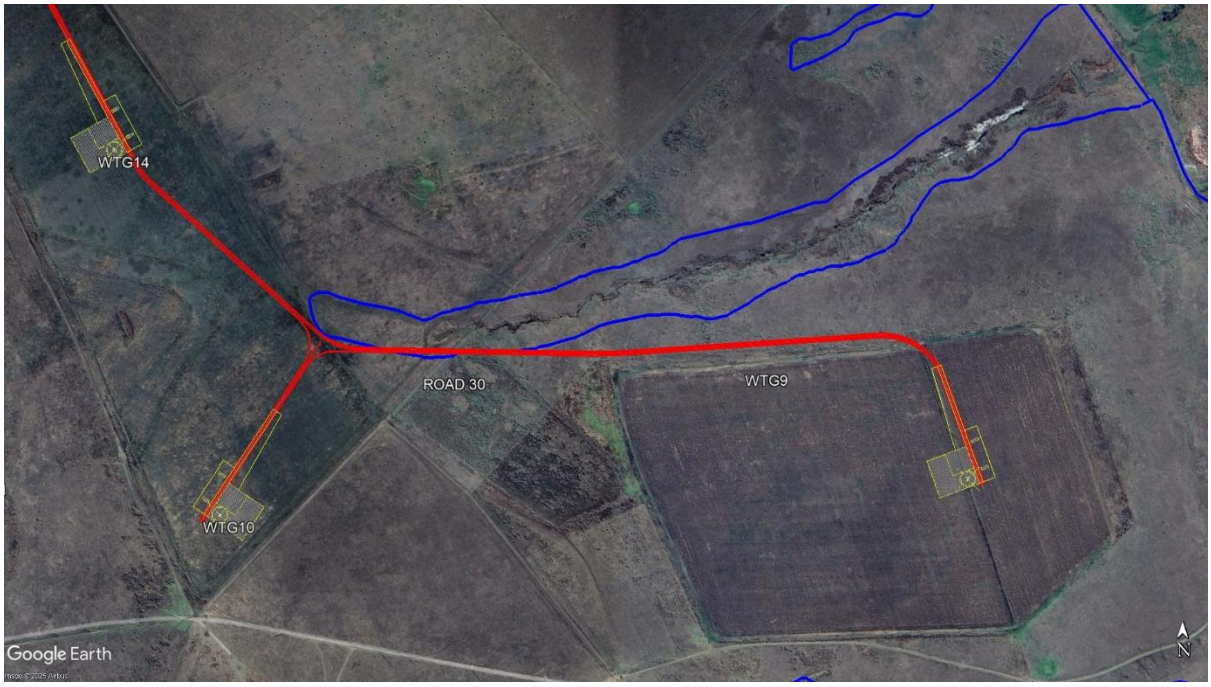

Figure 2: Google Earth image showing Road 30 traversing a seep wetland

In addition Road 30 has been realigned to the north in terms of the latest layout (see Figure 2), and will now be located within the upper part of a seep wetland and its buffer, with the realignment creating new issues and impacts, especially relating to physical alteration of wetland habitat:

In relation to the above, the following layout changes must be made:

- WTG42 must be relocated to fall outside of the wetland and its associated 15m non-development buffer, and
- Road 30 must be realigned to fall outside of the wetland and its associated 15m non-development buffer

These refinements to the layout must be made prior to development to ensure that the project exerts the least possible level of impact on the freshwater environment.

As certain project components such as cabling, BESS and laydown areas do not form part of the latest iteration of the layout, a further assessment of these components of the project will need to be undertaken by a freshwater specialist. This will need to form part of a walkdown of all final pre-construction components as undertaken by a freshwater specialist to sign off on roads and final turbine locations.

We trust this information will be useful in the decision-making process regarding the proposed development. Should you have any queries please feel free to contact me.

Yours Faithfully,

Digital Documentation Not Signed For Security Purposes
Paul da Cruz
Cert. Sci. Nat

SCIENTIFIC AQUATIC SERVICES

EIA-PHASE FRESHWATER ECOLOGICAL ASSESSMENT

AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED PHEFUMULA EMOYENI ONE WIND ENERGY FACILITY NEAR ERMELO, MPUMALANGA PROVINCE.

Prepared for:	Phefumula Emoyeni One (Pty) Ltd
Report authors:	P. da Cruz (Cert. Sci. Nat.) K Coertze (Pr.Sci.Nat)
Report reviewer:	S. van Staden (Pri. Sci. Nat.)
Report Reference:	SAS 23-1138
Date:	March 2025

Part of the SAS Environmental Group of Companies

Website: http://www.sasenvironmental.co.za

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) (Pty) Ltd was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment (EIA) process for the proposed Phefumula Emoyeni One Wind Energy Facility (WEF) in the Ermelo area of the Mpumalanga Province. The area of assessment consists of the development site of the WEF (the 'study area'), along with a 500 m "zone of investigation" (the investigation area), in accordance with Government Notice (GN) 4167 of December 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA). This report has been prepared in support of the WEF components application for Environmental Authorisation (EA), with a separate report compiled for the transmission infrastructure application for EA.

Delineation of freshwater ecosystems was undertaken using desk-based methods to identify all freshwater ecosystems in the study and investigation areas for further in field verification. The field verification site assessment was undertaken in March 2024 and February 2025 to verify and ground truth the presence of freshwater ecosystems as well as refining the delineations in areas that were not clear from desk based methods and lastly to gather data for the detailed assessment of freshwater ecosystems. The desk-based and field verification assessment has verified that the freshwater ecosystems in the study and investigation areas are all wetlands, with the predominant hydrogeomorphic (HGM) type being seep and valley bottom (both channelled and unchannelled) wetlands. The Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of seep and valley bottom wetlands has been separately assessed for three different component parts of the study area that fall into the three different quaternary catchments into which the study area falls. The state of wetlands varies according to the impacts acting on the respective HGM Unit, but valley bottom wetlands were generally assessed to be in a largely natural state with a high EIS, while seep wetlands were generally assessed to be in a moderately modified condition and displaying a moderate EIS.

In line with the designation of the department of Forestry Fishery and the Environment (DFFE's) National Web-based Environmental Screening Tool (2020), all freshwater ecosystems were verified to be associated with a very high freshwater-related sensitivity. This sensitivity has been used as the basis on which to identify development. The freshwater buffer tool has been applied to refine the non-development buffer of 100m that was assigned in the scoping phase. The buffer tool has stipulated a minimum of a 15m non-development buffer around the delineated wetland boundaries.

The impact assessment matrix as provided by the Environmental Impact Assessment Practitioner (EAP) and the Department of Water and Sanitation (DWS) Risk Assessment Matrix (RAM) (as contained within GN 4167 of 2023) have been applied to the proposed development to determine the nature and intensity of impacts that could potentially affect the study and investigation area freshwater environment. All activities associated with the construction of proposed infrastructure that are located within / or would directly affect wetlands and where no existing infrastructure is present would pose a "Medium" risk significance to the freshwater ecosystems within the study and investigation areas. All other activities would be associated with a "Low" risk significance. The freshwater related sensitivities of the study area as outlined in the scoping phase freshwater assessment have been adequately considered in the latest iteration of the development layout and all proposed turbine locations except two have avoided placement within any freshwater ecosystem or associated 15m non-development buffer. A recommendation has been made that these two wind turbine generators (WTG 5 and 42) be relocated outside of the wetlands and their associated buffer. In addition, a road realignment recommendation has been made to avoid the unnecessary impacting of another seep wetland. As the current layout does not indicate the position of proposed underground cabling, and other construction and operation infrastructure such as laydown areas, construction camps and Battery Energy Storage Systems (BESS) infrastructure, the finalised position of this infrastructure as well as of turbine locations and proposed roads must be assessed as part of a walkdown assessment of this infrastructure by a freshwater specialist. Should these recommendations be actioned and provided that all other mitigation measures as stipulated in this report are adhered to, the proposed development can be considered acceptable in a freshwater environment context.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) (Pty) Ltd was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment (EIA) process for the proposed Phefumula Emoyeni One Wind Energy Facility (WEF) in the Ermelo area of the Mpumalanga Province. The area of assessment consists of the development site of the WEF (the 'study area'). This report has been prepared in support of the WEF components application for Environmental Authorisation (EA), with a separate report compiled for the transmission infrastructure application for EA.

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 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 scoping-phase freshwater assessment was conducted in October 2023, in which possible freshwater ecosystems were identified for on-site investigation, and relevant national and provincial databases were consulted;
- An EIA-phase field assessment took place from the 04th to the 09th of March 2024 which confirmed that all freshwater ecosystems in the study area are wetlands, with the predominant hydrogeomorphic (HGM) type being seep and valley bottom (both channelled and unchannelled) wetlands; and
- Following the alteration of the layout, a further EIA-phase site assessment was undertaken from the 25th – 26th of February 2025 to assess wetlands crossed and wetlands located in close proximity to turbines and roads.

The present ecological state (PES) and Ecological Importance and Sensitivity (EIS) of seep and valley bottom wetlands has been separately assessed for three different component parts of the study area that fall into the three different quaternary catchments into which the study area falls. The results of the assessments of the wetlands are presented in Section 4 of this report, and are summarised in the table below:

Table A: Summary of the assessment results.

Freshwater Ecosystem	Present Ecological State (PES) / Ecostatus	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category / Recommended Management Objective / Best Attainable State
Quaternary Catchment B12A – valley bottom wetlands	PES Score : 1.49 - Category B (Largely natural)	Very High to Very Low	High	REC Category: B BAS Category: B RMO: Maintain
Quaternary Catchment B12A – seep wetlands	PES Score : 3.88 - Category C (Moderately modified)	High to Very Low	Moderate	REC Category: C BAS Category: C RMO: Maintain
Quaternary Catchment B11A – valley bottom wetlands	PES Score : 1.93 - Category B (Largely natural)	Very High to Very Low	High	REC Category: B BAS Category: B RMO: Maintain
Quaternary Catchment B11A – seep wetlands	PES Score : 3.47 - Category C (Moderately modified)	High to Very Low	Moderate	REC Category: C BAS Category: C RMO: Maintain

Freshwater Ecosystem	Present Ecological State (PES) / Ecostatus	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category / Recommended Management Objective / Best Attainable State
Quaternary Catchment C11F – valley bottom wetlands	PES Score : 1.66 - Category B (Largely natural)	Very High to Very Low	High	REC Category: B BAS Category: B RMO: Maintain
Quaternary Catchment C11F – seep wetlands	PES Score : 2.98 - Category C (Moderately modified)	Moderate to Very Low	Moderate	REC Category: C BAS Category: C RMO: Maintain

The DWS Risk Assessment Matrix (2023) was applied to determine the significance of impacts of the proposed WEF facility on the receiving freshwater environment, with the summarised results detailed in Table B:

Table B: Summary of the results of the risk assessment (after application of mitigation).

Phase	Activity	Impact	Risk Rating
Construction Phase	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of 100m radius of wetland boundaries . (All Turbines except for Turbines 5 and 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transportation of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	L
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of the delineated wetland boundary and within 100m radius of wetland boundaries. (Turbine 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transportation of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles. Risk of AIP proliferation in disturbed areas that could colonise the adjacent wetland areas.	L
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines and hardstands within a delineated wetland boundary (Turbine 5)	•Destruction of a certain area of wetland habitat in the footprint of the turbine and hardstand; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream freshwater ecosystem areas and may smother vegetation associated with the freshwater ecosystems; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	M
	Construction of surface infrastructure (all Turbines and Hardstands except for Turbine 5 and 42,) and including new access roads outside of 100m radius of wetland boundaries .	•Earthworks and exposure of soil could result in sedimentation of downgradient wetlands, which may be transported as runoff into the downgradient wetlands and may smother wetland vegetation;	L

Phase	Activity	Impact	Risk Rating
	Construction of surface infrastructure (Turbines and Hardstands 42) and new access roads) between the delineated wetland boundary and a 100m radius of wetland boundaries.	•Altered water quality in downgradient wetlands (if surface water is present) as a result of pollution as a result of oils (e.g. from spills) and concrete mixing; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	L
	Construction of Turbine and Hardstand 5 within the delineated wetland boundary.		M
	Potential upgrading of existing access roads within freshwater ecosystems: •Excavation within freshwater ecosystems for the removal of existing infrastructure and casting of a base (where applicable); •Placement of culvert structures atop concrete base.	•Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetland areas and may smother wetland vegetation; • Potential spillage of pollutants such as oil and or liquified cement which could damage wetland habitat and biota; •Movement of heavy machinery within the wetland adjacent to the crossing structure which would damage wetland soils and vegetation; •Proliferation of alien and/or invasive vegetation as a result of disturbances.	L
	Development of new road crossings of wetlands, involving: •Site preparation prior to construction activities including movement of construction equipment / vehicles within the freshwater ecosystems and removal of vegetation; •Ground-breaking and excavations and trenching within/adjacent to the freshwater ecosystems; •Construction of coffer dams for instream work, if required; and •Placement of culvert structures atop concrete base.	•Destruction of a certain area of wetland habitat in the footprint of the crossing structure; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetlands and may smother wetland vegetation; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; •Loss of ecological connectivity; •Potential hydrological impacts associated with crossing structures, including increased saturation and ponding upstream of the crossing structure, as well as deprivation of downstream reaches of water and sediment, which may lead to erosion in the long term; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	M
Operational phase	Operation and maintenance of the surface infrastructure associated with the proposed development located outside the delineated freshwater ecosystems and further than 100 m including turbines and associated foundations, and roads.	•Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and •Altered water quality (if surface water is present) as a result of increased availability of pollutants.	L
	Operation of surface infrastructure associated with the proposed development located within 100 m of the delineated freshwater ecosystems, including selected turbines and roads.		L
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater ecosystems (where applicable).	•Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the freshwater ecosystems (increase in the sediment load) and turbulent flows when surface water is present; •Higher flood peaks into the freshwater ecosystems due to reduced surface roughness in the freshwater ecosystems.	L
Decommissioning Phase	Removal of all surface infrastructure from the project area.	•Disturbance of soil and vegetation that established within the decommissioning area and associated indirect impacts on downgradient wetland, including sediment ingress, increased stormwater flows and potential pollution from oils and other pollutants; •Potential proliferation of alien invasive vegetation.	L

All activities associated with the construction of proposed infrastructure that are located within / or would directly affect wetlands and where no existing infrastructure is present would pose a “Medium” risk significance to the freshwater ecosystems within the study and investigation areas. All other activities would be associated with a “Low” risk significance. The freshwater related sensitivities of the study area as outlined in the scoping phase freshwater assessment have been adequately considered in the latest iteration of the development layout and all proposed turbine locations except two have avoided being placed within any freshwater ecosystem or associated 15m non-development buffer. A recommendation has been made that these two turbines (WTG 5 and 42) be relocated outside of the wetlands and associated buffers. In addition, a road realignment recommendation has been made to avoid the unnecessary impacting of a seep wetland. As the current layout does not indicate the position of proposed underground cabling, and other construction and operation infrastructure such as laydown areas, construction camps and BESS infrastructure, the finalised position of this infrastructure as well as of turbine locations and proposed roads must be assessed as part of a walkdown assessment of this infrastructure by a freshwater specialist. Should these recommendations be actioned and provided that all other mitigation measures as stipulated in this report are adhered to, the proposed development can be considered acceptable in a freshwater environment context.

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 Environment, Forestry, and Fisheries screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) as well as for the Environmental Impact Assessment (EIA) Regulations 2014 (as amended) requirements for Specialist Reports (Appendix 6).

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Front Page and Appendix I
2.2	Description of the preferred development site, including the following aspects-	
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution, and movement patterns	Section 4
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	Sections 3 and 4
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 7
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 7,8
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 3
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Section 3
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 7,8
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 7,8

	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 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 7,8
2.4.6	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 7,8
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	NA – WEF Facility not in proximity to estuaries.
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 2
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Section 1, 2, Appendix C, D,F
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 1.4
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 8
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 8
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 4.3
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 7
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	N/A
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.	Summaries and Section 9.1
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Sections 4.3
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 7
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate.	Sections 6 and 7
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Summaries and Section 9.1
3.16	Any conditions to which this statement is subjected.	Summaries and Section 9.1

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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.
Alluvial Material / Deposits	Sedimentary deposits resulting from the action of rivers, including those deposited within river channels, floodplains, etc
Apedal	A term indicating the degree of aggregation of soil particles within a soil horizon, where the material is well aggregated, but without well-formed peds (individual soil aggregates); in the context of the South African Soil Classification System, apedal soils also include structureless soils (e.g. sands) and somewhat more structured soils than the above description.
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.
Catena	A repeated sequence of soil profiles that is related to relief features, indicating the same sequence when traced from the crest (interfluve) to the valley floor. Profiles change in character as one moves downslope (change in slope angle and drainage conditions), so that different degrees of leaching / translocation are encountered
Cumulative Impact	The impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation, and/or hydrological indicators.
Drainage Density	A measure of the texture of a drainage system, expressed as the ratio of the total length of all stream channels within a catchment to the area of that catchment
Duplex Soils	Soils with a duplex morphology are characterised by the presence of a topsoil (A) horizon that differs markedly from the underlying subsoil in terms of texture, structure and composition, with an abrupt transition between the two soil horizons
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Endorheic	A term given to an inward oriented pattern of drainage that is not connected to a wider drainage system
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Fluvial:	The physical interaction of flowing water and the natural channels of rivers and streams.
Graminoid	Grasses, sedges and rushes.
Groundwater:	Subsurface water in the saturated zone below the water table.
Herb	A small non woody plant in which the aerial parts die back at the end of every growing season
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution, and movement of water over, on, and under the land surface.
Hydroperiod	The term hydroperiod describes the different variations in water input and output that form a freshwater ecosystem characterising its ecology – i.e. the water balance of the wetland
Land Type	Distinct areas defined as part of the Land Type Survey of South Africa based on a unique combination of soil pattern, macroclimate and terrain form
Macro channel (bank)	The (overall) compound channel of a watercourse that is situated between the two outermost and highest-lying banks
Melanic	A type of topsoil horizon that is dark-coloured and usually well-structured
Perennial:	Flows all year round.
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
Reach	A longitudinal stretch of a river
Redoximorphic	Features within soil that are a result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic.
Riparian Area / Corridor	The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a

	frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas
Vertic	Soils characterised by the presence of swelling and shrinking clays, typically formed where there is a distinct wet and dry period that affects the soils. These soils swell when they become saturated, and shrink again when they dry out, leading to characteristic 'cracking' on the surface of the ground
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam, or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may, in turn, have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
BESS	Battery Energy Storage System
CBA	Critical Biodiversity Area
CVB	Channelled Valley Bottom
CSIR	Council of Scientific and Industrial Research
DFFE	Department of Forestry, Fishery and the Environment
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EA	Environmental Authorisation
EC	Ecological Class
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMPr	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
ha	Hectares
HGM	Hydrogeomorphic
IPP	Independent Power Producer
m	Meter
MAP	Mean Annual Precipitation
MBSP	Mpumalanga Biodiversity Sector Plan
MPHW	Mpumalanga Highveld Wetlands
MTPA	Mpumalanga Tourism and Park Agency
MW	Megawatt
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystems Priority Areas
NBA	National Biodiversity Assessment
NWA	National Water Act
O & M	Operation and Maintenance
ONA	Other Natural Area
PES	Present Ecological State
RAM	Risk Assessment Matrix
REC	Recommended Ecological Category
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SQR	Sub quaternary catchment reach

subWMA	Sub-Water Management Area
UCVB	Unchannelled Valley Bottom
WetVeg Groups	Wetland Vegetation Groups
WEF	Wind Energy Facility
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WTG	Wind Turbine Generator
WUA	Water Use Authorisation
ZoR	Zone of Regulation

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) (Pty) Ltd was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment (EIA) for the proposed Phefumula Emoyeni One Wind Energy Facility (WEF) in the Ermelo area of the Mpumalanga Province. A scoping-phase freshwater assessment was produced in February 2024 and this report has been produced in support of the EIA phase specialist reporting requirements.

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

The purpose of this EIA phase freshwater report is to provide a description of the ecology of the freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF study and investigation area, including mapping of the natural freshwater ecosystems, verification of freshwater sensitivity in the context of the aquatic biodiversity sensitivity that has been assigned through the Department of Forestry Fishery and the Environment (DFFE) Web-based Screening Tool, assessment of the present ecological state (PES), Ecological Importance and Sensitivity (EIS) and ecosystem service provision and assessment of impacts on freshwater ecosystems that would potentially result from the development of the wind energy facility through the application of an Impact Assessment Matrix and the DWS Risk Assessment Matrix (RAM) as contained within GN4167 of 2023.

1.2 Project description[1]

The proposed Phefumula Emoyeni One WEF is located approximately 16kilometers (km) north of Ermelo in the Msukaligwa Local Municipality and Gert Sibande District Municipality, near the town of Ermelo, in the Mpumalanga Province of South Africa.

The proposed Phefumula Emoyeni One WEF will be developed within a project area of approximately 33 660 hectares (ha). There are 95 affected farm portions including State-owned Land in the WEF project area. The site will be accessed via the N11 and existing access roads. The following technical details are applicable to the proposed development:

- The WEF will have an export capacity of up to 550 Megawatt (MW);
- Up to 88 turbines of between 6 MW and 15 MW each are proposed;
- The turbines are proposed to have a rotor diameter and hub height of 200 meters (m);
- The hard standing dimensions would be approximately 75 m x 120 m;
- The turbine Foundation are proposed to have a diameter of up to 40 m per turbine;
- Each turbine would require an excavation of up to 6 m deep, constructed of reinforced concrete to support the mounting ring. Once tower is established the footprint of the foundation will be covered with soil;
- Substation and internal powerlines: 33 Kilovolt (kV) cabling to connect the wind turbines to the onsite collector substations, to be laid underground where practical;
- 3 x 33 kV/132 kV onsite collector substation (Independent Power Producer [IPP] Portion), each being up to 5 ha;
- Cabling between turbines, to be laid underground where practical;
- Construction camp and laydown area:
    - construction compounds including site office (approximately 300 m x 300 m in total but split into 3 ha each of 150 m x 200 m):
    - 3 x Batching plant of up to 4 ha to 7 ha;
    - 3 x construction compound / laydown area, including site office of 3 ha each (150 m x 200 m each); and
    - Laydown and crane hardstand areas (approximately 75 m x 120 m).
- Internal Roads12-13 m wide roads with 12m radius turning circles, gravel surface;
- Operation and Maintenance (O&M) Building: 3 x O&M office of approximately 1.5 ha each adjacent to each collector Sub Station; and
- Battery Energy Storage System (BESS) (200 MW/800 MWh):

[1] Note: the information in this section was provided by the proponent.

- The type of BESS has not been confirmed at this stage. It is proposed that all impacts related to both types be assessed in the EIA;
- Export Capacity of up to 800 MWh;
- Total storage capacity 200 MW;
- Storage capacity of up to 6-8 hours;
- The BESS will be housed in containers covering a total approximate footprint of up to 5 ha; and
- Battery types to be considered: Solid State Batteries as the preferred (Lithium Ion) and Redox Flow Batteries as the alternative (Vanadium Redox).

It should be noted that layout indicating the proposed location of the turbines has been provided for assessment. It is important to note that only turbines and access roads and no other infrastructure has been provided (Figure 3).

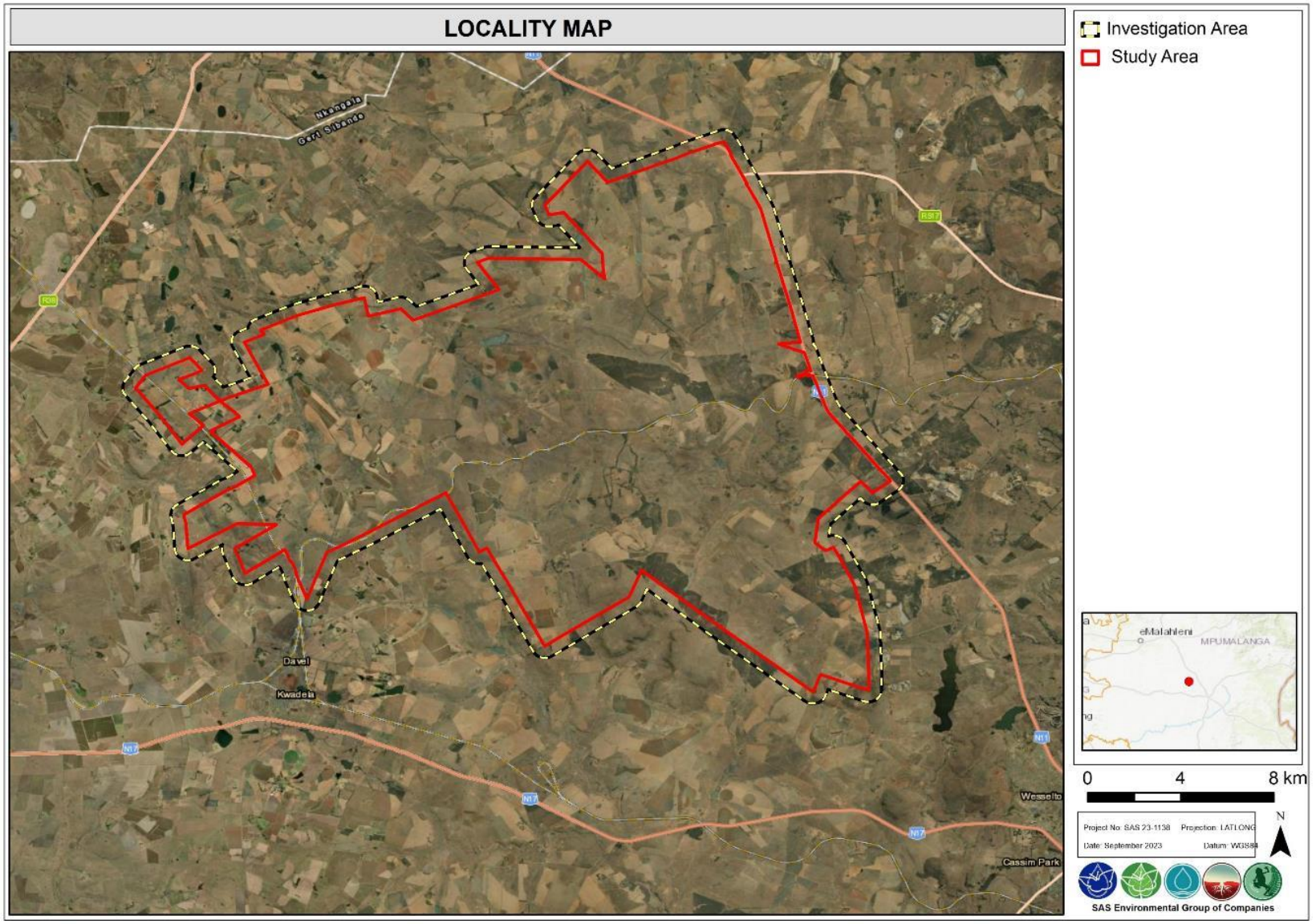


Figure 1: Digital satellite image depicting the location of the proposed Phefumula Emoyeni One WEF study area and associated investigation area in relation to the surrounding area.

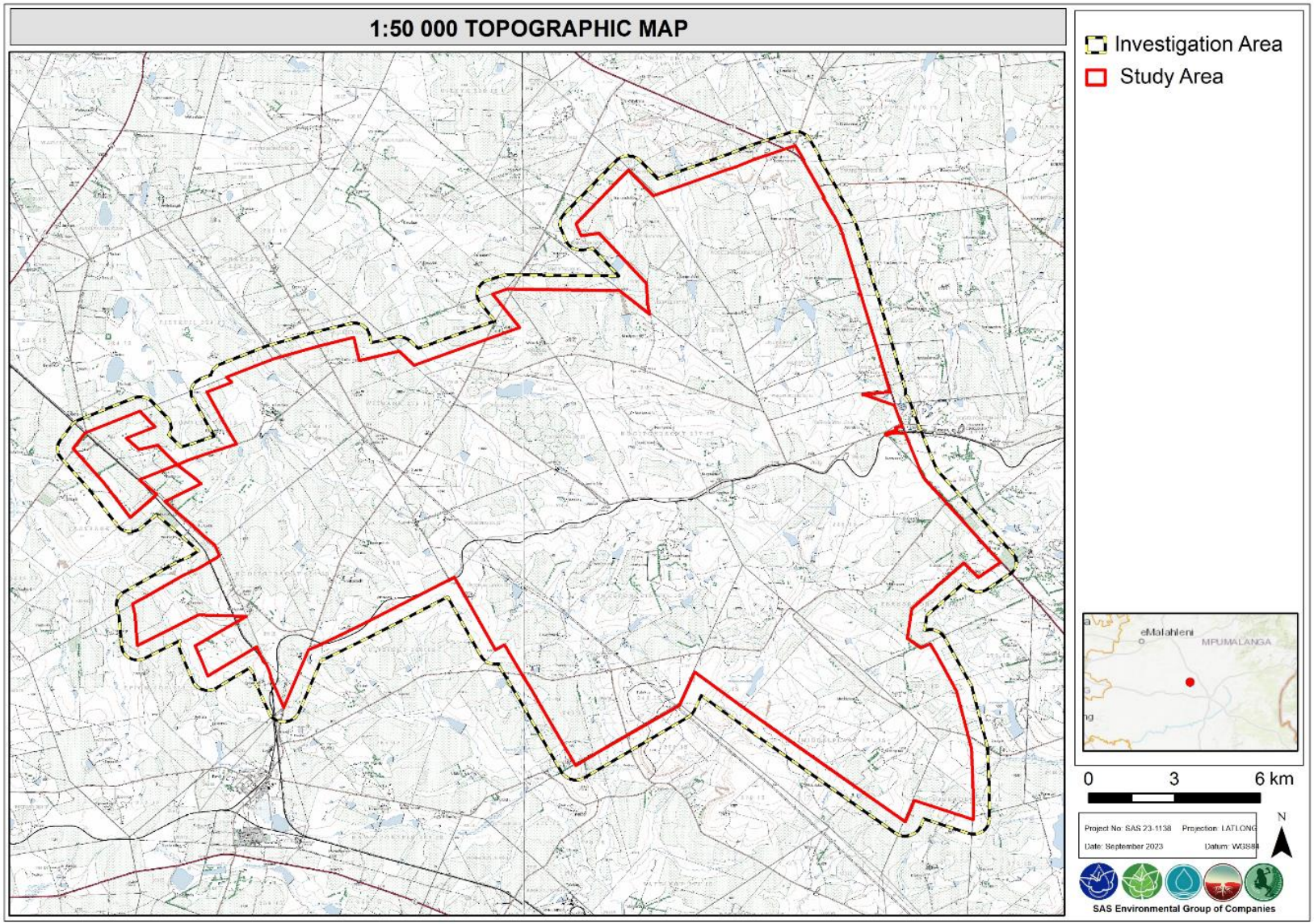


Figure 2: The proposed Phefumula Emoyeni One WEF, and associated investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.

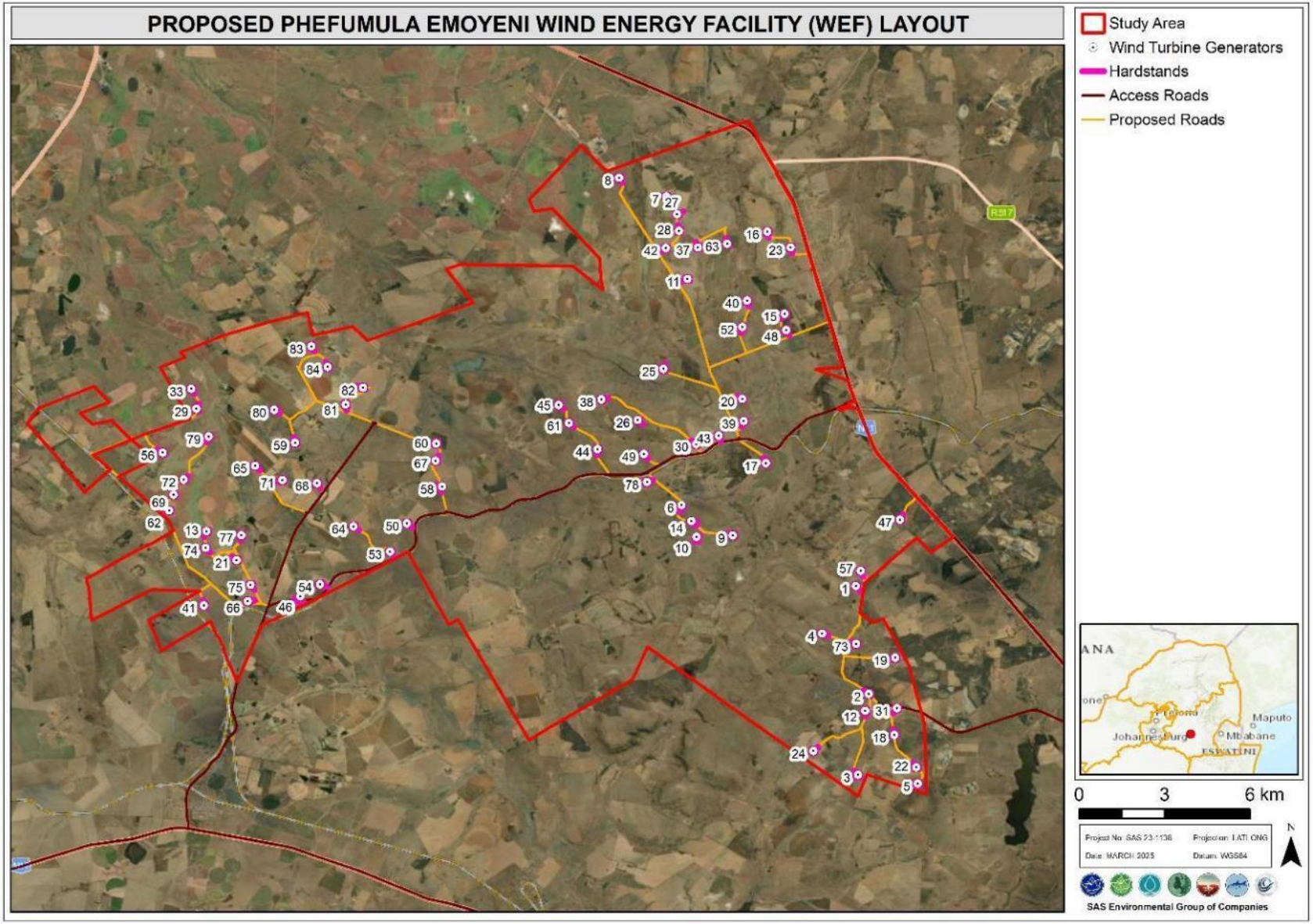


Figure 3: Proposed Phefumula Emoyeni One Wind Energy Facility layout.

1.3 Scope of Work

Specific outcomes in terms of this EIA-phase freshwater assessment report are outlined below:

- A background study of relevant national, provincial, and municipal datasets (such as National Freshwater Ecosystem Priority Areas [NFEPA] (2011), and the National Biodiversity Assessment [NBA] (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) databases were undertaken to aid in defining the Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems;
- All freshwater ecosystems associated with the study area and associated investigation area were delineated using desktop methods in accordance with GN 4167 of 2023 as it relates to activities as stipulated in the NWA and verified according to the "Department of Water Affairs and Forestry (DWAF)[2] (2008)[3]: 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 PES of the freshwater ecosystems was assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.* (2008);
- The EIS of the freshwater ecosystems was 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, recommended development exclusion buffer and legislated zones of regulation (ZoR) 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 ecosystems were assigned based on the results obtained from the PES and EIS assessments;

[2] 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.
[3] 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.

- In the context of the Water Use Authorisation (WUA) application, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (as contained within GN 4167 of 2023) was applied to identify potential impacts that may affect the freshwater ecosystems as a result of the proposed development, and to aim to quantify the significance thereof;
- In the context of the application for Environmental Authorisation (EA) in terms of the EIA Regulations of 2014, as amended, the WSP (EAP's) impact assessment matrix was also applied to assess potential impacts that may affect the freshwater ecosystems as a result of the proposed development, and to aim to quantify the significance thereof; and
- Management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact of the proposed development on the receiving freshwater environment have been presented.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- All freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF and within 500 m in fulfilment of GN4167, were and delineated using various desktop methods including the use of topographic maps, digital satellite imagery, and aerial photographs. Desk-based delineations were subject to ground-truthing where feasible which allowed for refinement of the delineations of the freshwater ecosystems upon completion of the freshwater assessment;
- The current iteration of the proposed development layout represents the third revision that has been presented to specialists for assessment. At the time of undertaking of the EIA phase fieldwork in March 2024, the first version of the layout which indicated proposed turbine locations and access roads was utilised as the basis on which to identify freshwater ecosystem reaches for in-field verification and assessment. The layout was revised again in late 2024 and fieldwork was undertaken in February 2025 to assess new proposed crossings of wetlands and wetlands located within a certain minimum distance of turbine locations;
- The layout provided for assessment does not indicate the position of certain proposed infrastructure including underground cabling, Battery Energy Storage System (BESS) infrastructure, construction laydown and construction camp locations and Operational and Control Buildings. As such the impact of these infrastructural components on the freshwater has been unable to be assessed as part of this report, and as part of the impact rating matrix and DWS risk assessment matrix. Once provided for assessment the DWS risk assessment matrix will need to be updated to include these components.

- A key recommendation made in this report in this context is that a detailed walkdown by a freshwater specialist must be undertaken prior to the start of construction in order to assess, make recommendations for micro-siting of and provide sign off of these infrastructure components as well as the final turbine locations and internal road alignments.
- Due to the absence of significant differences in landuse impacts, twinned with the high degree of homogeneity in wetland characteristics across the study area, individual wetland units have not been individually assessed in terms of the determination of PES, EIS, ecoservices and RMO / REC. Accordingly the study area was broken up into three sub-areas according to the respective quaternary catchment in which the study area is located. Different wetland hydrogeomorphic (HGM) units within each catchment component were collectively assessed. As many valley bottom wetlands share channelled and unchannelled characteristics within the same wider reach, valley bottom wetlands were collectively assessed. Lastly although a small number of depression wetlands exist in the study area, these were not assessed to be at risk of impact from the proposed development and thus were not included in the detailed assessment of wetlands;
- During the site assessment undertaken in February 2025, access to certain properties in the study area which are government-owned was denied by the inhabitants of those properties. Accordingly the proposed road crossings on those properties has been unable to be assessed in the field. However, this is not considered a fatal flaw and the assessment of wetlands downstream of the proposed crossings was able to be used to extrapolate the delineation and detailed assessment of these wetlands;
- This report does not report on a related, but separate component of the project relating to the grid connection-related power line and substation infrastructure;
- 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 survey equipment;
- The delineations as presented in this report are regarded as the best estimate of the boundaries based on desk-based delineation with limited ground truthing based on the site conditions present during the scoping-phase site assessment;
- Wetland, riparian, and terrestrial ecosystem 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 boundary may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results;

- With regards to data sources used to provide background information on the sensitivity of the assessed areas, it is important to note that although all data sources provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the proposed Phefumula Emoyeni One WEF's actual site characteristics at the scale required to inform the environmental authorisation and water use authorisation processes;
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the existing activities have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of aquatic, riparian, and wetland ecology; and
- The only activities which were assessed were the Phefumula Emoyeni One WEF and identified freshwater ecosystems within 500 m thereof that may be impacted by the development footprint. All other activities located outside these boundaries that may intercept/create other potential impacts were not considered.

1.5 Legislative Requirements and Provincial Guidelines

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

- The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996);
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA);
- The NEMA EIA Regulations of 2014, as updated (GN 982 of 04 December 2014);
- National Water Act, 1998 (Act No. 36 of 1998) as amended; and
- Government Notice (GN) 4167 as published in the Government Gazette 49833 of December 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended.

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;

For the purposes of this investigation, the definition of a freshwater ecosystem is considered to be synonymous with the definition of a watercourse as per the NWA and carries the same meaning as "watercourse" as defined by the Act.

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."

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 composition and physical structure distinct from those of adjacent areas.

2.2 Freshwater Ecosystem Field Verification

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 ecosystems at a desktop level prior to the undertaking of a 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.

A freshwater ecosystem site verification and assessment was undertaken from the 04th to the 09th of March 2024 (late summer season) and on the 25th – 26th of February 2025, during which the presence of any freshwater ecosystem characteristics as defined by the Department of Water Affairs and Forestry (2008) and the NWA were noted and delineated (please refer to Section 4 of this report). A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

The freshwater ecosystem delineation 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 soils;
- Vegetation that is adapted to saturated soils; and
- The presence of alluvial soil in stream systems.

It is important to note that vertic soils are predominant over large parts of the study area, particularly in valley bottom settings 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 the soils and the standard delineation procedure for wetlands in South Africa that relies mostly on soil wetness indicators cannot be applied. Wetland delineation in vertic settings is further complicated within the Rensburg soil form – the soil form that is typically associated with wetlands in vertic soil settings – by the potential occurrence of the gley (G) horizon at extreme depth (of up to 2m), with the soil horizon showing redoximorphic characteristics being well below the typical rooting depth of herbaceous plants.

Accordingly an adapted delineation methodology which was based on vegetation, terrain and hydrological indicators was applied.

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.

2.3 Impact Assessment, RAM and Recommendations

Following the completion of the assessment, an impact assessment (please refer to Appendix D for the method of approach) and the DWS RAM (please refer to Appendix E for the RAM methodology) were conducted. Recommendations were developed to address and mitigate impacts associated with the proposed Phefumula Emoyeni One development's activities. These recommendations also include general 'best practice' management measures, which apply to the proposed development activities as a whole, and which are presented in **Appendix H**. Mitigation measures have been developed to address issues in all phases throughout the life of the operation including planning, construction and operation. The detailed site-specific mitigation measures are outlined in Section 7 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 is 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 the integration of results by the reader to take place. Where required, further discussion and interpretation are provided, and information that was considered of importance was emboldened.

It is important to note that although all data sources are used to provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the proposed Phefumula Emoyeni One WEF’s actual site characteristics at the scale required to inform the EA process. 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 Phefumula Emoyeni One WEF and the associated investigation area. Actual site conditions at the time of the assessment may differ from the background information provided by various datasets. Please refer to Section 4 for details pertaining to the site investigation results.

Table 1: Desktop data relating to the characteristics of the freshwater ecosystems associated with Phefumula Emoyeni One WEF and investigation area [Quarter Degree Square (QDS) 2629BB, 2629BC and 2629BD].

Aquatic ecoregion and sub-regions in which Phefumula Emoyeni One study area is located		
Ecoregion	Highveld	
Catchments	Komati/Crocodile, Olifants North, and Vaal	
Quaternary Catchment (Figure 4)	X11A, C11F, C11H, B11A & B12A	
WMAs (Figure 5)	Inkomati, Olifants, and Upper Vaal	
subWMAs (Figure 6)	Komati west, Upper Olifants & Instream Vaal WMAs	
Dominant characteristics of the Highveld Ecoregion Level II (Kleynhans *et al.*, 2007) (Figure 7)		
Ecoregion Level II	11.05	11.02
Dominant primary terrain morphology	Slightly undulating plains, slightly irregular undulating plains, few hills;	Moderately undulating plains and pans;
Dominant primary vegetation types	Moist Clay Highveld Grassland.	Moist Sandy Highveld Grassland.
Altitude (m a.m.s.l)	1300 to 1900	
MAP (mm)	500 to 800	
Coefficient of Variation	20 to 29 (% of MAP)	
Rainfall concentration index	55 to 64	
Rainfall seasonality	Early summer	Early to mid-Summer
Mean annual temp. (°C)	14 to 16	12 to 8
Winter temperature (July)	0 to 18	0 to 20
Summer temperature (Feb)	12 to 26	10 to 26
Median annual runoff (mm)	20 to 150	20 to 80
Mpumalanga Highveld Wetlands (MPHW), (2014) (Figure 14-15)		
The Mpumalanga Highveld Wetlands Database indicates the presence of several wetland types within the study and investigation area. The majority of the wetlands are indicated to be in a natural to near-natural (A/B), moderately modified (Class C) and heavily to critically modified (Class Z) ecological condition. and overlain by artificial features. **Phefumula Emoyeni One WEF Eastern Land Parcels:** The majority of wetlands in the eastern portion of the study and investigation area are CVBs, seeps, floodplain and UCVB wetlands. Two floodplains and several artificial impoundments (dams) are also indicated by the database. A small UCVB and some depression wetlands are also indicated by the database.		

Details of the Phefumula Emoyeni One study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Wetland Vegetation Type (Figure 9)	The study area and investigation areas fall within the Mesic Highveld Grassland Group 3 and Group 4. These vegetation groups are considered to be Critically Endangered (CR) according to Mbona *et al.* (2015).
FEPA CODE (Figure 8)	The study area and investigation area fall within CODE 1 and 4 FEPA quinary catchments. **Code1 (FEPAs)** achieve biodiversity targets for river ecosystems and threatened fish species and were identified in rivers that are currently in a good condition. Although the FEPA status applies to the actual river reach within the sub-quaternary catchment the surrounding land and smaller stream network needs to be managed in a way that maintain the good condition of the river reach. **Code 4 (Upstream Management Areas**) are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale. Other parts of the study and investigation area have not been designated as being sensitive in a FEPA catchment context.
NFEPA Wetlands (Figure 10)	The NFEPA database indicates numerous wetlands within the study area and the associated investigation area, the majority of which are channelled valley bottom (CVB), seeps, flat, depressions and Unchannelled valley bottom (UCVB) wetlands. Most of the wetlands are indicated to be natural wetlands. Only 8 artificial wetlands were indicated by the database within the study and associated investigation area. All the wetlands that are indicated to be in a moderately modified (WETCON C) and good/natural (WETCON A/B) ecological condition are indicated by the database to be natural wetlands. The noticeable wetlands include a CVB, seep and flat wetlands indicated to be in a moderately modified ecological state, while the smaller seep and flats are indicated to be in a good/natural ecological condition.
NFEPA Rivers (Figure 10)	According to the NFEPA (2011) database, 4 rivers traverse the study area and its associated investigation area, *i.e.,* • **An Unnamed tributary of Xspruit River,** which is indicated as moderately modified (PES1999) and in a natural to near-natural (RIVERCON A/B) ecological condition; • The **Olifants River is** indicated as moderately modified (PES1999) and in a moderately modified (RIVERCON C) ecological condition; • The **Klein Olifants River is** indicated as moderately modified (PES1999) and in a moderately modified (RIVERCON C) ecological condition • The **Viskuile River** is indicated as moderately modified (PES1999) and in a heavily modified (RIVERCON D) ecological condition.
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems – (Figure 11-13).	

Phefumula Emoyeni One WEF Western Land Parcels: According to the MPHW (2014) database, seep, CVB, and floodplain wetlands are also indicated to occur in these land parcels. Artificial impoundments such as dams also dominate these land parcels.

National Web-Based Environmental Screening Tool (2020) (Accessed 2023) (Figure 16)

The Screening Tool is intended to allow for the pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.

The study and investigation areas are a mix of low and very high aquatic biodiversity sensitivity the exception of a very small area in the south eastern portion of the study and investigation which is designated as having a very high aquatic biodiversity sensitivity. Areas of very high sensitivity are triggered by the aquatic Critical Biodiversity Area (CBA), Ecological Support Area (ESA) wetlands and sub catchment and for being within a Freshwater Ecosystem Priority Area (FEPA) sub catchment.

Detail of the Phefumula Emoyeni One land parcels in terms of the Land Type Data (Figure 18)

The potential presence of wetlands in the study and investigation areas can be examined in the context of the land type for the area. The majority of the study and investigation areas fall within the Ea23 land type grouping and some small portions of the study and investigation area falls within Ab9 Bb4, Bb21, Ea23,Ea20, Ba33,Ba22,Ba19 land type grouping.

- The soils in the **Ea** land types grouping are one or more of: vertic, melanic, red structured diagnostic horizons, undifferentiated;
- The soils in this **Ba &Bb** grouping are Plinthic catena soils that are dystrophic and/or mesotrophic, where red soils are widespread, and upland duplex and margalitic soils are rare; and

  The soils in the Ab land type grouping are red and yellow, freely-drained apedal soils with Hutton, Griffin and Clovelly soils.

The NBA (2018) database like the NFEPA database, also indicates the presence of numerous wetlands, majority of which are CVB and seep wetlands. The CVB and seep wetlands are in a moderately and largely to critically modified (WETCON C & D/E/F) ecological condition. The Ecosystem Threat states (ETS) of the CVB wetlands is indicated as critically endangered and the Ecosystem Protection Level (EPL) is not protected, while the ETS of the seep wetlands is currently critically endangered and EPL is poorly protected.

The NBA Rivers database further indicates the Olifants River traversing the study and investigation area to the north west, the Viskuile River traversing the study area to the west, Klein Olifants River traversing to the north east, and the unnamed tributary of Xspruit River traversing the study area to the south east. The Olifants River and the Klein-Olifants River are indicated by the database to be in a moderately modified (RIVERCON C) ecological condition. The unnamed tributary of Xspruit River is indicated to be in a near natural to natural (RIVERCON A/B) ecological condition, and the Viskuile River is indicated to be in a largely modified (RIVERCON D) ecological state. All the mentioned above rivers are currently in a critically endangered (ETS) and poorly protected (EPL).

The NBA Artificial Wetlands Database furthermore indicates numerous dams within the study and associated investigation area. A small open reservoir was also indicated by the database in the western portion of the study area.

Mpumalanga Biodiversity Sector Plan (MBSP, 2019) (Figure 17)

Aquatic Critical Biodiversity Area (CBA)	The rivers traversing the study and investigation area are indicated as CBA: Aquatic River areas, as well as several wetlands in the study and investigation area. CBA Areas that are required to meet biodiversity targets for species, ecosystems, or ecological processes. These include all areas required to meet biodiversity pattern targets and to ensure the continued existence and functioning of species and ecosystems, special habitats, and species of conservation concern; Critically Endangered ecosystems; and critical linkages (corridor 'pinch-points') to maintain connectivity. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species.
Aquatic Ecological Support Area (ESA)	The majority of the study area is indicated as ESAs for important sub catchment areas and wetland ESAs. ESAs are areas that are not essential for meeting targets, but that play an important role in supporting the functioning of CBAs and that deliver important ecosystem services. ESAs need to be maintained in at least a functional and often natural state, supporting the purpose for which they were identified. They include features such as riparian habitat surrounding rivers or wetlands.
Other Natural Areas (ONA)	Patches of the study and investigation area scattered throughout are indicated as ONAs. ONAs are areas that have been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.
Moderately or Heavily Modified Areas (transformed)	Patches of the study and investigation area are indicated as heavily modified areas. Heavily modified areas are those that have been heavily modified by human activity so that they are by-and-large no longer natural, and do not contribute to biodiversity targets. Some of these areas may still provide limited biodiversity and ecological infrastructural functions but, their biodiversity value has been significantly and, in many cases, irreversibly compromised.

Detail of the study and investigation area according to the Strategic Water Source Areas (2017) Database

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 and investigation area are not associated with a surface or underground SWSA. They are, however, in proximity to the Upper Vaal SWSW for surface and groundwater, which is indicated by the database to be located 6.13 km south west of the study area and associated investigation area.

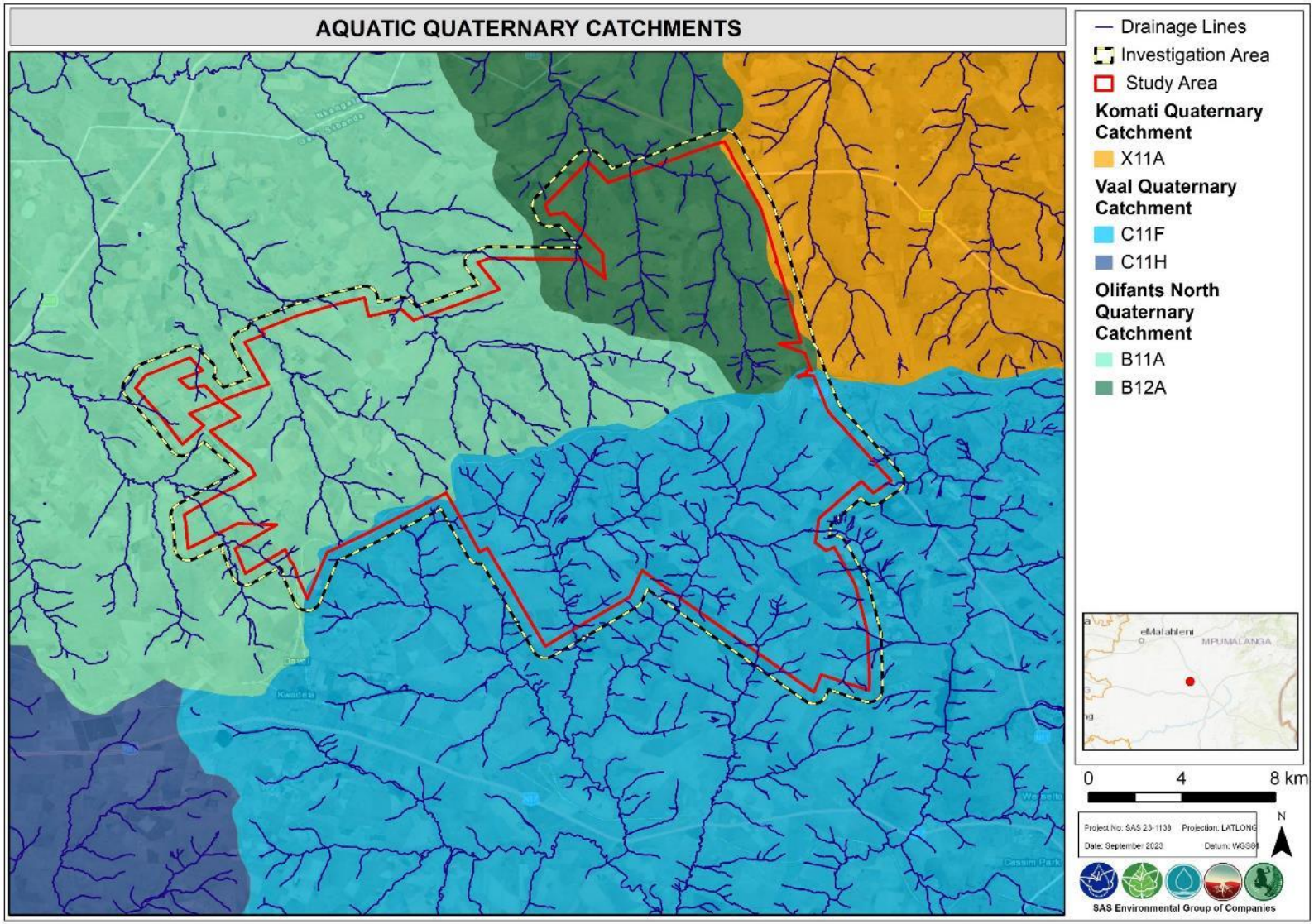


Figure 4: Quaternary catchments and overall surface water drainage associated with the proposed Phefumula Emoyeni One WEF study area and associated investigation area.

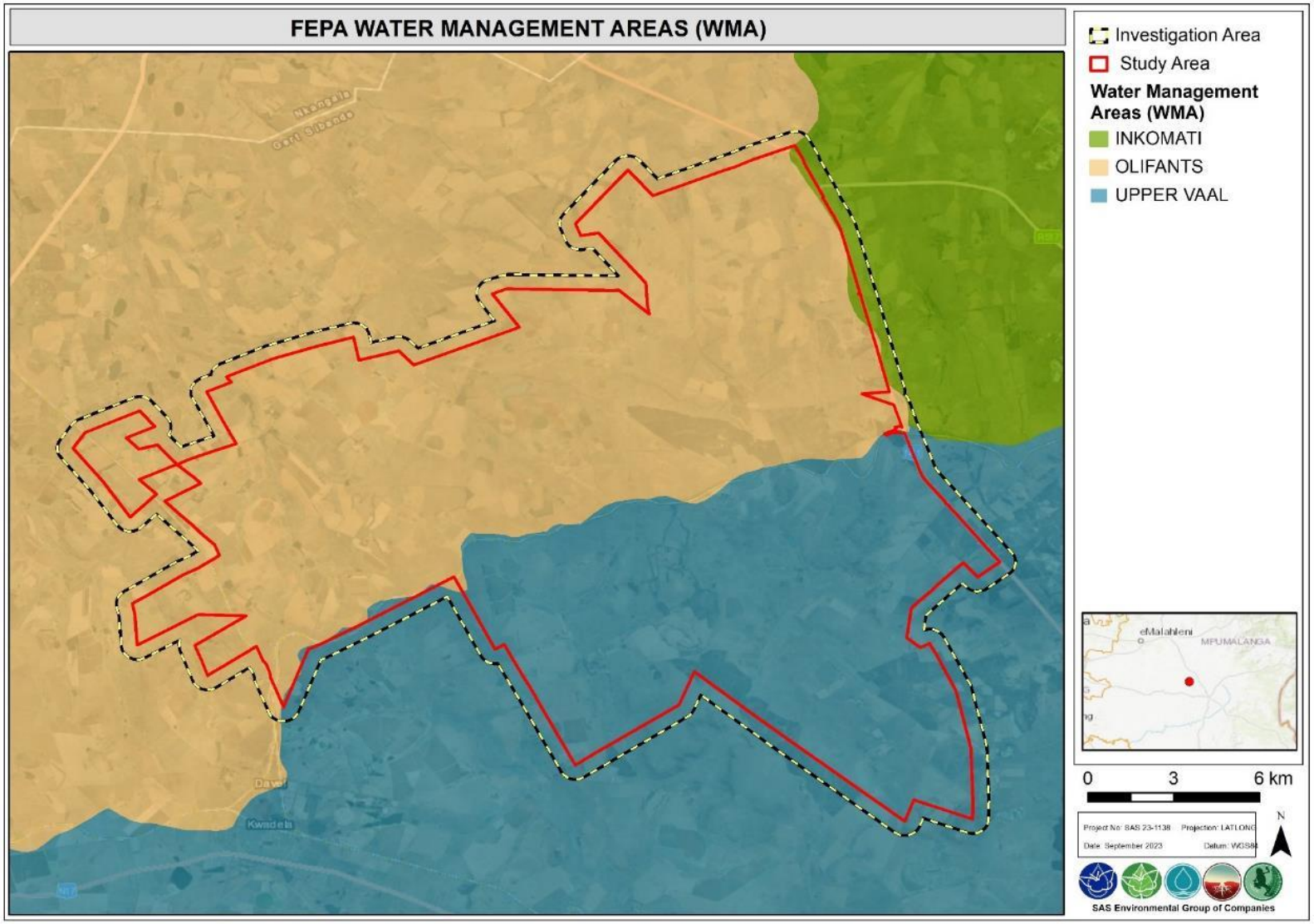


Figure 5: FEPA Water Management Areas (WMAs) associated with the proposed Phefumula Emoyeni One WEF study area and associated investigation area.

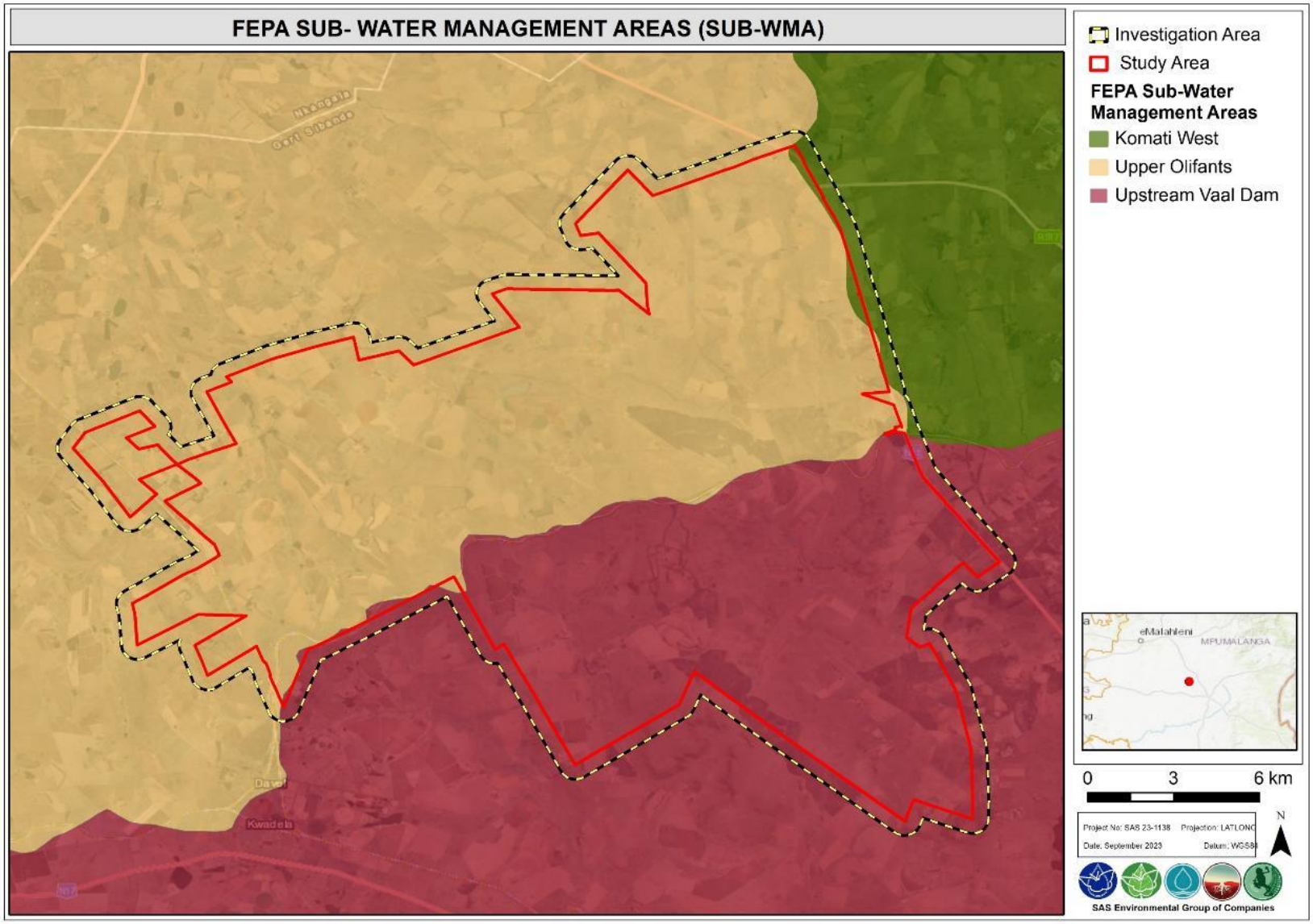


Figure 6: FEPA Sub WMAs associated with the proposed Phefumula Emoyeni One WEF study area and associated investigation area.

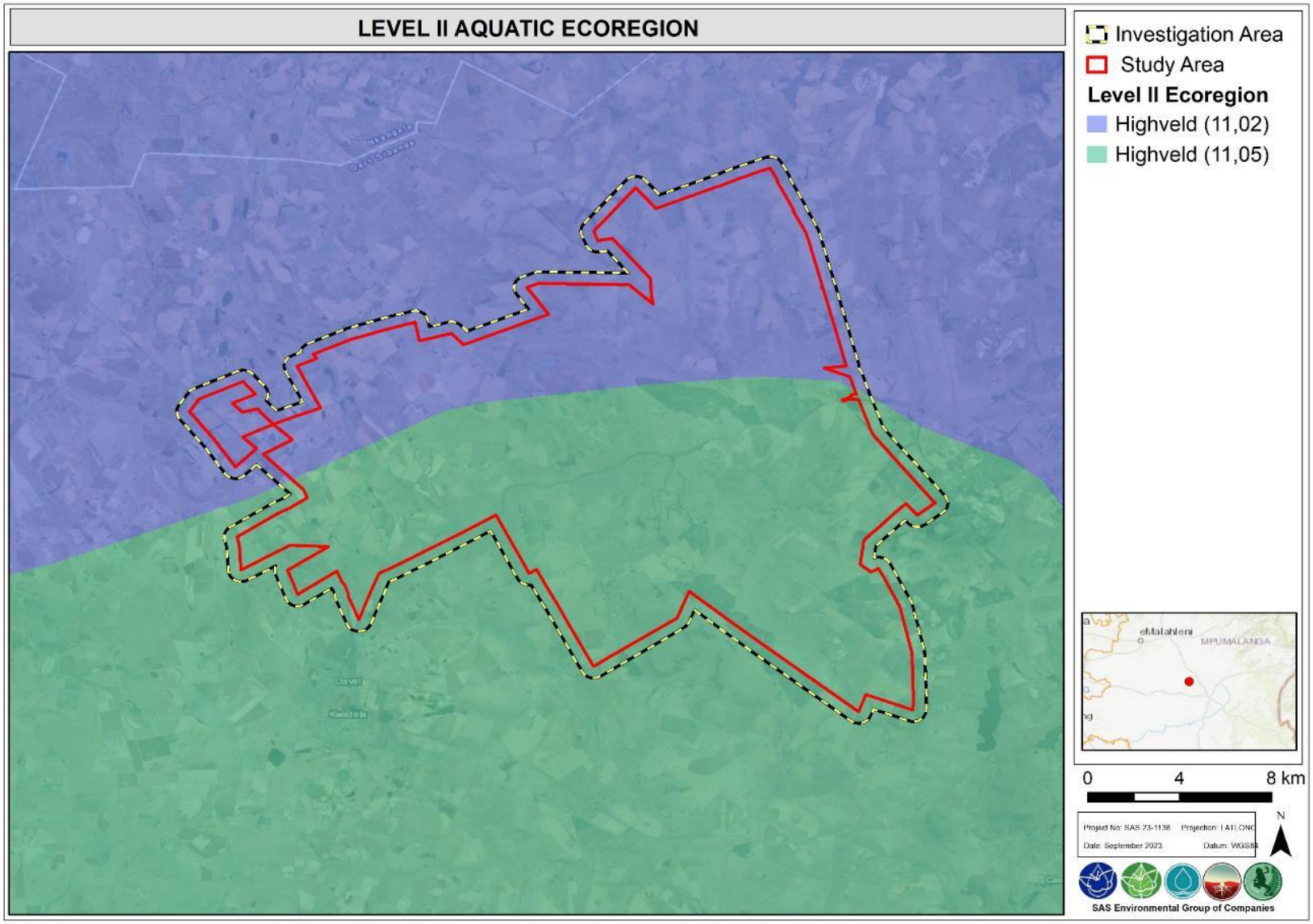


Figure 7: DWS Ecoregions in which the proposed Phefumula Emoyeni One WEF study area and associated investigation area are located.

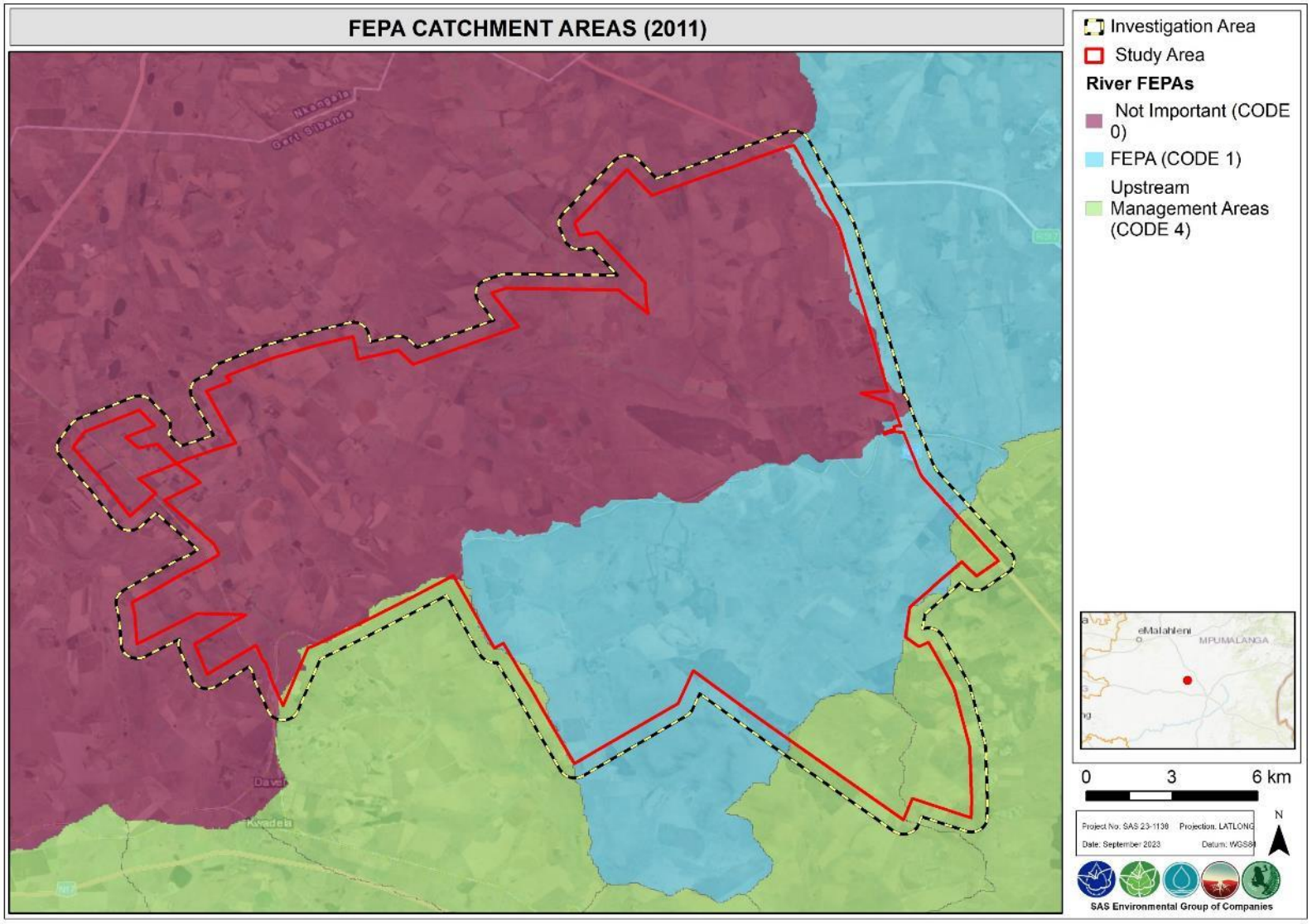


Figure 8: Freshwater Ecosystem Priority Areas (FEPAs) associated with the proposed Phefumula Emoyeni One WEF study area and associated investigation area according to the NFEPA (2011) database.

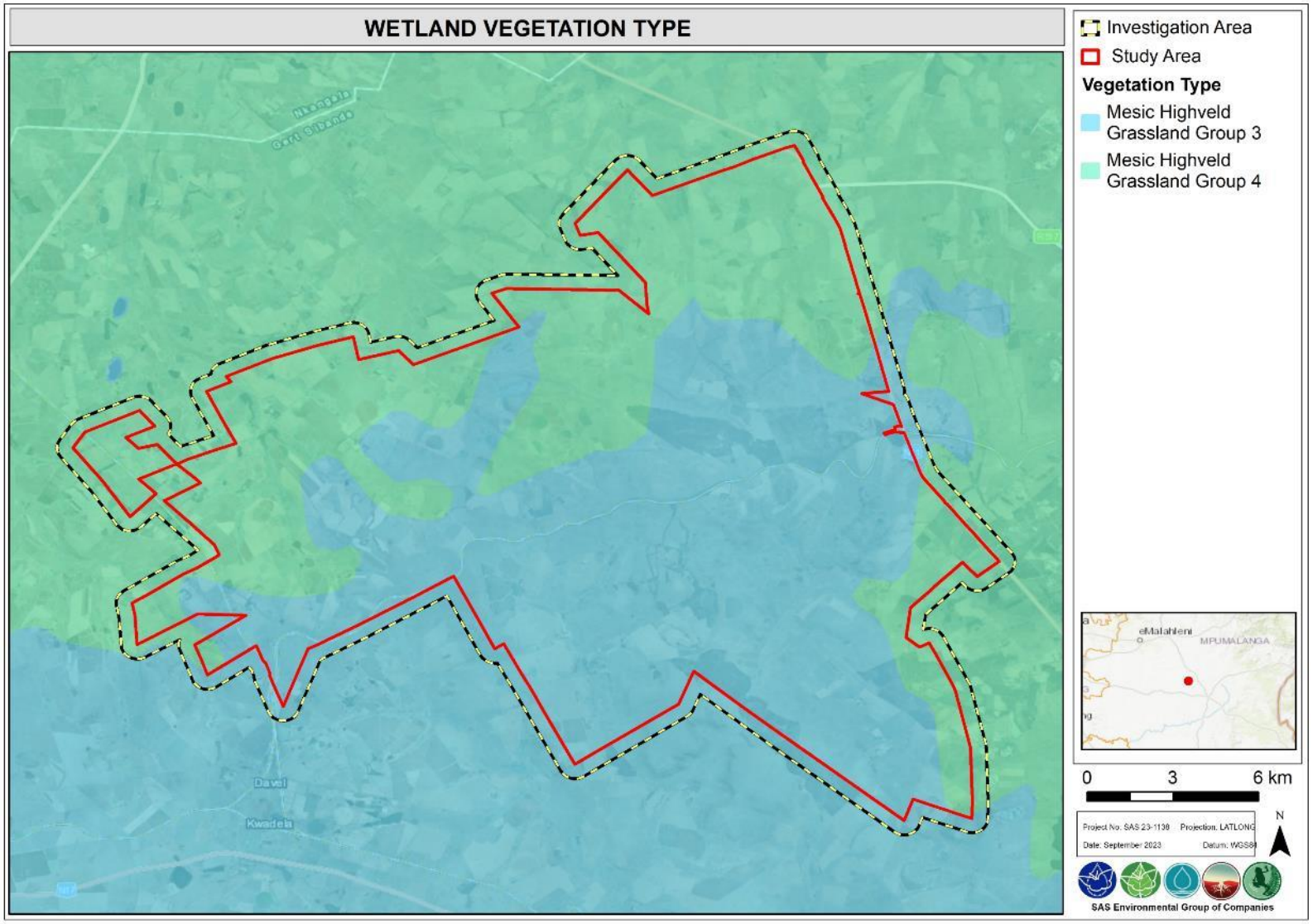


Figure 9: Freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF study area and associated investigation area according to the NFEPA (2011) database.

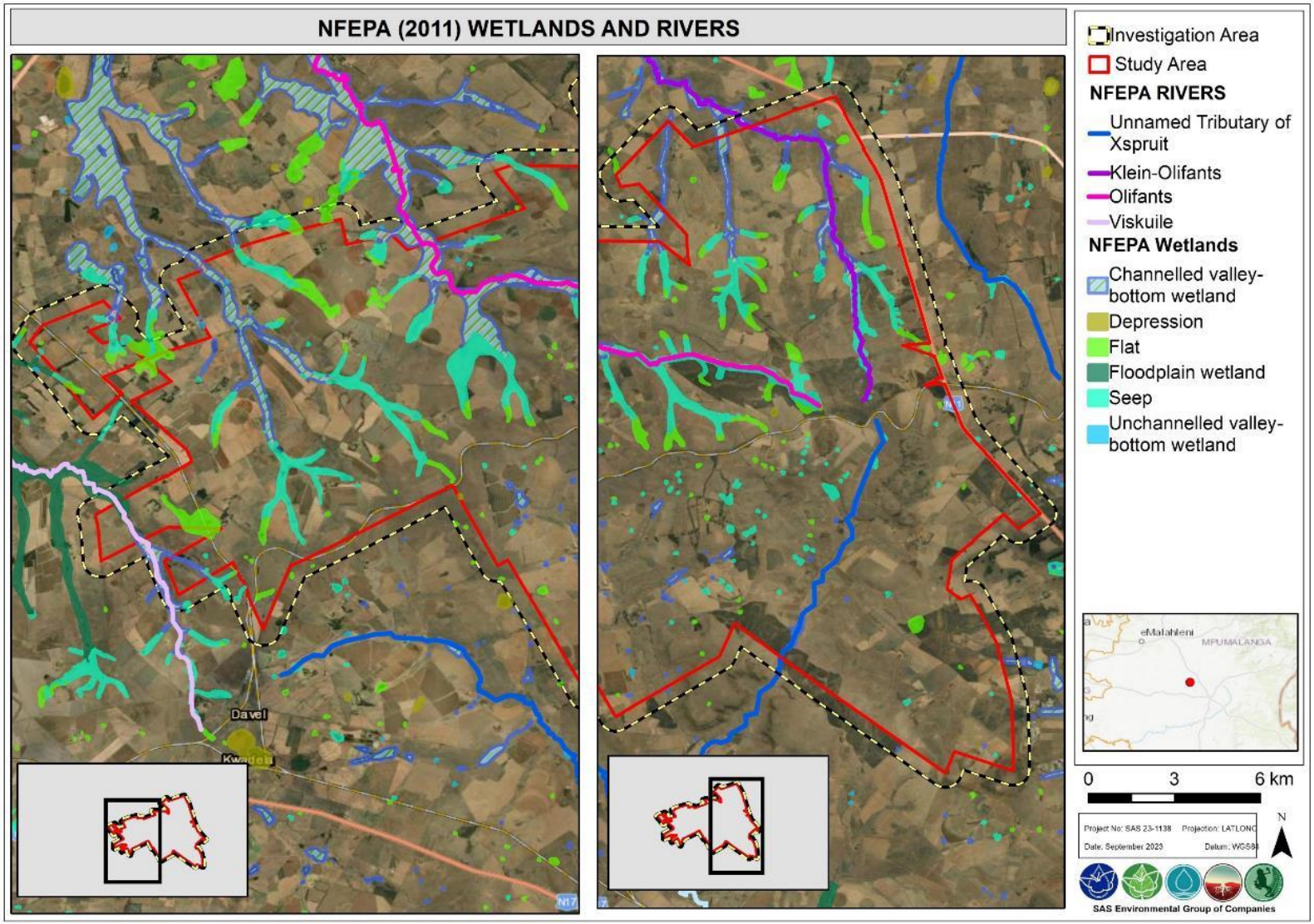


Figure 10: Freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the NFEPA (2011) database.

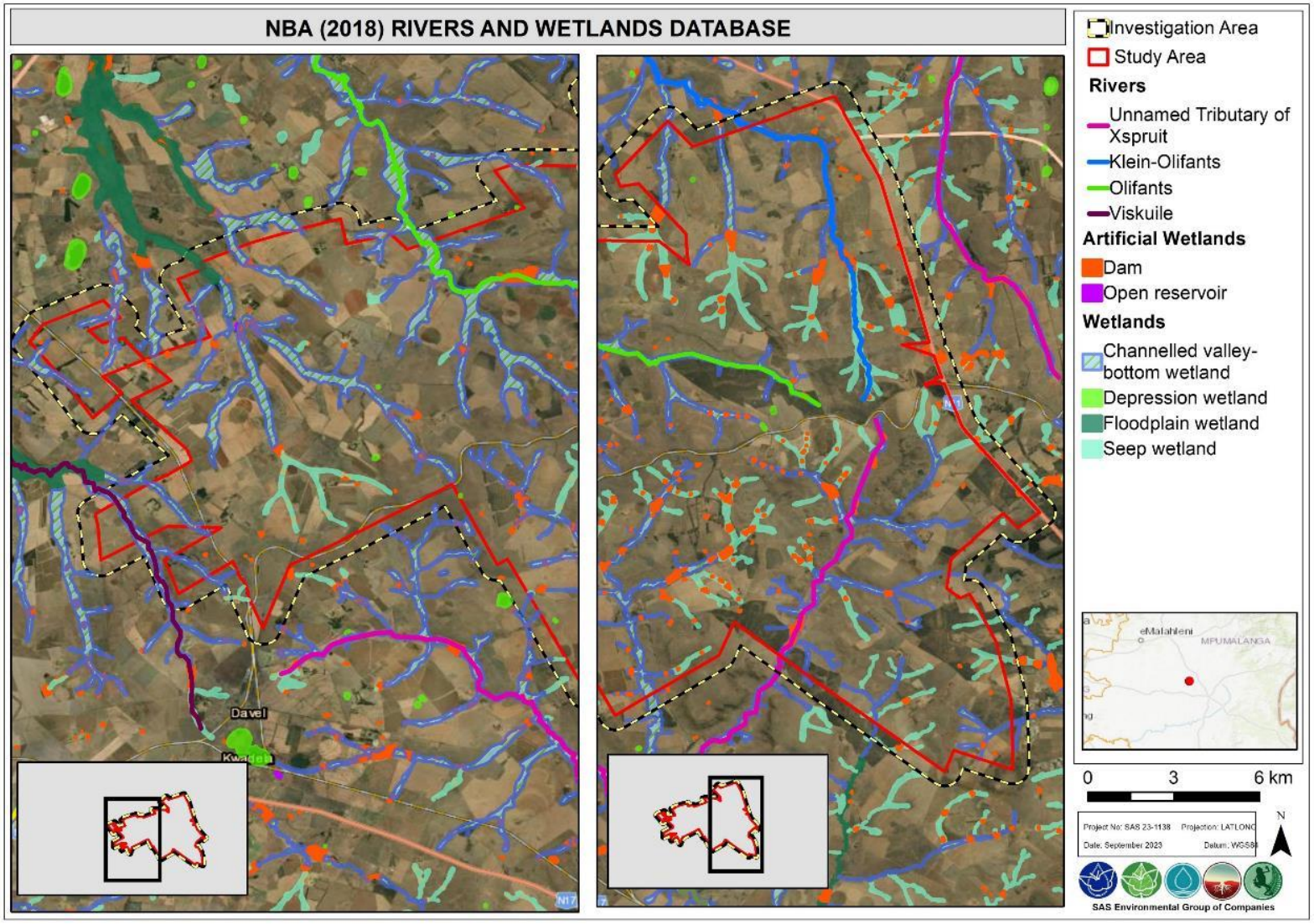


Figure 11: Freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the NBA (2018) database.

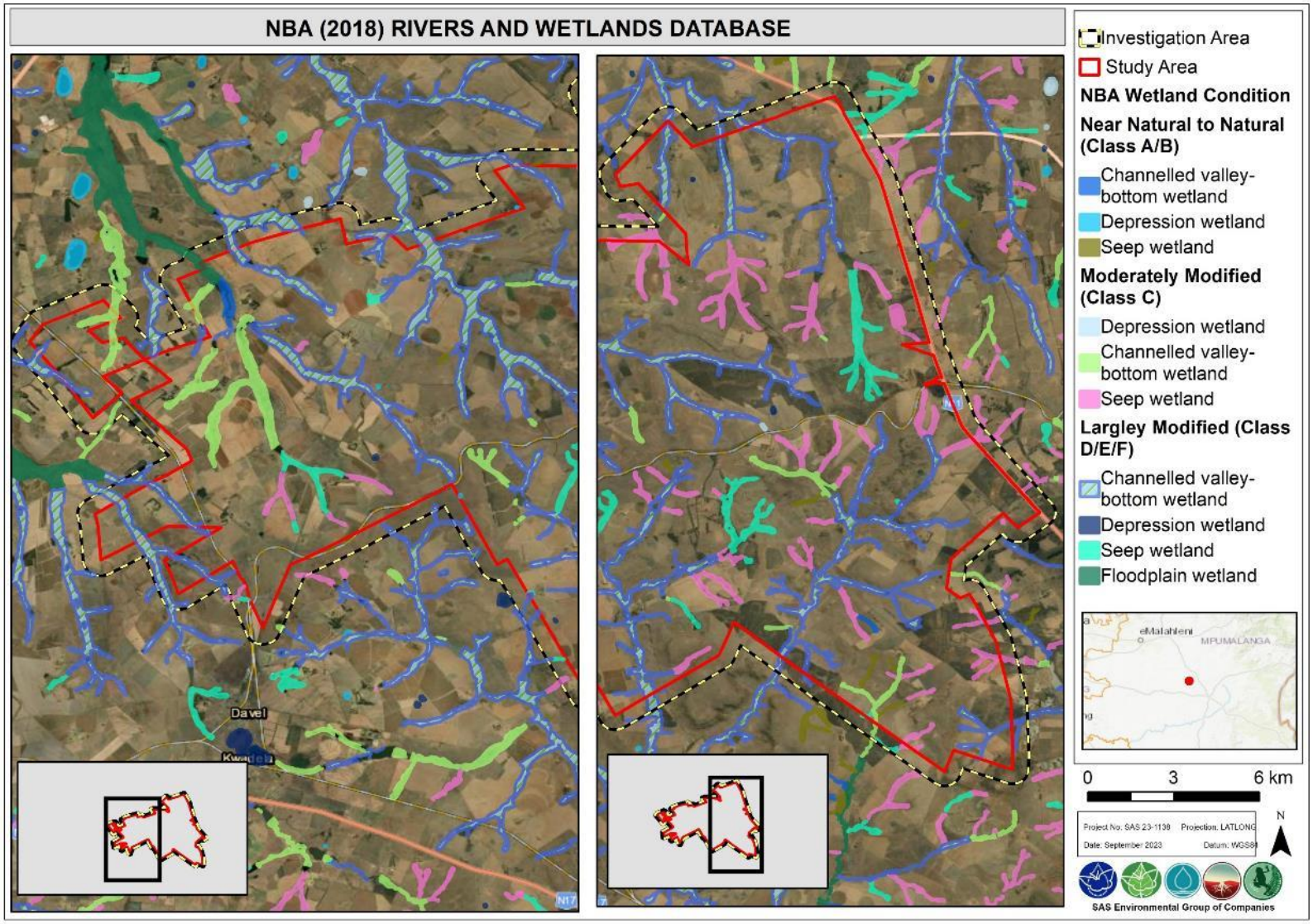


Figure 12: Wetland ecological condition associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the NBA (2018) database.

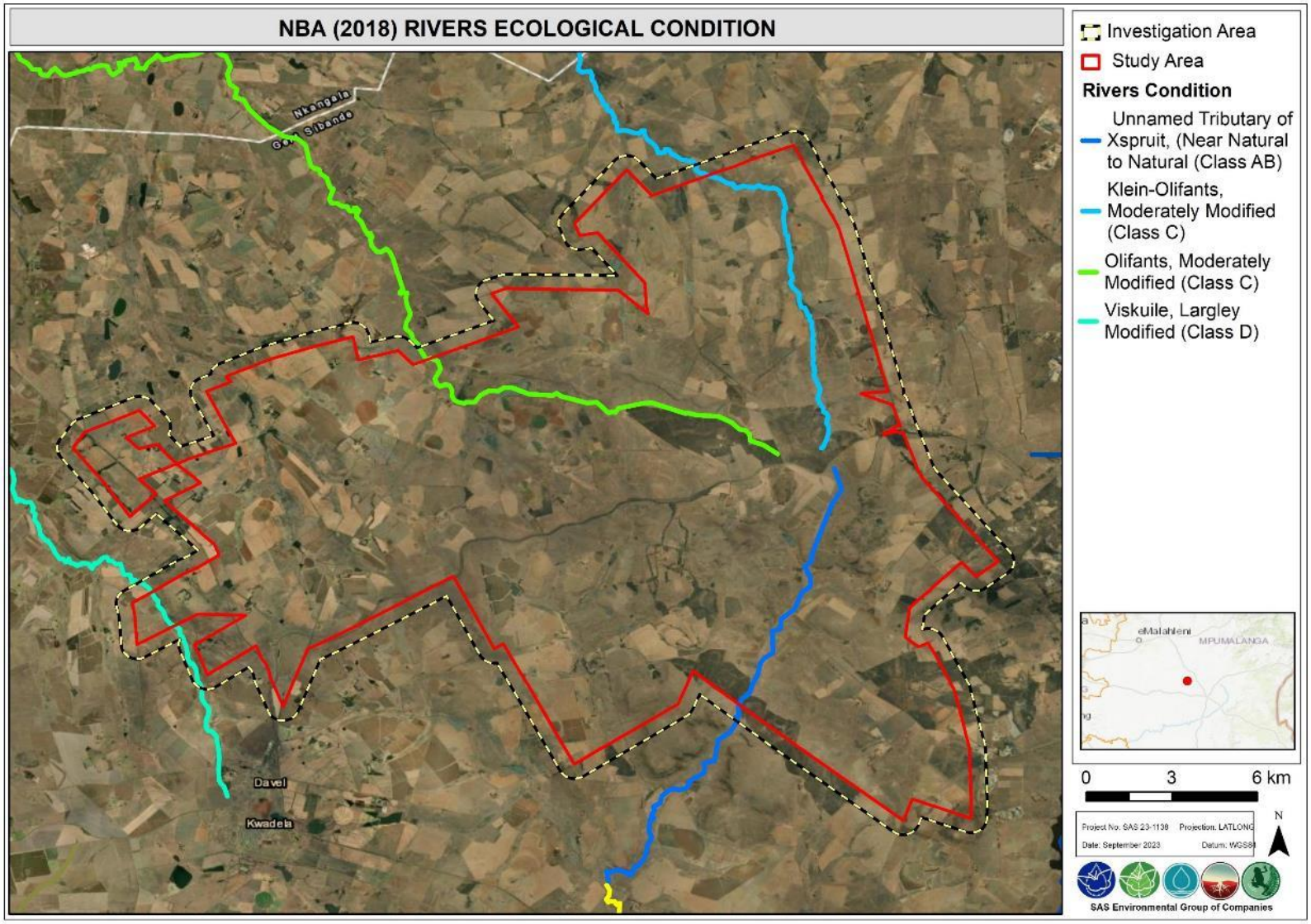


Figure 13: River ecological condition associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the NBA (2018) database.

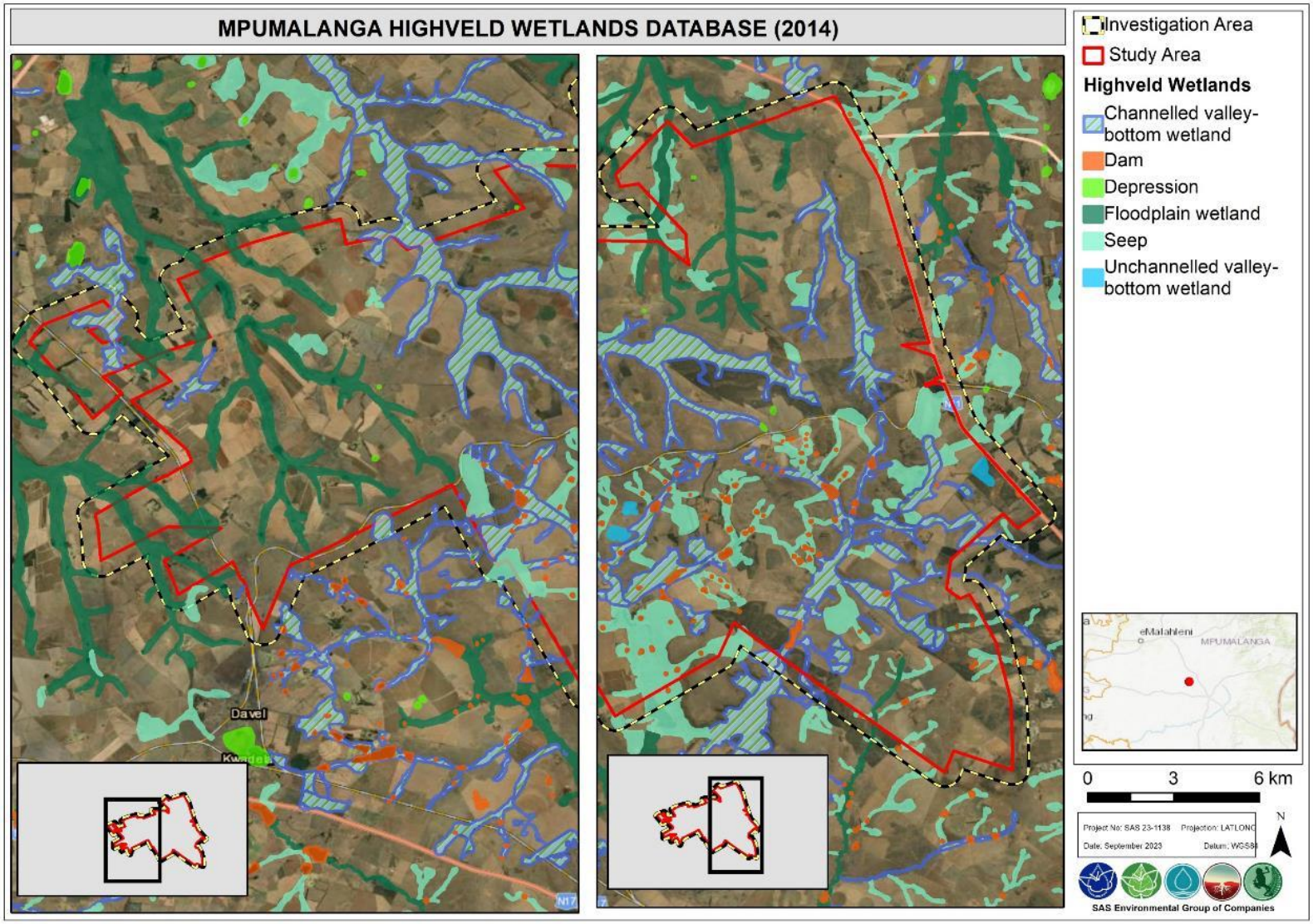


Figure 14: Freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the Mpumalanga Highveld Wetlands database.

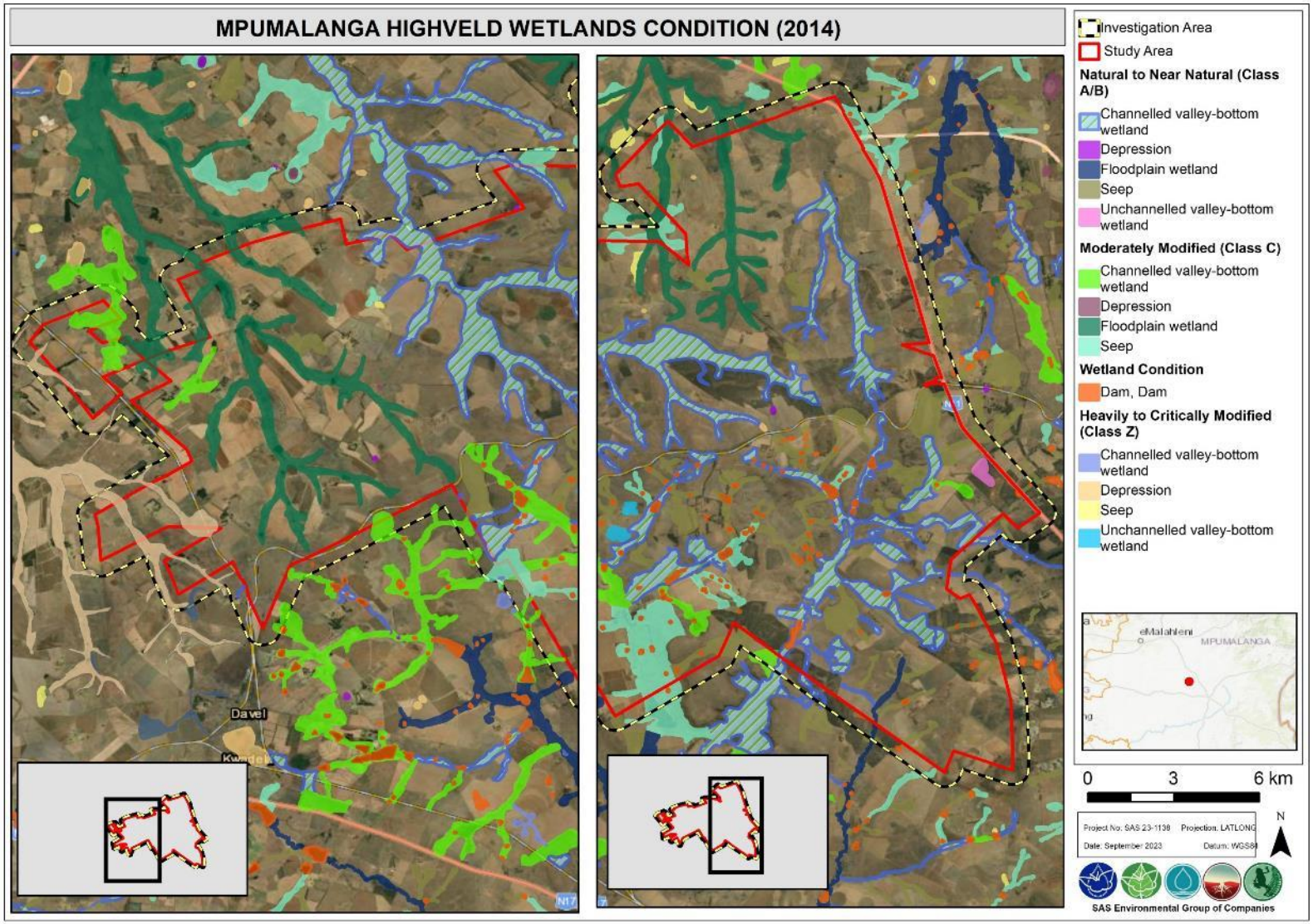


Figure 15: Freshwater ecosystem condition associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the Mpumalanga Highveld Wetlands database.

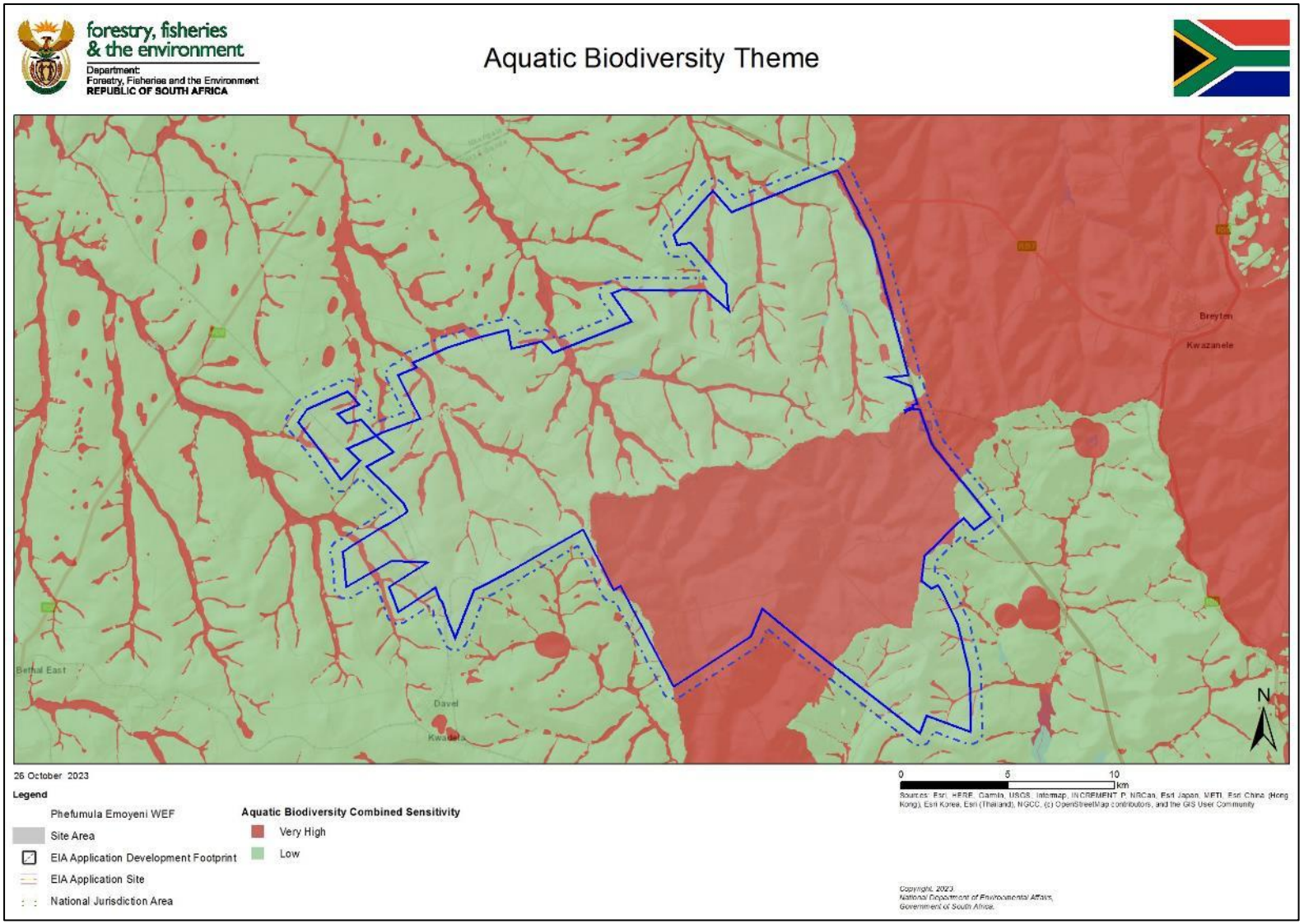


Figure 16: Map of relative aquatic biodiversity theme sensitivity for the proposed Phefumula Emoyeni One WEF's study area (blue solid line) and investigation area (blue dashed line) according to the National Web-Based Environmental Screening Tool (Accessed 2023).

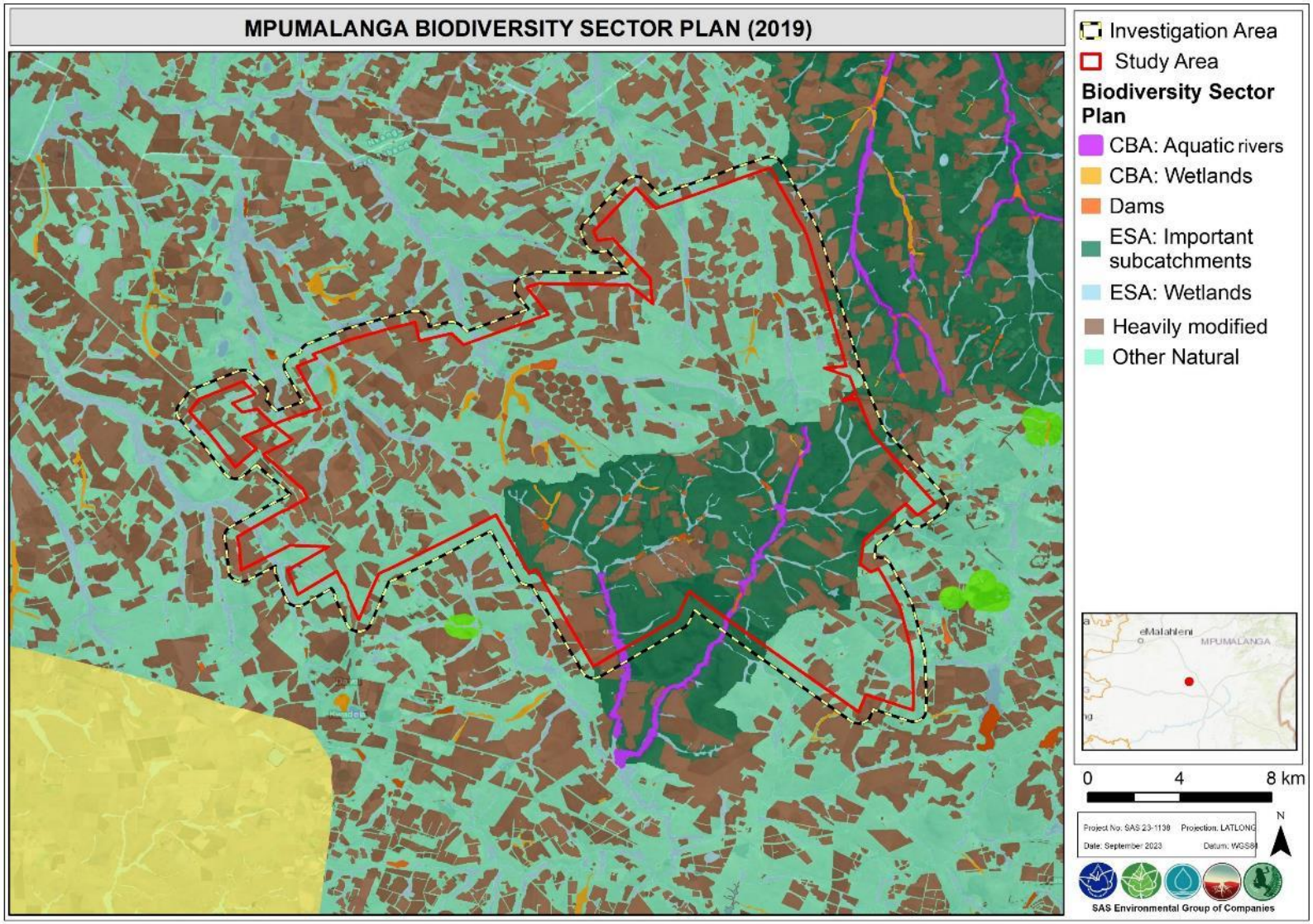


Figure 17: Areas of freshwater ecological importance associated with the proposed Phefumula Emoyeni One WEF's study area and investigation area and associated investigation area is indicated by the Mpumalanga Biodiversity Sector Plan (2019).

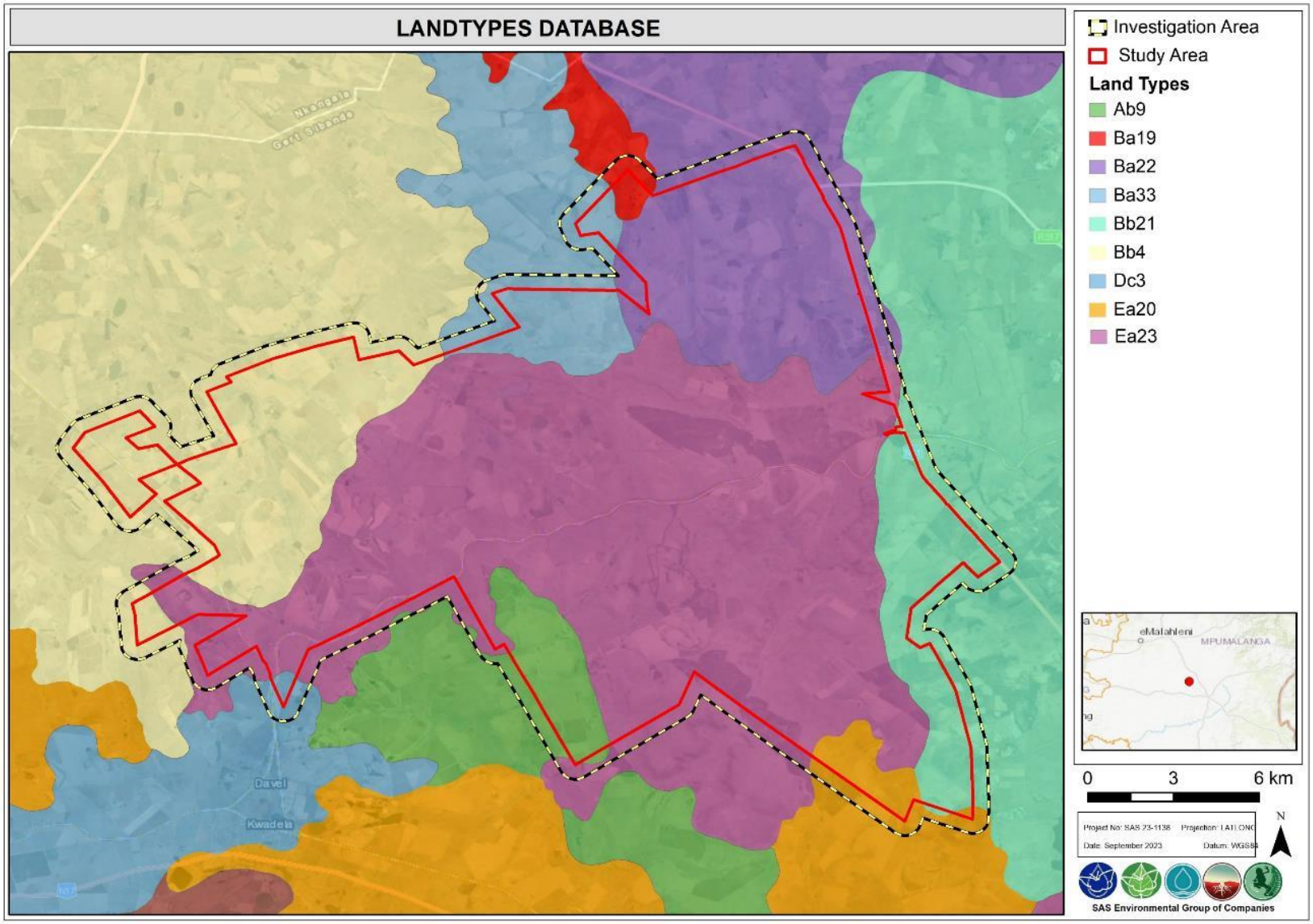


Figure 18: Land types located withing the proposed Phefumula Emoyeni One WEF study area and associated investigation area.

3.2 Ecological Status of Sub-Quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) 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 PES/EIS database has been made available to consultants since mid-August 2014. 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 Research Quality Information Services (RQIS) department from available sources of reliable information, such as SA RHP sites, Ecological Water Requirements (EWR) sites and Hydro Water Management system (WMS) sites.

In this regard, information for the SQR of the rivers within the study and investigation areas was obtained. (Figure 19). Key information on fish species, invertebrates and background conditions, associated with the rivers detailed in the Tables below, as contained in this database and pertaining to the Present Ecological State (PES), ecological importance and ecological sensitivity for the river, are tabulated below.

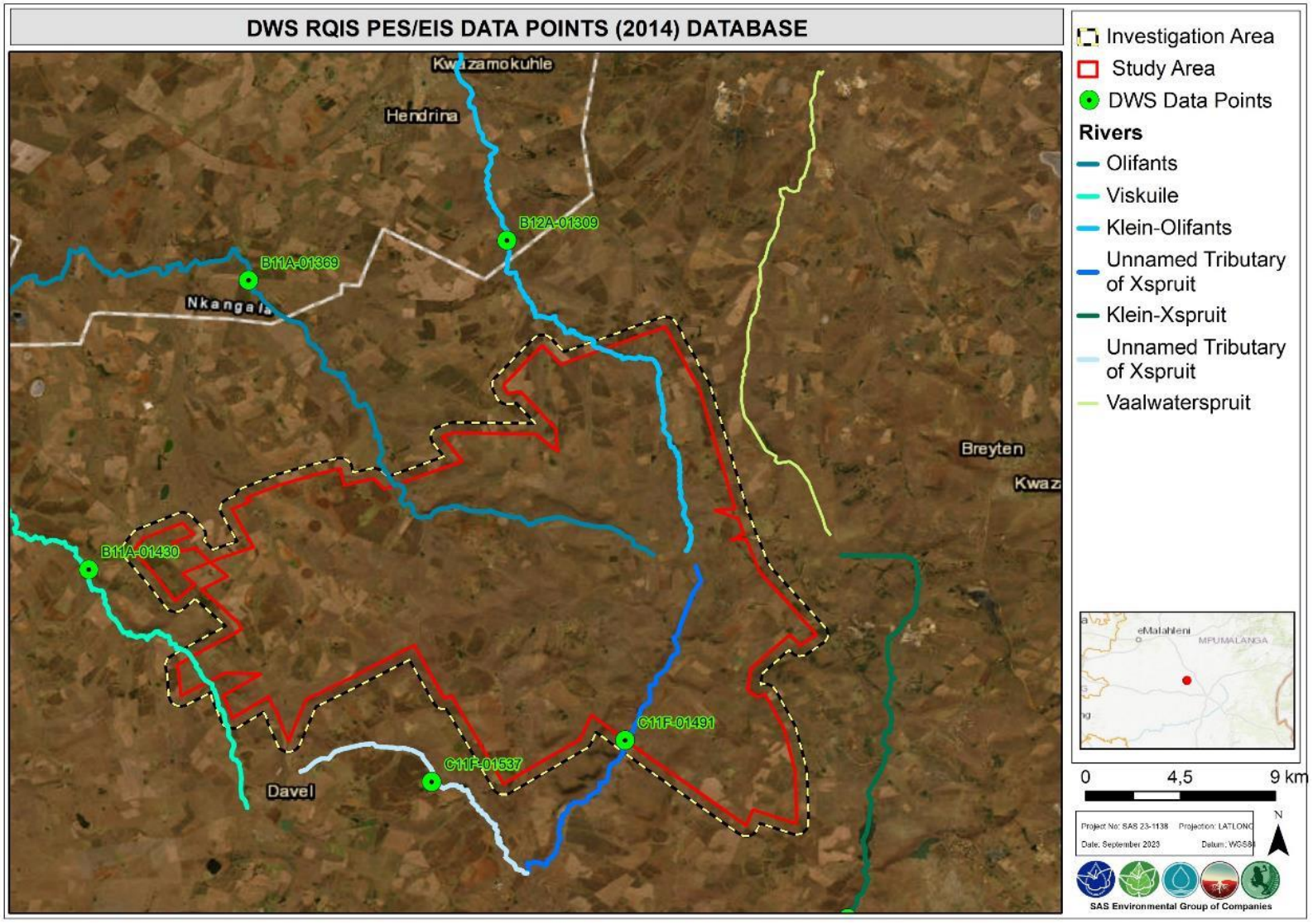


Figure 19: The relevant Sub-Quaternary Catchment Reach (SQR) associated with the proposed Phefumula Emoyeni One WEF and associated investigation area according to the DWS (2014).

Table 2: Fish species previously collected from or expected in the SQR associated with Olifants, Viskuile, Klein Olifants, Klein-Xspruit and unnamed tributary of Xspruit River

Fish species	B11A-01369	B11A-01430	B12A-01309	C11F-01491	C11F-01496	C11F-01537
Enteromius anoplus	X	X	X	X	X	X
Enteromius neefi	X	X	X			
Enteromius paludinosus	X	X	X	X	X	X
Clarias gariepinus	X	X	X		X	
Labeo capensis					X	
Labeo umbratus					X	
Labeobarbus aeneus					X	
Labeobarbus polylepis	X	X				
Pseudocrenilabrus philander	X	X	X	X	X	X
Tilapia sparrmanii	X	X	X	X	X	X

Table 3: Summary of the ecological status of the sub-quaternary (SQ) catchment reach associated with the freshwater ecosystems in proximity of the study area based on the DWS RQS PES/EIS dataset.

Ecological status	B11A-01369 (Olifants River)	B11A-01430 (Viskuile River)	B12A-01309 (Klein Olifants)	C11F-01491 (Unnamed tributary of Xspruit River)	C11F-01495 (Klein-Xspruit)	C11F-01537 (Unnamed tributary of Xspruit River)
Synopsis						
PES Category Median	C (Moderately Modified)	C (Moderately Modified)	C (Moderately Modified)	C (Moderately Modified)	D (Largely Modified)	C (Moderately Modified)
Mean EI class	High	High	High	Moderate	Moderate	Moderate
Mean ES class	High	High	High	Moderate	Moderate	Moderate
Length	55,00	32,00	42,00	18,95	44,38	14,53
Stream order	1	1	1	1	1	1
Default EC[4]	B (High)	B (High)	B (High)	C (Moderate)	C (Moderate)	C (Moderate)
PES Details						
Instream habitat continuity MOD	Moderate	Moderate	Moderate	Moderate	Large	Moderate
RIP/wetland zone continuity MOD	Small	Small	Small	Moderate	Moderate	Small

Ecological status	B11A-01369 (Olifants River)	B11A-01430 (Viskuile River)	B12A-01309 (Klein Olifants)	C11F-01491 (Unnamed tributary of Xspruit River)	C11F-01495 (Klein-Xspruit)	C11F-01537 (Unnamed tributary of Xspruit River)
Potential instream habitat MOD activities	Moderate	Large	Moderate	Moderate	Large	Moderate
Riparian/wetland zone MOD	Moderate	Moderate	Moderate	Moderate	Large	Moderate
Potential flow MOD activities	Moderate	Large	Moderate	Moderate	Large	Moderate
Potential physico-chemical MOD activities	Moderate	Moderate	Moderate	Small	Large	Small
EI Details						
Fish spp/SQ	7	7	6	4	8	4
Fish average confidence	1,00	2,43	4,67	1,00	2,50	1,00
Fish representivity per secondary class	Low	Low	Low	Low	High	Low
Fish rarity per secondary class	Moderate	Moderate	Low	Low	High	Low
Invertebrate taxa/SQ	48,00	45,00	46	39,00	38,00	39,00
Invertebrate average confidence	2,58	2,56	1	1,00	1,00	1,00
Invertebrate representivity per secondary class	High	High	High	High	High	High
Invertebrate rarity per secondary class	Very High	Very high	High	Low	Low	Low
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	High	High	High	Low	High	High
Habitat diversity class	Low	Low	Moderate	Moderate	Moderate	Low
Habitat size (length) class	Very High	Moderate	High	Low	Moderate	Very low
Instream migration link class	High	High	High	High	Moderate	High
Riparian-wetland zone migration link	Very high	Very high	Very high	High	High	Very high
Riparian-wetland zone habitat integrity class	High	High	High	High	High	High
Instream habitat integrity class	High	Moderate	High	High	Moderate	High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	High	High	High	Very high	Very High	High
Riparian-wetland natural vegetation rating based on expert rating	High	High	High	Low	High	Low
Fish physical-chemical sensitivity description	High	High	High	Moderate	Moderate	Moderate
Fish no-flow sensitivity description	High	High	High	Moderate	High	Moderate

Ecological status	B11A-01369 (Olifants River)	B11A-01430 (Viskuile River)	B12A-01309 (Klein Olifants)	C11F-01491 (Unnamed tributary of Xspruit River)	C11F-01495 (Klein-Xspruit)	C11F-01537 (Unnamed tributary of Xspruit River)
Invertebrates physical-chemical sensitivity description	Very high	Very high	Very high	Very high	Very high	Very high
Invertebrates velocity sensitivity	Very high	Very High	Very high	Very high	Very high	Very high
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	High	High	High	Low	High	High
Stream size sensitivity to modified flow/water level changes description	High	Very High	High	Low	Low	Low
Riparian-wetland vegetation intolerance to water level changes description	High	High	High	Low	Low	Low

Table 4: Aquatic Macro-invertebrate Species observed, or expected to occur at the river sites.

Invertebrate species	B11A-01369	B11A-01430	B12A-01309	C11F-01491	C11F-01495	C11F-01537
Aeshnidae	X	X	X	X	X	X
Ancylidae	X	X	X	X	X	X
Atyidae	X	X	X	X	X	X
Baetidae > 2 Sp	X	X	X	X	X	X
Belostomatidae	X	X	X	X	X	X
Caenidae	X	X	X	X	X	X
Ceratopogonidae	X	X	X	X	X	X
Chironomidae	X	X	X	X	X	X
Coenagrionidae	X	X	X	X	X	X
Corbiculidae	X	X	X	X	X	X
Corduliidae	X					X
Corixidae	X	X	X	X	X	
Crambidae (Pyralidae)	X	X				
Culicidae	X	X	X	X	X	X
Dixidae	X	X	X	X		

Invertebrate species	B11A-01369	B11A-01430	B12A-01309	C11F-01491	C11F-01495	C11F-01537
Dytiscidae	X	X	X		X	X
Ecnomidae	X		X			
Elmidae/Dryopidae			X			
Gerridae	X	X	X	X	X	X
Gomphidae	X	X	X	X	X	X
Gyrinidae	X	X	X	X	X	X
Hirudinea	X	X	X	X	X	X
Hydracarina	X	X	X	X	X	X
Hydraenidae	X	X	X			X
Hydrometridae	X	X	X	X	X	X
Hydrophilidae	X	X	X	X	X	
Hydropsychidae 2 Sp	X		X			
Hydropsychidae 1 Sp		X		X	X	X
Hydroptilidae	X	X	X	X	X	X
Leptoceridae	X	X	X	X	X	X
Leptophlebiidae	X		X	X		X
Libellulidae	X	X	X	X	X	X
Lymnaeidae	X	X	X			
Muscidae	X	X	X	X	X	X
Naucoridae	X	X	X	X	X	X
Nepidae	X	X	X	X	X	X
Notonectidae	X	X	X	X	X	X

4 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

4.1 Freshwater Ecosystem Characterisation and Delineation

The desk-based delineation and ground truthing confirmed the presence of numerous freshwater ecosystems that are distributed in most parts of the study area and within the associated investigation area. These freshwater ecosystems were confirmed to all be wetlands. The two most commonly occurring wetland hydrogeomorphic (HGM) forms are:

- Seep wetlands; and
- Valley Bottom wetlands.

The following wetland HGM form is also found in the study area:

- Depression wetlands.

The freshwater ecosystems identified were classified according to the Classification System (Ollis *et al.*, 2013) as Inland Systems. The freshwater ecosystems fall within the Highveld Aquatic Ecoregion and the Mesic Highveld Grassland Groups 3 and 4 WetVeg (wetland vegetation) groups, classified by Mbona *et al.* (2015) as "Critically Endangered". At Levels 3 (Landscape Unit) and 4 (HGM Type) of the Classification System, the systems were classified as per the summary in Table 5, below. The freshwater ecosystems are depicted in the maps in Figures 21-24 below.

Table 5: Characterisation at Levels 3 and 4 of the Classification System (Ollis *et al*., 2013) of the freshwater ecosystems associated with the Phefumula Emoyeni One WEF study and investigation areas.

Freshwater Ecosystem HGM Type	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) Type
Channelled Valley Bottom Wetland	Valley floor—the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	A mostly flat wetland area located along a valley floor, characterised by the presence of an active channel running through it.
Unchannelled Valley Bottom Wetland		A mostly flat wetland area located along a valley floor without a river channel running through it.
Depression wetland	Plain: an extensive area of low relief. These areas are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100.	A wetland or aquatic ecosystem with closed (or near closed) elevation contours which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates
Seep Wetland	Slope-an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	A wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

It should be noted that dashboards below present the finding of the detailed assessment of wetlands in the study area .Due to the high number of wetlands associated with the study area, and as crossed by the proposed new access roads or within the applicable regulated area of the turbines and proposed access roads, each individual wetland unit could not be assessed in terms of the determination of PES, EIS, ecoservices and RMO / REC. Accordingly the study area was broken up into three sub-areas according to the respective quaternary catchment in which the study area is located. Different wetland hydrogeomorphic (HGM) units within each catchment component were collectively assessed. As many valley bottom wetlands share channelled and unchannelled characteristics within the same wider reach, valley bottom wetlands were collectively assessed. Lastly although a small number of depression wetlands exist in the study area, these were not assessed to be at risk of impact from the proposed development and thus were not included in the detailed assessment of wetlands.

4.2 Freshwater ecosystem: Site Verification Results

The study area is located within the context of the north-eastern highveld and is thus relatively high-lying with altitudes ranging from around 1 650 m to just over 1 800 m.a.m.s.l. From a wider drainage and surface water occurrence perspective the study area is of significance as it is located in a wider area in which a number of large regional rivers rise. This wider area contains parts of the headwaters of the Olifants (Lepelle), Vaal, Crocodile and Phongolo Rivers. The study area straddles the catchment divide between the Olifants (drainage to the north) and Vaal Rivers (drainage to the south), and the study area thus straddles the continental divide, with drainage to the north flowing into the Indian Ocean via the Oliphants River and Limpopo Rivers and drainage to the south flowing into the Atlantic Ocean via the Vaal and Orange Rivers. The study area accordingly falls over three quaternary catchments, the B11A and B12A catchments which are two of the uppermost catchments of the Olifants River, as drained by the headwaters of the Olifants and Klein Olifants Rivers respectively, and the C11F catchment in the southern half of the study area which comprises of parts of the uppermost catchment of the Vaal River (Figure 4).

The nature of the terrain and soil and geological characteristics are the main drivers of freshwater occurrence and typology in the study area. The predominant geology of the study area is characterised by sandstone and shales of the Vryheid Formation of the Ecca Group - sedimentary geology belonging to the Karoo Supergroup which characterises much of the interior of South Africa and the Mpumalanga Highveld. Such geology is typically associated with gently to moderately undulating terrain which is largely characteristic of the study area. However parts of the study area are typified by significant intrusions of Karoo dolerite, an

igneous rock of much greater resistance to weathering than the dominant sedimentary rocks of the Ecca Group. The Karoo dolerites consist of a network of dolerite sills, sheets and dykes, which have intruded into the sedimentary geology and are particularly prominent in the central part of the study area, associated with the high-lying ground of the Olifants-Vaal watershed.

The presence of igneous geology such as dolerite often leads to the formation of vertic and melanic soils – soils of highly clayey character that are typified by their distinctive swelling and shrinking characteristics in response to wetting and drying. Accordingly most of the study area, including the southern and central parts are characterised by the Ea23 land type. Ea land types are characterised by high base status, dark coloured and/or red structured soils, usually of clay texture, associated with basis igneous rocks (Job *et al*, 2019). In Ea land types more than half of the land surface is covered by vertic, melanic or red structured diagnostic horizons. Duplex soils or exposed rock may cover significant portions of the land surface, but vertic, melanic or red structured horizons are dominant (Job *et al,* 2019).

The Ea23 land type is strongly typified by the presence of vertic clay soils, especially in lower-lying parts of the landscape, including most valley bottoms. As such the vast majority of the valley bottom terrain unit within this land type consists of vertic soil forms, particularly the Rensburg Soil Form, which can be a wetland-related soil form. Vertic soils are still predominant on the hillslopes within this land type, but other poorly draining clayey soil forms (e.g. Valsrivier and Bonheim) are present. From a wetland / hydromorphic soils perspective the occurrence of the Kroonstad Soil Form in approximately 20% of the hillslope terrain form is strongly indicative of the presence of wetlands as the Kroonstad soil form is a distinctive wetland soil form. Clay soils continue to dominate on the midslopes with the increasing presence of weathered or hard rock, and with an absence of soils displaying signs of wetness. Accordingly from an analysis of the Ea23 land type, wetlands are mostly like to occur in bottomlands and to a lesser extent on footslopes, which was borne out by observations during the site visit where the Rensburg soil form was noted to be dominant in many valley bottom wetlands.

The remainder (largely the northern parts of the study area) are characterised by Ba and Bb land types. Ba and Bb Land Types are generally located in the eastern and central interior basins of South Africa and are characterised by the predominant presence of dystrophic red (Ba) and yellow-brown and grey soils (Bb). Plinthic soils are present in a small portion of these land types and depending on the underlying geology, the bottomlands are characterised by a predominance of dark clay soils (in areas of igneous geology) or Katspruit soil forms (a soil form associated with permanently saturated wetlands) and streambeds predominate where

the geology is sedimentary. In the latter setting footslopes are typically predominated by Kroonstad and Pinedene soil forms (both wetland soil forms) (Job *et al*, 2019).

The Bb4 land type (far north-western part of the study area) is characterised by a predominance of Rensburg and Katspruit soil forms in the bottomlands, indicating the widespread presence of wetlands, as confirmed during the scoping site assessment. The observed presence of seep wetlands on the footslopes is supported by the widespread presence of the Longlands soil form as indicated in the land type sheet, occupying just under a third of the terrain unit land area.

Within the Ba22 land type (far north-eastern part of the study area) the Longlands soil form is similarly present and along with the presence of Katspruit, Rensburg and Willowbrook and Kroonstad soil forms occupying the vast majority of the remainder of the bottomlands. As with the Bb4 land type, the presence of seep wetlands in part of the landscape as confirmed to be widespread is supported by the presence of the Longlands and Avalon soil forms (both showing soft plinthic characteristics).

Observations from the scoping and EIA phase field assessments indicated that vertic soils are dominant in the valley bottoms across most of the study area. This means that the dominant soil form in most of the valley bottom wetlands in the study area is the Rensburg Soil form, as evident in many exposed soil profiles along wetland channel banks in the study area. Wetlands in vertic soil settings show certain distinctive characteristics – valley bottom wetlands and seeps are predominantly channelled, with the wetland often being narrow in lateral extent and with the wetland habitat with the entire later extent of the wetland often being limited to the confines of a single thread channel. This characteristic is often exacerbated by erosion with the vertic soils being highly erosive.

Wetland soils sampled in seep wetlands typically displayed different soil conditions. In most seep wetlands sampled apedal as opposed to heavy clay soils were encountered, with shallow soils that overly a hard plinthic or hard rock sub-layer being present. The widespread presence of albic (E) horizons is strongly indicative of interflow and in some instances soft plinthic horizons were present, which are indicative of a seasonal rising and falling water table.

Please refer to Figure 20 for representative photographs of the above mentioned soils associated with the wetlands.

Figure 20: Examples of soil samples displaying redoximorphic characteristics from different diagnostic subsoil horizons in wetlands in the study area; Top left: an albic (E) horizon displaying distinctive iron mottling from a seep wetland; Top right: another example of an albic horizon; Bottom left: an example of a soft plinthic B horizon; Bottom right: gley (G) horizon.

Vegetatively, the study area is located within the grassland biome and accordingly wetlands are largely graminoid-dominated, with the occurrence of forbs and herbs, many of which are annual in nature. *Phragmites australis* reedbeds and areas of *Typha capensis* are only locally dominant, primarily in channelled valley bottom settings and where wetlands have been impounded. Rather wetlands (seeps and valley bottoms) can be characterised as moist grassland or marshland, with a handful of grass and sedge species typically occurring in most wetlands:

Wetland margins or drier vertic soil-dominated wetlands:

- *Pennisetum thunbergii;*
- *Eragrostis rotifer;*
- *Paspalum urvillei;*
- *Agrostis lachnantha;* and
- *Imperata cylindrica.*

Seasonally or permanently saturated wetland areas (e.g. channel benches, depressions, seeps):

- *Leersia hexandra;*
- *Hermarthria altissima;*
- *Arundinella nepalensis;*
- *Paspalum distichum;*
- *Juncus effusus;*
- *Eleocharis dracaena;* and
- *Schoenoplectus corymbosus.*

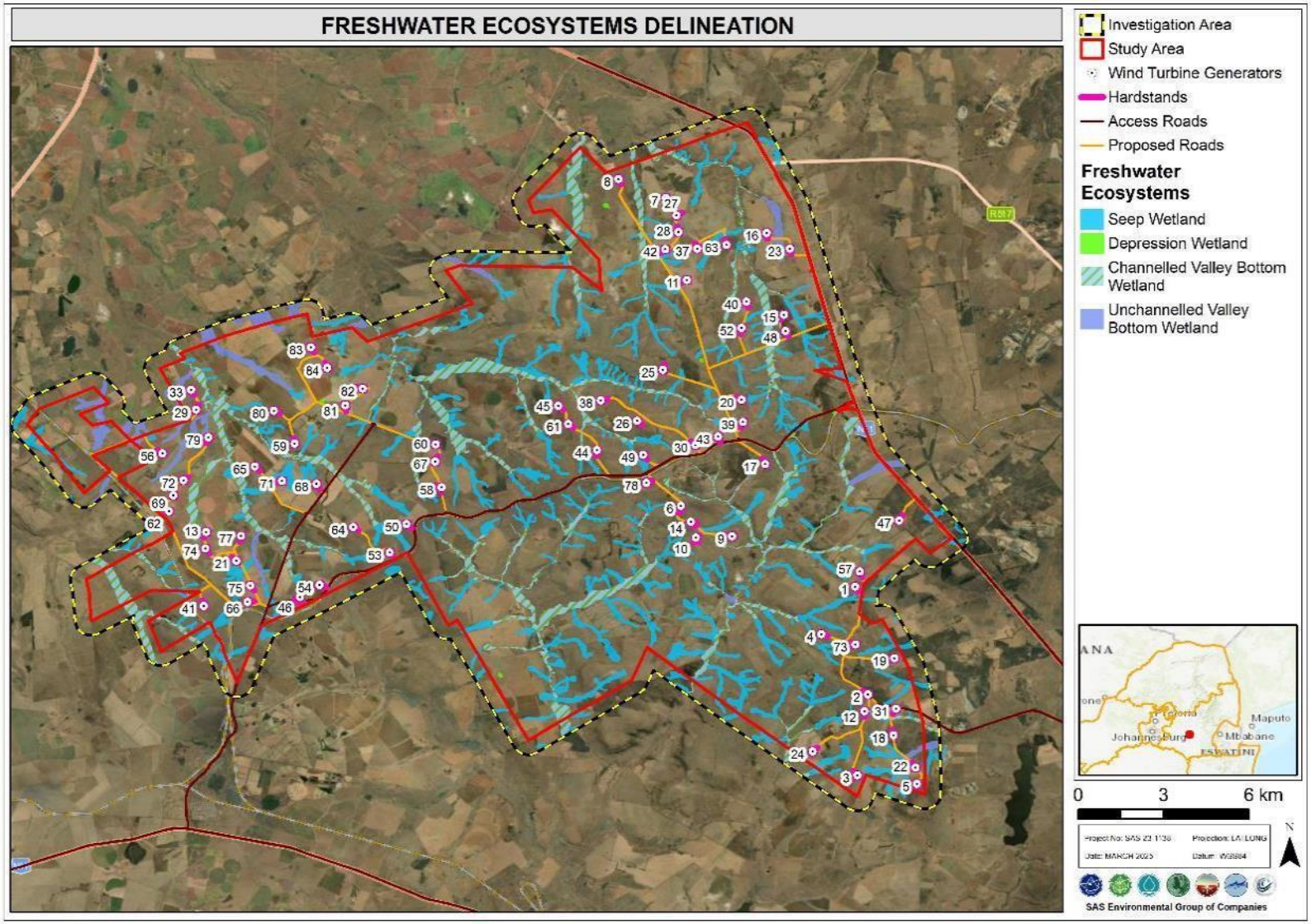


Figure 21: Delineated freshwater ecosystems associated with the proposed Phefumula Emoyeni One WEF study area and associated investigation area.

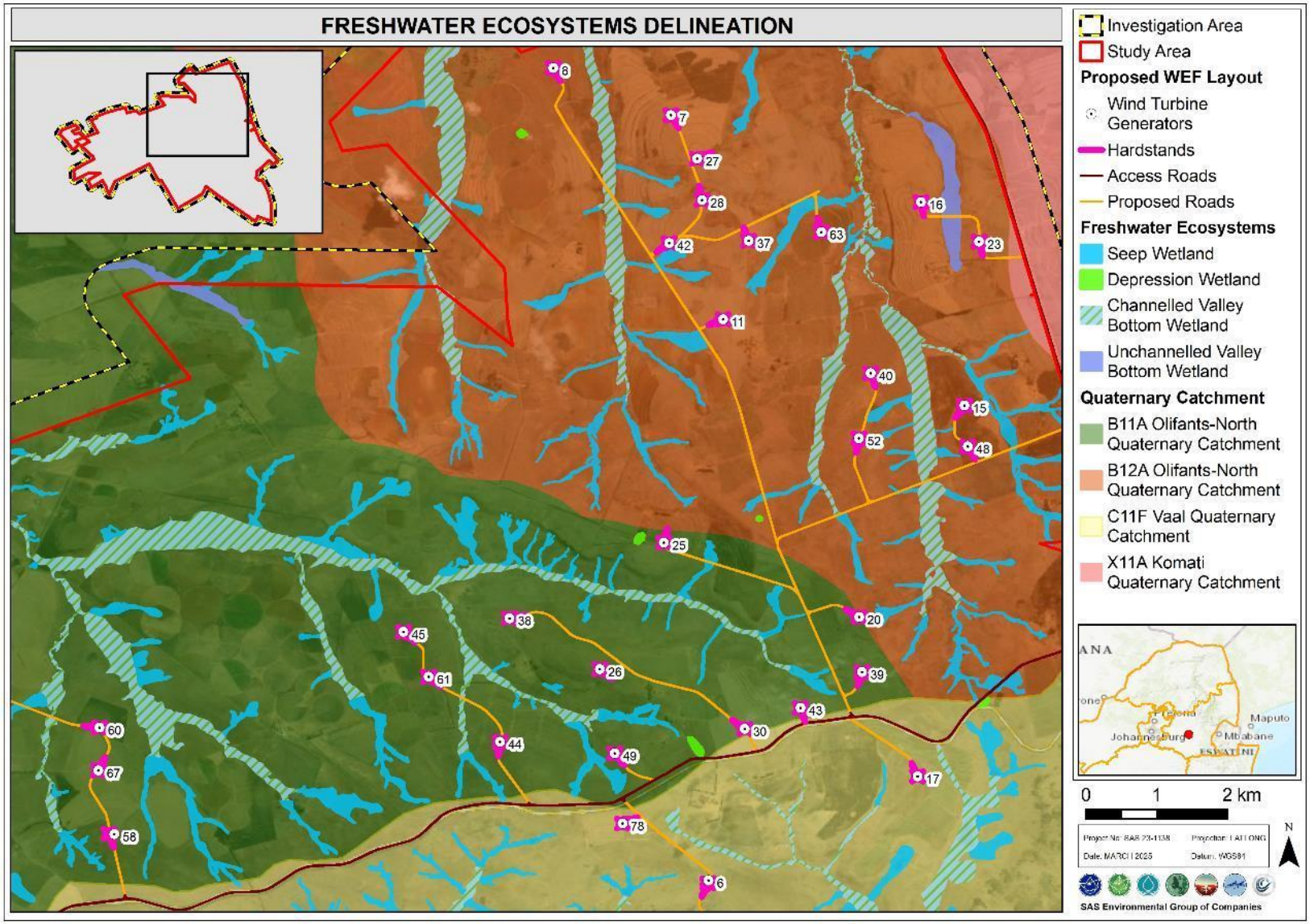


Figure 22: Delineated freshwater ecosystems associated with the B12A quaternary catchment within the study and investigation areas.

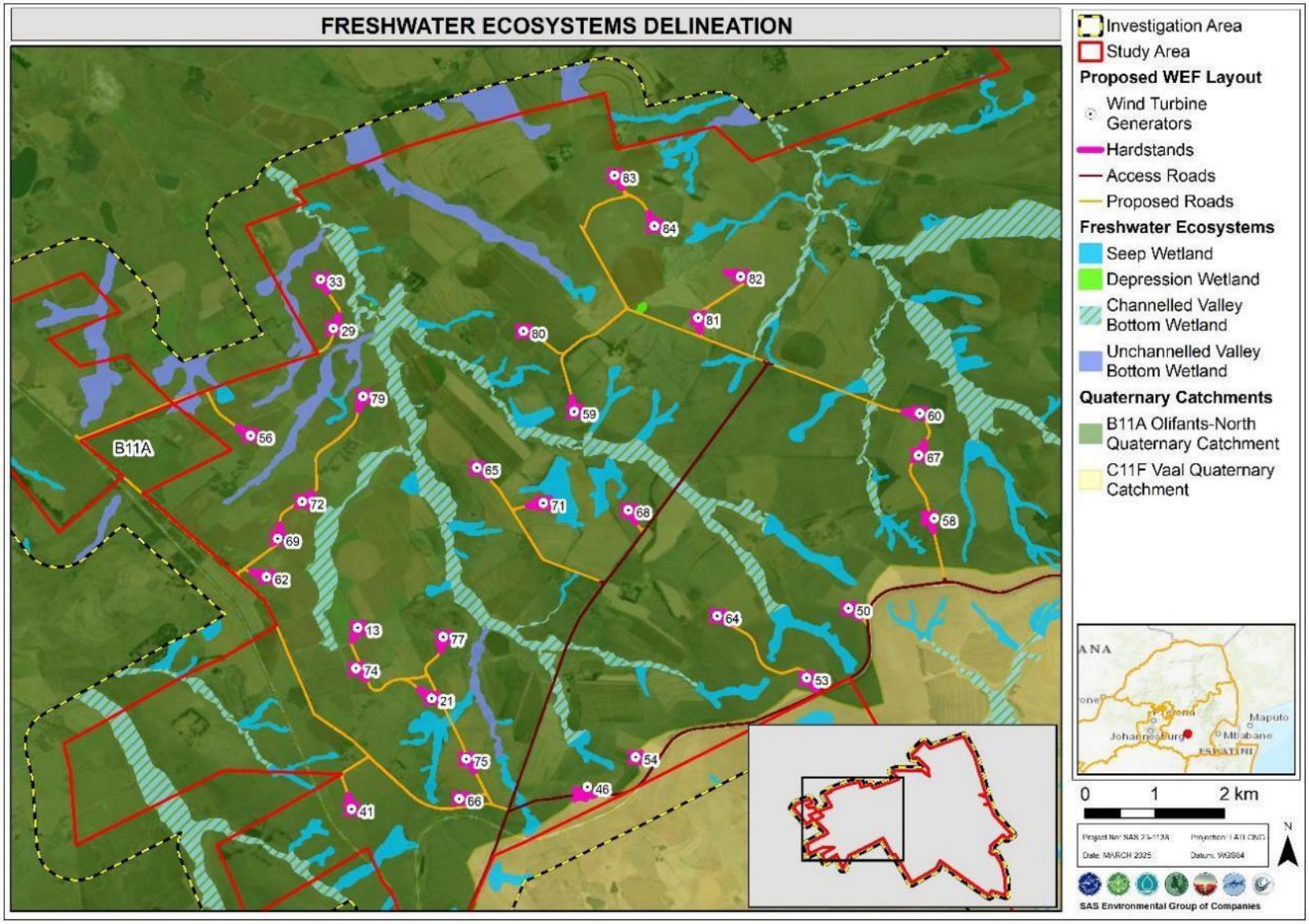


Figure 23: Delineated freshwater ecosystems associated with the B11A quaternary catchment within the study and investigation areas.

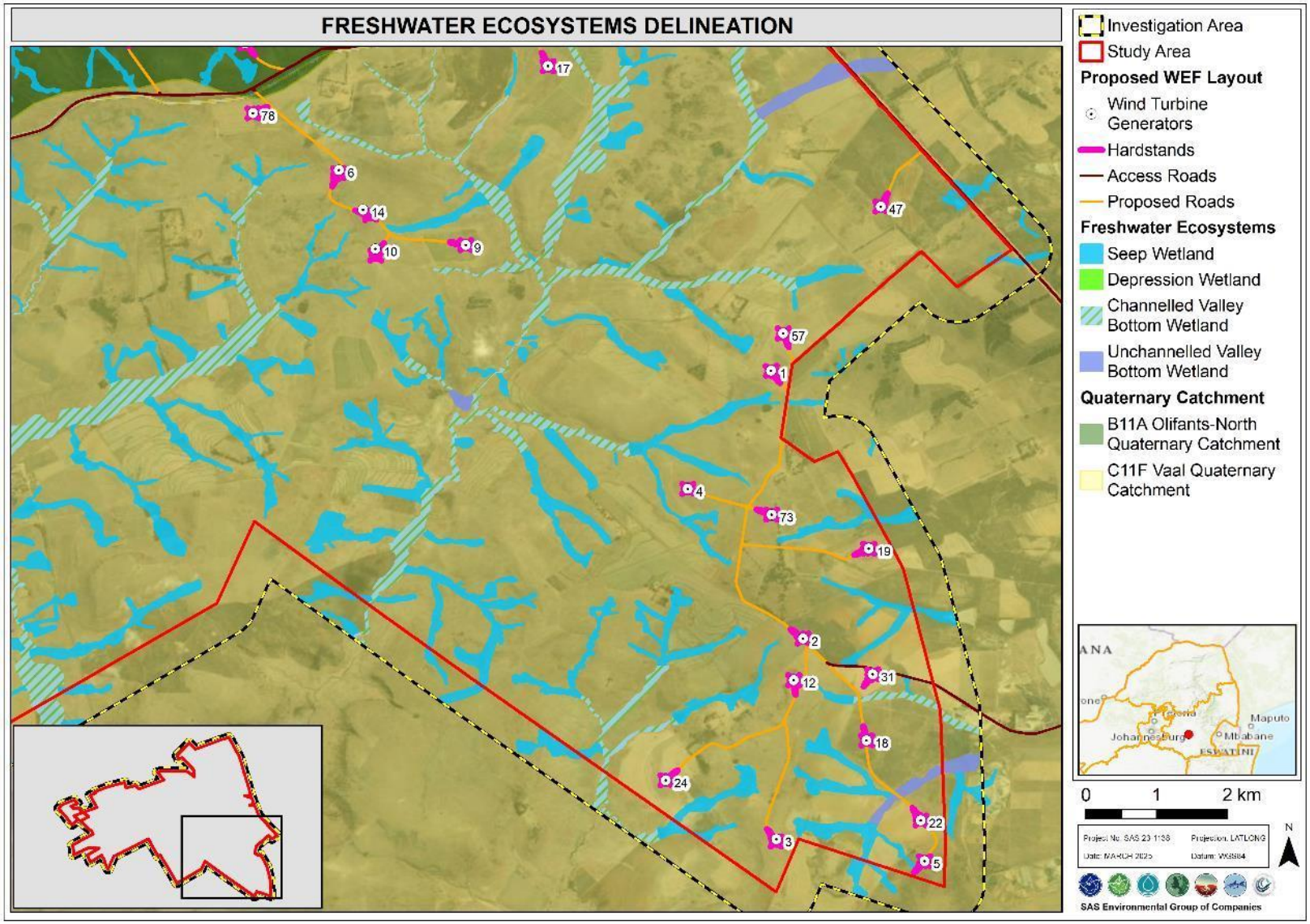
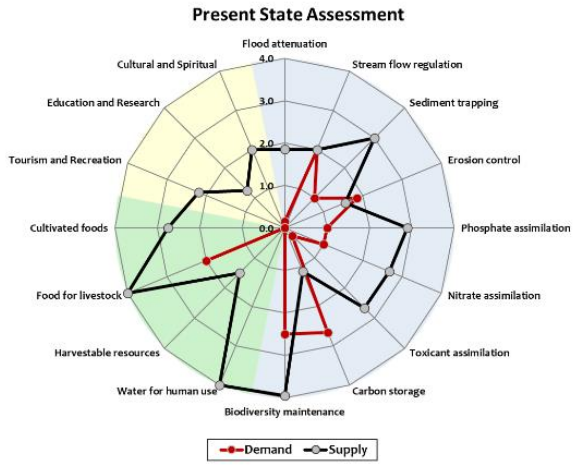


Figure 24: Delineated freshwater ecosystems associated with the C11F quaternary catchment within the study and investigation areas.

Table 6: Summary of the assessment of valley bottom wetlands located in the B12A quaternary catchment in the Study Area.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td rowspan="2"> 
Photograph notes: Top left: A large dam along the Klein Olifants Stream with flanking cultivated fields; Top right: Dam wall (left) with permanent wetland habitat in an unchannelled valley bottom (right) as fed by seepage from the dam; Bottom left: The channel of a typical channelled valley bottom wetland in a wetland soil setting; Bottom right: A channel of a valley bottom wetland displaying sediment deposition in the wetland.</td></tr>
<tr><td>Ecoservice provision</td><td>Biodiversity Maintenance and Food for Livestock – Very High, Water for Human Use – Moderately High, All other services – Moderate to Very Low
Valley bottom wetlands in the portion of the study area located within the B12A quaternary catchment provision maintenance of biodiversity maintenance and food for livestock to a very high degree, reflective of similarly high scores for both supply and demand of these services. The relatively natural state of the wetlands provides significant habitat for certain threatened faunal species. For parts of the study area where livestock husbandry is practiced, valley bottom wetlands provide a very important component of the year-round grazing resource. The presence of various relatively large dams along the Klein Olifants Stream and its tributaries provide a high level of supply for human use water supply, but the demand for such water is lower. Most hydrological regulating services are provided to an overall lower degree, due to the absence of extensive wetland lateral wetland habitat.</td></tr>
<tr><td>PES/ discussion</td><td colspan="2">PES Category: B At an overall quaternary catchment level, valley bottom wetlands were assessed to be in a largely natural condition. It should be noted that certain individual wetland units are subject to greater impacts and thus will be in a poorer state. Certain reaches of the valley bottom wetlands are impounded (dammed) which has an important impact in terms of alteration of wetland habitat upstream of the dam, but more importantly in terms of depriving the downstream reaches of baseflow and sediment. However the overall proportion of reaches that are dammed is relatively small, amounting to only 10% of all valley bottom wetlands. There are relatively few transformative impacts relating to landuse other than impoundments. Certain wetlands have catchments that have been transformed to dryland cultivation, but in much of the catchment the predominance of vertic soils precludes the cultivation of crops, with a natural catchment remaining for many wetlands. The overall portion of AIPs was noted to be low, though</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">certain smaller valley bottoms in cultivated terrain were noted to be subject to high levels of weed and AIP proliferation. Cattle grazing has certain transformative impacts, but the rotation of camps allows wetland vegetation cover and composition to remain largely natural.</td></tr>
<tr><td>EIS discussion</td><td colspan="2">EIS Category: High
The EIS of the valley bottom wetlands in catchment B12A in the study area has been assessed to be “High”, primarily due to their ecological importance. Biodiversity support is considered to be most important with the wetlands deemed to be important for certain Red Listed bird and mammal species. The landscape context is important, with the valley bottoms in the Mesic Highveld Grassland considered to be endangered, and certain wetlands being designated as ESAs. This must be contextualised in terms of the largely natural state of most of the reaches which is significant in the context of wider catchment level impacts relating to mining and agriculture, amongst other impacts, as well as immediate catchment impacts with wetlands immediately to the north of the study area being adversely impacted by coal mining operations. Hydro-functional importance (i.e., provisioning of services such as flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control) supplied by the wetlands is of lower significance. Retention of sediment is likely to be locally significant, and despite the potential sediment imbalance caused by impoundments, erosion was not noted to be relatively minimal. The primary aspect of socio-cultural importance is the provision of year round grazing resources for cattle and the provision of water for agricultural uses.</td><td>REC Category: B
RMO: Maintain
BAS: B (Maintain)
Since valley bottom wetlands in the B12A catchment have been assessed to be in largely natural state with a high EIS rating, the ecological condition of the wetlands line must be maintained. This entails that development associated with the WEF in the catchment of the reaches of the wetlands and within the wetlands themselves should carefully consider the impact on the wetlands to ensure that the ecological state of the valley bottom wetlands does not become further degraded due to the proposed WEF development. Accordingly the recommendations made in Section 7 are important to ensure that realisation of the REC.</td></tr>
<tr><td colspan="4">Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):</td></tr>
<tr><td colspan="4">The part of the WEF development area that falls within the B12A catchment includes the uppermost parts of the catchment of the Klein Olifants Stream, which forms the primary channelled valley bottom wetland in this part of the study area. Two tributary valley bottom wetland systems of the Klein Olifants drain north through the study area. The upper parts of the catchment are characterised by dolerite-dominated geology while the remainder is comprised of sandstone and shale of the Ecca Group. The resultant landform is gently undulating with the three valley bottom wetland systems in the catchment draining long very shallow valleys which are characterised by numerous seeps draining lateral valley heads. The presence of vertic soils in the uppermost part of the catchment influences landuse (absence of cultivation) and runoff characteristics, with a relatively high degree of runoff and from vertic soils which quicky become saturated. Conversely the catchments of the wetlands in the northern parts of the catchment are characterised by apedal soils which are able to be cultivated. Valley bottom wetlands are variously channelled and unchanneled, but most display an active channel. Even in unchannelled valley bottoms linear depressional features are present. Valley bottoms are most likely to be fed by lateral flows from the catchment with flow channel overtopping being less important, but nonetheless a hydrological driver. Lateral inflows from the catchment are enhanced by the presence of seep compartments adjacent to many valley bottom wetlands which are located at the valley floor-footslope interface and from which groundwater actively seeps. The hydrology of these wetlands has been modified by impoundments which have changed the wetness regimes of both upstream and downstream parts of the wetlands. The wetlands have been assessed to be geomorphologically stable. Erosion is largely limited to the active channels, but lateral erosion heads beyond the macro channel bank of channelled systems were noted in some reaches. The abundance of cultivated fields in the catchments of wetlands is expected to be a source of sediment into wetlands, and although some areas of sediment deposition were noted no areas of excess sedimentation were noted. The valley bottom wetlands can be characterised as moist grassland, with reedbeds only occurring along active channels. A diverse assemblage of grasses and especially sedges occurs within wetlands, with the grass species Pennisetum thunbergii being particularly prominent as a wetland hydrophyte in areas of vertic soils.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Under the revised WEF layout, four (4) valley bottom wetlands are crossed by proposed roads in which there is no existing transformative impact no existing infrastructural footprint and will have a resultant transformative impact on the affected reach, with downstream and upstream impacts possible. No other roads or turbines are proposed to be located within 100m of any other valley bottom wetland in the B12A catchment and thus the proposed infrastructure is unlikely to adversely affect any valley bottom wetlands.</td></tr>
<tr><td colspan="4">Risk Assessment Outcome & Business Case:</td></tr>
<tr><td>MEDIUM</td><td colspan="3">The above-mentioned infrastructure that is proposed in wetlands will result in a medium level of risk to the affected wetland units, as assessed through the DWS risk matrix. Other activities within the catchment of wetlands will only pose a threat of indirect impacts and has been assessed to be associated with a low risk to downgradient wetlands. It is recognised that on a project of this scale and spatial extent, wetland crossings are impossible to avoid, however consideration should be given to rather using existing farm roads to access turbine locations wherever posisble. The design of wetland crossing structure is highly important to avoid impacts, especially upstream and downstream impacts.</td></tr>
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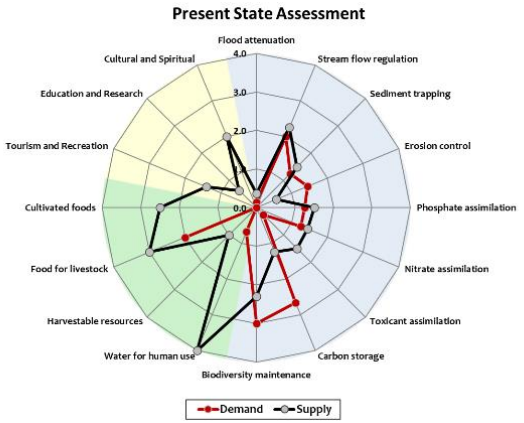
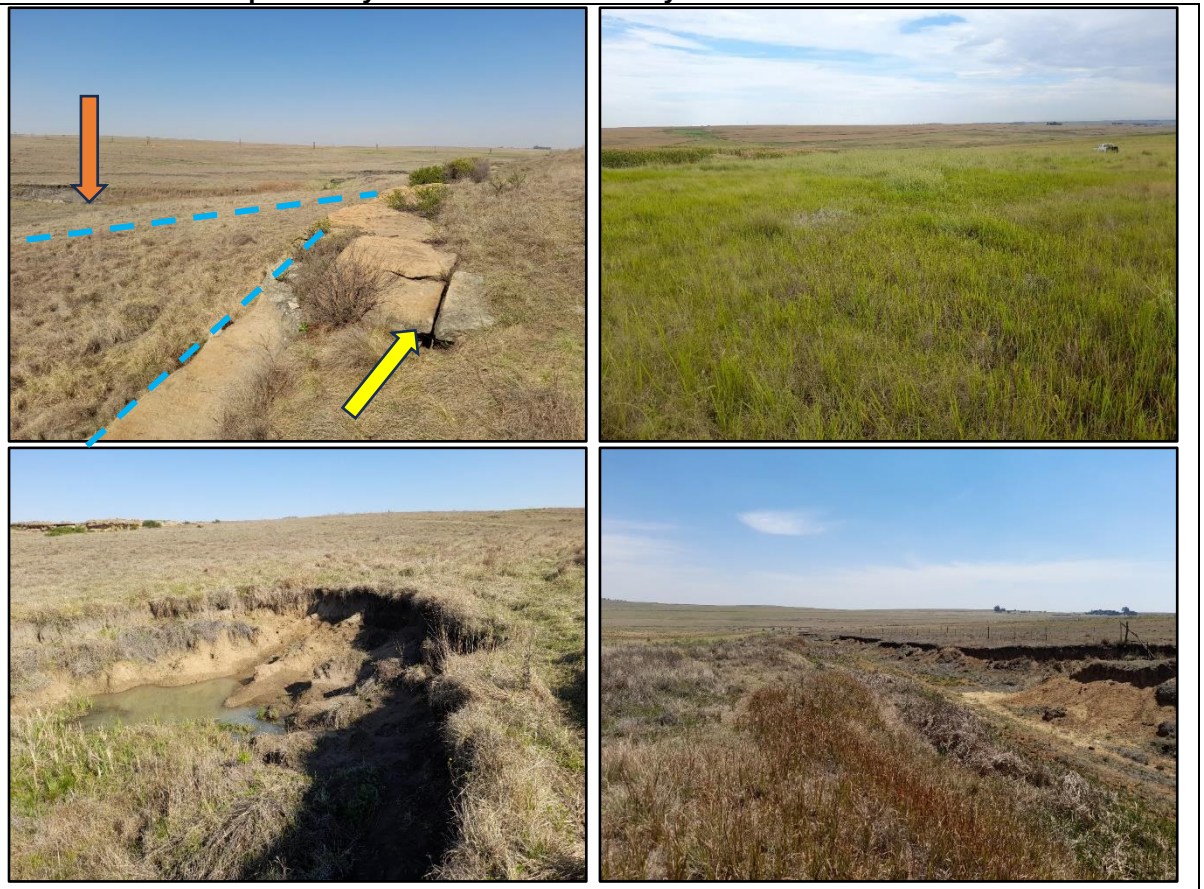
Table 7: Summary of the assessment of seep wetlands located in the B12A quaternary catchment in the Study Area.

Ecological & socio-cultural service provision graph:



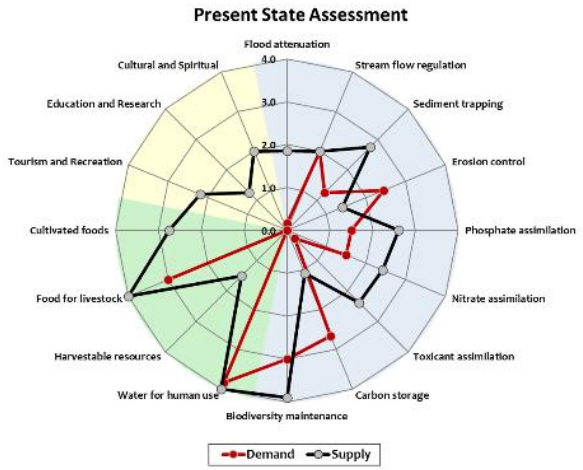
Ecoservice provision	**Water for Human Use – High; Biodiversity Maintenance and Food for Livestock – Moderately High, Streamflow Regulation – Moderate All other services – Low or Very Low** The highest performing ecosystem service is water for human use but this is more reflective of potential for supply of such water as opposed to actual use (demand) of water from seep wetlands. Biodiversity maintenance is significant but seeps cannot meet the demand for provision of this service, primarily due to the more greatly modified state of many seeps due mainly to erosion within them. The presence of year round moisture in many of the seeps makes these wetland types important for livestock grazing. Despite the eroded nature of many seeps, these display a moderate degree of importance for streamflow regulation, reflective of similarly high scores for both supply and demand. Most other hydrological regulating services are provided to an overall low degree, due to the absence inherent properties of seeps as a wetland HGM and due to their physical properties as narrow, often channelled features and the resultant absence of extensive wetland lateral wetland habitat.
PES/ discussion	**PES Category: C** At an overall quaternary catchment level, seep wetlands were assessed to be in a moderately modified condition. It is important to note however that hydrology was assessed to be largely modified (PES Category D) due mainly to changes to water distribution & retention patterns within the wetlands. This is primarily a result of in-wetland headcut and gully erosion, livestock grazing and trampling and damming of most seep wetlands which deprives downstream sections of the wetland of baseflow (seepage). Geomorphological processes are moderately modified, primarily as a result of erosion that is worse in certain wetland units than others. Lastly vegetation was similarly moderately modified due mainly to loss of seepage wetland habitat due to gulley and headcut erosion, vegetative transformation associated with the upstream and downstream effects of impounding structures and some areas of wetland loss due to encroachment of croplands into the wetland units.



Photograph notes: **Top left**: A lateral seep compartment (as indicated by dotted blue lines) located below a sandstone outcropping (yellow arrow) and adjacent to the valley bottom wetland of the Klein Olifants Stream (orange arrow) ; **Top right**: A seep wetland dominated by *Leersia hexandra* with flanking crop fields; **Bottom left**: A large active headcut in a seep wetland; **Bottom right**: A significantly eroded seep within which a gully has destroyed much of the seep wetland habitat. Note the *Imperata cylindrica* grass in the foreground

EIS discussion	**EIS Category: Moderate** The EIS of the seep wetlands in catchment B12A in the study area have been assessed to be "Moderate", with the most important aspect being ecological importance. Despite their greater levels of degradation as opposed to valley bottoms, seeps are nonetheless important habitats for certain threatened flora species and offer foraging habitat for certain threatened faunal species that are known to breed in the area. The landscape context is important, with seep wetlands in the Mesic Highveld Grassland 4 wetland vegetation type considered to be critically endangered, and thus residual areas of functional seep wetland habitat are ecologically sensitive in a wider regional context. Hydro-functional importance (i.e., provisioning of services such as flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control) supplied by the wetlands is of lower significance. Retention of sediment is likely to be locally significant, but the combination of slope and erodible substrates, along with the imbalance in sediment inputs to reaches downstream of dams is likely to be responsible for many of the erosion gullies observed. The primary aspect of socio-cultural importance is the provision of year round grazing resources for cattle and the provision of water for agricultural uses.	**REC, RMO & BAS Category**	**REC Category: C** **RMO: Maintain** **BAS: C (Maintain)** Since the seep wetlands have been assessed to be in moderately modified state with a moderate EIS rating, the ecological condition of these wetlands must be maintained. This entails that development associated with the WEF in the catchment of the reaches of the wetlands and within the wetlands themselves should carefully consider the impact on the wetlands to ensure that the ecological state of the valley bottom wetlands does not become further degraded due to the proposed WEF development. Accordingly the recommendations made in Section 7 are important to ensure that realisation of the REC.
Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):			
The part of the WEF development area that falls within the B12A catchment includes the uppermost parts of the catchment of the Klein Olifants Stream, which forms the primary channelled valley bottom wetland in this part of the study area. The upper parts of the catchment are characterised by dolerite-dominated geology while the remainder is comprised of sandstone and shale of the Ecca Group. The resultant landform is gently undulating with the primary north-south oriented shallow valleys being shallow valleys which are characterised by numerous seeps draining lateral valley heads. The spatial occurrence of seeps is related to topography, but substrate and subsurface water movement is a major driver. Soils in certain seeps were noted to be relatively shallow with the presence of dominant interflow being illustrated by an albic (E) horizon, which often overlays hard plinthic or rocky substrate. Where active seepage occurred this often occurred as 'seepage lines' aligned along valley lines and at the valley bottom-footslope interface where interflow is expected to discharge to the surface. Discharge of sub-surface water was similarly noted to commonly occur below sandstone outcroppings, and in some cases dolerite outcroppings on footslopes and midslopes, thus allowing the development of seep wetland habitat. The hydrology of these seep wetlands has been modified by impoundments which have changed the wetness regimes of both upstream and downstream parts of the wetlands, and which was often associated with significant downgradient erosion. Headcut erosion is present in many seeps, and although erosion in steeply sloping settings is a natural phenomenon, the headcuts and associated gullies have resulted in a significant loss of wetland habitat that would naturally be characterised by diffuse flows. As discussed above, erosion is a natural process in sloping wetland settings, but is likely to have been significantly modified by anthropogenic modifiers including concentration of livestock and overgrazing which make wetlands more vulnerable to erosion of substrate, along with changes to the sediment balance in wetlands as caused by certain impoundments which trap sediment and deprive downstream reaches of sediment. The abundance of cultivated fields in the immediate catchments of many seep wetlands is expected to be a source of sediment into wetlands, but no areas of excess sedimentation were noted. The seep wetlands can vegetatively be characterised as moist grassland, reedbeds largely absent, expect in modified dam habitats. Certain grass and sedge species were commonly noted to be dominant in seep wetlands with the most commonly occurring species being *Leersia hexandra, Hermarthria altissima, Andropogon eucomus* and *Imperata cylindrica.*		
Extent of modification anticipated	Under the revised WEF layout, four (4) seep wetlands are crossed by proposed roads in which there is no existing transformative impact no existing infrastructural footprint and will have a resultant transformative impact on the affected reach, with downstream and upstream impacts possible. No other roads or turbines are proposed to be located within 100m of any other valley bottom wetland in the B12A catchment and thus the proposed infrastructure is unlikely to adversely affect any other seep wetlands.		
Risk Assessment Outcome & Business Case:			
MEDIUM	The above-mentioned infrastructure that is proposed in wetlands will result in a medium level of risk to the affected wetland units, as assessed through the DWS risk matrix. Other activities within the catchment of wetlands will only pose a threat of indirect impacts and has been assessed to be associated with a low risk to downgradient wetlands. A recommendation has been made to relocate WTG 42 out of the 15m non-development boundary of the delineated seep wetland to the south as a minimum to avoid the direct impacting of the seep wetland. It is recognised that on a project of this scale and spatial extent, wetland crossings are impossible to avoid, however consideration should be given to rather using existing farm roads to access turbine locations wherever possible. The design of wetland crossing structure is highly important to avoid impacts, especially upstream and downstream impacts. However it is also recommended that Road 60 be slightly realigned to not run through the seep wetland located east of WTG 51 crossed, rather around it.		

Table 8: Summary of the assessment of valley bottom wetlands located in the B11A quaternary catchment in the Study Area.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td rowspan="2"> 
Photograph notes: Top left: Seasonally to permanently saturated wetland habitat consisting primarily of stands of Leersia hexandra and Typha capensis in an unchannelled valley bottom wetland; Top right: A depression within a valley bottom wetland that is seasonally inundated, with a differentiation in vegetation species composition between the surrounding wetland habitat (dominated by Pennisetum thunbergii) and the depression (dominated by Eleocharis spp); Bottom left: A farm access track through a wetland showing the vegetative response to the impounding impact of the track with Typha capensis dominant in the upstream side (left); Bottom right: A typical channel of a valley bottom wetland in a vertic soils setting.</td></tr>
<tr><td>Ecoservice provision</td><td>Biodiversity Maintenance, Food for Livestock and Water for Human Use – Very High; Sediment Trapping and Phosphate Assimilation – Moderate, All other services – Moderately Low to Very Low
Valley bottom wetlands in the portion of the study area located within the B11A quaternary catchment perform maintenance of biodiversity maintenance, water for human use and food for livestock at a very high level, reflective of similarly high scores for both supply and demand. The relatively natural state of the wetlands provides significant habitat for certain threatened faunal species. For parts of the study area where livestock husbandry is practiced, valley bottom wetlands provide a very important component of the year-round grazing resource. The presence of various relatively large dams along the Upper Olifants River and its tributaries provides a high level of supply for human use water supply, but the demand for such is lower. Most hydrological regulating services are provided to an overall low degree, due to the absence of extensive wetland lateral wetland habitat, but phosphate assimilation and sediment trapping are significant, owing to the relative predominance of cultivated areas which occur over much of the catchment of the valley bottom wetlands.</td></tr>
</table>

<table>
<tr><td>PES/ discussion</td><td colspan="3">PES Category: B At an overall quaternary catchment level, valley bottom wetlands were assessed to be in a largely natural condition. Certain reaches of the valley bottom wetlands are impounded (dammed) which has an important impact in terms of alteration of wetland habitat upstream of the dam, but more importantly in terms of depriving the downstream reaches of baseflow and sediment. Some of the largest dams in the study area are located in quaternary catchment B11A thus resulting in significant transformation of wetland habitat on the level of the actual reach. However the overall proportion of reaches that are dammed is still relatively small, amounting to less than 10% of all valley bottom wetlands in the catchment area. There are relatively few transformative impacts relating to landuse other than impoundments. Many valley bottom wetlands have catchments that have been transformed to dryland cultivation (to a greater degree than catchment B12A), but in certain parts of the wider B11A catchment the predominance of vertic soils preclude the cultivation of crops, with a natural catchment remaining for many wetlands. The overall portion of AIPs was noted to be low, though certain smaller valley bottoms in cultivated terrain were noted to be subject to high levels of weed and AIP proliferation. Cattle grazing and trampling has certain transformative impacts, but the rotation of camps allows wetland vegetation cover and composition to remain largely natural. Erosion was noted to be prevalent in certain valley bottom wetland reaches, with the most prominent aspect of erosion being lateral erosion from the macro channel bank in channelled reaches characterised by vertic soils.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category: High
The EIS of the valley bottom wetlands in catchment B12A in the study area has been assessed to be “High”, primarily due to their ecological importance. Biodiversity support is considered to be most important with the wetlands deemed to be important for certain Red Listed bird and mammal species. The landscape context is important, with unchannelled valley bottoms in the Mesic Highveld Grassland Group 4 considered to be critically endangered, and certain wetlands being designated as ESAs. This must be contextualised in terms of the largely natural state of most of the reaches which is significant in the context of wider catchment level impacts relating to mining and agriculture, amongst other impacts. Hydro-functional importance (i.e., provisioning of services such as flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control) supplied by the wetlands is of lower significance. Retention of sediment is likely to be locally significant,. The primary aspect of socio-cultural importance is the provision of year round grazing resources for cattle and the provision of water for agricultural uses.</td><td>REC, RMO & BAS Category</td><td>REC Category: B
RMO: Maintain
BAS: B (Maintain)
Since valley bottom wetlands in the B11A catchment have been assessed to be in largely natural state with a high EIS rating, the ecological condition of the wetlands line must be maintained. This entails that development associated with the WEF in the catchment of the reaches of the wetlands and within the wetlands themselves should carefully consider the impact on the wetlands to ensure that the ecological state of the valley bottom wetlands does not become further degraded due to the proposed WEF development. Accordingly the recommendations made in Section 7 are important to ensure that realisation of the REC.</td></tr>
<tr><td colspan="4">Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):</td></tr>
<tr><td colspan="4">The part of the WEF development area that falls within the B11A catchment includes the headwaters of the Olifants River, which forms the primary channelled valley bottom wetland in this part of the study area. The catchment divide with the Vaal River forms the highest lying part of the study area and this uppermost part of the catchment is characterised by dolerite. Apart from the Olifants River, the study area also encompasses the upper catchment of the Bank Spruit, a tributary of the Upper Olifants River. The lower reaches of the Olifants and Bank Spruit are underlain conversely by sandstone, which gives rise to gently undulating topography and predominantly apedal soils, allowing the widespread dryland cultivation of this part of the study area.

Valley bottom wetlands are primarily channelled, but certain valley bottom reaches are unchanneled. In such unchannelled settings a series of partly linear depressional features are typically present. Valley bottoms are most likely to be fed by lateral flows from the catchment with limited flow channel overtopping, although the presence of wetland habitat in depressions located adjacent to the active channel in certain locations is an indication that such floodplain-like features are present along the wider valley bottoms. The hydrology of these wetlands has been modified by impoundments which have changed the wetness regimes of both upstream and downstream parts of the wetlands.

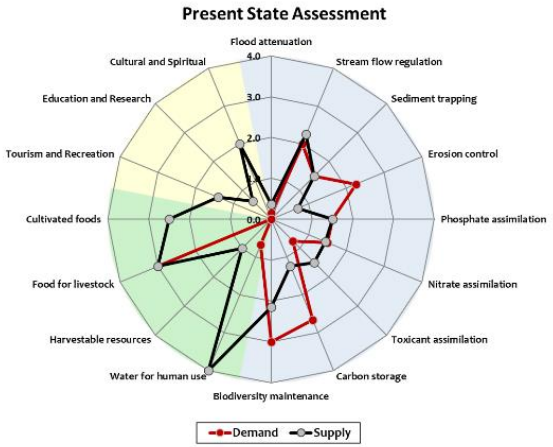
The wetlands were assessed to be largely geomorphologically stable with no reaches noted where erosion has resulted in extensive loss of wetland habitat. Erosion is largely limited to the active channels, but lateral erosion heads migrating off the macro channel bank were noted in some reaches. The abundance of cultivated fields in the catchments of wetlands is expected to be a source of sediment into wetlands, and although some areas of sediment deposition were noted no areas of excess sedimentation were noted.

The valley bottom wetlands can be characterised as moist grassland, with reedbeds only occurring along active channels. A diverse assemblage of grasses and especially sedges occurs within wetlands, with the grass species Pennisetum thunbergii being particularly prominent as a wetland hydrophyte in areas of vertic soils. The wettest parts of the wetlands, either within the confines of the macro channel in channelled valley bottom settings, or in linear depressions in unchannelled settings were characterised by certain obligate hydrophytes, in particular Leersia hexandra.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Under the revised WEF layout, three (3) valley bottom wetlands are crossed by proposed roads in which there is no existing transformative impact no existing infrastructural footprint and will have a resultant transformative impact on the affected reach, with downstream and upstream impacts possible. No other roads or turbines are proposed to be located within 100m of any other valley bottom wetland in the B11A catchment and thus the proposed infrastructure is unlikely to adversely affect any other valley bottom wetlands.</td></tr>
</table>

Risk Assessment Outcome & Business Case:	
MEDIUM	The above-mentioned infrastructure that is proposed in wetlands will result in a medium level of risk to the affected wetland units, as assessed through the DWS risk matrix. Other activities within the catchment of wetlands will only pose a threat of indirect impacts and has been assessed to be associated with a low risk to downgradient wetlands. It is recognised that on a project of this scale and spatial area, wetland crossings are impossible to avoid, however consideration should be given to rather using existing farm roads to access turbine locations. The design of wetland crossing structure is highly important to avoid impacts, especially upstream and downstream impacts. Of specific mention is the proposed new internal road to WTG 60 which will bisect a CVB wetland which from a freshwater resource management perspective, will require the placement of a box culvert to safely cross the wetland area.

Representative photographs of the CVB wetland which would be crossed by the proposed new road leading to WTG 60.

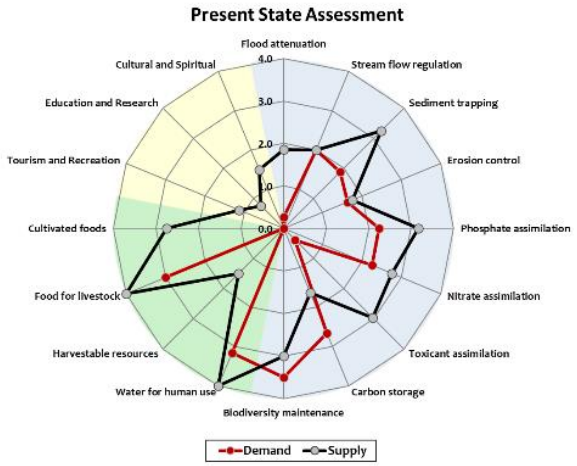
Table 9: Summary of the assessment of seep wetlands located in the B11A quaternary catchment in the Study Area.

<table>
<tr><td>Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
Photograph notes: Top left: Andropogon eucomus grass within a seep close to the continental divide with a catchment comprising of residual natural grassland underlain by doleritic geology; Top right: A seep wetland dominated by Leersia hexandra with crop fields in its immediate catchment; Bottom left: An erosion head in a seep wetland; Bottom right: Weedy vegetation and pioneer, emergent hydrophytes within the upper parts of a seep wetland that has been previously cultivated and now left fallow.</td></tr>
<tr><td>Ecoservice provision</td><td colspan="2">Water for Human Use and Foor for Livestock – High; Biodiversity Maintenance and Streamflow Regulation – Moderate; All other services – Low or Very Low
The ecosystem services performed to the highest degree are related to supply of water and food for livestock. Water for human use is characterised by a much higher level of supply that demand, but the dams within the seeps are likely to be important water sources for livestock. A key aspect of the provisioning services of the seeps is ensuring a year-round supply of livestock grazing. Biodiversity maintenance is significant but seeps cannot meet the demand for provision of this service, primarily due to more greatly degraded state of many seeps due mainly to erosion within them as well as their limited size. Despite the eroded nature of many seeps, these display a moderate degree of importance for streamflow regulation. Most other hydrological regulating services are provided to an overall low degree, due to the absence inherent properties of seeps as a wetland HGM and due to their physical properties as narrow, often channelled features and the resultant absence of extensive wetland lateral wetland habitat.</td></tr>
<tr><td>PES/ discussion</td><td colspan="2">PES Category: C At an overall quaternary catchment level, seep wetlands were assessed to be in a moderately modified condition. It is important to note however that hydrology of seeps in the B11A catchment was assessed to be largely modified (PES Category D) due mainly to changes to water distribution & retention patterns within the wetlands. This is primarily a result of in-wetland headcut and gully erosion, livestock grazing and trampling and damming of most seep wetlands which deprives downstream sections of the wetland of baseflow (seepage). Geomorphology is moderately modified, primarily as a result of erosion that is worse in certain wetland units than others. Lastly vegetation was similarly moderately modified due mainly to loss of seepage wetland habitat due to gulley and headcut erosion,</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">vegetative transformation associated with the upstream and downstream effects of impounding structures and particularly due to destruction of natural wetland vegetation where seeps have been cultivated and due to encroachment of weeds and AIPs into seeps located close to cultivated areas.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category: Moderate
The EIS of the seep wetlands in catchment B11A in the study area has been assessed to be “Moderate”, with the most important aspect being ecological importance in terms of biodiversity support and their importance at a landscape scale. Despite their greater levels of degradation as opposed to valley bottoms, seeps are nonetheless important habitats for certain threatened flora species and offer foraging habitat for certain threatened faunal species that are known to breed in the area. The landscape context is important, with seep wetlands in the Mesic Highveld Grassland 4 wetland vegetation type considered to be critically endangered, and thus residual areas of functional seep wetland habitat are ecologically sensitive in a wider regional context. Hydro-functional importance (i.e., provisioning of services such as flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control) supplied by the wetlands is of lower significance. Retention of sediment is likely to be locally significant, but the combination of slope and erodible substates, along with the imbalance in sediment inputs to reaches downstream of dams is likely to be responsible for many of the gullies observed. The primary aspect of socio-cultural importance is the provision of year round grazing resources for cattle and the provision of water for agricultural uses.</td><td>REC, RMO & BAS Category</td><td>REC Category: C
RMO: Maintain
BAS: C (Maintain)
Since the seep wetlands have been assessed to be in moderately modified state with a moderate EIS rating, the ecological condition of these wetlands must be maintained. This entails that development associated with the WEF in the catchment of the reaches of the wetlands and within the wetlands themselves should carefully consider the impact on the wetlands to ensure that the ecological state of the valley bottom wetlands does not become further degraded due to the proposed WEF development. Accordingly the recommendations made in Section 7 are important to ensure that realisation of the REC.</td></tr>
<tr><td colspan="4">Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):</td></tr>
<tr><td colspan="4">The part of the WEF development area that falls within the B11A catchment includes the uppermost parts of the catchment of the Olifants River, as well as one of its tributaries, the Bank Spruit, The uppermost parts of the catchment are characterised by dolerite-dominated geology while the remainder is comprised of sandstone and shale of the Ecca Group. The resultant landform over much of the B11A catchment in the study area is gently undulating with steeper terrain only occurring close to the continental divide or in localised areas where lines of dolerite outcropping occur. The shallow valleys that characterise most of the catchment area are characterised by numerous seeps draining lateral valley heads. The spatial occurrence of seeps is related to topography, but substrate and subsurface water movement is a major driver. Soils in certain seeps were noted to be relatively shallow with the presence of dominant interflow being illustrated by an albic (E) horizon, which often overlay hard plinthic or hard rock, or in other settings the presence of a soft plinthic subsoil is suggestive of a seasonally rising and falling water table. The hydrology of these seep wetlands has been modified by impoundments which have changed the wetness regimes of both upstream and downstream parts of the wetlands, and which was often associated with significant downgradient erosion. Headcut erosion is present in certain seeps Erosion is a natural process in sloping wetland settings, but is likely to have been significantly modified by anthropogenic modifiers including concentration of livestock and overgrazing which make wetlands more vulnerable to erosion of substrate, along with changes to the sediment balance in wetlands as caused by certain impoundments which trap sediment and deprive downstream reaches of sediment. The abundance of cultivated fields in the immediate catchments of most of the seep wetlands in the catchment is expected to be a source of sediment into wetlands, but no areas of excess sedimentation were noted. The seep wetlands can vegetatively be characterised as moist grassland, with reedbeds largely absent, expect in modified dam habitats. Certain grass and sedge species were commonly noted to be dominant in seep wetlands with the most commonly occurring species being Leersia hexandra, Hermarthria altissima, Andropogon eucomus and Imperata cylindrica. A relatively high proportion of seep wetlands in the B11A catchment were noted to be impacted vegetatively by being ploughed for cultivation, or if in direct proximity to cultivated areas, subject to significant levels of weed and AIP proliferation.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Under the revised WEF layout, four (4) seep wetlands are crossed by proposed roads in which there is no existing transformative impact no existing infrastructural footprint and will have a resultant transformative impact on the affected reach, with downstream and upstream impacts possible. One other road (road 24) is proposed to be located within 100m of a seep wetland, but no proposed turbine locations are located within 100m of any other valley bottom wetland in the B11A catchment and thus the proposed infrastructure is unlikely to significantly adversely affect any other seep wetlands.</td></tr>
<tr><td colspan="4">Risk Assessment Outcome & Business Case:</td></tr>
<tr><td>MEDIUM</td><td colspan="3">The above-mentioned infrastructure that is proposed in wetlands will result in a medium level of risk to the affected wetland units, as assessed through the DWS risk matrix. Other activities within the catchment of wetlands will only pose a threat of indirect impacts and has been assessed to be associated with a low risk to downgradient wetlands. It is recognised that on a project of this scale and spatial area, wetland crossings are impossible to avoid, however consideration should be given to rather using existing farm roads to access turbine locations. The design of wetland crossing structure is highly important to avoid impacts, especially upstream and downstream impacts. Of specific mention is the existing road to WTG 25 which bisects a seep wetland, which at the time of assessment, and due to the heavy rains, have started to wash away/sink in. A pipe culvert was noted at the crossing area, however as part of the road upgrade, a box culvert is proposed for this area to ensure the safe crossing of the wetland by large trucks and farmers.</td></tr>
</table>

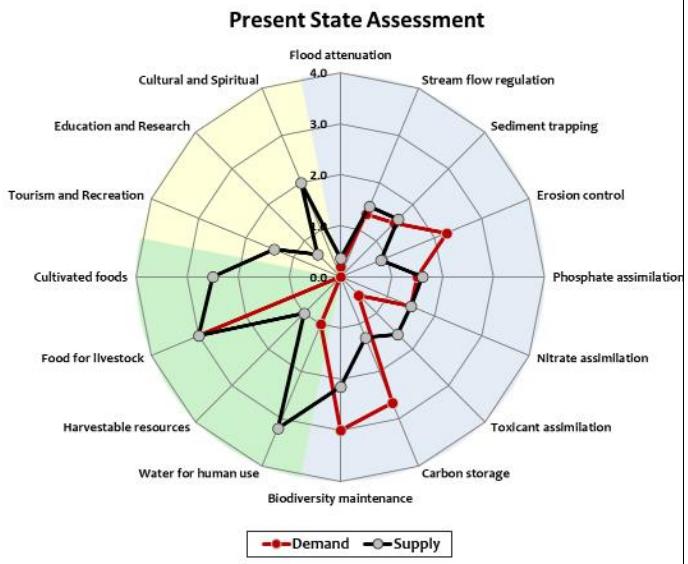
Representative photographs of the current condition of the seep wetland crossing to WTG 25 which requires immediate attention.

Table 10: Summary of the assessment of valley bottom wetlands located in the C11F quaternary catchment in the Study Area.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td rowspan="2"> 
Photograph notes: Top left: Narrow valley bottom wetland habitat within the confines of the macro channel banks of a valley bottom wetland; Top right: A channel of a valley bottom showing displaying a stand of the wetland hydrophyte Imperata cylindrica (as shown by a blue arrow); Bottom left: A localised area of chronic livestock trampling across a valley bottom wetland with complete loss of wetland vegetation; Bottom right: A mining-related cut-off drain in the catchment of an unchannelled valley bottom wetland (the location of the lowest point (valley floor) of the wetland is indicated by a dashed blue line.</td></tr>
<tr><td>Ecoservice provision</td><td>Biodiversity Maintenance, Food for Livestock and Water for Human Use – Very High; Phosphate Assimilation – High, Sediment Trapping and Nitrate Assimilation – Moderately High; All other services – Moderately Low to Very Low
Valley bottom wetlands in the portion of the study area located within the C11F quaternary catchment perform maintenance of biodiversity maintenance, water for human use and food for livestock at a very high level. The demand score for biodiversity maintenance is slightly higher than supply, which is reflective of the inability of the wetlands to provide the required level of biodiversity maintenance. Nonetheless the wetlands are highly important for the sustaining of at least three threatened faunal species. For both water for human use and for livestock the supply provided by the seep wetlands is higher than the demand. The regulating services of phosphate and nitrate assimilation and sediment trapping are also significant, being reflective of the presence and predominance of cultivation across catchments of many of the valley bottom wetlands.</td></tr>
<tr><td>PES/ discussion</td><td colspan="2">PES Category: B At an overall quaternary catchment level, valley bottom wetlands were assessed to be in a largely natural condition. Certain reaches of the valley bottom wetlands are impounded (dammed) which has an important impact in terms of alteration of wetland habitat upstream of the dam, but more importantly in terms of depriving the downstream reaches of baseflow and sediment. However the overall proportion of reaches that are dammed is relatively small, amounting to less than 10% of all valley bottom wetlands. There are relatively few transformative impacts relating to the predominant landuse other than impoundments. Most valley bottom wetlands have catchments that have been transformed to dryland cultivation, and these areas of cultivation are expected to feed sediment into the downgradient</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">wetlands. The overall diversity of AIPs was noted to be low, though certain smaller valley bottoms in cultivated terrain were noted to be subject to high levels of weed and AIP proliferation. In most wetlands, the presence of Scottish Thistle (Cirsium vulgare) – a Category 1b invasive species – was noted on the margins of the wetland. Cattle grazing and trampling has certain transformative impacts, but the rotation of camps allows wetland vegetation cover and composition to remain largely natural. Nonetheless trampling was noted to be significant in certain localised areas.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category: High
The EIS of the valley bottom wetlands in catchment C11F in the study area has been assessed to be “High”, primarily due to their ecological importance. Biodiversity support is considered to be most important with the wetlands deemed to be important for certain Red Listed bird and mammal species. The landscape context is important, with unchannelled valley bottoms in the Mesic Highveld Grassland Group 4 considered to be critically endangered, and certain wetlands being designated as ESAs. Furthermore the C11F catchment has been designated as a FEPA catchment. This biodiversity importance must be contextualised in terms of the largely natural state of most of the reaches which is significant in the context of wider catchment level impacts relating to mining and agriculture, amongst other impacts. Hydro-functional importance (i.e., provisioning of services such as flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control) supplied by the wetlands is of lower significance, but the widespread presence of cultivation in the catchment and the presence of wetland habitat in many wetlands in which unconfined or partly confined flows occur is important in assimilating nutrients and trapping sediments. The primary aspect of socio-cultural importance is the provision of year round grazing resources for cattle and the provision of water for agricultural uses.</td><td>REC, RMO & BAS Category</td><td>REC Category: B
RMO: Maintain
BAS: B (Maintain)
Since valley bottom wetlands in the C11F catchment have been assessed to be in largely natural state with a high EIS rating, the ecological condition of the wetlands line must be maintained. This entails that development associated with the WEF in the catchment of the reaches of the wetlands and within the wetlands themselves should carefully consider the impact on the wetlands to ensure that the ecological state of the valley bottom wetlands does not become further degraded due to the proposed WEF development. Accordingly the recommendations made in Section 7 are important to ensure that realisation of the REC.</td></tr>
<tr><td colspan="4">Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):</td></tr>
<tr><td colspan="4">As opposed to the parts of the WEF study area that fall into the Olifants River primary catchment (B11A and B12A catchments), the C11F catchment consists of drainage that forms tributaries of the upper Vaal River. The catchment divide between the Olifants and Vaal Rivers forms the highest lying part of the study area and this uppermost part of the catchment is characterised by dolerite. Several valley bottom wetland systems drain southwards from the catchment divide into through the southern parts of the study area. Most of these valley bottom systems are channelled. In certain areas the channel is relatively incised and wetland habitat is largely limited to the confines of the macro channel and its immediate surrounds, but in other cases valley bottom wetlands are very weakly channelled, or unchannelled and are characterised by seasonal wetland habitat that extends laterally.
The hydrology of most valley bottom wetlands has been modified by impoundments which have changed the wetness regimes of both upstream and downstream parts of the wetlands.
The wetlands were assessed to be largely geomorphologically stable with no reaches noted where erosion has resulted in extensive loss of wetland habitat. Erosion is largely limited to the active channels, but lateral erosion heads migrating off the macro channel bank were noted in some reaches. The abundance of cultivated fields in the catchments of wetlands is expected to be a source of sediment into wetlands, but no areas of excess sedimentation were noted.
The valley bottom wetlands can be characterised as moist grassland, with reedbeds only occurring along active channels and in the seasonally inundated parts of unchannelled valley bottom wetlands. A diverse assemblage of grasses and especially sedges occurs within wetlands, with the grass species Pennisetum thunbergii being particularly prominent as a wetland hydrophyte in areas of vertic soils within the temporary zone. The wettest parts of the wetlands, either within the confines of the macro channel in channelled valley bottom settings, or in linear depressions in unchannelled settings were characterised by certain obligate hydrophytes, in particular Leersia hexandra, Arundinella nepalensis, Hermarthria altissima and Paspalum distichum.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Under the revised WEF layout, two (2) valley bottom wetlands are crossed by proposed roads in which there is no existing transformative impact no existing infrastructural footprint and will have a resultant transformative impact on the affected reach, with downstream and upstream impacts possible. No other roads or turbines are proposed to be located within 100m of any other valley bottom wetland in the B11A catchment and thus the proposed infrastructure is unlikely to adversely affect any other valley bottom wetlands.</td></tr>
<tr><td colspan="4">Risk Assessment Outcome & Business Case:</td></tr>
<tr><td>MEDIUM</td><td colspan="3">The above-mentioned infrastructure that is proposed in wetlands will result in a medium level of risk to the affected wetland units, as assessed through the DWS risk matrix. Other activities within the catchment of wetlands will only pose a threat of indirect impacts and has been assessed to be associated with a low risk to downgradient wetlands. It is recognised that on a project of this scale and spatial area, wetland crossings are impossible to avoid, however consideration should be given to rather using existing farm roads to access turbine locations. The design of wetland crossing structure is highly important to avoid impacts, especially upstream and downstream impacts.</td></tr>
</table>

Table 11: Summary of the assessment of seep wetlands located in the C11F quaternary catchment in the Study Area.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td rowspan="2"> 
Photograph notes: Top left: A seep on the upper footslopes terrain unit which is not connected by a channelled outflow to the stream network; Top right: An area of active groundwater seepage in the upper part of a seep close to the Olifants-Vaal catchment boundary; Bottom left: A narrow seep characterised by proliferation of weeds such as Bidens formosa and cultivated fields in its immediate catchment; Bottom right: A seep wetland subject to high levels of cattle trampling.</td></tr>
<tr><td>Ecoservice provision</td><td>Food for Livestock: High; Biodiversity Maintenance and Water for Human Use – Moderate; All other services – Low or Very Low
The ecosystem service performed to the highest degree is related to food for livestock. A key aspect of the provisioning services of the seeps is ensuring a year-round supply of livestock grazing. Biodiversity maintenance is moderately provisioned but seeps cannot meet the demand for provision of this service, primarily due their limited size and for certain the level of vegetative transformation caused by crop cultivation and invasion by weeds. Most other hydrological regulating services are provided to an overall low degree, due to the absence inherent properties of seeps as a wetland HGM and due to their physical properties as narrow, often channelled features and the resultant absence of extensive wetland lateral wetland habitat.</td></tr>
<tr><td>PES/ discussion</td><td colspan="2">PES Category: C At an overall quaternary catchment level, seep wetlands were assessed to be in a moderately modified condition. The hydrology of seeps was assessed to have been modified to a certain degree by a number of factors such as damming, AIP and weed proliferation, cattle trampling and some headcut erosion, but none of which were sufficiently large to cause wetlands to become largely modified. Despite the slope factor and sometimes intensive presence of livestock geomorphology is largely natural. Lastly vegetation was similarly moderately modified due mainly to loss of seepage wetland habitat due to the above-mentioned factors.</td></tr>
</table>

EIS discussion	**EIS Category: Moderate** The EIS of the seep wetlands in catchment C11F in the study area has been assessed to be "Moderate", with the most important aspect being ecological importance in terms of biodiversity support and their importance at a landscape scale. Despite their greater levels of degradation as opposed to valley bottoms, seeps are nonetheless important habitats for certain threatened flora species and offer foraging habitat for certain threatened faunal species. The landscape context is important, with seep wetlands in the Mesic Highveld Grassland 4 wetland vegetation type considered to be critically endangered and the wider catchment designated as a FEPA catchment, and thus residual areas of functional seep wetland habitat are ecologically sensitive in a wider regional context. Hydro-functional importance (i.e., provisioning of services such as flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control) supplied by the wetlands is of lower significance. Retention of sediment is likely to be locally significant, but the combination of slope and erodible substates, along with the imbalance in sediment inputs to reaches downstream of dams is likely to be responsible for many of the gullies observed. The primary aspect of socio-cultural importance is the provision of year round grazing resources for cattle and the provision of water for agricultural uses.	**REC, RMO & BAS Category**	**REC Category: C** **RMO: Maintain** **BAS: C (Maintain)** Since the seep wetlands have been assessed to be in moderately modified state with a moderate EIS rating, the ecological condition of these wetlands must be maintained. This entails that development associated with the WEF in the catchment of the reaches of the wetlands and within the wetlands themselves should carefully consider the impact on the wetlands to ensure that the ecological state of the valley bottom wetlands does not become further degraded due to the proposed WEF development. Accordingly the recommendations made in Section 7 are important to ensure that realisation of the REC
Freshwater Ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):			
The part of the WEF development area that falls within the wider Vaal catchment is located south of an east-west aligned watershed. The uppermost parts of the catchment are characterised by dolerite-dominated geology while the remainder is comprised of sandstone and shale of the Ecca Group. A number of seeps drain the south-facing slopes. These and other seeps located elsewhere within the upper valley heads are typically narrow drainage features, being characterised by a narrow lateral extent, often in the form of a shallow channel. Most of the seeps sampled in the upper parts of the catchment displayed areas of active groundwater seepage, which were often associated with localised areas of dolerite and sandstone bedrock outcropping. Such springs were often located in small lateral seepage heads, feeding into the main part of the seep. In certain locations seeps were encountered which unlike the seeps above which naturally transition into valley bottom wetlands, did not display any channelled outflow and which were not connected at the surface to downgradient drainage. Such seeps were noted to take the form of seep lines oriented to be parallel with the slope, or larger areas occupying a large part of the footslope terrain unit above a valley bottom. The hydrology of most seep wetlands has been modified by impoundments which have changed the wetness regimes of both upstream and downstream parts of the wetlands, with a notable reduction in wetness downstream of the dam. Thus although not large, the small earthen dams located along most seeps were noted to often exert a significant hydrological impact. Headcut erosion is present in certain seeps; erosion is a natural process in sloping wetland settings, but is likely to have been significantly modified by anthropogenic modifiers including concentration of livestock which leads to overgrazing and trampling of saturated soils which make wetlands more vulnerable to erosion of substrate, along with changes to the sediment balance in wetlands as caused by certain impoundments which trap sediment and deprive downstream reaches of sediment. The abundance of cultivated fields in the immediate catchments of most of the seep wetlands in the catchment is expected to be a source of sediment into wetlands, but no areas of excess sedimentation were noted. The seep wetlands can vegetatively be characterised as moist grassland, with reedbeds largely absent, expect in modified dam habitats. Certain grass and sedge species were commonly noted to be dominant in seep wetlands with the most commonly occurring species being *Leersia hexandra, Hermarthria altissima, Andropogon eucomus* and *Imperata cylindrica.* A relatively high proportion of seep wetlands in the C11F catchment were noted to be impacted vegetatively by being subject to high levels of invasion of weeds and AIPs, especially where cultivated areas extend right up to the wetland boundary, with *Pennisetum clandestinum, Cirsium vulgare, Bidens Formosa* and *Verbena bonariensis* being the most common species encountered.		
Extent of modification anticipated	Under the revised WEF layout, no seep wetlands are crossed by proposed roads, however one new road (road 55) is proposed to be located within 100m of a seep wetland. Most significantly the hardstand of a turbine (WTG 5) has been located within the upper part of a seep wetland, which would result in significant potential impacts on the affected part of the wetland.		
Risk Assessment Outcome & Business Case:			
MEDIUM	The above-mentioned infrastructure that is proposed in wetlands will result in a medium level of risk to the affected wetland units, as assessed through the DWS risk matrix. Other activities within the catchment of wetlands will only pose a threat of indirect impacts and has been assessed to be associated with a low risk to downgradient wetlands. A recommendation has been made to relocate WTG 5 out of the affected seep wetland and its 15m non-development boundary as a minimum to avoid the direct impacting of the seep wetland.		

4.3 Freshwater Buffers

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

The Mpumalanga Biodiversity Spatial Plan Handbook (2014) provides guidance on freshwater buffers. In a freshwater context the handbook stipulates the following:

- For Freshwater CBAs – a buffer of 100 m should be used to buffer rivers and wetlands, unless DWS's river / wetland buffer tool has been applied;
- For ESA Important Sub-catchments and Fish Support Areas – generic buffers of 100 m should be established around streams and wetlands within these catchments; and
- For ESA Wetlands: Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetland.

As detailed in section 3.1 most wetlands in the study area have been designated as ESA wetlands, with certain wetlands in the south-eastern part of the study area being designated as CBA wetlands. Furthermore much of the southern part of the study area falls within an ESA Important Sub-catchment. As all of these areas are associated with a 100m buffer the 100m Mpumalanga Tourism and Park Agency (MTPA) buffer was applied as a preliminary freshwater buffer forming part of the designation of freshwater-related opportunities and constraints in the scoping phase freshwater assessment.

In order to provide a refinement of the buffer in the study the scientific buffer Guideline tool was applied to the wetlands in the study area. The buffer guideline provides an Excel™ based

Buffer Zone Tool to determine suitable buffer zone requirements. The tool includes a rapid desktop tool for determining potential aquatic impact buffer zone requirements together with a site-based tool for determining buffer zone requirements for rivers, wetlands and estuaries. Central to the tool is a buffer model, which is populated automatically from the data inputted. This is based on best available science and is used to generate buffer zone recommendations as part of the assessment process. Figure 25 below outlines an overview of the step-wise assessment process for buffer zone determination as applied through the tool. The buffer assessment was determined using site-based parameters using data collected for the (on-site) detailed assessment of freshwater ecosystems in the study area. Due to the size of the study area and different types of infrastructure proposed, certain assumptions had to be made, with the selection of roads as the worst-case (highest impact) type of development utilised. Table 12 details the results of the refined buffer assessment.

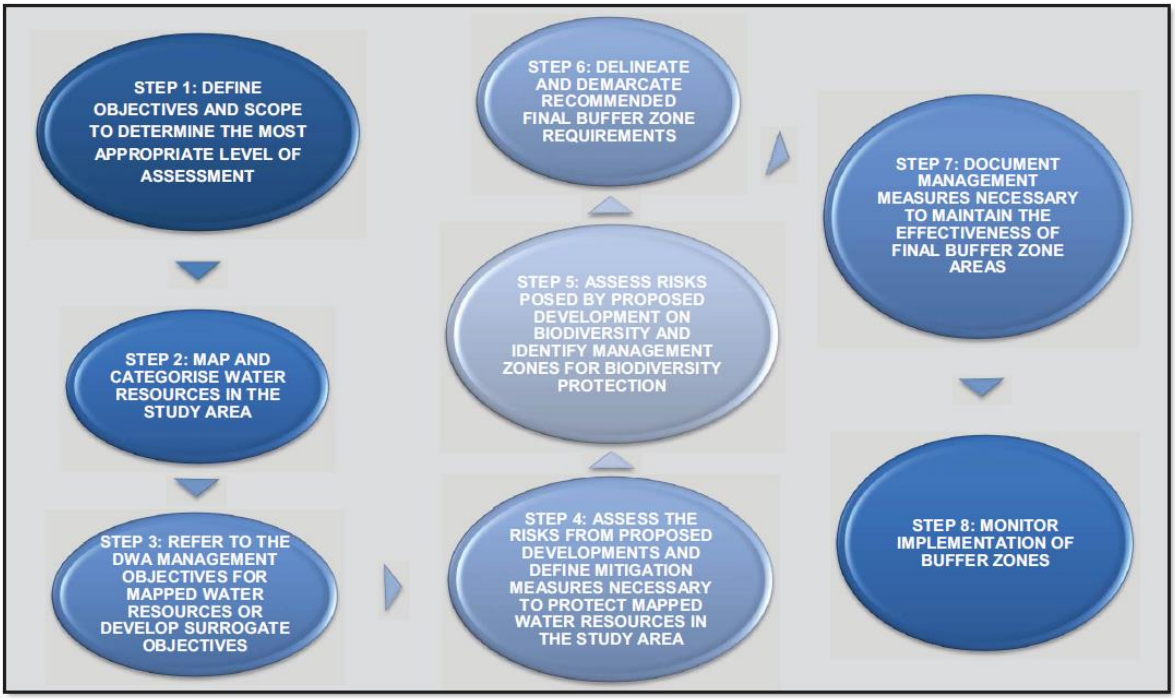


Figure 25: Overview of the step-wise assessment process for buffer zone determination and applied through the buffer tool

Table 12: Buffers as recommended by the buffer tool for the Phefumula Emoyeni 1 Study Area wetlands.

Freshwater Ecosystem	Construction phase buffer	Operational Phase buffer	Final aquatic impact buffer
Study Area wetlands	15m	15m	**15m**

The final aquatic impact buffer requirement is based on the maximum of the recommended buffers for the construction and operational phases and taking practical considerations into account (Figures 26 – 28) .

It is important to note that a 15m buffer must be maintained around all wetlands in both the construction and operational phases of the development. This buffer must be strictly enforced as a non-developable area within which no infrastructure or construction activities must occur with the exception of road crossings and associated construction Rights of Way (RoW) through wetlands, as well as where access roads are upgraded and the existing road is within 15m of a wetland. There are certain new access roads which are proposed to be located within <15m of a wetland and these access roads should be realigned, as described in Section 7 below.

It should be noted that for certain activities with a higher risk of impact, especially in terms of pollution, a wider exclusion area around wetlands has been stipulated. As detailed in Section 7 below, all areas / activities that could reasonably pose a risk of pollution to freshwater ecosystems must be kept at least 100m from a wetland boundary. This applies to laydown areas and construction camps where dangerous goods or other pollutants may be stored.

5 LEGISLATIVE REQUIREMENTS

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

- Constitution of the Republic of South Africa, 1996[4];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA);
- The NEMA EIA Regulations of 2014, as updated (GN 326 of 07 April 2017);
- The National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA); and
- Government Notice 4167 (GN4167) as published in the Government Gazette 49833 of December 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

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

[4] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". 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.

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

Regulatory authorisation required	Zone of applicability
Water Use Authorisation Application in terms 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 December 2023 as it relates to the National Water Act, 1998 (Act No.36 of 1998) as amended. In accordance with GN4167 of December 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i) is defined as: • the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake, or dam; • in the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • **a 500 m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.**
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended in 2017[5]. **Department of Forestry, Fisheries and the Environment (DFFE).**	**Activities of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended):** **Activity 12** *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* *(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;* *c) if no development setback exists, within **32 metres of a watercourse**, measured from the edge of a watercourse.* ***Activity 48:*** *The expansion of—* *(i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; or* *(ii) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 100 square metres or more;* *where such expansion 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;*

[5] Note – only listing notice activities that are associated with a zone of regulation are detailed in this table. This does not exclude the applicability of other potentially applicable activities that relate to the freshwater environment (e.g., Listing Notice 1 Activity 19) or any other applicable listing notice activity to the proposed development.

Regulatory authorisation required	Zone of applicability
	Activities of Listing Notice 3 (GN 324) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) applicable to Mpumalanga, outside of urban areas. ***Activity 10***: *The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.* *(f)Mpumalanga:* *(i) Outside urban areas:* *(hh). Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland.* ***Activity 14***: *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 10 square metres; or* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—;* ***a) within a watercourse;*** *b) in front of a development setback;* *if no development setback exists, within **32 metres of a watercourse**, measured from the edge of a watercourse* *(f) Mpumalanga -i. Outside urban areas:* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.* ***Activity 23:*** *The expansion of—* *(i) infrastructure or structures where the physical footprint is expanded by 10 square metres or more; or* *(ii) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 10 square metres or more;* *where such expansion 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;* *(f) Mpumalanga -i. Outside urban areas:* *(ee) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.*

Due to the predominance of wetlands in the study area, a 500 m GN4167-related Zone of Regulation will apply to all freshwater ecosystems on the site.

In terms of the NEMA EIA Regulations, two different ZoR's could apply. Due to the potential development of new access roads, as well as the potential expansion of existing access roads, both Listing Notice 1 Activities 12 and 48 which are associated with a 32m Zone of Regulation would potentially apply to the proposed development (should the activity trigger the 100m^2 threshold). Within areas designated by the 2014 Mpumalanga Biodiversity Sector Plan as ESAs or CBAs (most freshwater drainage in the study area has been designated at ESAs), activities 14 and 23 of Listing Notice 3 would also apply to potential new and expanded road crossings of freshwater ecosystems, as well as to any other infrastructure of >10m^2 in physical extent. These two LN3 activities are also associated with a 32 m Zone of Regulation.

Lastly Activity 10 of Listing Notice 1, relating to the storage of dangerous goods with a combined capacity of >30 to <80 m^3 would be triggered within 100 m of a freshwater ecosystem. Accordingly should the proponent wish to store dangerous goods (e.g. fuel) on the development site, a 100m ZoR related to the NEMA EIA Regulations (in addition to the 32m ZoR) would apply to the development.

The applicable zones of regulation for the proposed Phefumula Emoyeni One WEF can be summarised as follows:

- 32 m Zone of Regulation (NEMA EIA Regulations) (Figures 29 – 31);
- (Potential) 100 m Zone of Regulation (NEMA EIA Regulations) (Figures 29 – 31); and
- 500m Zone of Regulation (GN4167) (Figures 32 – 34).

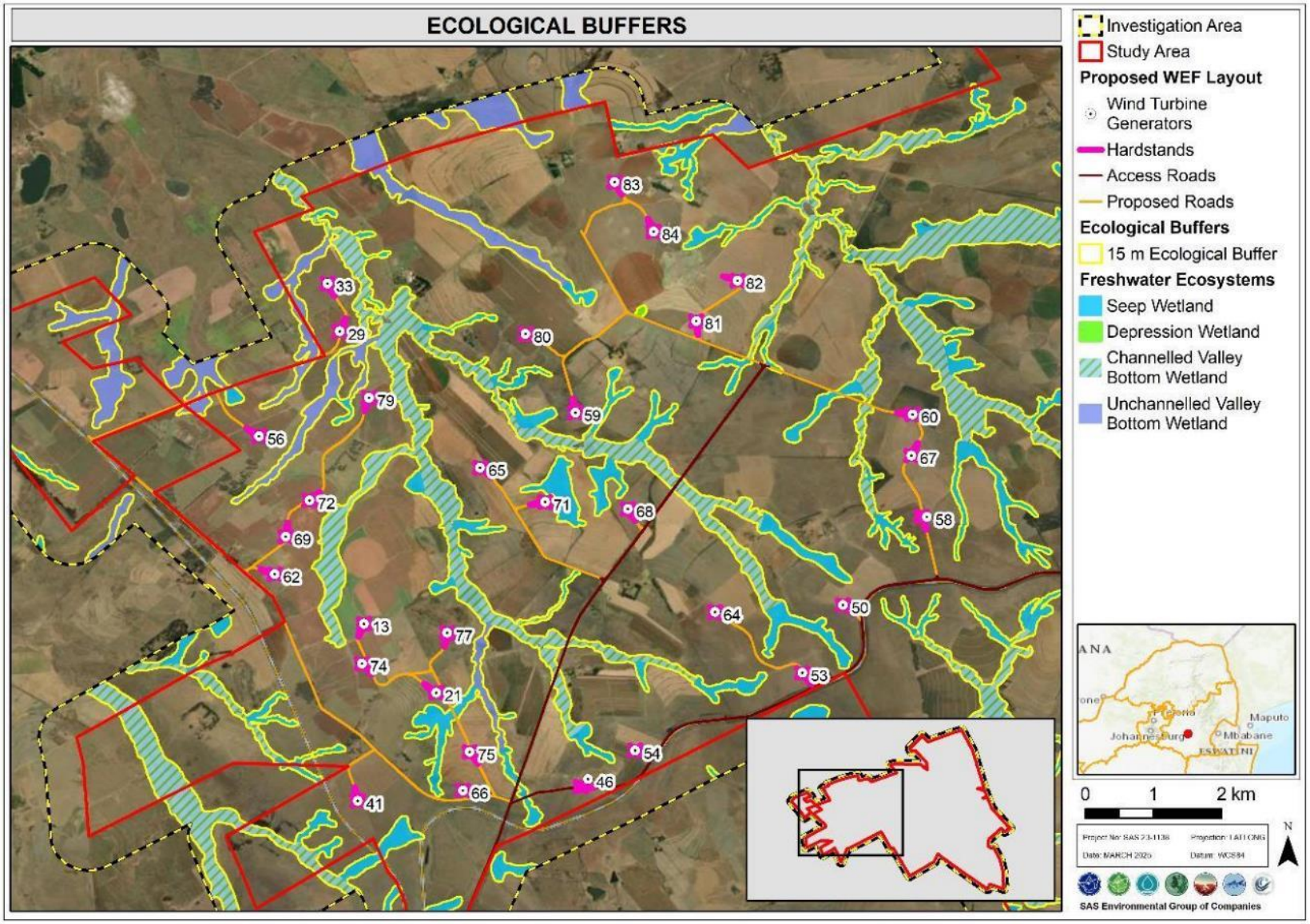


Figure 26: Conceptual presentation of the ecological buffers applicable to the delineated freshwater ecosystems within the western portion of the study and investigation areas.

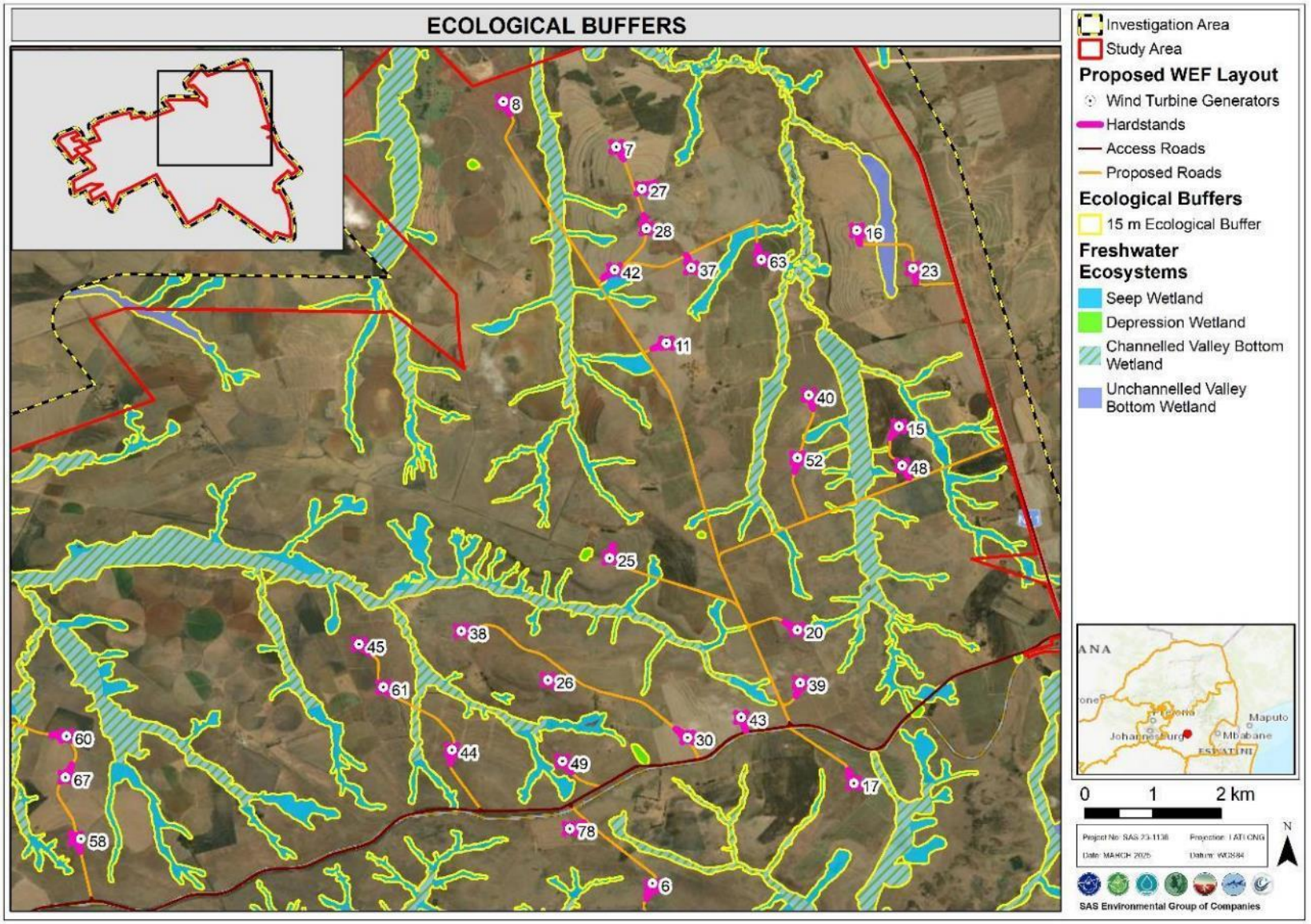


Figure 27: Conceptual presentation of the ecological buffers applicable to the delineated freshwater ecosystems within the northern portion of the study and investigation areas.

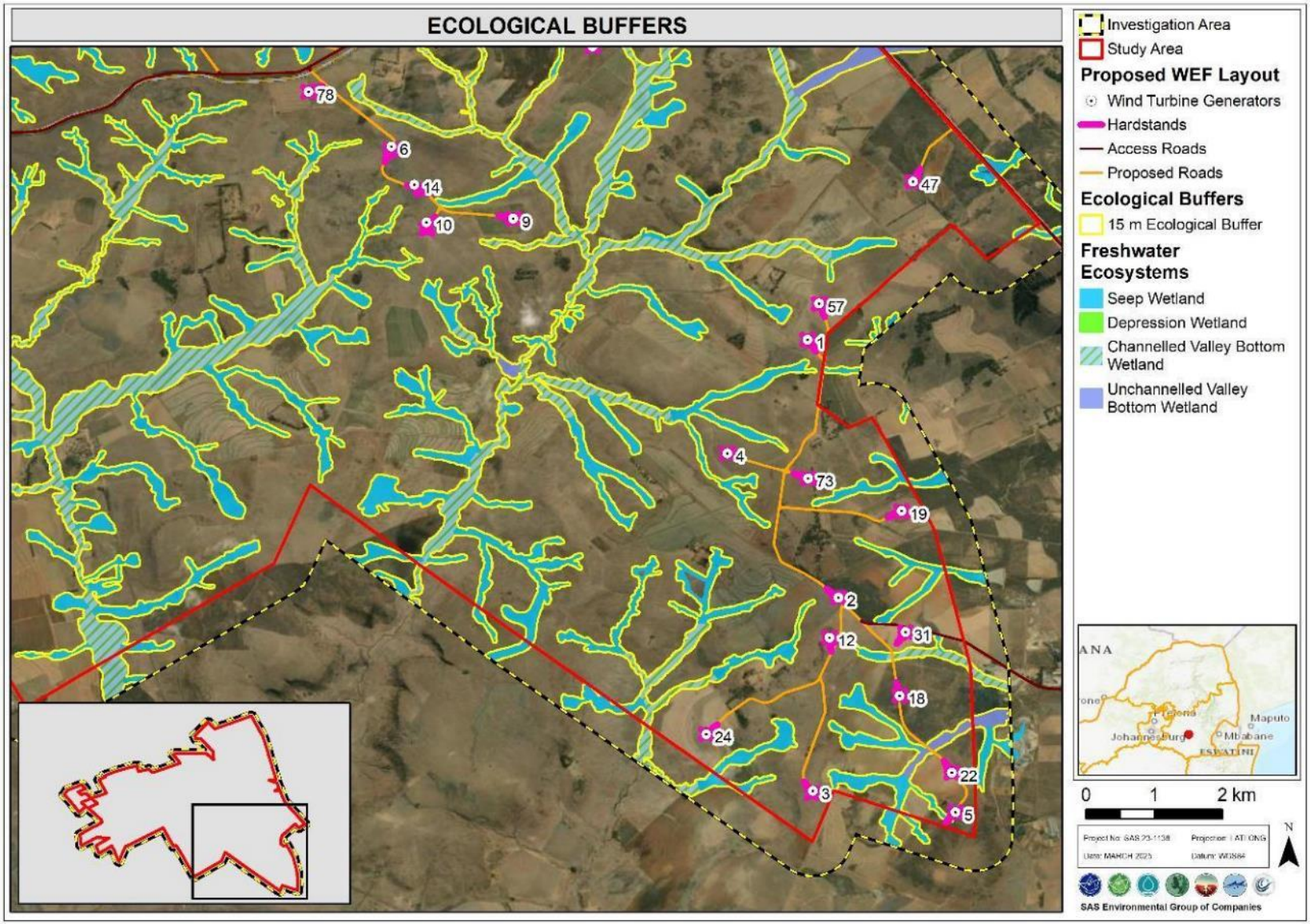


Figure 28: Conceptual presentation of the ecological buffers applicable to the delineated freshwater ecosystems within the southern portion of the study and investigation areas.

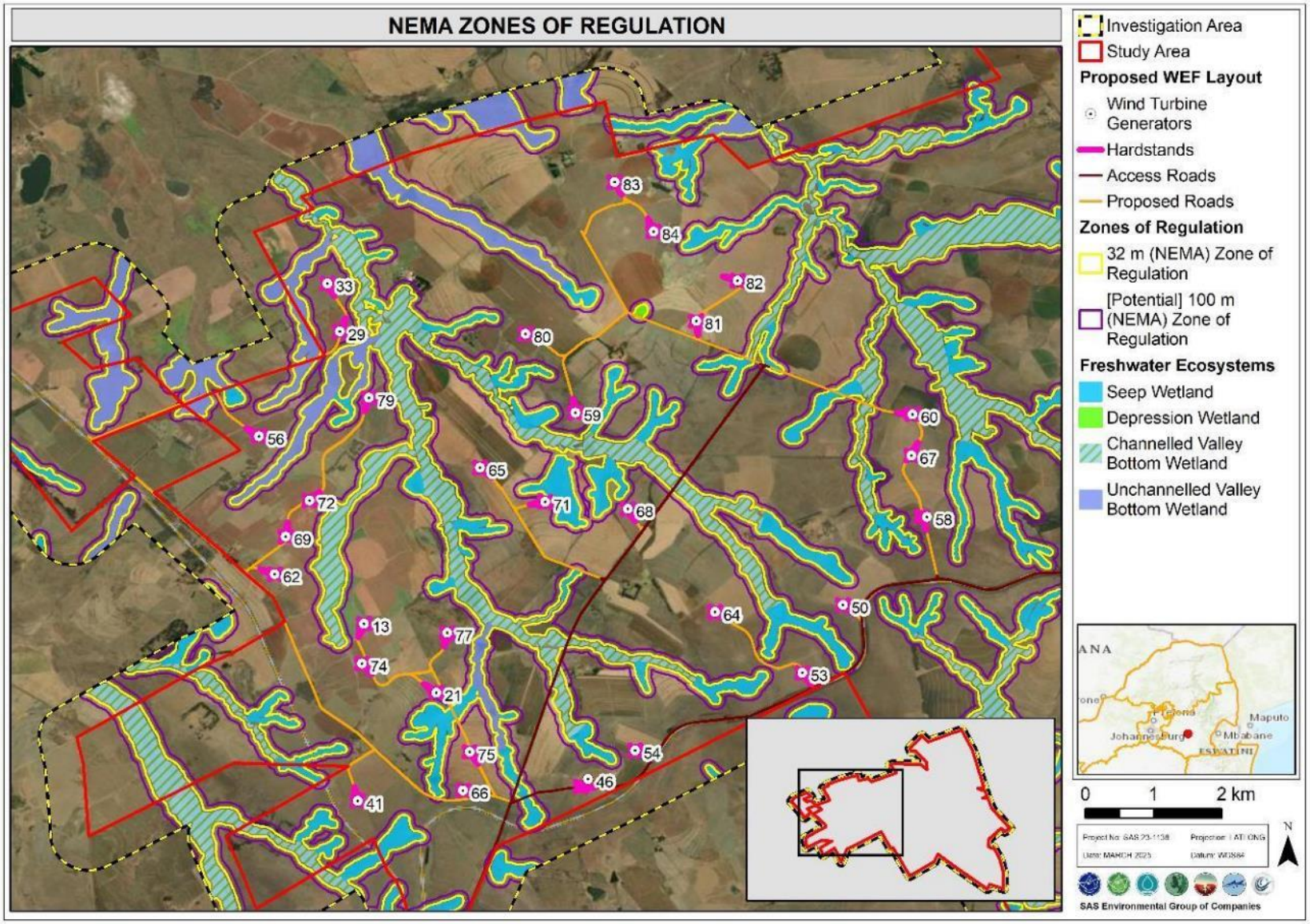


Figure 29: Conceptual presentation of the NEMA zones of regulation applicable to the delineated freshwater ecosystems within the western portion of the study and investigation areas.

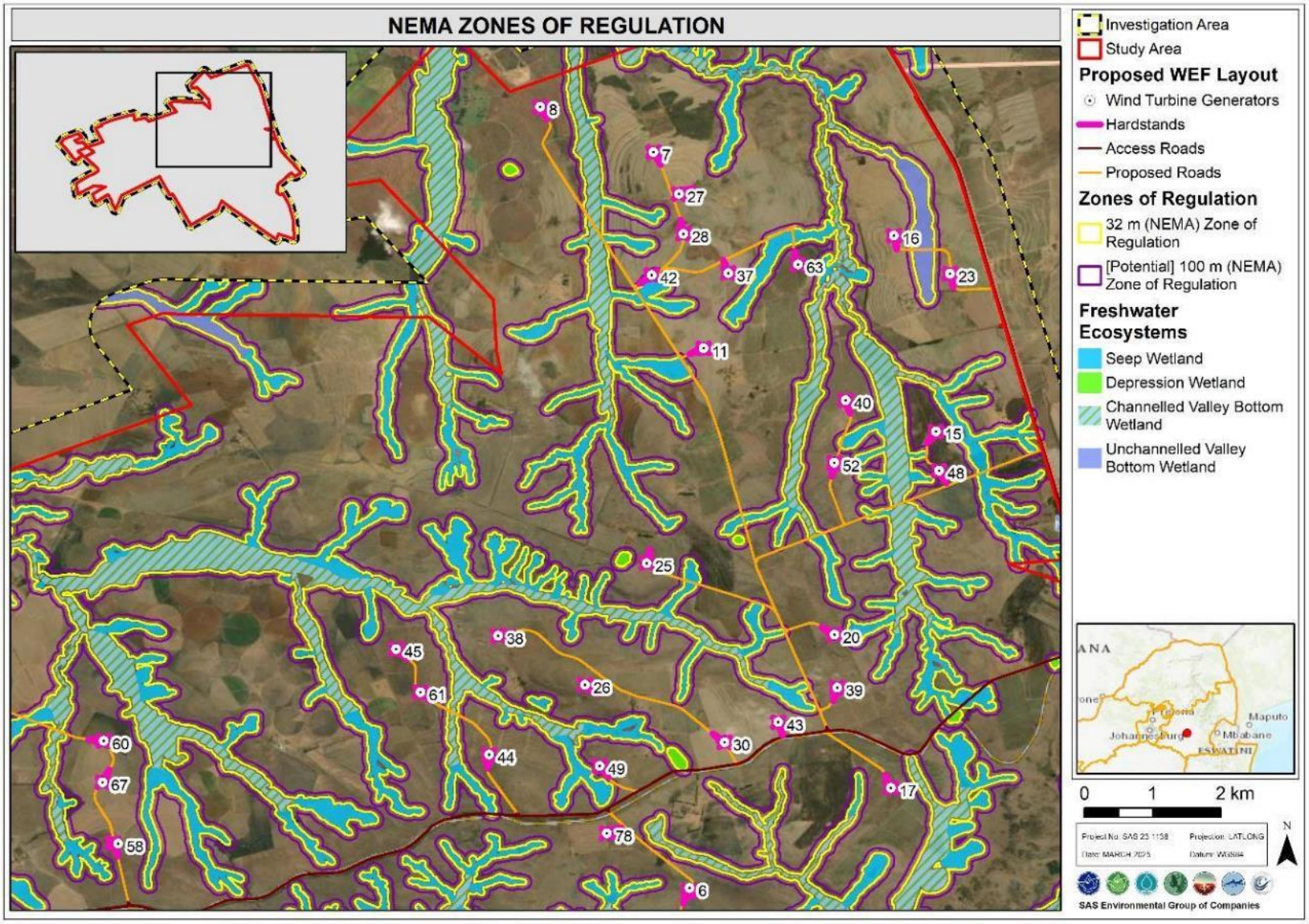


Figure 30: Conceptual presentation of the NEMA zones of regulation applicable to the delineated freshwater ecosystems within the northern portion of the study and investigation areas.

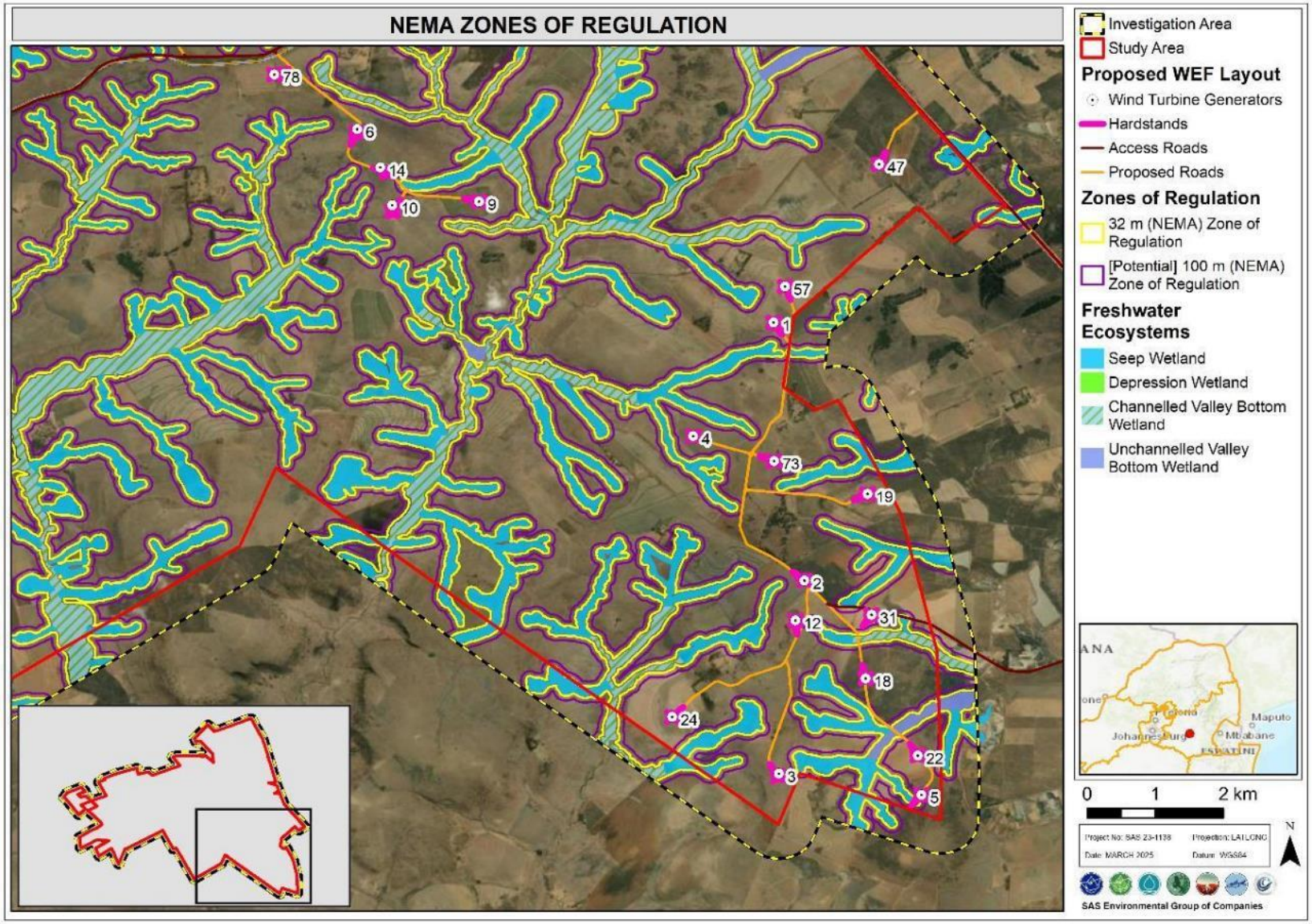


Figure 31: Conceptual presentation of the NEMA zones of regulation applicable to the delineated freshwater ecosystems within the southern portion of the study and investigation areas.

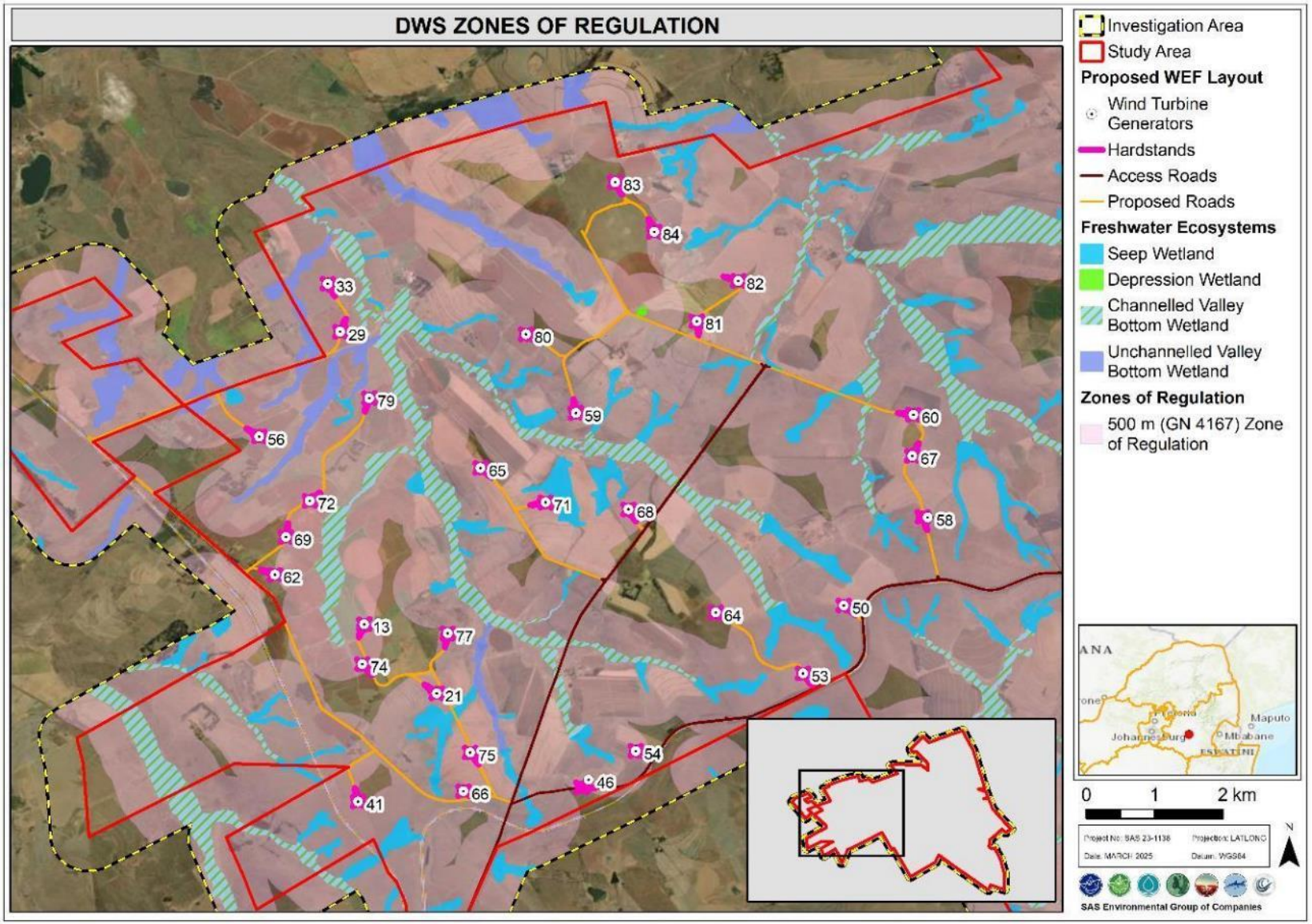


Figure 32: Conceptual presentation of the GN 4167 zones of regulation (as it relates to the NWA) applicable to the delineated freshwater ecosystems within the western portion of the study and investigation areas.

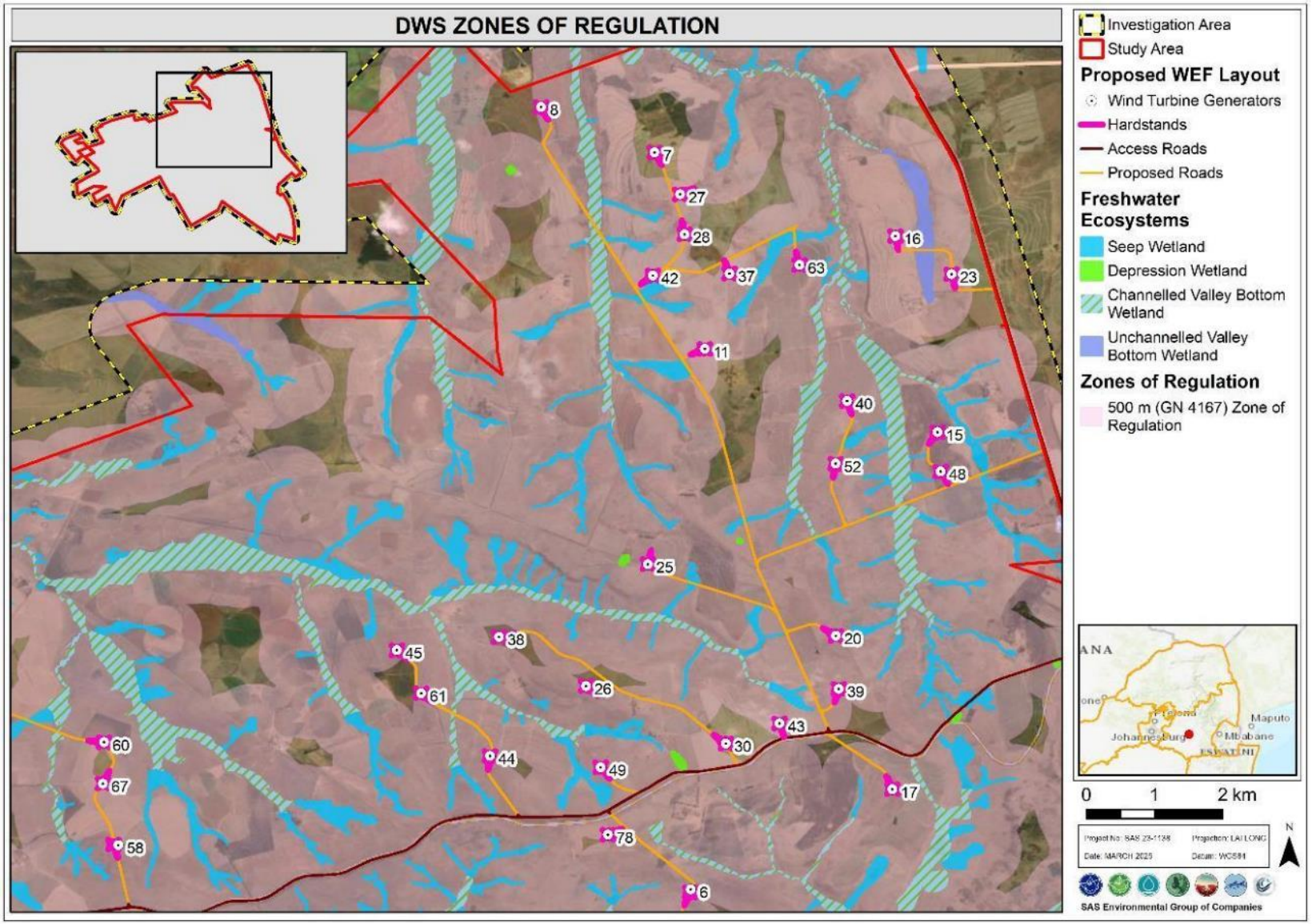


Figure 33: Conceptual presentation of the GN 4167 zones of regulation (as it relates to the NWA) applicable to the delineated freshwater ecosystems within the northern portion of the study and investigation areas.

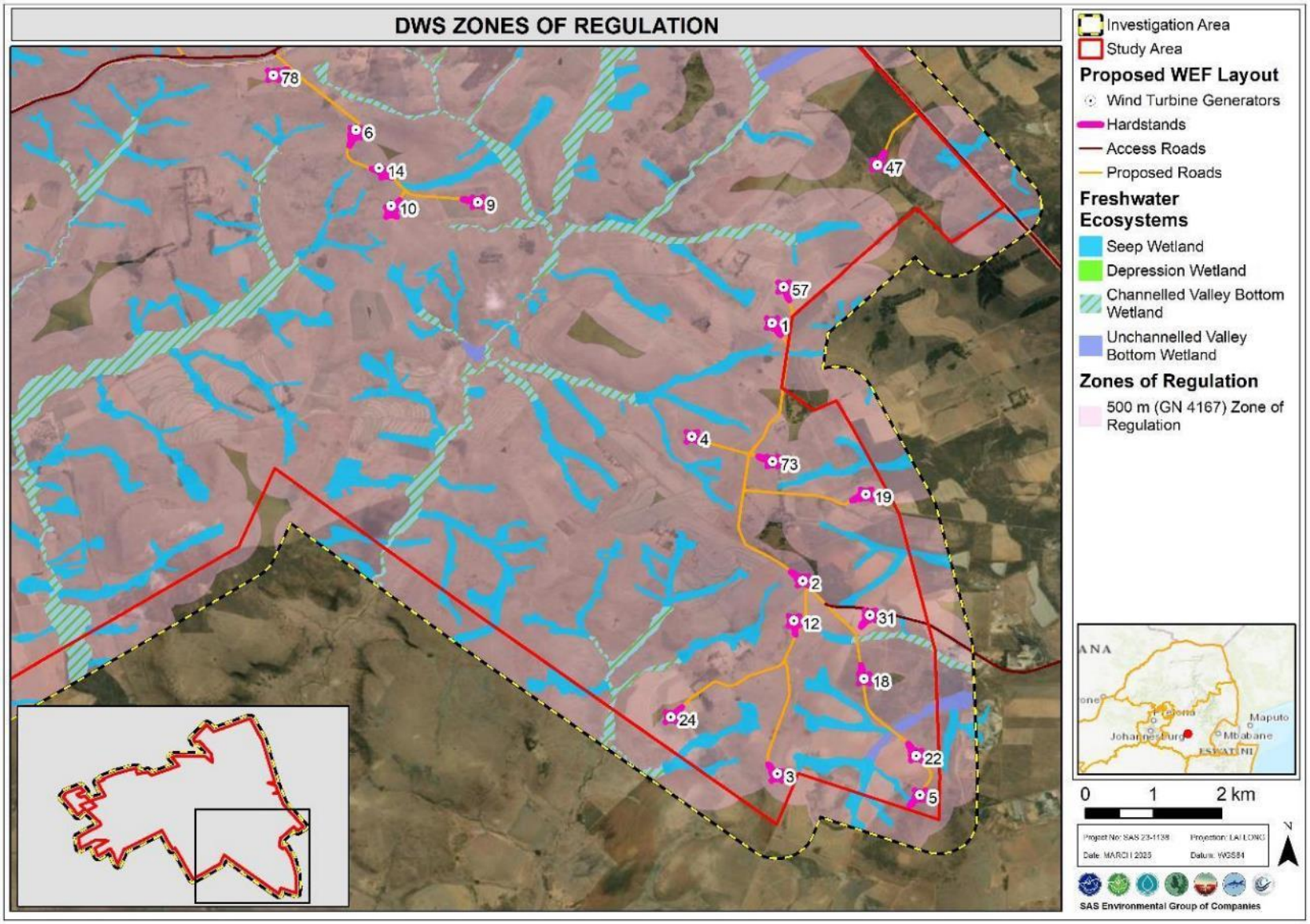


Figure 34: Conceptual presentation of the GN 4167 zones of regulation (as it relates to the NWA) applicable to the delineated freshwater ecosystems within the southern portion of the study and investigation areas.

6 FRESHWATER SENSITIVITY VERIFICATION

The protocol for the assessment of freshwater and aquatic biodiversity prepared in support of the Department of Forestry, Fisheries and Environment (DFFE) (previously the Department of Environmental Affairs (DEA)) National Web-based Environmental Screening Tool (2020), provides the criteria for the assessment and reporting of impacts on aquatic/freshwater biodiversity for activities requiring Environmental Authorisation (EA). For the aquatic / freshwater biodiversity theme, the requirements are for sites which support various levels of biodiversity. The relevant aquatic / freshwater biodiversity theme in the National Web-based Environmental Screening Tool (2020) has been provided by the South African National Biodiversity Institute (SANBI). Based on the sensitivity rating, a suitably qualified specialist must prepare the relevant report or opinion memorandum which is to be submitted as part of the EA application.

According to the guidelines, an applicant intending to undertake an activity on a site identified as being of “very high sensitivity” for an aquatic biodiversity theme must submit an Aquatic Biodiversity Impact Assessment, or if the area is identified as being of “low sensitivity” then an Aquatic Biodiversity Compliance Statement must be compiled and submitted to the competent authority. It is noted, however, that during a site survey undertaken by a suitably qualified freshwater ecologist should the sensitivity be determined different from that assigned by the screening tool (i.e. that a high risk to the regional aquatic biodiversity or freshwater ecosystems in the area is likely even though it is assigned as a “low” sensitivity, or if it is assigned a high sensitivity, however, the proposed development risks are deemed low) then the relevant assessment approach must be followed based on the site survey results and not the screening tool allocation.

As part of the process of the background information gathering, the screening tool was applied to the study and investigation areas. According to the screening tool, certain parts of the study area and investigation area of the Phefumula Emoyeni One WEF are within areas of very high aquatic/ freshwater biodiversity significance, (Figure 16) including a large section of the south-eastern part of the study area and all surface water drainage in the study area. The tool has designated these areas as being of very high freshwater sensitivity due to numerous factors. A sub-catchment (quinary catchment) of the C11F catchment in the south-eastern part of the study area is delineated as a Phase 1 FEPA catchment and has accordingly been designated as very high freshwater sensitivity. In addition, various other designations have triggered areas of very high sensitivity:

- CBA: Aquatic rivers
- CBA: Wetlands
- ESA: Important sub-catchments
- ESA: Wetlands
- Rivers: PES AB - D
- Wetlands in the Mesic Highveld Grassland Bioregion

Based on the site verification undertaken by Scientific Aquatic Services and the findings thereof presented in this report, the designation of very high sensitivity to freshwater features in the wider area by the DFFE Screening Tool has been supported through the findings of the freshwater assessment that has confirmed the very high sensitivity of all freshwater ecosystems (primarily wetlands) that are present within the study and investigation areas. The ecological and hydrological functionality of the freshwater ecosystems in a study area context in the context of their location within threatened (critically endangered) freshwater ecosystems and their designation as both FEPAs and CBAs renders them as ecologically very sensitive.

Under the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity, (GN320 of March 2020), for areas of very high aquatic biodiversity sensitivity an Aquatic Biodiversity Assessment must be produced. Such a reporting approach (scoping and EIA-phase freshwater reports) have accordingly been compiled.

Please see below map of the specialist site tracks and investigation points during the site assessment undertaken in March 2024 and February 2025.

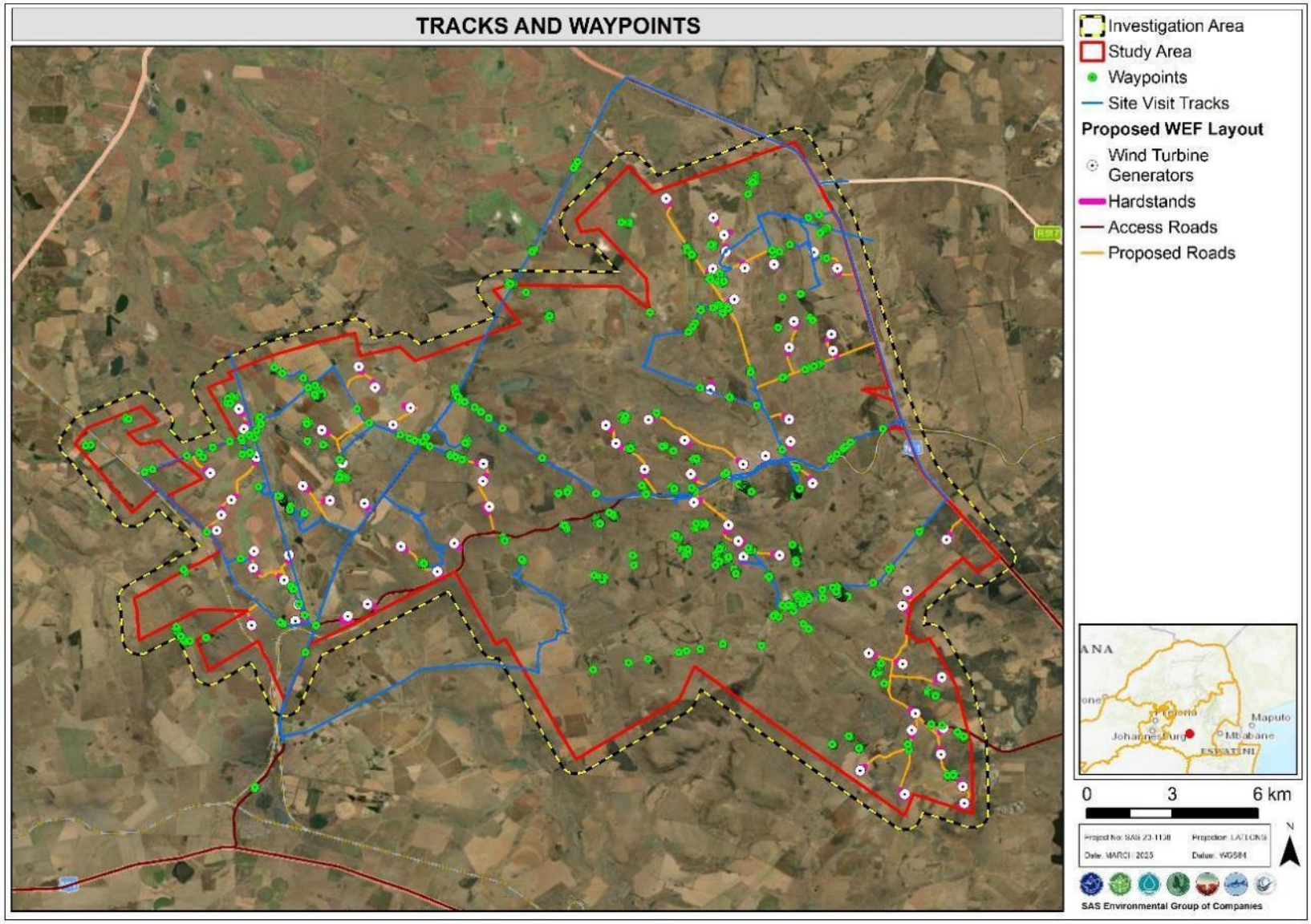


Figure 35: Specialist site tracks and assessment points as per the field verification undertaken in March 2024 and February 2025.

7 DWS RISK ASSESSMENT

7.1 Consideration of impacts and application of mitigation measures

Following the assessment of the freshwater ecosystems associated with the proposed WEF facility, the DWS prescribed Risk Assessment Matrix (as prescribed by GN 4167 of December 2023) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these freshwater ecosystems.

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

- The DWS Risk Assessment Matrix (2023) was applied assuming that a high level of mitigation will be implemented, thus the results, provided in this report presents the perceived impact significance ***post-mitigation***;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA *et al.* (2013) would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- As no information on BESS sites, as well as proposed laydown areas and O&C infrastructure has been provided these aspects have not been assessed in the RAM; and
- Most impacts are considered to be easily detectable, with the exception of potential contamination of surface and groundwater which will require some effort. Assessing these potential impacts falls outside of the scope of this freshwater ecosystem study.

7.2 Risk Assessment discussion of anticipated ecological impacts

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

- Loss of wetland 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, some impacts can be avoided or adequately

minimised where avoidance is not feasible. 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 proposed development activities, is provided in the table below, whilst a comprehensive outcome of the risk assessment is presented in **Appendix E**.

Table 14 - Summary of the results of the DWS risk assessment matrix applied to the freshwater ecosystems associated with the proposed Phefumula Emoyeni 1 WEF development.

Phase	Activity	Impact	Potentially affected watercourses				Significance (max = 100)	Risk Rating
			Name/s	PES	Overall Watercourse Importance			
CONSTRUCTION	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of 100m radius of wetland boundaries . (All Turbines except for Turbines 5 and 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transportation of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	All VB wetlands	B	High		4	L
			All seep wetlands	C	Moderate		3	L
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of the delineated wetland boundary and within 100m radius of wetland boundaries . (Turbine 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transport of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles. •Risk of AIP proliferation in disturbed areas that could colonise the adjacent wetland areas.	All VB wetlands	B	High		16	L
			All seep wetlands	C	Moderate		12	L

Phase	Activity	Impact	Potentially affected watercourses				Significance (max = 100)	Risk Rating
			Name/s	PES	Overall Watercourse Importance			
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines and hardstands within a delineated wetland boundary (Turbine 5).	•Destruction of a certain area of wetland habitat in the footprint of the turbine and hardstand; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream freshwater ecosystem areas and may smother vegetation associated with the freshwater ecosystems; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	C11A seep wetland	C	Moderate		**36**	**M**
	Construction of surface infrastructure (all Turbines and Hardstands except for Turbine 5 and 42,) and including new access roads outside of 100m radius of wetland boundaries .	•Earthworks and exposure of soil could result in sedimentation of downgradient wetlands, which may be transported as runoff into the downgradient wetlands and may smother wetland vegetation; •Altered water quality in downgradient wetlands (if surface water is present) as a result of pollution as a result of oils (e.g. from spills) and concrete mixing; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	All VB wetlands	B	High		**4**	**L**
			All seep wetlands	C	Moderate		**3**	**L**
	Construction of surface infrastructure (Turbines and Hardstands 42) and new access roads) between the delineated wetland boundary and a 100m radius of wetland boundaries.		All VB wetlands	B	High		**16**	**L**
			All seep wetlands	C	Moderate		**12**	
	Construction of Turbine and Hardstand 5 within the delineated wetland boundary	•Earthworks associated with the turbine foundation and laying of sub-surface concrete would result in disturbances to sub-surface movement of water within the wetland; •Earthworks could result in sedimentation of the downstream wetland, which may smother wetland vegetation; •Altered water quality (if surface water is present) as a result of spills associated with vehicles or other construction activities, especially concrete mixing; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	C11F seep wetland	C	Moderate		**36**	**M**

Phase	Activity	Impact	Potentially affected watercourses				Significance (max = 100)	Risk Rating
			Name/s	PES	Overall Watercourse Importance			
	Potential upgrading of existing access roads within freshwater ecosystems: •Excavation within freshwater ecosystems for the removal of existing infrastructure and casting of a base (where applicable); •Placement of culvert structures atop concrete base;	•Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetland areas and may smother wetland vegetation; • Potential spillage of pollutants such as oil and or liquified cement which could damage wetland habitat and biota; •Movement of heavy machinery within the wetland adjacent to the crossing structure which would damage wetland soils and vegetation; •Proliferation of alien and/or invasive vegetation as a result of disturbances.	All VB wetlands	B	High		**25.6**	**L**
			All seep wetlands	C	Moderate		**19.2**	**L**
	Development of new road crossings of wetlands, involving: •Site preparation prior to construction activities including movement of construction equipment / vehicles within the freshwater ecosystems and removal of vegetation; •Ground-breaking and excavations and trenching within/adjacent to the freshwater ecosystems; •Construction of coffer dams for instream work, if required; and • Placement of culvert structures atop concrete base.	•Destruction of a certain area of wetland habitat in the footprint of the crossing structure; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetlands and may smother wetland vegetation; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; •Loss of ecological connectivity; •Potential hydrological impacts associated with crossing structures, including increased saturation and ponding upstream of the crossing structure, as well as deprivation of downstream reaches of water and sediment, which may lead to erosion in the long term; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	B12A valley bottom wetlands (4 wetland crossings)	B	High		**40**	**M**
			B12A seep wetlands (3 wetland crossings)	C	Moderate		**30**	**M**

Phase	Activity	Impact	Potentially affected watercourses				Significance (max = 100)	Risk Rating
			Name/s	PES	Overall Watercourse Importance			
			B11A valley bottom wetlands (3 wetland crossings)	B	High		**40**	**M**
			B11A seep wetlands (4 wetland crossings)	C	Moderate		**30**	**M**
			C11F valley bottom wetlands (2 wetland crossings)	B	High		**40**	**M**
			C11F seep wetlands	C	Moderate		**7,2**	**L**
OPERATIONAL	Operation and maintenance of the surface infrastructure	•Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and	All VB wetlands	B	High		**5.6**	**L**

Phase	Activity	Impact	Potentially affected watercourses				Significance (max = 100)	Risk Rating
			Name/s	PES	Overall Watercourse Importance			
	associated with the proposed development located outside the delineated freshwater ecosystems and further than 100 m including turbines and associated foundations and roads.	•Altered water quality (if surface water is present) as a result of increased availability of pollutants.	All seep wetlands	C	Moderate		**4.2**	**L**
	Operation of surface infrastructure associated with the proposed development located within 100 m of the delineated freshwater ecosystems, including selected turbines and roads;		All VB wetlands	B	High		**16**	**L**
			All seep wetlands	C	Moderate		**12**	
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater ecosystems (where applicable).	•Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the freshwater ecosystems (increase in the sediment load) and turbulent flows when surface water is present; •Higher flood peaks into the freshwater ecosystems due to reduced surface roughness in the freshwater ecosystems.	All VB wetlands	B	High		**24**	**L**
			All seep wetlands	C	Moderate		**18**	**L**
DECOMMISSIONING	Removal of all surface infrastructure from the project area.	•Disturbance of soil and vegetation that established within the decommissioning area and associated indirect impacts on downgradient wetland, including sediment ingress, increased stormwater flows and potential pollution from oils and other pollutants; •Potential proliferation of alien invasive vegetation.	All VB wetlands	B	High		**24**	**L**
			All seep wetlands	C	Moderate		**18**	**L**

Table 15: Summary of the development-specific impacts and associated mitigation measures stipulated for the proposed Phefumula Emoyeni 1 WEF.

Phase	Activity	Impact	Mitigation measures
Construction Phase	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of 100m radius of wetland boundaries . (All Turbines except for Turbines 5 and 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within freshwater ecosystems not proposed to be directly impacted from indirect impacts; •Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; •Risk of AIP proliferation in disturbed areas that could colonise the adjacent wetland areas; and •Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	•It is recommended that Turbine 42 be relocated to the north to be located outside of the 15m non-development buffer of the seep wetland to the south as a minimum. •All construction areas must be clearly demarcated prior to the start of site clearing to prevent any accidental clearing of vegetation or construction impacts from adversely impacting areas outside of the development footprint (layout). •All construction and site clearing should ideally take place during the dry season to limit potential impacts to downgradient freshwater ecosystems as a result of construction activities; •A designated contractor laydown area(s) that is located outside the freshwater ecosystems and outside of a 100m radius of any wetland should be approved by the Environmental Control Officer (ECO) prior to use; •An ECO must be appointed in order to ensure all water related aspects are adequately mitigated for the duration of the construction phase; •All development footprint areas to remain within the approved development footprint and vegetation clearing to be limited to what is essential within those approved footprints; •Retain as much indigenous vegetation as possible; •Where clearing of vegetation at a large scale is to be undertaken, no large-scale indiscriminate clearing of vegetation from the entire footprint must be undertaken. Rather blocks of vegetation must be systematically cleared of vegetation to avoid the creation of large volumes of dust and to control stormwater runoff during construction; •All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) must be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility;

Phase	Activity	Impact	Mitigation measures
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of the delineated wetland boundary and within 100m radius of wetland boundaries . (Turbine 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transportation of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles. Risk of AIP proliferation in disturbed areas that could colonise the adjacent wetland areas.	•During construction of the surface infrastructure regular spraying of non-potable water or the use of chemical dust suppressants, that are approved for use near freshwater ecosystems must be implemented to reduce dust and to ensure no smothering of vegetation within the freshwater ecosystems occurs from excessive dust settling. It is recommended that a suitably qualified specialist be consulted for approval of the product and conditions for use; •As soon as areas of vegetation are cleared, construction-phase stormwater controls must be implemented on the downgradient side of the cleared areas to mitigate the risk of stormwater transporting sediment towards wetlands; •The freshwater ecosystems outside the construction footprint not having authorised road crossings must be considered as no-go areas. No construction vehicles, nor construction personnel or vehicles may traverse through these freshwater ecosystems (except on approved road crossings); •As far as possible, existing roads must be utilised to gain access to construction sites; •All vehicle re-fuelling is to take place in specifically designated re-fuelling areas that must be located outside of a 100m radius of wetlands.

Phase	Activity	Impact	Mitigation measures
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines and hardstands within a delineated wetland boundary (Turbine 5)	•Destruction of a certain area of wetland habitat in the footprint of the turbine and hardstand; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream freshwater ecosystem areas and may smother vegetation associated with the freshwater ecosystems; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	It is strongly recommended that Turbine 5 be relocated so that not part of its footprint is located within the delineated wetland boundary or its associated 15m non development buffer.
	Construction of surface infrastructure (all Turbines and Hardstands except for Turbine 5 and 42,) and including new access roads outside of 100m radius of wetland boundaries .	•Earthworks and exposure of soil could result in sedimentation of downgradient wetlands, which may be transported as runoff into the downgradient wetlands and may smother wetland vegetation; •Altered water quality in downgradient wetlands (if surface water is present) as a result of pollution as a result of oils (e.g. from spills) and concrete mixing; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	**It is strongly recommended that Turbine 5 be relocated outside of the seep wetland and its affected 15m non-development buffer so that no part of its footprint affects the wetland.** **With regards to excavation activities:** **With regards to excavation activities:** •During excavation activities, the topsoil and vegetation must be stockpiled separately from other material outside the delineated extent of the freshwater ecosystems; •Excavated materials must not be contaminated, and it must be ensured that the minimum surface area is taken up by any stockpiled materials. The mixture of the lower and upper layers of the excavated soil must be kept to a minimum, so as for later use as backfill material after construction has commenced; •All exposed soils must be protected from wind using tarpaulins for the duration of the construction phase to prevent potential erosion and sedimentation of the freshwater ecosystems; •Suitable drainage must be ensured within construction areas (including contractor laydown areas, material storage facilities, etc.) in order to ensure that water does not pond or drain in a concentrated manner into the downgradient freshwater ecosystems. Consideration must be given to ensuring that stormwater is allowed to diffusely spread across the landscape, by ensuring adequate surface roughness of the surrounding terrestrial/freshwater area;

Phase	Activity	Impact	Mitigation measures
	Construction of surface infrastructure (Turbines and Hardstands 42) and new access roads) between the delineated wetland boundary and a 100m radius of wetland boundaries.	• Earthworks and exposure of soil could result in sedimentation of downgradient wetlands, which may be transported as runoff into the downgradient wetlands and may smother wetland vegetation; • Altered water quality in downgradient wetlands (if surface water is present) as a result of pollution as a result of oils (e.g. from spills) and concrete mixing; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	•No concentrated runoff from the surface infrastructure construction areas must enter the freshwater ecosystems. This must be achieved by installing silt traps or placing hay bales downgradient of the construction footprint (until suitable basal vegetation cover has been restored) to ensure no sediment laden or concentrated runoff generates from the construction footprint; and •It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction. **With regards to concrete mixing on site:** Concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal must minimise or eliminate discharges into the freshwater ecosystems. High alkalinity associated with cement, can dramatically affect and contaminate both soil and ground water. The following measures must be adhered to: •Fresh concrete and cement mortar must not be mixed near the freshwater ecosystems. Mixing of cement may be done within the construction camp, however, may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be given to the use of ready mix concrete; • No mixed concrete may be deposited directly onto the ground within the freshwater ecosystems (outside of the designated area) or associated riparian habitat. A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing; •A washout area must be designated outside of the freshwater ecosystems, and wash water must be treated on-site or discharged to a suitable sanitation system; •Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream; and •Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided. **With regards to backfilling of excavated areas:** •Stockpiled material must be used as backfill material; •All excavated areas must be backfilled to the natural ground level with excavated material; and •Soil must be suitably compacted, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process.
	Construction of Turbine and Hardstand 5 within the delineated wetland boundary .	•Earthworks associated with the turbine foundation and laying of sub-surface concrete would result in disturbances to sub-surface movement of water within the wetland; •Earthworks could result in sedimentation of the downstream wetland, which may smother wetland vegetation; • Altered water quality (if surface water is present) as a result of spills associated with vehicles or other construction activities, especially concrete mixing; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	

Phase	Activity	Impact	Mitigation measures
	Potential upgrading of existing access roads within freshwater ecosystems: •Excavation within freshwater ecosystems for the removal of existing infrastructure and casting of a base (where applicable); •Placement of culvert structures atop concrete base;	•Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetland areas and may smother wetland vegetation; • Potential spillage of pollutants such as oil and or liquified cement which could damage wetland habitat and biota; •Movement of heavy machinery within the wetland adjacent to the crossing structure which would damage wetland soils and vegetation; •Proliferation of alien and/or invasive vegetation as a result of disturbances.	•The design of upgraded crossing structures must improve ecological and hydrological connectivity through the increased number of culverts; •The construction footprint must be limited to a construction 10m wide construction Right of Way; •Upgrading of (informal) roads and tracks must take cognisance of the delineated extent of the freshwater ecosystem traversed by the existing informal access road and that located within close proximity to the road; •Material to be used (gravel – if applicable) as part of the upgrading of the existing roads / development of new crossings must be stockpiled outside the delineated extent of the freshwater ecosystems and outside the freshwater ecosystem non development buffer to prevent sedimentation thereof and to avoid any other vegetation being impacted by the construction activities. These stockpiles may not exceed a height of 2 m and must be protected from wind using tarpaulins; •The disturbed area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring; •An alien vegetation management plan must be implemented concurrently with the commencement of construction; and •All existing alien and invasive vegetation must be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site. •Silt controls must be implemented downstream / downgradient of the works area; •Should flows be encountered in wetlands during construction periods the construction methodology must account for this with the use of coffer dams, etc. where needed; •All mobile machinery that could leak oil must operate on a drip tray; •Vehicles involved in construction must be regularly checked for leaks and removed if found to be non-compliant and the leak immediately repaired; •See above regarding excavation and trenching; •See above for control measures specific to concrete works

Phase	Activity	Impact	Mitigation measures
	Development of new road crossings of wetlands, involving: •Site preparation prior to construction activities including movement of construction equipment / vehicles within the freshwater ecosystems and removal of vegetation; •Ground-breaking and excavations and trenching within/adjacent to the freshwater ecosystems; •Construction of coffer dams for instream work, if required; and •Placement of culvert	•Destruction of a certain area of wetland habitat in the footprint of the crossing structure; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetlands and may smother wetland vegetation; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; •Loss of ecological connectivity; •Potential hydrological impacts associated with crossing structures, including increased saturation and ponding upstream of the crossing structure, as well as deprivation of downstream reaches of water and sediment, which may lead to erosion in the long term; and •Proliferation of alien and/or invasive vegetation as a result of disturbances.	•It is imperative that all construction works within the freshwater ecosystems be undertaken during dry periods when there is no flow within the freshwater ecosystems, and thus no diversion of flow would be necessary. It is also recommended that existing crossings through freshwater ecosystems be prioritised for upgrading rather than development of new crossings, where possible; •The throughflow structures must be designed to ensure that the structures are geotechnically sound and that they are hydraulically stable, even if a 1:100 year flood event was to occur. The designs must include box culverts installed intermittently to ensure a free draining landscape at various flood levels. It is recommended that a suitably qualified hydrologist be consulted to provide guidance on the relevant sizes and width requirements to ensure that the hydraulic functioning of the system is maintained and the design should be signed off by a suitably qualified freshwater ecologist; •In addition, the crossings must be designed such that they remain stable in the event of over-topping during high-flow events and do not lead to excessive downstream erosion and incision. It must be ensured that the final design accounts for appropriate wetting frequencies and patterns are maintained in the pre-development condition (with input from the freshwater ecologist, where necessary). •The reaches of the freshwater ecosystems where no activities are planned to occur must be considered no-go area; •A 10m construction Right of Way (RoW) is proposed at road crossings that would allow for construction personnel, and equipment or vehicles (if applicable) to enter the freshwater ecosystem; •Should saturated soils be encountered within the footprint of the works area a form of running track to prevent heavy vehicles from damaging wetland substrate may need to be laid down where vehicles need to access wetland areas; •The clearing of vegetation within the footprint area must be kept to a minimum to avoid unnecessary disturbance within the active channel; •The removed vegetation must be stockpiled outside of the delineated boundary of the freshwater ecosystem. The footprint areas of these stockpiles must be kept to a minimum, and may not exceed a height of 2 m. Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site; With regards to excavation, trenching and soil compaction activities within the freshwater ecosystems, the following are applicable with regards to excavation works and any concrete related activities: •During the excavation activities, any soil/sediment or silt removed from the freshwater ecosystem may be temporarily stockpiled in the construction RoW but outside the delineated extent of the freshwater ecosystem. These stockpiles may not exceed 2 m in height, and their footprint must be kept to a minimum. Stockpiling of removed

Phase	Activity	Impact	Mitigation measures
	structures atop concrete base.		materials may only be temporary (may only be stockpiled during the period of construction at a particular site) and must be disposed of at a registered waste disposal facility; •During trenching activities, seepage water may be present within the trench - invariably this will be filled with silt and be muddy. Therefore, any seepage must not be discharged straight into the river channel but through a silt trapping area first before entering the downstream reach; •Excavated materials must not be contaminated, and it must be ensured that the minimum surface area is taken up. Mixture of the lower and upper layers of the excavated soil must be kept to a minimum, for later usage as backfill material or as part of rehabilitation activities; •Excavated topsoil must be stored separately and may not be contaminated. Furthermore, the soil layers must be placed in the same order and the topsoil returned last; •Care must be taken to ensure that no scouring or erosion occurs as a result of the proposed road crossings. Installation of riprap or gabion mattresses and/or concrete aprons associated with any culverts must be included in design; •All construction material (with specific mention of prefabricated culvert structures) must be stockpiled in the laydown area and must only be imported to the construction site when required; •Construction equipment/vehicles used to install culvert structures must be parked on the existing road surface and may not enter the freshwater ecosystems; and •Reno-mattresses or riprap must be installed at the outlet side of the culvert/bridge structures to ensure energy dissipation and prevent concentrated runoff into the downstream freshwater feature. The reno mattress/riprap must be installed flush with the culvert outlet. • See above for control measures specific to concrete works.
Operational phase	Operation of surface infrastructure associated with the proposed development located outside of delineated freshwater ecosystems,.	•Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and •Altered water quality (if surface water is present) as a result of increased availability of pollutants.	•No indiscriminate movement of maintenance equipment or vehicles through the freshwater ecosystems may be permitted during standard operational activities or maintenance activities. Use must be made of the existing road crossings only; •Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided; •Vehicles used in the development site must be regularly washed (on a non-permeable surface or off-site) to avoid the dispersal of seeds on any alien or invasive species into the freshwater ecosystems; •Should erosion be noted at the base of the hardstands that may potentially impact on a freshwater ecosystem, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation; •The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas form erosion gullies leading to erosion and sedimentation of the receiving freshwater ecosystems. Should these impacts be noted, these gullies/preferential flow paths must be infilled with in situ material and appropriately stabilised and/or revegetated; and

Phase	Activity	Impact	Mitigation measures
			•Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the hardstands. Should alien and invasive plant species be identified, they must be removed and disposed of as per an alien and invasive species control plan and the area must be revegetated with suitable indigenous vegetation. •Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings/instream infrastructure. Such maintenance activities must specifically be undertaken after high rainfall events; •Stormwater runoff from the road crossings must be monitored, to ensure it does not result in erosion of the freshwater ecosystems. Stormwater must be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the freshwater feature (through vegetation and rocky areas); •Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the freshwater ecosystems may be permitted.
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater ecosystems (where applicable).	•Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the freshwater ecosystems (increase in the sediment load) and turbulent flows when surface water is present; •Higher flood peaks into the freshwater ecosystems due to reduced surface roughness in the freshwater ecosystems.	•No indiscriminate movement of maintenance equipment or vehicles through the freshwater ecosystems must be permitted during standard operational activities or maintenance activities. Use must be made of the existing road crossings only; •Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided; •Vehicles used in the development site must be regularly washed (on a non-permeable surface or off-site) to avoid the dispersal of seeds on any alien or invasive species into the freshwater ecosystems; •Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor any build-up of debris that will impact on structure integrity or lead to erosion and sedimentation. Furthermore, monitoring to determine the establishment of indigenous vegetation and the presence of any alien or invasive plant species; •Hot spots for the accumulation of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure; •Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings/instream infrastructure. Such maintenance activities must specifically be undertaken after high rainfall events; •Stormwater runoff from the road crossings must be monitored, to ensure it does not result in erosion of the freshwater ecosystems. Stormwater must be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the freshwater feature (through vegetation and rocky areas); •During periodic maintenance activities of the roads, monitoring for erosion must be undertaken; and •Should erosion be observed, caused by the road crossings/instream infrastructure, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks collected from the surrounding area to infill any area prone to erosion (however, these must be sustainably sourced not taken from the surrounding freshwater ecosystems including rivers in the local area).

Phase	Activity	Impact	Mitigation measures
DECOMMISSIONING	Removal of all surface infrastructure from the project area.	•Disturbance of soil and vegetation that established within the decommissioning area.	•No indiscriminate movement of construction equipment in the freshwater ecosystems may be permitted. Use must be made of the existing roads during the decommissioning phase; •If applicable, for infrastructure within the non-perennial drainage line that is to be decommissioned, all materials must be removed from the freshwater ecosystems and may be stored/ stockpiled temporarily outside of the delineated extent of the freshwater ecosystems and their associated 32m buffer, whereafter it must be removed from site and disposed of at a registered disposal facility; •High flood peaks from the decommissioning footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure area and subsequent cleared area enters the freshwater ecosystems. The velocity of surface water flow from these areas must be reduced by the strategic placement of silt traps of hay bales as a means to obstruct flow but still allow flow to percolate at a reduced velocity and encourages a diffuse flow pattern. In this regard it is recommended at an alien and invasive plant species management plan be implemented during the decommissioning phase to specifically prevent the spread of any such species into the sensitive ecological areas; •Areas where surface infrastructure have been decommissioned and removed must be suitably compacted/ripped and revegetated to ensure that no erosion occurs which may contribute to the sediment load of the freshwater ecosystems; •Should erosion gullies be noted, these areas must be rehabilitated by infilling them with suitable soil and ensuring the area is vegetated. The increased surface roughness will discourage concentrated flow paths to develop and ensure diffuse flow patterns; •Should road crossings be decommissioned, road footprint areas within a freshwater feature must be levelled to the same level and shape as that of the upstream and downstream reaches. This will ensure a continuous bed level and prevent any concentration of surface flow from occurring; •Channel banks associated with the freshwater ecosystems must be suitably rehabilitated (shaped end revegetated) to prevent any erosion from occurring; •Follow up revegetation must take place where initial revegetation is not successful; and •Post-closure monitoring of the freshwater ecosystems (for a period of 3 years), with specific mention of the invasion of alien vegetation species) is recommended to be undertaken.

All activities associated with the construction of proposed infrastructure that are located within / or would directly affect wetlands and where no existing infrastructure is present would pose a “Medium” risk significance to the freshwater ecosystems within the study and investigation areas. All other activities would be associated with a “Low” risk significance. Activities associated with a medium risk relate to the single turbine and hardstand located within a wetland (Turbine WTG 5), as well as Turbine WTG 42 which is located immediately adjacent to a wetland and which needs to be relocated to the north to lie outside of the wetland’s 15m non-development buffer as a minimum, as well as number of internal road crossings. The potential re-alignment / relocation of certain infrastructure is highly important in the context of mitigating such impacts and reducing their spatial footprint. It has been strongly recommended that Turbine WTG 42 be slightly relocated to the north or east to be located outside of the delineated extent of and associated 15 m non-development buffer of the seep wetland in which it has been located and that Turbine WTG 5 be relocated outside of the seep wetland in which it has been located. Furthermore, it is recommended that Road 60 be re-aligned to run outside of the seep wetland located to the east of WTG 51 so as to avoid the direct impact on the wetland. All other new road crossings of wetlands cross the wetland unit perpendicularly and provided the suitable design measures in the crossing structures are implemented, these crossings are considered acceptable and would be unlikely to significantly adversely affect the wetland unit.

These refinements to the road’s layout must be made prior to development to ensure that the project exerts the least possible level of impact on the freshwater environment.

As certain project components such as cabling, BESS and laydown areas do not form part of the latest iteration of the layout, a further assessment of these components of the project will need to be undertaken by a freshwater specialist. This will need to form part of a walkdown of all final pre-construction components as undertaken by a freshwater specialist to sign off on roads and final turbine locations.

In addition, all mitigation measures as stipulated in the above table, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

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

8 IMPACT ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the freshwater ecosystems. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed activities and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

8.1 Impact assessment analysis

Following the assessment of the freshwater ecosystems associated with the proposed WEF facility, the Impact Assessment Matrix as provided by the EAP was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the receiving freshwater environment (**Appendix F**).

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

- Loss of wetland 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, some impacts can be avoided or adequately minimised where avoidance is not feasible. 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 Impact Assessment Matrix applied to the proposed development activities, both pre- and post-mitigation is provided in the tables below.

Table 16:Significance of Potential Impacts before application of mitigation associated with the Phefumula-Emoyeni WEF as based on the impact assessment) methodology.

Project Phase	Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Impact Significance
Construction	Indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater due to clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to infrastructure including new access roads outside of the delineated wetland boundary.	4	2	3	5	3	Moderate (42)
	Direct impacts in terms of destruction of a certain area of wetland habitat, sedimentation and water quality impacts related to clearing of Vegetation and Terrain Levelling (Bulk Earthworks) within a delineated wetland boundary.	4	2	3	5	5	High (70)
	Indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater due to construction of surface infrastructure outside of 100m buffer of wetland boundaries .	2	2	3	2	2	Low (18)
	Indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater due to construction outside of the delineated wetland boundary	3	2	3	2	3	Low (30)
	Potential pollution (water quality impacts), impacts on wetland soils, hydrology and vegetation due to construction of Turbines and Hardstands 5 and 24 within, or immediately adjacent to the delineated wetland boundary .	3	2	3	2	5	Moderate (50)
	Water Quality impacts and damage to wetland soils and vegetation due to potential upgrading of existing access roads within freshwater ecosystems:	2	2	3	2	3	Low (27)
	Permanent loss of a certain area of wetland habitat, Water Quality impacts and damage to wetland soils and vegetation due to development of new road crossings of wetlands	4	2	3	4	5	High (65)
Operation	Indirect impacts, including hydrological alteration due to stormwater discharges related to operation and maintenance of the surface infrastructure located outside the delineated freshwater ecosystems.	2	2	3	4	4	Moderate (44)
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater ecosystems (where applicable), as well as Turbine 42	3	2	3	4	3	Moderate (36)
Decommissioning	Potential Direct and Indirect impacts related to removal of all surface infrastructure from the project area.	2	2	3	2	3	Low (27)

Table 17: Significance of Potential Impacts after application of mitigation associated with the Phefumula-Emoyeni WEF as based on the impact assessment) methodology.

Project Phase	Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Impact Significance
Construction	Indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater due to clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to infrastructure including new access roads outside of the delineated wetland boundary.	3	2	3	5	2	Low (26)
	Direct impacts in terms of destruction of a certain area of wetland habitat, sedimentation and water quality impacts related to clearing of Vegetation and Terrain Levelling (Bulk Earthworks) within a delineated wetland boundary.	4	2	3	5	5	High (70)
	Indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater due to construction of surface infrastructure outside of 100m buffer of wetland boundaries .	1	2	3	2	1	Very Low (8)
	Indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater due to construction outside of the delineated wetland boundary	2	2	3	2	2	Low (18)
	Potential pollution (water quality impacts), impacts on wetland soils, hydrology and vegetation due to construction of Turbines and Hardstands 5 and 42 within, or immediately adjacent to the delineated wetland boundary .	3	2	3	2	5	Moderate (50)
	Water Quality impacts and damage to wetland soils and vegetation due to potential upgrading of existing access roads within freshwater ecosystems:	2	2	3	2	2	Low (18)
	Permanent loss of a certain area of wetland habitat, Water Quality impacts and damage to wetland soils and vegetation due to development of new road crossings of wetlands	4	2	3	4	5	High (65)
Operation	Indirect impacts, including hydrological alteration due to stormwater discharges related to operation and maintenance of the surface infrastructure located outside the delineated freshwater ecosystems.	2	2	3	4	2	Low (22)
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater ecosystems (where applicable), as well as Turbine 42	3	2	3	4	2	Low (24)
Decommissioning	Potential Direct and Indirect impacts related to removal of all surface infrastructure from the project area.	2	2	3	2	2	Low (18)

8.2 Cumulative Impacts

Freshwater ecosystems within the wider area of the eastern Mpumalanga Highveld are under continued threat due a variety of factors primarily related to landuse which, in the long term, may prove to be unsustainable. The expansion of agricultural landuses, in particular cultivation and mining (especially coal mining), as well as urban expansion typically result in transformative impacts on freshwater ecosystems. Development of renewable energy infrastructure, including wind and solar energy facilities can also form part of the cumulative impact on freshwater ecosystems (Figure 36). Other factors such as existing linear infrastructure (roads and railways) as well as climate change also exert impacts on the freshwater ecosystems in the wider region.

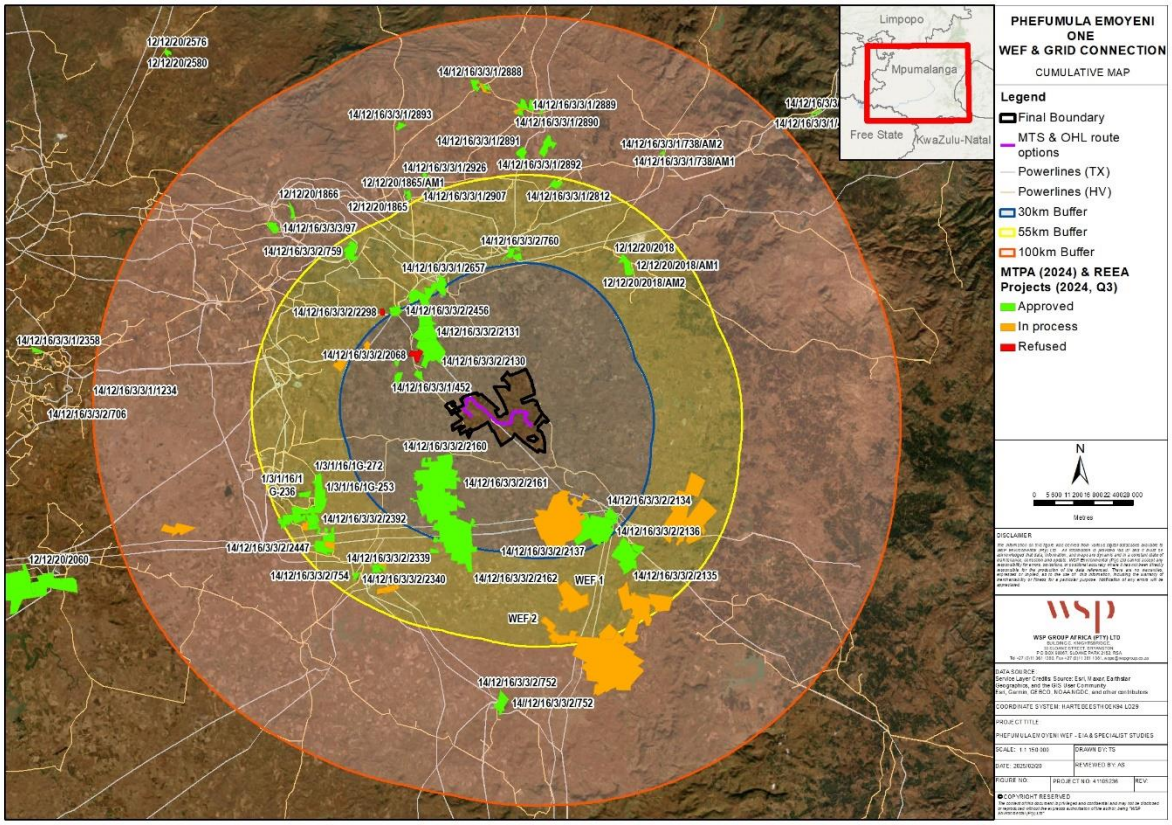


Figure 36: Map showing Renewable Energy Developments within 100km of the proposed project.

The development of the Phefumula Emoyeni One WEF will impact freshwater resources, primarily in terms of the creation of new crossings of certain wetlands in the study area. A number of mitigation measures have been stipulated to reduce the overall significance of the impact but transformation of a certain area of wetland habitat will occur. Such transformation will be highly localised at the scale of the individual crossing, but cumulatively this will represent a larger area of wetland habitat loss. If mitigation measures as stipulated in this

report are implemented, the impacting of upstream and downstream reaches of rivers crossed and of wetland reaches downgradient of turbine and other infrastructure locations will be greatly minimised or even avoided. In conclusion, the proposed development will result in impacts to a number of reaches, that together, and in combination with other impacts in the three respective quaternary catchments in which the study area is located will constitute a cumulative impact. However provided that the mitigation measures as recommended in this report are implemented, the degree of impact on the freshwater resources in the study area would be considered acceptable.

9 CONCLUSION

Scientific Aquatic Services (SAS) (Pty) Ltd was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment for the proposed Phefumula Emoyeni One WEF. The results of the field verification indicated that there is a high density of drainage (natural freshwater ecosystems) in the study area. The state of wetlands varies according to the impacts acting on the respective reach, but valley bottom wetlands were generally assessed to be in a largely natural state with a high EIS, while seep wetlands were generally assessed to be in a moderately modified condition and displaying a moderate EIS.

The proposed development in terms of the latest iteration of the proposed roads and turbine locations layout would directly impact certain freshwater features, especially in the context of various new internal roads that would need to cross freshwater ecosystems. The latest layout provided by the project proponent indicates that all turbines have been placed outside of the delineated freshwater ecosystem boundaries with the exception of one that has been placed within a seep wetland. A recommendation has been made to relocate this turbine to outside the wetland and the requisite 15m non development buffer. Similarly recommendations to realign a number of access roads to avoid the crossing of wetlands have been made.

9.1 Impact Statement

It is the reasoned opinion of the freshwater specialist that the proposed Phefumula Emoyeni One WEF development can be granted environmental authorisation. The freshwater related sensitivities of the study area as outlined in the scoping phase freshwater assessment have been adequately considered in the latest iteration of the development layout and all proposed turbine locations except one have avoided being placed within any freshwater ecosystem or associated 15m non-development buffer, except one. A recommendation has been made that this turbine be relocated outside of the wetland and associated buffer. In addition a number of road realignment recommendations have been made to avoid the unnecessary impacting of

wetlands. As the current layout does not indicate the position of proposed underground cabling, and other construction and operation infrastructure such as laydown areas, construction camps and BESS infrastructure, the finalised position of this infrastructure as well as of turbine locations and proposed roads must be assessed as part of a walkdown assessment of this infrastructure by a freshwater specialist. Should these recommendations be actioned and provided that all other mitigation measures as stipulated in this report are adhered to, the proposed development can be considered acceptable in a freshwater environment context.

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APPENDIX A – Terms of Use and Indemnity

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

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 (NEMA) (Act No. 107 of 1998)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
The National Water Act (NWA) (Act No. 36 of 1998)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
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).
Government Notice 598 Alien and Invasive Species Regulations (2014), including the Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates	NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. This act in terms of alien and invasive species aims to: ➢ Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur, ➢ Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and ➢ Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

to the National Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004)	Alien species are defined, in terms of the NEMBA as: (a) A species that is not an indigenous species; or (b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention. Categories according to NEMBA (Alien and Invasive Species Regulations, 2017): ➢ **Category 1a:** Invasive species that require compulsory control; ➢ **Category 1b:** Invasive species that require control by means of an invasive species management programme; ➢ **Category 2:** Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and ➢ **Category 3:** Ornamentally used plants that may no longer be planted.
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 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 GA. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
National Environmental Management: Waste Act, No 59 of 2008 (NEMWA)	NEMWA, which reforms the law regulating waste management in order to protect the health and the environment by providing reasonable measures for the prevention of pollution; provides for national norms and standards for regulating the management of waste by all spheres of government and provides for the licensing and control of waste management activities.

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 ecosystems present or in close proximity of the 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 study area.

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

The freshwater ecosystems encountered within the 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[6] (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.

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

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

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

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

Level 3: Landscape Setting

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

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

Level 4: Hydrogeomorphic Units

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

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

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

3. WET-Health

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

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

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

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

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

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

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

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

Impact category	Description	Impact score range	Present State category
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. Freshwater ecosystem 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".[7] The assessment of the ecosystem services supplied by the identified freshwater ecosystems was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

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

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

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

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

Table C5: Classes for determining the likely extent to which a benefit is being supplied.

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

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

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other freshwater ecosystem 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 C6) of the wetland system being assessed.

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

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

6. 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 ecosystem (sections above), with the objective of either maintaining, or improving the ecological integrity of the freshwater ecosystem in order to ensure continued ecological functionality.

Table C7: 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 ecosystem fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A freshwater ecosystem may receive the same class for the REC as the PES if the freshwater ecosystem 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 freshwater ecosystem.

Table C8: Description of Recommended Ecological Category (REC) classes.

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

7. 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 C8 below.

Table C9: 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

4. Index of 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 C10 below.

Table C10: 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

8. Freshwater ecosystem delineation

The freshwater ecosystem delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

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

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators and can accordingly be classified as both. If you are adjacent to a freshwater ecosystem, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

- topography associated with the freshwater ecosystem;
- vegetation; and
- alluvial soils and deposited material.

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

APPENDIX D – Risk Assessment Methodology

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[8]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[9].

[8] The definition has been aligned with that used in the ISO 14001 Standard.
[9] Some risks/impacts that have low significance will however still require mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (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 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table D8: Rating Classes

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

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

Table D9: Calculations

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

The following points were considered when undertaking the assessment:

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

Control Measure Development

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

- Mitigation and performance improvement measures and actions that address the risks and impacts[10] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and

[10] Mitigation measures should address both positive and negative impacts.

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

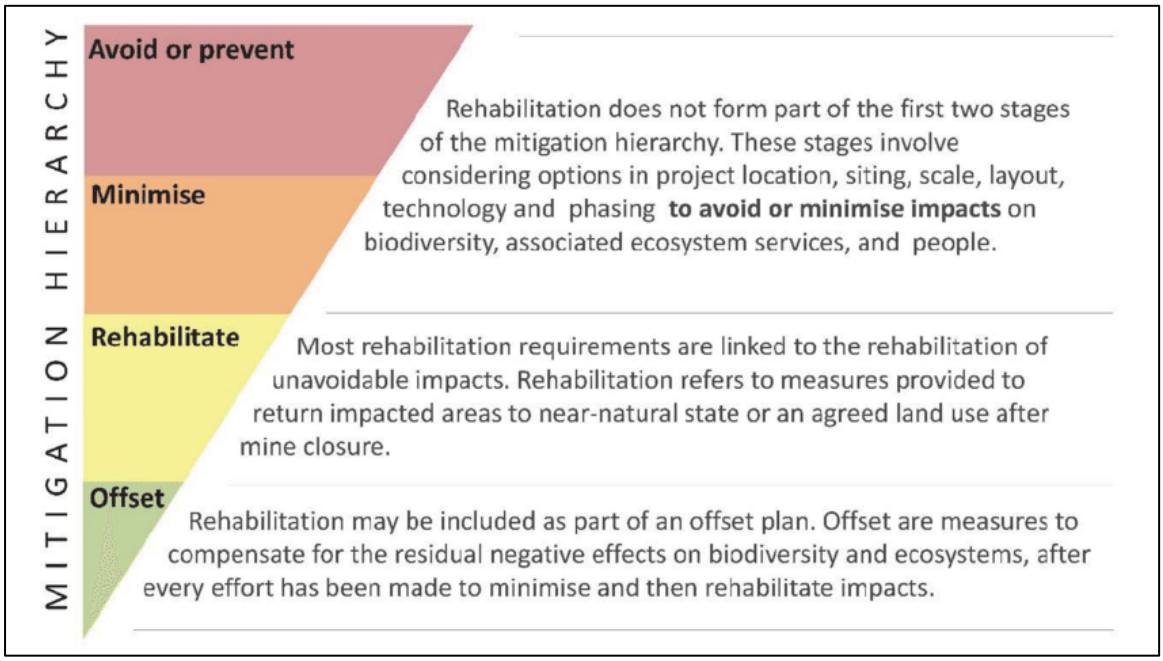


Figure D1: Impact Minimisation hierarchy as advocated by the DEA *et al.*, (2013)

Recommendations

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

Table D10: Reversibility of impacts on the freshwater ecosystems

Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent)
	Partially reversible (The impact is reversible to a degree e.g. acceptable revegetation measures can be implemented but the pre-impact species composition and/or diversity may never be attained. Impacts may be partially reversible within a short (during construction), medium (during operation) or long term (following decommissioning) timeframe
	Fully reversible (The impact is fully reversible, within a short, medium or long-term timeframe)

APPENDIX E – Results of DWS Risk Assessment

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
CONSTRUCTION	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of 100m radius of wetland boundaries . (All Turbines except for Turbines 5 and 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transportation of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater	B12A valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	2	**5**	**4**	**20**	20%	**4**	L	High
			B12A seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	2	**5**	**3**	**15**	20%	**3**	L	High
			B11A valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	2	**5**	**4**	**20**	20%	**4**	L	High
			B11A seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	2	**5**	**3**	**15**	20%	**3**	L	High
			C11F valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	2	**5**	**4**	**20**	20%	**4**	L	High
			C11F seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	2	**5**	**3**	**15**	20%	**3**	L	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
		contamination from oils and hydrocarbons originating from construction vehicles.																		
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines, hardstands and other infrastructure including new access roads outside of the delineated wetland boundary and within 100m radius of wetland boundaries . (Turbine 42)	•Transformation of freshwater vegetation, associated habitat and ecosystem services within downgradient freshwater ecosystems related to indirect impacts, including hydrological alteration due to stormwater discharges, increased erosion or development of new erosion, and deposition of increased sediment from dust or transported by stormwater; •Transportation of construction materials can result in disturbances to soils, increased risk of sedimentation/erosion and dust generation; and •Soil and stormwater contamination from	B12A valley bottom wetlands	B	High	1	1	1	1	1	**2**	2	2	**6**	**4**	**24**	40%	**9,6**	**L**	High
			B12A seep wetlands	C	Moderate	3	3	2	3	1	**6**	2	2	**10**	**3**	**30**	80%	**24**	**L**	High
			B11A valley bottom wetlands	B	High	1	1	1	1	1	**2**	2	2	**6**	**4**	**24**	40%	**9,6**	**L**	High
			B11A seep wetlands	C	Moderate	3	2	2	1	1	**6**	2	2	**10**	**3**	**30**	40%	**12**	**L**	High
			C11F valley bottom wetlands	B	High	3	3	2	2	1	**6**	2	2	**10**	**4**	**40**	40%	**16**	**L**	High
			C11F seep wetlands	C	Moderate	3	3	3	3	1	**6**	2	2	**10**	**3**	**30**	60%	**18**	**L**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
		oils and hydrocarbons originating from construction vehicles. Risk of AIP proliferation in disturbed areas that could colonise the adjacent wetland areas.																		
	Clearing of Vegetation and Terrain Levelling (Bulk Earthworks) related to Turbines and hardstands within a delineated wetland boundary (Turbine 5)	•Destruction of a certain area of wetland habitat in the footprint of the turbine and hardstand; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream freshwater ecosystem areas and may smother vegetation associated with the freshwater ecosystems; •Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; and •Proliferation of alien	C11A seep wetland	C	Moderate	4	4	3	4	3	**8**	2	2	**12**	**3**	**36**	100%	**36**	**M**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
		and/or invasive vegetation as a result of disturbances.																		
	Construction of surface infrastructure (all Turbines and Hardstands except for Turbine 5 and 42,) and including new access roads outside of 100m radius of wetland boundaries .	• Earthworks and exposure of soil could result in sedimentation of downgradient wetlands, which may be transported as runoff into the downgradient wetlands and may smother wetland vegetation; • Altered water quality in downgradient wetlands (if surface water is present) as a result of pollution as a result of oils (e.g. from spills) and concrete mixing; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	B12A valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	2	**5**	**4**	**20**	20%	**4**	L	High
			B12A seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	2	**5**	**3**	**15**	20%	**3**	L	High
			B11A valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	2	**5**	**4**	**20**	20%	**4**	L	High
			B11A seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	2	**5**	**3**	**15**	20%	**3**	L	High
			C11F valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	2	**5**	**4**	**20**	20%	**4**	L	High
			C11F seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	2	**5**	**3**	**15**	20%	**3**	L	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	Construction of surface infrastructure (Turbines and Hardstands 42) and new access roads) between the delineated wetland boundary and a 100m radius of wetland boundaries.	• Earthworks and exposure of soil could result in sedimentation of downgradient wetlands, which may be transported as runoff into the downgradient wetlands and may smother wetland vegetation; • Altered water quality in downgradient wetlands (if surface water is present) as a result of pollution as a result of oils (e.g. from spills) and concrete mixing; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	B12A valley bottom wetlands	B	High	1	1	1	1	1	**2**	2	2	**6**	**4**	**24**	20%	**4,8**	L	High
			B12A seep wetlands	C	Moderate	3	3	3	2	1	**6**	2	2	**10**	**3**	**30**	80%	**24**	L	High
			B11A valley bottom wetlands	B	High	1	1	1	1	1	**2**	2	2	**6**	**4**	**24**	40%	**9,6**	L	High
			B11A seep wetlands	C	Moderate	1	1	1	1	1	**2**	2	2	**6**	**3**	**18**	40%	**7,2**	L	High
			C11F valley bottom wetlands	B	High	2	3	2	2	1	**6**	2	2	**10**	**4**	**40**	40%	**16**	L	High
			C11F seep wetlands	C	Moderate	2	3	2	2	1	**6**	2	2	**10**	**3**	**30**	40%	**12**	L	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	Construction of Turbine and Hardstand 5 within the delineated wetland boundary .	•Earthworks associated with the turbine foundation and laying of sub-surface concrete would result in disturbances to sub-surface movement of water within the wetland; •Earthworks could result in sedimentation of the downstream wetland, which may smother wetland vegetation; • Altered water quality (if surface water is present) as a result of spills associated with vehicles or other construction activities, especially concrete mixing; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	C11F seep wetland	C	Moderate	4	3	3	3	2	**8**	2	2	**12**	**3**	**36**	100%	**36**	**M**	High
	Potential upgrading of existing access roads within	• • Earthworks and exposure of soil could result in sedimentation of the downstream wetland,	B12A valley bottom wetlands	B	High	2	2	2	2	1	**4**	2	2	**8**	**4**	**32**	80%	**25,6**	**L**	Medium

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	freshwater ecosystems: • Excavation within freshwater ecosystems for the removal of existing infrastructure and casting of a base (where applicable); • Placement of culvert structures atop concrete base;	which may be transported as runoff into the downstream wetland areas and may smother wetland vegetation; • Potential spillage of pollutants such as oil and or liquified cement which could damage wetland habitat and biota; •Movement of heavy machinery within the wetland adjacent to the crossing structure which would damage wetland soils and vegetation; • Proliferation of alien and/or invasive vegetation as a result of disturbances.	B12A seep wetlands	C	Moderate	2	2	2	2	1	**4**	2	2	**8**	**3**	**24**	80%	**19,2**	**L**	Medium
			B11A valley bottom wetlands	B	High	2	2	2	2	1	**4**	2	2	**8**	**4**	**32**	80%	**25,6**	**L**	Medium
			B11A seep wetlands	C	Moderate	2	2	2	2	1	**4**	2	2	**8**	**3**	**24**	80%	**19,2**	**L**	Medium
			C11F valley bottom wetlands	B	High	2	2	2	2	1	**4**	2	2	**8**	**4**	**32**	80%	**25,6**	**L**	Medium
			C11F seep wetlands	C	Moderate	2	2	2	2	1	**4**	2	2	**8**	**3**	**24**	80%	**19,2**	**L**	Medium

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	Development of new road crossings of wetlands, involving: • Site preparation prior to construction activities including movement of construction equipment / vehicles within the freshwater ecosystems and removal of vegetation; • Ground-breaking and excavations and trenching within/adjacent to the freshwater ecosystems; •Construction	•Destruction of a certain area of wetland habitat in the footprint of the crossing structure; •Earthworks and exposure of soil could result in sedimentation of the downstream wetland, which may be transported as runoff into the downstream wetlands and may smother wetland vegetation; • Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; •Loss of ecological connectivity; •Potential hydrological impacts associated with crossing structures, including increased saturation	B12A valley bottom wetlands (4 wetland crossings)	B	High	3	2	2	3	2	**6**	2	2	**10**	**4**	**40**	100%	**40**	**M**	High
			B12A seep wetlands (3 wetland crossings)	C	Moderate	3	2	3	3	1	**6**	2	2	**10**	**3**	**30**	100%	**30**	**M**	High
			B11A valley bottom wetlands (3 wetland crossings)	B	High	3	2	2	3	2	**6**	2	2	**10**	**4**	**40**	100%	**40**	**M**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	of coffer dams for instream work, if required; and • Placement of culvert structures atop concrete base.	and ponding upstream of the crossing structure, as well as deprivation of downstream reaches of water and sediment, which may lead to erosion in the long term; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	B11A seep wetlands (4 wetland crossings)	C	Moderate	3	2	3	3	2	**6**	2	2	**10**	**3**	**30**	100%	**30**	**M**	High
			C11F valley bottom wetlands (2 wetland crossings)	B	High	3	2	2	3	2	**6**	2	2	**10**	**4**	**40**	100%	**40**	**M**	High
			C11F seep wetlands	C	Moderate	1	1	1	1	1	**2**	2	2	**6**	**3**	**18**	40%	**7,2**	**L**	High
OPERATIONAL	Operation and maintenance of the surface infrastructure	Disturbance to soil and ongoing erosion as a result of periodic maintenance	B12A valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	4	**7**	**4**	**28**	20%	**5,6**	**L**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	associated with the proposed development located outside the delineated freshwater ecosystems and further than 100 m including turbines and associated foundations, and roads.	activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants	B12A seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	4	**7**	**3**	**21**	20%	**4,2**	L	High
			B11A valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	4	**7**	**4**	**28**	20%	**5,6**	L	High
			B11A seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	4	**7**	**3**	**21**	20%	**4,2**	L	High
			C11F valley bottom wetlands	B	High	1	1	1	1	1	**2**	1	4	**7**	**4**	**28**	20%	**5,6**	L	High
			C11F seep wetlands	C	Moderate	1	1	1	1	1	**2**	1	4	**7**	**3**	**21**	20%	**4,2**	L	High
	Operation of surface infrastructure associated with the proposed development located within 100 m of the delineated freshwater	• Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants.	B12A valley bottom wetlands	B	High	2	2	1	1	1	**4**	2	4	**10**	**4**	**40**	40%	**16**	L	High
			B12A seep wetlands	C	Moderate	2	2	1	1	1	**4**	2	4	**10**	**3**	**30**	40%	**12**	L	High
			B11A valley bottom wetlands	B	High	2	2	1	1	1	**4**	2	4	**10**	**4**	**40**	40%	**16**	L	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	ecosystems, including selected turbines and roads;		B11A seep wetlands	C	Moderate	2	2	1	1	1	**4**	2	4	**10**	**3**	**30**	40%	**12**	L	High
			C11F valley bottom wetlands	B	High	2	2	1	1	1	**4**	2	4	**10**	**4**	**40**	40%	**16**	L	High
			C11F seep wetlands	C	Moderate	2	2	1	1	1	**4**	2	4	**10**	**3**	**30**	40%	**12**	L	High
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater ecosystems (where applicable).	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the freshwater ecosystems (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the freshwater ecosystems due to reduced surface roughness in the	B12A valley bottom wetlands	B	High	2	2	2	2	2	**4**	2	4	**10**	**4**	**40**	60%	**24**	L	High
			B12A seep wetlands	C	Moderate	2	2	2	2	2	**4**	2	4	**10**	**3**	**30**	60%	**18**	L	High
			B11A valley bottom wetlands	B	High	2	2	2	2	2	**4**	2	4	**10**	**4**	**40**	60%	**24**	L	High
			B11A seep wetlands	C	Moderate	2	2	2	2	2	**4**	2	4	**10**	**3**	**30**	60%	**18**	L	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood	Significance	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
		freshwater ecosystems.	C11F valley bottom wetlands	B	High	2	2	2	2	2	**4**	2	4	**10**	**4**	**40**	60%	**24**	L	High
			C11F seep wetlands	C	Moderate	2	2	2	2	2	**4**	2	4	**10**	**3**	**30**	60%	**18**	L	High
DECOMMISIONING	Removal of all surface infrastructure from the project area.	•Disturbance of soil and vegetation that established within the decommissioning area and associated indirect impacts on downgradient freshwater ecosystems, including sediment ingress, increased stormwater flows and potential pollution from oils and other pollutants; •Potential proliferation of alien invasive vegetation.	B12A valley bottom wetlands	B	High	2	3	2	3	2	**6**	2	2	**10**	**4**	**40**	60%	**24**	L	Medium
			B12A seep wetlands	C	Moderate	2	3	2	3	2	**6**	2	2	**10**	**3**	**30**	60%	**18**	L	Medium
			B11A valley bottom wetlands	B	High	2	3	2	3	2	**6**	2	2	**10**	**4**	**40**	60%	**24**	L	Medium
			B11A seep wetlands	C	Moderate	2	3	2	3	2	**6**	2	2	**10**	**3**	**30**	60%	**18**	L	Medium
			C11F valley bottom wetlands	B	High	2	3	2	3	2	**6**	2	2	**10**	**4**	**40**	60%	**24**	L	Medium
			C11F seep wetlands	C	Moderate	2	3	2	3	2	**6**	2	2	**10**	**3**	**30**	60%	**18**	L	Medium

APPENDIX F – Impact Assessment Methodology

ASSESSMENT OF IMPACTS AND MITIGATION

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct, indirect, secondary as well as cumulative impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria presented in Table F1.

Table F1 - Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore

the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

he mitigation sequence/hierarchy is shown in Figure F1 below.

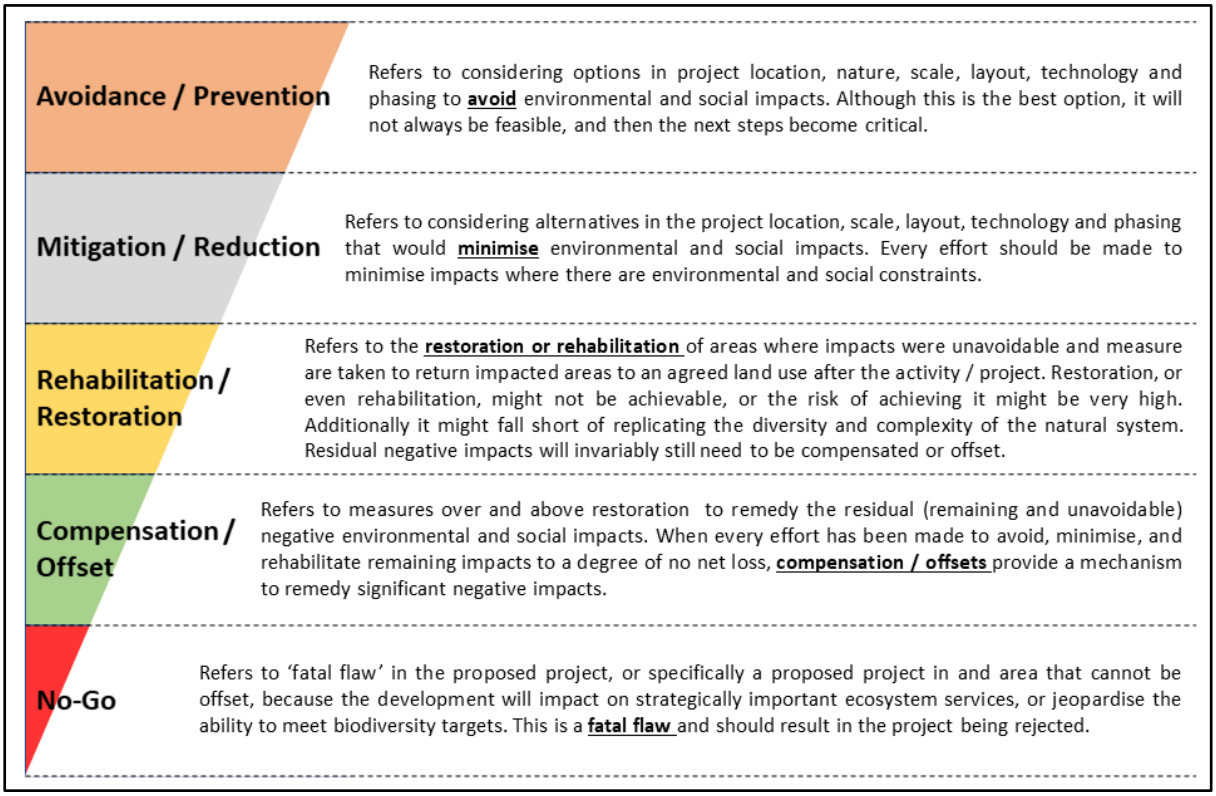


Figure F1 – The mitigation hierarchy.

APPENDIX G –Results of Freshwater Field Verified Assessment

PRESENT ECOLOGICAL STATE (PES), ECOSERVICE PROVISION AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table G1: Presentation of the results of the PES assessments applied to the valley bottom wetlands in the B12A quaternary catchment.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1.0	0	1.0	0	2.7	0
1.0	0.0	1.0	0.0	2.7	0.0
B	→	A	→	C	→
Overall PES Score		1.49			

Table G2: Presentation of the results of the PES assessments applied to seep wetlands in the B12A quaternary catchment.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1.0	0	1.0	0	2.7	0
1.0	0.0	1.0	0.0	2.7	0.0
5.0	0.0	2.3	↓	3.8	→
Overall PES Score		3.877			

Table G3: Presentation of the results of the PES assessments applied to the valley bottom wetlands in the B11A quaternary catchment.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1.0	0	1.0	0	2.7	0
1.0	0.0	1.6	0.0	3.7	0.0
B	→	B	→	C	→
Overall PES Score		1.928			

Table G4: Presentation of the results of the PES assessments applied to seep wetlands in the B11A quaternary catchment.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1.0	0	1.0	0	2.7	0
3.5	0.0	2.3	-1.0	4.6	0.0
C	→	C	↓	D	→
Overall PES Score		3.46			

Table G5: Presentation of the results of the PES assessments applied to the valley bottom wetlands in the C11F quaternary catchment.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1.0	0	1.0	0	2.7	0
1.0	0.0	1.2	0.0	3.2	0.0
B	→	B	→	C	→
Overall PES Score		1.66			

Table G6: Presentation of the results of the PES assessments applied to seep wetlands in the C11F quaternary catchment.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1.0	0	1.0	0	2.7	0
3.5	0.0	1.6	0.0	3.6	0.0
C	→	B	→	C	→
Overall PES Score		2.98			

Table G7: Presentation of the results of the Ecoservices assessment applied to valley bottom wetlands in quaternary catchment B12A.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.9	0.2	0.4	Very Low
	Stream flow regulation	2.0	2.0	1.5	Moderately Low
	Sediment trapping	3.0	1.0	2.0	Moderate
	Erosion control	1.5	1.9	1.0	Low
	Phosphate assimilation	2.9	1.0	1.9	Moderate
	Nitrate assimilation	2.7	1.0	1.7	Moderately Low
	Toxicant assimilation	2.7	0.3	1.3	Low
	Carbon storage	1.1	2.7	0.9	Low
	Biodiversity maintenance	4.0	2.5	3.7	Very High
PROVISIONING SERVICES	Water for human use	4.0	0.0	2.5	Moderately High
	Harvestable resources	1.5	0.0	0.0	Very Low
	Food for livestock	4.0	2.0	3.5	Very High
	Cultivated foods	2.8	0.0	1.3	Low
CULTURAL SERVICES	Tourism and Recreation	2.2	0.0	0.7	Very Low
	Education and Research	1.3	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

Table G8: Presentation of the results of the Ecoservices assessment applied to seep wetlands in quaternary catchment B12A.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.4	0.1	0.0	Very Low
	Stream flow regulation	2.3	2.0	1.8	Moderate
	Sediment trapping	1.5	1.3	0.6	Very Low
	Erosion control	0.6	1.4	0.0	Very Low
	Phosphate assimilation	1.5	1.3	0.6	Very Low
	Nitrate assimilation	1.4	1.3	0.6	Very Low
	Toxicant assimilation	1.5	0.3	0.1	Very Low
	Carbon storage	1.2	2.7	1.1	Low
	Biodiversity maintenance	2.3	3.0	2.3	Moderately High
PROVISIONING SERVICES	Water for human use	4.0	0.7	2.8	High
	Harvestable resources	1.0	0.0	0.0	Very Low
	Food for livestock	3.0	2.0	2.5	Moderately High
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	1.4	0.0	0.0	Very Low
	Education and Research	0.6	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

Table G9: Presentation of the results of the Ecoservices assessment applied to valley bottom wetlands in quaternary catchment B11A.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.9	0.2	0.4	Very Low
	Stream flow regulation	2.0	2.0	1.5	Moderately Low
	Sediment trapping	2.8	1.3	1.9	Moderate
	Erosion control	1.4	2.4	1.1	Low
	Phosphate assimilation	2.6	1.5	1.9	Moderate
	Nitrate assimilation	2.4	1.5	1.7	Moderately Low
	Toxicant assimilation	2.4	0.3	1.0	Low
	Carbon storage	1.1	2.7	0.9	Low
	Biodiversity maintenance	3.9	3.0	3.9	Very High
PROVISIONING SERVICES	Water for human use	4.0	3.8	4.0	Very High
	Harvestable resources	1.5	0.0	0.0	Very Low
	Food for livestock	4.0	3.0	4.0	Very High
	Cultivated foods	2.8	0.0	1.3	Low
CULTURAL SERVICES	Tourism and Recreation	2.2	0.0	0.7	Very Low
	Education and Research	1.3	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

Table G10: Presentation of the results of the Ecoservices assessment applied to seep wetlands in quaternary catchment B11A.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.4	0.2	0.0	Very Low
	Stream flow regulation	2.3	2.0	1.8	Moderate
	Sediment trapping	1.5	1.5	0.8	Very Low
	Erosion control	0.7	2.3	0.3	Very Low
	Phosphate assimilation	1.5	1.5	0.8	Very Low
	Nitrate assimilation	1.4	1.5	0.7	Very Low
	Toxicant assimilation	1.5	0.8	0.4	Very Low
	Carbon storage	1.2	2.7	1.1	Low
	Biodiversity maintenance	2.2	3.0	2.2	Moderate
PROVISIONING SERVICES	Water for human use	4.0	0.7	2.8	High
	Harvestable resources	1.0	0.0	0.0	Very Low
	Food for livestock	3.0	3.0	3.0	High
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	1.4	0.0	0.0	Very Low
	Education and Research	0.6	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

Table G11: Presentation of the results of the Ecoservices assessment applied to valley bottom wetlands in quaternary catchment C11F.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.9	0.3	0.5	Very Low
	Stream flow regulation	2.0	2.0	1.5	Moderately Low
	Sediment trapping	3.3	1.9	2.7	Moderately High
	Erosion control	1.8	1.6	1.1	Low
	Phosphate assimilation	3.2	2.3	2.8	High
	Nitrate assimilation	2.8	2.3	2.4	Moderately High
	Toxicant assimilation	3.0	0.4	1.6	Moderately Low
	Carbon storage	1.6	2.7	1.5	Moderately Low
	Biodiversity maintenance	3.0	3.5	3.3	Very High
PROVISIONING SERVICES	Water for human use	4.0	3.2	4.0	Very High
	Harvestable resources	1.5	0.0	0.0	Very Low
	Food for livestock	4.0	3.0	4.0	Very High
	Cultivated foods	2.8	0.0	1.3	Low
CULTURAL SERVICES	Tourism and Recreation	1.1	0.0	0.0	Very Low
	Education and Research	0.8	0.0	0.0	Very Low
	Cultural and Spiritual	1.5	0.0	0.0	Very Low

Table G12: Presentation of the results of the Ecoservices assessment applied to seep wetlands in quaternary catchment C11F.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.4	0.2	0.0	Very Low
	Stream flow regulation	1.5	1.3	0.7	Very Low
	Sediment trapping	1.6	1.5	0.8	Low
	Erosion control	0.9	2.3	0.5	Very Low
	Phosphate assimilation	1.6	1.5	0.9	Low
	Nitrate assimilation	1.5	1.5	0.8	Very Low
	Toxicant assimilation	1.6	0.5	0.3	Very Low
	Carbon storage	1.3	2.7	1.1	Low
	Biodiversity maintenance	2.2	3.0	2.2	Moderate
PROVISIONING SERVICES	Water for human use	3.2	1.0	2.2	Moderate
	Harvestable resources	1.0	0.0	0.0	Very Low
	Food for livestock	3.0	3.0	3.0	High
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	1.4	0.0	0.0	Very Low
	Education and Research	0.6	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

Table G13: Presentation of the results of the EIS for wetlands across different quaternary catchments in the study area.

Ecological Importance and Sensitivity			VB Wetlands – B12A	Seep Wetlands – B12A	VB Wetlands – B11A	Seep Wetlands – B11A	VB Wetlands – C11F	Seep Wetlands – C11F
			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Biodiversity support			A (average)	A (average)	A (average)	A (average)	A (average)	A (average)
			3.l7	2.33	3.l7	2.33	3.l7	2.33
Presence of Red Data species			4	3.5	4	3.5	4	3.5
Populations of unique species			2.5	1.5	2.5	1.5	2.5	1.5
Migration/breeding/feeding sites			3	2	3	2	3	2
Landscape scale			B (average)	B (average)	B (average)	B (average)	B (average)	B (average)
			3	2.4	3	2.4	3	2.4
Protection status of the wetland			3	3	3	3	3	3
Protection status of the vegetation type			4	4	4	4	4	4
Regional context of the ecological integrity			3.5	2	3.5	2	3.5	2
Size and rarity of the wetland type/s present			2.5	1.5	2.5	1.5	2.5	1.5
Diversity of habitat types			2	1.5	2	1.5	2	1.5
Sensitivity of the wetland			C (average)	C (average)	C (average)	C (average)	C (average)	C (average)
			2.5	1.67	2.5	1.67	2.5	1.67
Sensitivity to changes in floods			2.5	1,5	2.5	1,5	2.5	1,5
Sensitivity to changes in low flows/dry season			3	1.5	3	1.5	3	1.5
Sensitivity to changes in water quality			2	2	2	2	2	2
Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Regulating & supporting benefits	**Flood attenuation**		2.5	1.5	3	1.5	3	1.5
	Streamflow regulation		2.5	3	2	3	1.5	3
	Water Quality Enhancement	2.5	3	2	2	2	3	2
		0.5	2.5	1.5	2.5	2	2.5	2
		0.5	2.5	1.5	2.5	2	2.5	2
		0	1	1	1	1	1	1
		3	3	1.5	2	1.5	2.5	1.5
	Carbon storage		1.5	1	1.5	1	1.5	1
Direct Human Benefits			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Subsistence	***Water for human use***		2	2	3	2	3	2
	Harvestable resources		2	2	2	2	2	2
	Cultivated foods		0	0	0	0	0	0
Cultural benefits	***Cultural heritage***		0	0	0	0	0	0
	Tourism and recreation		0	0	0	0	0	0
	Education and research		0	0	0	0	0	0

APPENDIX H – General "Good Housekeeping" Mitigation Measures

General construction management and good housekeeping practices

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

Development footprint

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

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practised 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.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. Whilst not considered severe at this time, the vegetation component within the freshwater ecosystem environment is already transformed. However, alien invasive species are opportunistic, and where disturbances do occur, they will promulgate; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered within the freshwater ecosystem must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998); and
- Species-specific and area-specific eradication recommendations:
    - Footprint areas should be kept as small as possible when removing alien plant species; and
    - No vehicles should be allowed to drive through designated sensitive freshwater ecosystems areas during the eradication of alien and weed species.

Soils

- Sheet runoff from compacted areas should be slowed down by the strategic placement of berms;
- It is considered ideal that activities occur within the current season (low rainfall) to minimise impacts of sedimentation;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils;
- Temporary stockpiling of excavated material from trenches can be retained alongside trenches, as required for backfilling. Any soil to be stockpiled for longer than a month should be moved to a designated stockpile area, as approved by the Environmental Control Officer (ECO);
- All soils compacted during the repair and maintenance phase should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area, as well as the immediate vicinity of the proposed work area, should be removed.

APPENDIX I – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Stephen van Staden: MSc (Environmental Management) (University of Johannesburg)
Paul da Cruz BA (Hons) (Geography and Environmental Studies) (University of the Witwatersrand)
Kristen Coertze MSc (Botany) (University of the Free State)

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

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc Environmental Management (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional 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)		

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 (reviewer)** 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, Paul da Cruz, declare that -

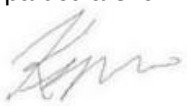
- I act as the **independent specialist** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity 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, Kristen Coertze, 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 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

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
International – United Kingdom (England and Scotland); USA

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 KRISTEN COERTZE

PERSONAL DETAILS

Position in Company	Freshwater Ecologist
Joined SAS Environmental Group of Companies	2021

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional Scientist at South African Council for Natural Scientific Professions (Pri.Sci.Nat #146386)
Member of the Gauteng Wetland Forum
Member of the Grassland Society of Southern Africa
Member of the South African Wetland Society
Golden Key Honorary Society

EDUCATION

Qualifications

MSc Botany (University of the Free State)	2023
BSc (Hons) Environmental Science (University of the Free State)	2019
BSc Geography and Environmental Science (University of the Free State)	2018

AREAS OF WORK EXPERIENCE

South Africa – Free State, Western Cape, Northern Cape, North West, Gauteng, Mpumalanga, Limpopo Provinces.
Central Africa – Democratic Republic of Congo (DRC)

DEVELOPMENT SECTORS OF EXPERIENCE

1. Linear developments (energy transmission, telecommunication, pipelines, roads)
2. Renewable energy (wind and solar)
3. Commercial development
4. Residential development
5. Industrial/chemical
6. Mining: Cole, chrome Platinum Group Metals (PGMs)
7. Agriculture

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Freshwater Offset Plan
- Maintenance and Management Plans
- Plant Species and Landscape Plans

Legislative Requirements, Processes and Assessments

Water Use Applications (Water Use License Applications / General Authorisations)