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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE WATER USE AUTHORISATION PROCESS FOR THE PROPOSED 99 MW OYA WIND ENERGY FACILITY (WEF) AND THE 239 MW KUDUSBERG WEF AND ASSOCIATED INFRASTRUCTURE BETWEEN SUTHERLAND AND MATJIESFONTEIN IN THE WESTERN AND NORTHERN CAPE PROVINCES

Prepared for

G7 Renewable Energies (Pty) Ltd

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EXECUTIVE SUMMARY

FEN Consulting was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Oya Wind Energy Facility (WEF) and Kudusberg WEF. These WEF development includes the construction of various turbines linked via underground cabling, wherever technically feasible, to an onsite 33/132 kV substation (referred to as the Kudusberg substation). A construction camp will be developed for each WEF development that hosts the on-site batching plant for use during the construction phase and offices, administration and operations and maintenance (O&M) buildings during the operational phase. New internal road crossings over watercourses are proposed as well as the upgrading of existing roads where necessary. The exisitign R356 road will be utilised to access the Oya WEF development. A large drainage network of ephemeral watercourses, considered to be largely natural, was identified within the development area and appropriate mitigation measures were proposed.

The proposed Kudusberg WEF construction camp is located approximately 11 m a watercourse, the Kudusberg substation is located approximately 26 m from a watercourse and the Kudusberg WEF Turbine 23 crane pad is located approximately 26 m from a watercourse. All other surface infrastructure is located at least 42 m from the watercourses. New roads are proposed to traverse watercourses and roads located across watercourses are also proposed to be upgraded, including the R356 access road. The proposed Oya WEF overhead collector power line will also traverse several watercourses, however the pylons will be constructed outside the 32m NEMA zone of regulation.

It was determined that the proposed WEF development will have a Negative Moderate to Low risk significance on the watercourses without the implementation of mitigation measures. The risk significance can be reduced should the above listed infrastructure components be moved to be located at least 32 m from a watercourse and the watercourse road crossings only be constructed during the driest period of the year; the impacts significance for the construction and operation for these components can be considered low with mitigation.

Based on the findings of the assessment, no fatal flaws in terms of freshwater ecological aspects were identified. The outcome of the risk assessment must be revised when detailed designs for watercourse road crossings become available. With the adherence to cogent, well-conceived and ecologically sensitive construction plans and the implementation of the mitigation measures provided in this report and providing that general good construction practice is adhered to, from a freshwater conservation perspective the proposed WEF developments are considered acceptable.

MANAGEMENT SUMMARY

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Oya Wind Energy Facility (WEF) and Kudusberg WEF between Matjiesfontein and Sutherland in the Northern and Western Cape provinces (hereafter referred to as the 'proposed WEF development'). In 2018, BlueScience (Pty) Ltd compiled a freshwater specialist study for the proposed WEF development as part of the Environmental Authorisation process, which has been granted. FEN Consulting (Pty) Ltd reviewed this study to determine if it complies with the requirements for Specialist Studies as per Annexure D6 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) to inform the WUA process. The BlueScience (2018) study proved to predominantly comply with the abovementioned requirements, with the omission of minor details. As such, FEN Consulting (Pty) Ltd compiled this current specialist freshwater ecological study to ensure full compliance with the specialist study requirements, with specific mention of the application of the Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

The purpose of this report is to ensure that the description and assessment of the ecology of the proposed WEF development in terms of the watercourse characteristics as described by Blue Science

(2018) are accurate, including mapping of the natural watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES) of the watercourses associated with the proposed WEF development. The Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the impacts associated with the proposed WEF development and mitigatory measures were identified which aim to minimise the potential impacts.

A desktop study was conducted, in which the watercourses were identified prior to the on-site investigation, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 4 of this report.

A field assessment took place on the 22nd and 23rd of September 2020 and on the 22nd to the 24th of October (early summer season), in order to ground truth, the identified watercourses as per BlueScience (2018) associated with the proposed WEF development. A single vernal pool and several headwater episodic drainage lines (EDLs) without riparian vegetation which flow into larger ephemeral tributaries located outside the investigation area. Several of these vernal pools were identified within the ephemeral tributaries and episodic drainage lines, however this small individual pool was located on top of the mountain area. Its characterised by a solid base, hosting a shallow layer of sediment. No obligate or facultative vegetation were found in this pool, nevertheless it may be of seasonal value to a diversity of habitat, as surface water will be present for a short period of time. As per the outcome of the BlueScience (2018) study, the vernal pools can be considered a natural ecological condition (PES = A) and of moderate ecological condition (EIS = B).Although these episodic drainage lines cannot be classified as rivers or streams in the traditional sense thereof due to the lack of saturated soils and riparian vegetation, they do still function as waterways, through episodic conveying of water. Based on the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998), water does flow regularly or intermittently within these drainage lines, conveying water from the upgradient catchment area into the downgradient tributaries and the larger river systems outside the proposed WEF development project Area. As such, they can be considered as watercourses due to their importance for hydrological functioning and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998). The results of the ecological assessment of the watercourses are discussed in Section 5 of this report is summarised in the table below.

Table A: Summary of results of the BlueScience (2018) ecological assessment as discussed in Section 5.

Watercourse	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Vernal pool, Windheuwels River, Tankwa River, Ephemeral tributaries with riparian vegetation, and Episodic drainage lines	A/B (Largely natural with few modifications)	Intermediate (1,5)	High (Windheuwels River) and Moderate (ephemeral tributaries and EDLs)	REC: Category B (Largely natural with few modifications)

No surface infrastructure components are located within any of the delineated watercourses, with the exception of road crossings. However, the proposed Kudusberg WEF construction camp is located approximately 11 m an EDL, the Kudusberg substation is located approximately 26 m from an EDL and Kudusberg WEF Turbine 23 crane pad is located approximately 26 m from an EDL. As such it is recommended these infrastructure components be relocated at least 32 m from the delineated extent of the watercourse. The Oya WEF overhead collector power line will also traverse several watercourses, however the pylons will be constructed outside the 32m NEMA ZoR. The DWS Risk Assessment was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed watercourses and assuming that the construction camp will be relocated as recommended. A summary of the outcome of the risk assessment is provided in Table B.

Table B: Summary of the outcome of the DWS Risk Assessment for the proposed WEF development (with the implementation of mitigation measures).

	Impact and Aspect	Risk	Adjusted Risk Rating
Construction Phase	Site preparation prior to construction activities of surface infrastructure components located outside the watercourses and at least 32 m from the delineated extent of a watercourse, but still within the 100 m GN509 ZoR, which includes the Oya WEF overhead collector system, Oya WEF construction camp, Kudusberg WEF construction camp, Kudusberg Substation and the identified crane pads within the 100m GN509 ZoR. • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles; • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Low	
	Site preparation prior to construction activities relating to the upgrading of existing roads and installation of underground cables traversing through watercourses: • Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Low	
	Site preparation prior to the construction of new roads and installation of underground cables (along new roads) traversing through watercourses: • Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Medium	Low
	Construction of surface infrastructure outside of the watercourses and at least 32 m from the delineated extent of a watercourse (as all proposed infrastructure will be located outside the 32m NEMA ZoR), but still within the 100 m GN509 ZoR, which includes the Oya WEF overhead collector system, Oya WEF construction camp, Kudusberg WEF construction camp, Kudusberg Substation and the identified crane pads within the 100m GN509 ZoR: • Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Mixing and casting of concrete for construction purposes.	Low	
	Upgrading of existing road crossings and trenching through the watercourses: • Compaction of soil in the existing road crossing footprint to increase the width of the roads; • Importation of materials to construct the roads.	Low	
	Construction of new road crossings and trenches through watercourses: • Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Compaction of soil in the road crossing footprint area; • Backfilling of excavated and disturbed areas.	Medium	Low
Operational Phase	Operation and maintenance of the surface infrastructure outside the watercourses and at least 32 m from the delineated extent of a watercourse, but still within the 100 m GN509 ZoR: • Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; • Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (with specific mention of the crane pads and construction camp area).	Low	
	Operation and maintenance of roads traversing watercourses: • Concentrated runoff entering the watercourses; • Disturbance to the watercourse vegetation.	Low	
Decommissioning Phase	Removal of all surface infrastructure from the project area: • Movement of construction vehicles and personnel; • Disturbance to the buffer zone surrounding the watercourses	Low	

No fatal flaws in terms of freshwater ecological aspects were identified. Should the Kudusberg WEF construction camp, the Kudusberg substation, Kudusberg WEF Turbine 23 crane pad and all pylons of the Oya WEF overhead collector power line be located at least 32 m from the delineated extent of a watercourse and watercourse road and cable crossings be constructed only in the driest periods of the year and implementing the recommended mitigation measures it is the opinion of the freshwater specialist, the risk significance of the proposed WEF development can be reduced and Water Use Authorisation by means of General Authorisation in terms of Section 21(c) and (i) water uses may potentially be obtained in consultation with the Department of Water and Sanitation (DWS). However, the DWS, the custodian of water resources in South Africa, must be consulted with regards to the outcome of this assessment. Once road watercourse crossing designs become available, with specific mention of the R356 road watercourse crossings, they should be reviewed by a freshwater ecological specialist and of the DWS Risk assessment be revised. It must be noted that the outcome of the DWS Risk assessment may thus change pending the outcome of the watercourse road crossing designs.

The following mitigation measures must be implemented as part of the construction and operational phases:

Construction phase:

- It is considered imperative that all watercourse road crossing construction work be undertaken during the driest period of the year to limit surface water contamination and the need for any surface water diversion during the construction period (diverting the flow of water through a pipe or an excavated channel was not included as part of this assessment). In so doing, the severity scoring (specifically pertaining to the flow regime) will be significantly reduced as would the frequency of an impact. Should this specific mitigation measure be implemented and with implementation of the below mitigation measures it is the opinion of the freshwater ecologist that the risk of the proposed road crossing construction in the watercourses be deemed 'low';
- The designs of the watercourse road crossings should be guided and be signed off by a suitably qualified ecologist and engineer, paying specific attention to the risk of erosion, incision and sedimentation as well as any risks to ecological connectivity;
- For trenching of the cables, the topsoil has to be stored separately and may not be contaminated. Furthermore, the soil layers should be replaced in the same order and the topsoil returned last;
- Suitable drainage should be insured along the crane pads, in order to ensure that water does not pool on the crane pad or drain in a concentrated manner into the watercourses. This must be considered as part of the stormwater management plan and be overseen by a freshwater ecologist;
- All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential;
- Retain as much indigenous freshwater vegetation as possible;
- All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) must be stockpiled in designated areas (at least 32 m from the delineated extent of a watercourse) or disposed of at a registered waste disposal facility;
- The watercourse area where no construction activities are proposed (with the exception of watercourse road crossings) must be considered as no-go areas. No construction vehicles, nor construction personnel or vehicles may indiscriminately traverse through these watercourses;
- No vegetation may be removed from at least 32 m from the delineated extent of a watercourse where no infrastructure is planned (with the exception for the construction of authorised road and cable crossings), as this provides a natural buffer zone around the watercourses which disperse surface runoff into the watercourses, and thus prevents sedimentation and erosion thereof.

Operational phase:

- No indiscriminate movement of construction equipment through the watercourses may be permitted during standard construction, operational activities or maintenance activities. Use must be made of the existing and newly constructed watercourse crossings only;
- Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided;
- Vehicles used in the development site must be regularly washed to avoid the dispersal of seeds on any alien or invasive species into the watercourses;

- 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. This must form part of the monitoring activities stipulated in the Stormwater Management Plan and Erosion Management Plan. Furthermore, monitoring to determine the establishment of indigenous vegetation and the presence of any alien or invasive plant species;
- The surface infrastructure (with specific mention of watercourse road crossings and crane pads) areas must be inspected to ensure that no concentrated runoff from these areas forms erosion gullies leading to erosion and sedimentation of receiving watercourses. Should these impacts be noted, these gullies/preferential flow paths must be infilled with in situ material and appropriately stabilised and/or revegetated;
- Stormwater runoff from the road crossings should be monitored (by the Operation and Maintenance (O&M) Manager), to ensure it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas);
- Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the road crossings and surface infrastructures. This should form part of the monitoring as stipulated in the Alien and Invasive Plant Management Plan. 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.

Based on the findings of the freshwater ecological assessment and the results of the impact and risk assessments, it is the opinion of the ecologist that the proposed Oya WEF development and Kudusberg WEF development poses a **low** risk to the integrity of the watercourses in the project t area provided that adherence to cogent, well-conceived and ecologically sensitive construction plans are implemented and the mitigation measures provided in this report as well as general good construction practice are adhered to, the proposed WEF development is considered acceptable.

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	
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Cover Page and Appendix G.
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 4.1: Table 1 and Section 4.2
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 4: Table 1
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 4: Table 1
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 5: Table 6 and 7
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:	
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Yes, with implementation of the proposed mitigation measures
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
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.) and d. Assessment of the risks associated with water use/s and related activities.	Section 5: Table 6 and 7

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); c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled 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); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. Loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc).	Section 7: Table 10
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 5: Table 6 and 7
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 5: Table 6 and 7
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 – Closest estuary is approximately 180 km south of the study area
3.	The report must contain as a minimum the following information:	
3.1	Contact detail of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Appendix G
3.2	A signed statement of independence by the specialist.	Appendix G
3.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 3.1
3.4	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Section 3, Appendix C and Appendix D
3.5	A description of the assumptions made, any uncertainties or gaps in knowledge or data.	Section 1.3
3.6	The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.	Section 6
3.7	Additional environmental impacts expected from the proposed development.	Section 7
3.8	Any direct, indirect and cumulative impacts of the proposed development on site.	Section 7
3.9	The degree to which impacts, and risks can be mitigated.	Section 7
3.10	The degree to which impacts, and risks can be reversed.	Section 7, Appendix F – Table F1
3.11	The degree to which the impacts and risks can cause loss of irreplaceable resources.	Section 7
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 6
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.	Section 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.	Section 8
3.16	Any conditions to which this statement is subjected.	Section 8

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Episodic drainage lines	Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period or may flow only once in several years.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
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).
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
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.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	The outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year.
Vernal pool	Also called vernal ponds or ephemeral pools, are temporary pools of water that provise habitat for distinctive aquatic plants and animals that are adapted to the very short inundation periods of these pools (BlueScience, 2018)
Watercourse:	In terms of the definition contained within the National Water Act, 1998 (Act No. 36 of 1998) 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
AC	Alternating Current
BA	Basic Assessment
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
DC	Direct Current
DEFF	Department of Environment, Forestry and Fisheries
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
FEN	Freshwater Ecologist Network
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
kV	Kilovolt
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NEMA	The National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NWCS	National Wetland Classification System
O&M	Operation and Maintenance
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
REDZ	Renewable Energy Zones
REIPPPP	Renewable Energy Independent Power Producer Procurement Program (REIPPPP)
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SARERD	South African Renewable Energy Resource Database
SQR	Sub-quaternary catchment reach
subWMA	Sub-Water Management Area

WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WULA	Water Use Licence Application
WRC	Water Research Commission
ZOR	Zone of Regulation

1 INTRODUCTION

1.1 *Background*

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Oya Wind Energy Facility (WEF) and Kudusberg WEF between Matjiesfontein and Sutherland in the Northern and Western Cape provinces (hereafter referred to as the 'proposed WEF development') (Figure 1 and 2). Please refer to Section 2 for the project description.

In order to identify all watercourses that may potentially be impacted by the proposed WEF development, a 500 m "zone of investigation" was implemented around the proposed WEF development, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (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 WEF development - will henceforth be referred to as the 'investigation area'.

In 2018, BlueScience (Pty) Ltd compiled a freshwater specialist study[1] for the proposed WEF development as part of the Environmental Authorisation process, which has since been granted. FEN Consulting (Pty) Ltd reviewed this study to determine if it complies with the requirements for specialist studies as per Annexure D6 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) to inform the WUA process. The BlueScience (2018) study proved to predominantly comply with the abovementioned requirements, with the omission of minor details. As such, FEN Consulting (Pty) Ltd compiled this current specialist freshwater ecological study to ensure full compliance with the specialist study requirements, with specific mention of the application of the Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

The purpose of this report is to ensure that the description and assessment of the ecology of the proposed WEF development in terms of the watercourse characteristics as described by Blue Science (2018) are accurate, including mapping of the natural watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES) of the watercourses associated with the proposed WEF development. The Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the impacts associated with the proposed WEF development and mitigatory measures were identified which aim to minimise the potential impacts.

This study further aims to provide detailed information to guide the proposed WEF development in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development. This report, after consideration of the above, must guide the proponent, by means of a reasoned opinion and recommendations, as to the viability of the proposed Kudusberg WEF from a watercourse management perspective.

[1] BlueScience. 2018. Freshwater Specialist Study: Basic Assessment for the proposed development of the 325 MW Kudusberg Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces.

1.2 *Structure of this report*

This report investigates the impact significance of the proposed WEF development, as explained the National Water Act, 1998 (Act No. 36 of 1998) (NWA) by means of the DWS Risk Assessment Matrix. The following structure is applicable to this report:

Section 1: Introduction
Provides an introduction, the structure of this report, the assumptions and limitations.

Section 2: Project Description
Provides the location of the proposed WEF development as well as a brief summary of the proposed activities associated with the proposed WEF development.

Section 3: Assessment Approach
Provides the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the risk assessment approach.

Section 4: Desktop Assessment Results
Reports on the findings from the relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2014 database and the Western Cape Biodiversity Spatial Plan (2017), National Biodiversity Assessment (NBA) 2018, and the Critical Biodiversity Areas of the Northern Cape, 2016 database) was undertaken to aid in defining the PES and EIS of the watercourses.

Section 5: Site Based Watercourse Assessment Results (Terms of Reference)
This section reports the following:

- A description and delineation of all watercourses associated with the proposed WEF development t according to "Department of Water Affairs and Forestry (DWAF)[2] (2008)[3]: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". The watercourses as identified by BlueScience (2018) were also site verified;
- Delineation of all watercourses (using desktop methods) within 500 m of the proposed WEF development in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998);
- The classification of the watercourses according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The Ecological assessment of the watercourses, as obtained from BlueScience (2018) utilised the following methodologies:
  - The EIS of the watercourses according to the method described by DWAF (1999);
  - The services provided by the watercourses associated with the proposed WEF development were assessed according to the method of Kotze et al. (2009);
  - The Present Ecological State (PES) of the watercourses according to the national River Health Programme (2006); and
- The allocation of a suitable Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) to the watercourse based on the results obtained from the PES, Ecoservices and EIS assessments.

[2] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known 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] Although 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.

Section 6: Legislative Requirements
Provides the applicable legislative requirements based on the findings from Section 5 and indicates any applicable zones of regulation that may trigger various enviro-legal authorisation requirements.

Section 7: Impact and Risk Assessment
Provides the outcomes from the DWS Risk Assessment Matrix which highlights all potential impacts and that may affect the surrounding watercourses. Management and mitigation measures are provided which should be implemented during the various proposed WEF development activities (planning, construction and operational phases) in order to assist in minimising the impact on the receiving environment.

Section 8: Conclusion
Summarises the key findings and recommendations based on the risk assessment outcomes and legislative requirements.

1.3 *Assumptions and Limitations*

- The ground-truthing and verification of the delineated extent of the watercourses identified by BlueScience (2018) are confined to a single site visit undertaken on the 22nd and 23rd of September 2020 (early spring season) and on the 22nd to the 24th of October (early summer season) of the proposed WEF development. All watercourses identified within the investigation area were delineated in fulfilment of Government Notice 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) using various desktop methods with limited field verification including the use of topographic maps, historical and current digital satellite imagery and aerial photographs;
- It is proposed that new or existing boreholes will supply water to the on-site batching plant as part of the proposed WEF development (please refer to Section 2). These activities (abstraction of water, pipeline construction) will be applied for separately should it be required by the relevant authorities, and as such, were not considered or assessed as part of this assessment. It is however recommended that a geohydrological investigation be undertaken for the borehole to ensure sustainable abstraction that does not impact other water users or the water resources within the area;
- Due to the landscape in some areas being rugged and very undeveloped, some reaches of the identified watercourses were inaccessible. Therefore, verification points for watercourses were located at points as close to the watercourse to be verified as possible and, where necessary the conditions at the exact point required were inferred or extrapolated;
- Due to the majority of the watercourses being ephemeral within the region, very few areas were encountered that displayed more than one watercourse characteristic as defined by the DWAF (2008) method (such as containing alluvial or inundated soils, or hosts riparian vegetation adapted to saturated conditions). As a result, identification of the outer boundary of the temporary watercourse zones and marginal riparian zones proved difficult in some areas and, in particular, in the areas where watercourse conditions and riparian zones are marginal, and therefore delineations were augmented with the use of digital satellite imagery. Nevertheless, the watercourse delineations as presented in this report are regarded as a best estimate of the watercourse boundaries based on the site conditions present at the time of assessment and the results obtained are considered sufficiently accurate to allow informed planning and decision making to take place;
- At the time of this assessment, no designs for the proposed watercourse road crossings or underground cable crossings were available (see details in Section 2 below). As such, once these designs become available, they should be reviewed by a freshwater ecological specialist and the impact/risk assessment updated. It must be noted that the outcome of the risk assessment may thus change pending the outcome of the watercourse road crossing designs;
- Global Positioning System (GPS) technology is inherently somewhat inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. However, the

delineations as provided in this report are deemed accurate enough to fulfil the environmental authorisation requirements as well as the implementation of the mitigation measures provided;

- Watercourses and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the watercourse boundaries may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the watercourses have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

2 PROJECT DESCRIPTION

Kudusberg Wind Farm (Pty) Ltd (hereafter referred to as "Kudusberg Wind Farm") was issued with an Environmental Authorisation (EA) for the proposed construction of the 325 MW Kudusberg Wind Energy Facility (WEF) and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces. The EA was granted on 25 March 2019 (DEFF Reference No.: 14/12/16/3/3/1/1976 and subsequently amended on 04 April 2019 to correct a minor naming error (14/12/16/3/3/1/1976/AM1). Kudusberg Wind Farm is now proposing to submit a Part 2 EA Amendment Application to split the authorised Kudusberg WEF (14/12/16/3/3/1/1976/AM1) into two (2) separate smaller WEF projects, namely the Kudusberg WEF and Oya WEF, which will result in a number of technical and administrative changes detailed below in Table 1. The split is being proposed to allow the projects to be suitable for numerous opportunities such as either the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP), other government run procurement programmes that may arise or for sale to private entities, if enabled and/or required in the drive for energy security in South Africa. Following the split, the northern section of the authorised WEF will become the Oya WEF, while the southern section of the authorised WEF will remain known as the Kudusberg WEF (authorised under 14/12/16/3/3/1/1976/AM1) (Table 1). In addition to the split, the final layout for the Oya WEF is being submitted which has been informed by detailed specialist walk-throughs and on-site micro-siting as per condition 29 of the Kudusberg EA[4]

Furthermore, the approved EMPr authorised as part of the Kudusberg EA is being amended to each WEF and to incorporate the final layout for the Oya WEF, management plans and the walk-throughs. The following amendments are proposed for each of the two (2) WEF mentioned above:

[4] Condition 29 of Kudusberg EA [DEFF Ref: 14/12/16/3/3/1/1976/AM1 – Page 15 of EA (page 17 of full document)]: *the final placement of turbines must follow a micro siting procedure involving a walk-through and identification of any sensitive areas by ecological, avifaunal, bat, surface water and heritage specialists.*

Table 1: Proposed amendments to the spilt of the Kudusberg WEF to the Oya WEF (northern ridge) and Kudusberg WEF (southern ridge).

Aspect to be amended	Authorised	Proposed Amendment	
		Oya WEF	Kudusberg WEF
Administrative Aspects			
Amend the holder of the EA's	Kudusberg Wind Farm (Pty) Ltd	Oya Energy (Pty) Ltd	Kudusberg Wind Farm (Pty) Ltd
Amend the name of the WEFs	Kudusberg Wind Energy Facility	Oya Wind Energy Facility	Kudusberg Wind Energy Facility
Contact Details	kudusberg@g7energies.com	oya@g7energies.com	kudusberg@g7energies.com
Extend the validity of the EA	This activity must commence within a period of five (05) years from the date of issue of this environmental authorization.	This activity must commence within a period of five (05) years from the date of issue of this amended environmental authorization.	This activity must commence within a period of five (05) years from the date of issue of this amended environmental authorization.
Location of Activity and SG codes	**Western Cape** 1. Portion 1 of 156 Gats Rivier Farm: C01900000000015600001 2. Portion 3 of 156 Gats River Farm: C01900000000015600002 3. Remainder of 156 Gats Rivier Farm: C01900000000015600000; 4. Portion 1 of 157 Riet Fontein Farm: C019000000000157001 5. Portion 1 of 158 Amandelbloom Farm: C019000000000158001 6. Remainder of 158 Amandelboom Farm: C019000000000158000 7. Portion 1 of 159 Oliviers Berg Farm: C019000000000159001 8. Remainder of 159 Oliviers Berg Farm: C019000000000159000 9. Portion 2 of 157 Riet Fontein Farm: C019000000000157002 10. Remainder of 161 Muishond Rivier Farm: C019000000000161000	**Western Cape** 1. Portion 1 of the Farm Gats Rivier No 156: C01900000000015600001; 2. Portion 2 of the Farm Gats Rivier No 156: C01900000000015600002; 3. Remainder of the Farm Gats Rivier No 156: C01900000000015600000; 4. Portion 1 of the Farm Riet Fontein No 157: C01900000000015700001 5. Portion 2 of the Farm Riet Fontein No 157: C01900000000015700002 6. Portion 1 of the Farm Amandelbloom No 158: C01900000000015800001 7. Remainder of the Farm Amandelboom No 158: C01900000000015800000 8. Portion 1 of the Farm Oliviers Berg No 159: C01900000000015900001 9. Remainder of the Farm Oliviers Berg No 159: C01900000000015900000 **Northern Cape** 10. Portion 4 of the Farm Urias Gat No 193: C07200000000019300004	**Western Cape** 1. Remainder of the Farm Gats Rivier No 156: C01900000000015600000 2. Portion 1 of the Farm Gats Rivier No 156: C01900000000015600001 3. Portion 1 of the Farm Oliviers Berg No 159; C01900000000015900001 4. Remainder of the Farm Oliviers Berg No 159: C01900000000015900000 5. Klipbanks Fontein No 395: C01900000000039500000 6. Remainder of the FarmMuishond Rivier No 159: C01900000000016100000 **Northern Cape** 7. Remainder of the Farm Karee Kloof No 196: C07200000000019600000 8. Remainder of the Farm Matjes Fontein No 194: C07200000000019400000 9. Portion 1 of the Farm 156 Gats Rivier **Properties affected by access road:**

	11. Remainder of 395 Klipbanks Fontein Farm: C01900000000019500 000 **Northern Cape** 12. 12. Portion 4 of 193 Urias Gat Farm: C07200000000019300 004 13. Portion 6 of 193 Urias Gat Farm: C07200000000019300 006 14. Remainder of 193 Urias Gat Farm: C07200000000019300 000 15. Remainder of 194 Matjes Fontein Farm: C07200000000019400 000 16. Remainder of 196 Karree Kloof Farm: C07200000000019600 000 **Properties affected by public road:** 17. 169 Zeekoegat Farm: C07200000000016900 000 18. Portion 1 of 170 Roodeheuvel Farm: C07200000000017000 001 19. Remainder of 170 Roodeheuvel Farm: C07200000000017000 000 20. Remainder of 190 Wind Heuvel Farm: C07200000000019000 000 21. Portion 1 of 190 Wind Heuvel Farm: C07200000000019000 001 22. Portion 5 of 193 Urias Gat Farm: C07200000000019300 005 23. Remainder of 171 Vinke Kuil Farm: C07200000000017100 000 24. Alkant Re/220 Farm: C07200000000022000 000 25. Portion 1 of 174 Lange Huis Farm: C07200000000017400 001	11. Portion 6 of the Farm Urias Gat No 193: C07200000000019300006 12. Remainder of the Farm Urias Gat No 193: C07200000000019300000 13. Remainder of the Farm Matjies Fontein No 194: C07200000000019400000 14. Portion 5 of the Farm Urias Gat No 193: C07200000000019300005 **Properties affected by access road:** 1. Zeekoegat Farm No 169: C07200000000016900000 2. Portion 1 of the Farm Roodeheuvel No 170: C07200000000017000001 3. Remainder of the Farm Roodeheuvel No 170: C07200000000017000000 4. Remainder of the Farm Wind Heuvel No 190: C07200000000019000000 5. Portion 1 of the Farm Wind Heuvel No 190: C07200000000019000001 6. Portion 5 of the Farm Urias Gat No 193: C07200000000019300005 7. Remainder of the Farm Vinke Kuil No 171: C07200000000017100000 8. Alkant Farm No 220: C07200000000022000000 Portion 1 of the Farm Lange Huis No 174: C07200000000017400001	10. Zeekoegat Farm No 169: C072000000000169000000 11. Portion 1 of the Farm Roodeheuvel No 170: C072000000000170000001 12. Remainder of the Farm Roodeheuvel No 170: C072000000000170000000 13. Remainder of the Farm Wind Heuvel No 190: C072000000000190000000 14. Portion 1 of the Farm Wind Heuvel No 190: C072000000000190000001 15. Portion 5 of the Farm Urias Gat No 193: C072000000000193000005 16. Remainder of the Farm Vinke Kuil No 171: C072000000000171000000 17. Alkant Farm No 220: C072000000000220000000 18. Portion 1 of the Farm Lange Huis No 174: C072000000000174000001

This report will form part of the separate Water Use Authorisation processes for the two different WEF developments. The freshwater ecological assessment is provided in a combined fashion due to the WEFs being located adjacent to each other within proximity to the same watercourses, and is referred to as the 'proposed WEF development' going forward (Figure 1 and 2).

Access to the proposed WEF development will be obtained via the existing R356 road. The road is an existing gravel road, which may potentially be widened at turns, but will however remain gravel. At the time of this assessment no formal designs or details pertaining to upgrade the existing watercourse crossings along the R356 road was available.

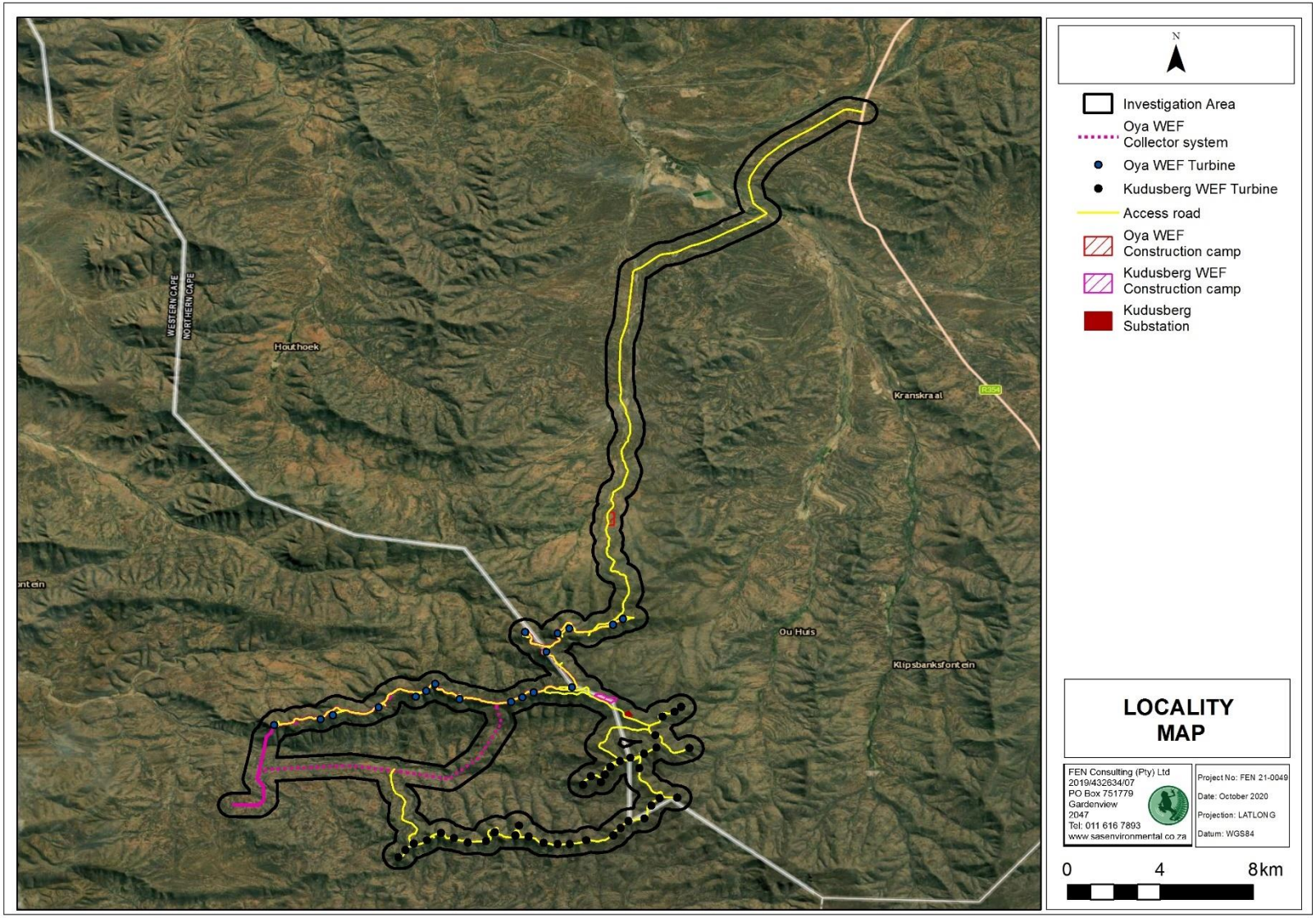


Figure 1: Digital satellite image depicting the proposed WEF development and the investigation area in relation to its surroundings.

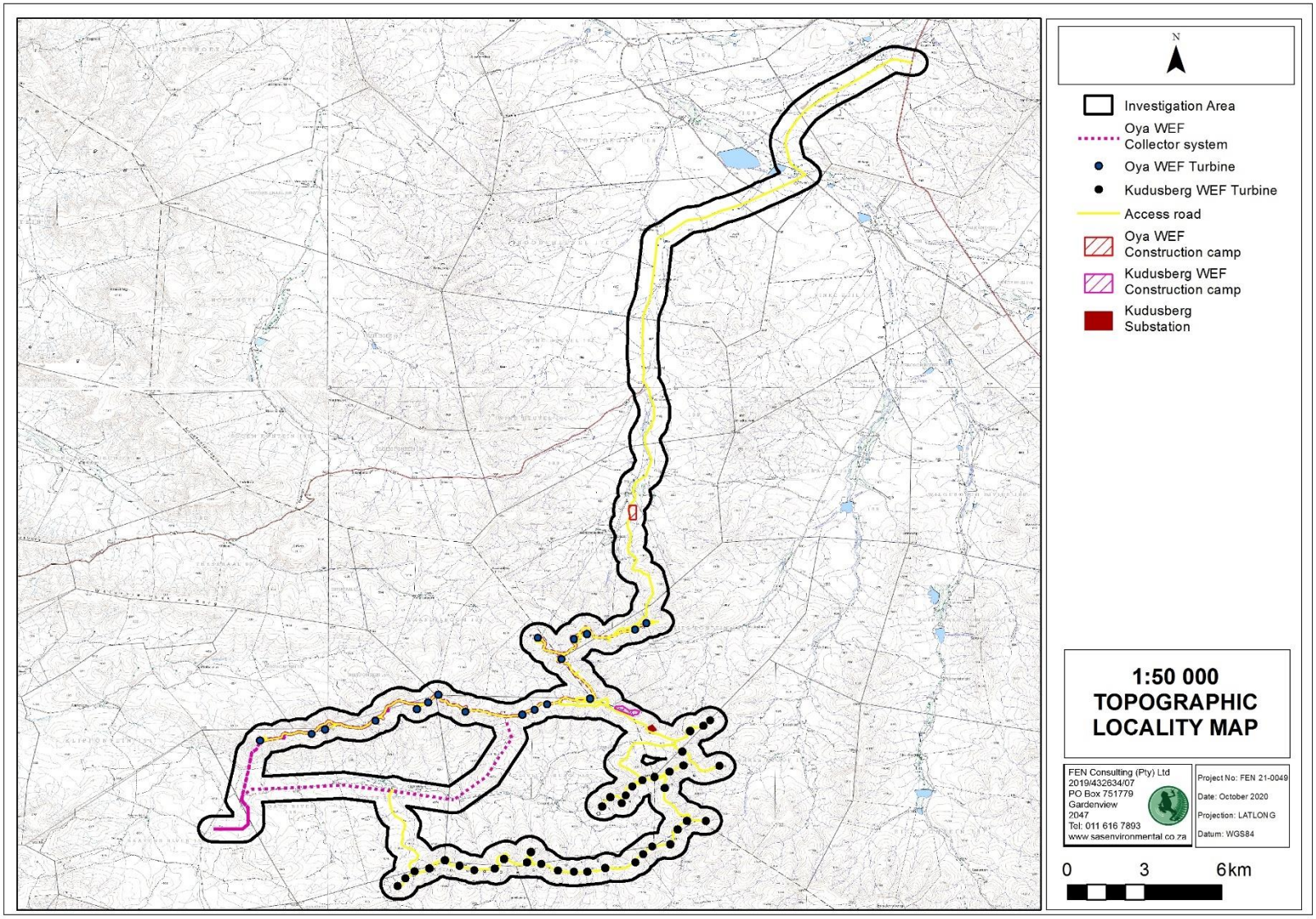


Figure 2: Location of the proposed WEF development and the investigation area depicted on a 1:50 000 topographical map in relation to surrounding areas.

3 ASSESSMENT APPROACH

3.1 *Watercourse Field Verification*

As part of this assessment, the following definitions, as per the National Water Act, 1998 (Act No. 36 of 1998) are of relevance:

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 of the Gazette, declare a watercourse.

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 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.

A field verification was undertaken on the 22nd and 23rd of September 2020 (early spring season[5]) and on the 22nd to the 24th of October (early summer season), during which the presence of any watercourse characteristics as defined by DWAF (2008) or wetlands and riparian resources as defined by the NWA were noted (please refer to Sections 4 and 5 of this report). Although FEN Consulting did not undertake the detailed assessment of the delineated watercourses, as the data presented by BlueScience (2018) were utilised to inform this report, time factors affecting the integrity of the watercourses were taken into consideration and aided in additional description of the functioning and the ecological and socio-cultural services provided by the watercourses. A detailed explanation of the methods of assessment as presented in the BlueScience (2018) study is provided in **Appendix C** of this report.

The watercourse delineation took place 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 watercourses have several distinguishing factors including the following:

- Landscape position;
- 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.

[5] Site surveys are recommended to take place during a seasonal period where the probability of detecting an identifiable life history stage of vegetation species (such as facultative vegetation species) is highest and in the rainy period to ensure optimised conditions for the identification of seasonal watercourses, which may otherwise be overlooked. Thus, the site conditions at the time of the field assessment are considered optimal as rainfall had occurred in the local area prior to the site assessment undertaken September 2020.

3.2 *Sensitivity Mapping*

All watercourses associated with the proposed WEF development were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map presented in Section 6 should guide the design, layout and management of the proposed WEF development.

3.3 *Risk and Impact Assessment and Recommendations*

Following the completion of the assessment, a risk assessment (DWS Risk Assessment) was conducted (please refer to **Appendix D** for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed WEF development . These recommendations also include general management measures, which apply to the proposed construction and operational/maintenance activities. The detailed mitigation measures are outlined in Section 7 of this report, while the general management measures which are considered best practice mitigation applicable to this project, are outlined in **Appendix F**.

4 DESKTOP ASSESSMENT RESULTS

4.1 *National and Provincial Datasets*

The following section contains data accessed as part of the desktop assessment and presented as a “dashboard-style” report below (Table 2). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation are provided.

It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics associated with the proposed WEF development at the scale required to inform the environmental authorisation and/or water use authorisation processes. Given these limitations, this information is considered useful as background information to the study, is important in legislative contextualisation of the risks and impacts, and was thus used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance during the field survey. It must, however, be noted that site verification 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.

Table 2: Desktop data (from desktop databases only) relating to the characteristics of the proposed WEF development and its associated investigation area.

Aquatic ecoregion and sub-regions in which the investigation area is located		Detail of the investigation area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Ecoregion	Great Karoo	FEPACODE	The investigation area is located in a sub-quaternary catchment classified as an upstream management catchment which is required to be managed to prevent downstream degradation of Freshwater Ecosystem Priority Areas (FEPAs) and fish support areas (FEPA CODE = UPSTREAM).
Catchment	Olifants - Cape		
Quaternary Catchment (Figure 3)	E22B, E232, E23B, E23G, E23H		
WMA	Olifants/Doorn		
subWMA	Doring		
Dominant characteristics of the Great Karoo Ecoregion Level II (21.03) (Kleynhans *et al.*, 2007)			
Level II Code	21.03		
Dominant primary terrain morphology	Low Mountains, Parallel Hills and Lowlands, Mountains and Lowlands.	NFEPA Wetlands (Figure 4 and 5)	According to the NFEPA database (2011), six artificial wetlands are located within the investigation area, three are associated with the internal access road, and another with the collector system. Two of these artificial features are located adjacent to the R365 access road. None of these features will be directly traversed by the proposed WEF development. These wetlands are classified as seep, channelled and unchanneled valley bottom wetlands and considered to be in a heavily to critically modified ecological condition (WETCON = Z3). During the field investigation, these features were identified as artificial impoundments.
Dominant primary vegetation types	Great Nama Karoo, Escarpment Mountains Renosterveld, Upland Succulent Karoo, Upper Nama Karoo		
Altitude (m a.m.s.l)	500 – 1700	Wetland Vegetation Type	The investigation area is located in the Karoo Shale Renosterveld Wetland Vegetation type (least threatened) and the Rainshadow Valley Karoo (Skv) Wetland Vegetation type (critically endangered). The threat status of each wetland vegetation type is provided by Mbona *et al.* (2015).
MAP (mm)	100 – 300		
The coefficient of Variation (% of MAP)	30 – 40		
Rainfall concentration index	30 – 55		
Rainfall seasonality	Very late summer, Winter	NFEPA Rivers (Figure 6)	As per the NFEPA database (2011), the headwaters of the Windheuwels, Ongeluks, Brak and Jakkelshok Rivers are located in the investigation area. The R356 access road traverses the Windheuwels and Tankwa Rivers. The Ongeluks, Tankwa and Brak Rivers are considered to be in a moderately modified ecological condition (RIVCON = C) according to the NFEPA database (2011), while the Windheuwels and Jakkelshok Rivers are considered to be largely natural with only a few modifications (RIVCON = AB). All these rivers are considered to be in a moderately modified ecological condition (Class C) according to the PES 1999 dataset.
Mean annual temp. (°C)	14 – 18		
Winter temperature (July)	0 – 18		
Summer temperature (Feb)	10 – 30		
Median annual simulated runoff (mm)	<5 - 20		
Importance of the investigation area according to the Western Cape Biodiversity Spatial Plan (2017) (Figure 7)			
According to the Western Cape Biodiversity Spatial Plan (2017), several areas within the most western and southern portions of the investigation area are classified as Critical Biodiversity Areas (CBA) 1, of watercourse and terrestrial ecological importance. CBAs are areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure, in this case specifically for riverine environments. CBA 1 are areas likely to be in a natural condition. The headwaters of the regional drainage network as identified by the topographical map are considered to be Ecological Support Areas (ESAs) 1 (of aquatic importance). ESAs are important in supporting the functioning of CBAs and are often vital for delivering ecosystem services. ESA 1 are areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. Small areas classified as ESA 2 are also located in the investigation area. ESA 2 are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas (PAs) or CBAs and are often vital for delivering ecosystem services. All other remaining areas in the investigation area are considered to be Other Natural Areas (ONAs). These are areas that have not 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 infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.			

Importance of the investigation area according to the Critical Biodiversity Areas of the Northern Cape (2016) (Figure 7)
According to the Critical Biodiversity Areas of the Northern Cape (2016), the investigation area is located within several areas classified as Ecological Support Areas (ESAs) and Other Natural Areas (ONAs). ESAs are areas that are not essential for meeting biodiversity targets, but play an important role in supporting the ecological functioning in Critical Biodiversity Areas (CBAs). The R356 access road (existing road traverses an area classified as a CBA 1. CBAs are areas that must remain in good ecological condition in order to meet biodiversity targets for ecosystem types, species of special concern or ecological processes. CBA 1 areas that are considered to be irreplaceable or near irreplaceable for meeting biodiversity targets. ONAs are areas that have not 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 infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.
National Web Based Environmental Screening Tool (2020): Aquatic Biodiversity sensitivity
The majority of the investigation area is located within areas considered of low aquatic biodiversity sensitivity. However, the NFEPA Rivers associated with the investigation area are considered to be of very high aquatic biodiversity importance, and due to their biodiversity importance classification as per the WCBSP (2017) and NCCBA (2016) datasets.
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA)
No inland aquatic ecosystems are located within the investigation area.

EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; EN = Endangered; m.a.m.s.l = Metres above mean sea level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Area; OESA = Other Ecological Support Area; PES = Present Ecological State; WMA = Water Management Area.

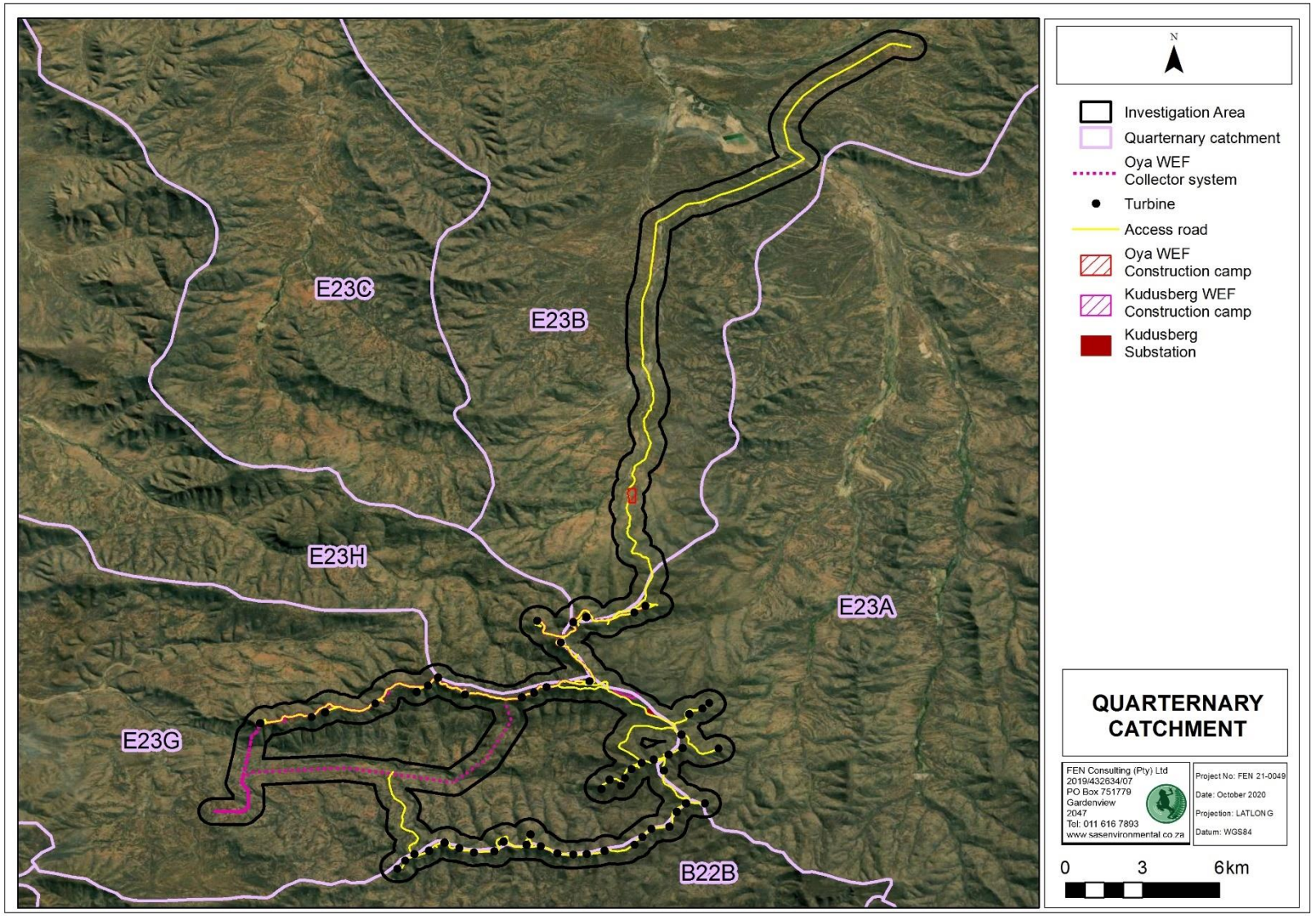


Figure 3: Map presenting the quaternary catchments in which the proposed WEF development is located.

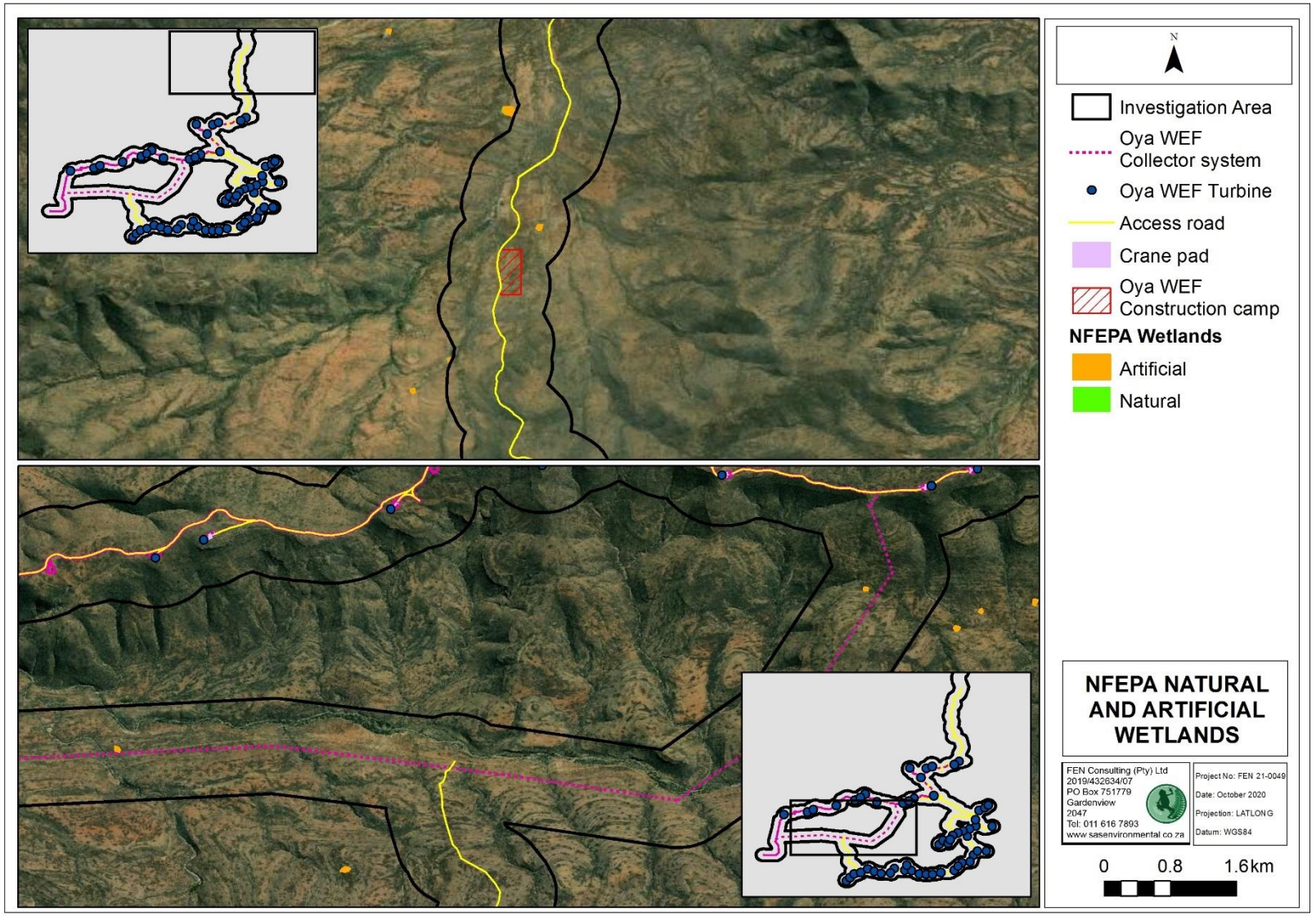


Figure 4: NFEPA listed natural and artificial wetlands associated with the proposed WEF development and investigation area, according to the NFEPA database (2011). No natural wetlands as identified by the NFEPA database (2011) are located in the investigation area. Some artificial features were identified within the investigation area along the internal access road associated with the WEF.

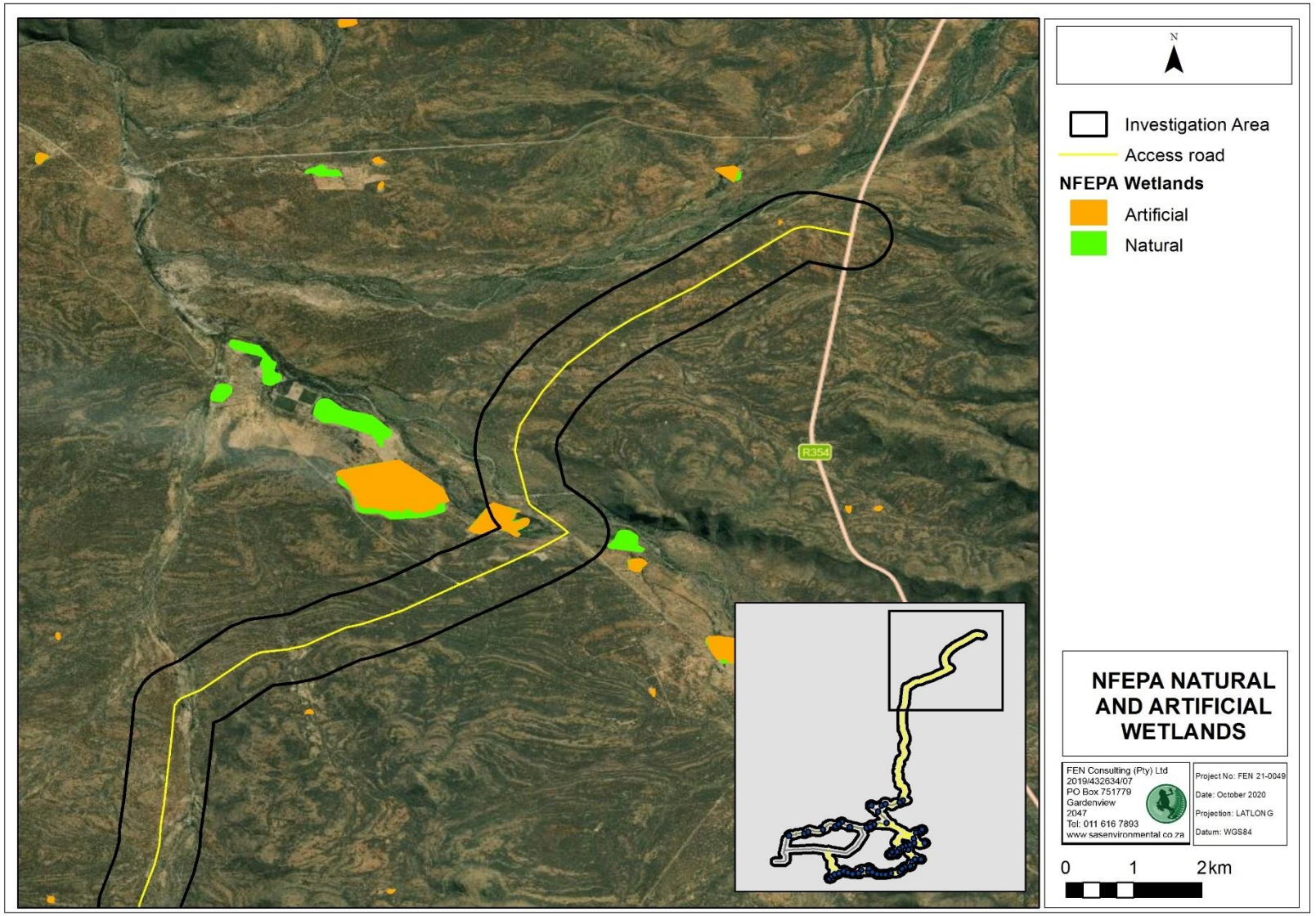


Figure 5: NFEPA listed natural and artificial wetlands associated with the proposed WEF development and investigation area, according to the NFEPA database (2011). No natural wetlands as identified by the NFEPA database (2011) are located in the investigation area. Some artificial features were identified within the investigation area along the R356 access road.

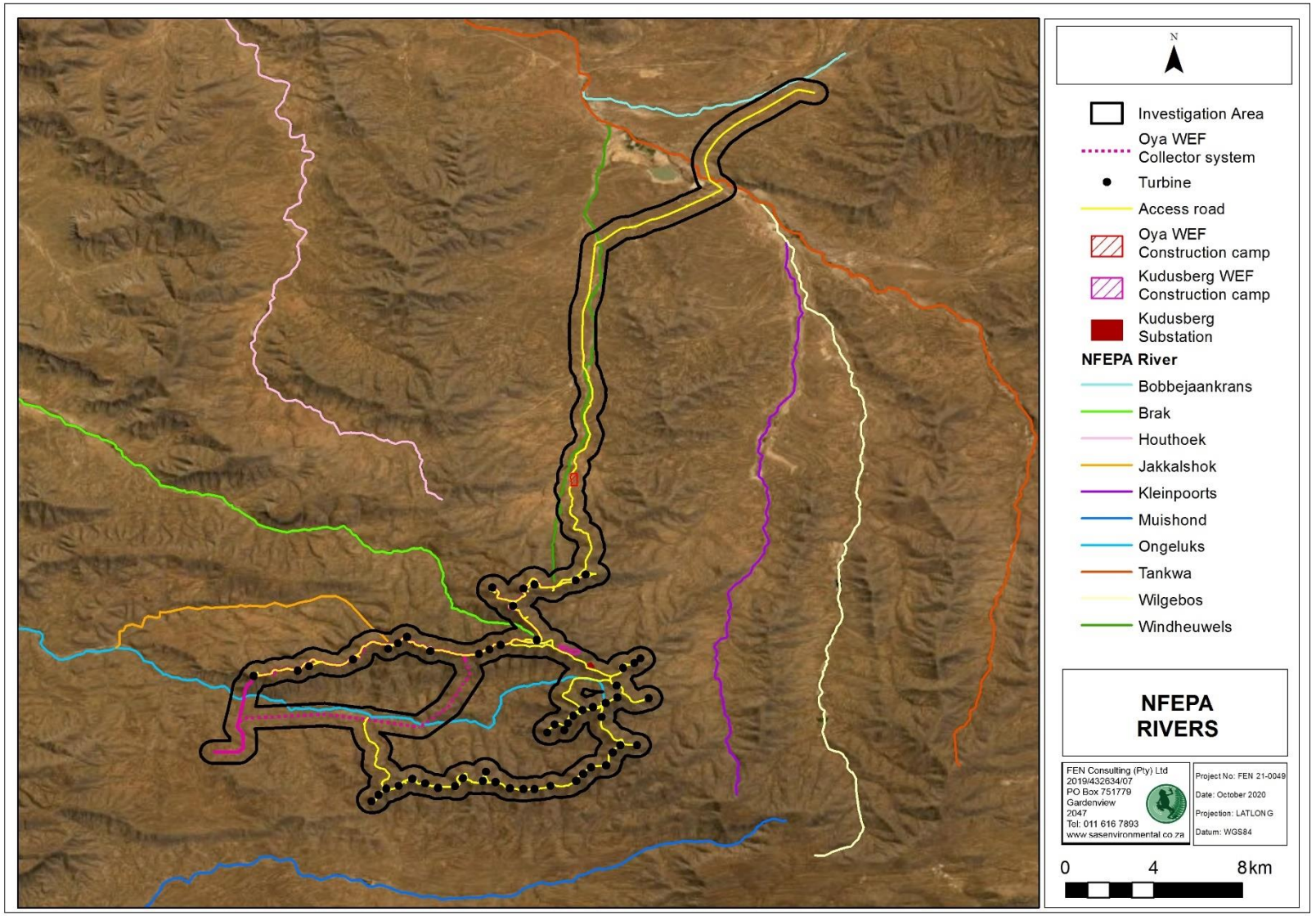


Figure 6: NFEPA listed rivers associated with the proposed WEF development and investigation area, according to the NFEPA database (2011).

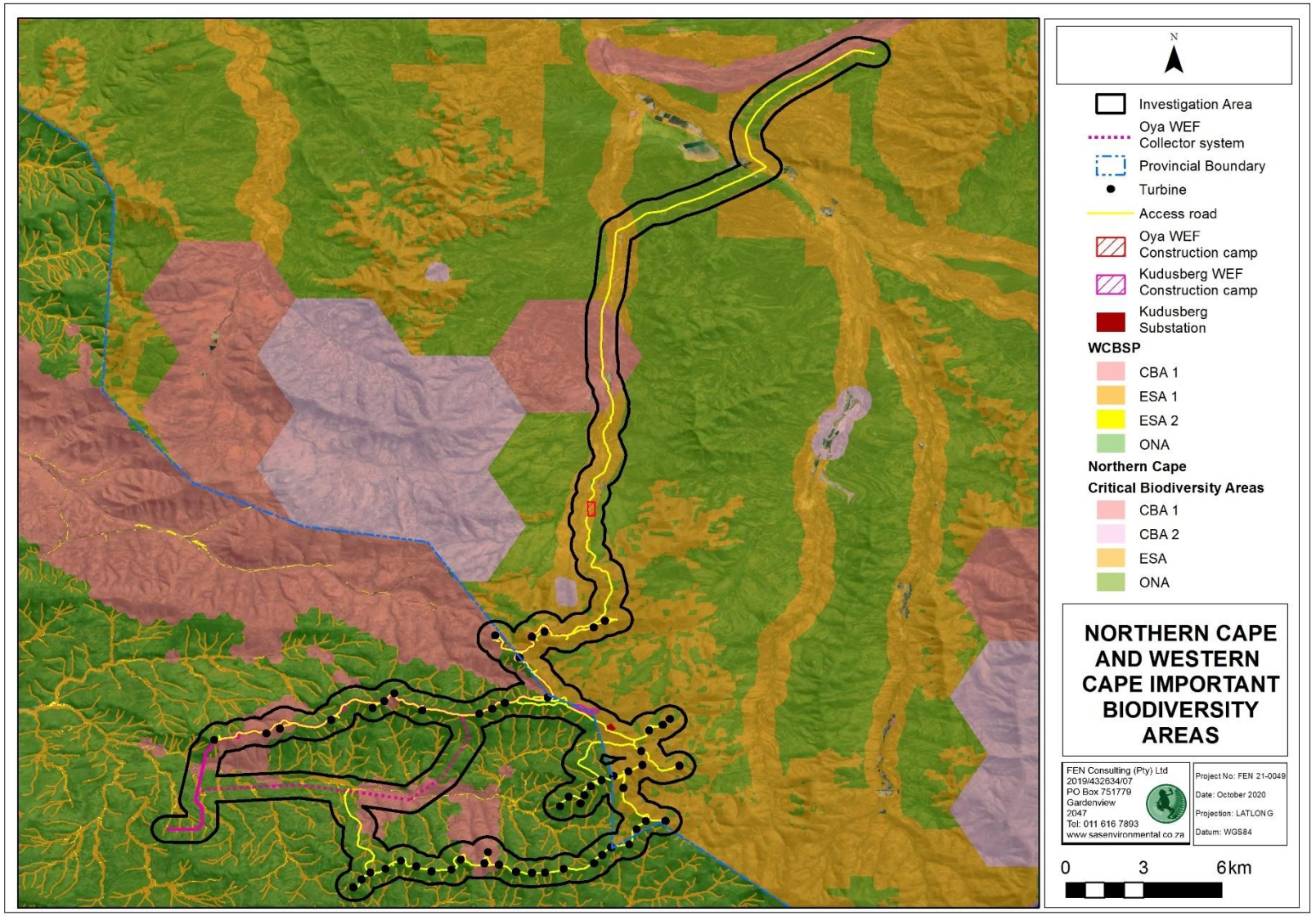


Figure 7: The areas of biodiversity importance associated with the proposed WEF development and investigation area, according to the Western Cape Biodiversity Spatial Plan (2017) and the Critical Biodiversity Areas of the Northern Cape (2016) database.

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

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

Key information on invertebrates and background conditions associated with the SQRs E23B-07811 (Windheuwels River), E23G-08038 (Jakkelshok River), E23G-08076 (Ongeluks River), E23H-07869 (Brak River) as contained in this database and pertaining to the PES and EIS are tabulated in Tables 2 and 3 and visually represented in Figure 8 that follows.

Table 3: Invertebrates previously collected from or expected at the SQR monitoring points.

Macro-Invertebrates	E23G-08038 (Jakkelshok River), E23H-07869 (Brak River) and E23B-07811 (Windheuwels River)	E23G-08076 (Ongeluks River)
Aeshnidae	X	X
Ancylidae	X	
Baetidae 1 Sp	X	X
Belostomatidae	X	X
Ceratopogonidae	X	
Caenidae	X	X
Chironomidae	X	
Coenagrionidae	X	X
Corduliidae	X	X
Corixidae	X	X
Culicidae	X	
Dytiscidae	X	
Gerridae	X	X
Gyrinidae	X	
Hydracarina	X	X
Lestidae	X	X
Libellulidae	X	X
Lymnaeidae	X	
Muscidae	X	
Notonectidae	X	X
Oligochaeta	X	X
Physidae	X	
Pleidae	X	X
Simuliidae	X	
Veliidae/Mesoveliidae	X	X

Table 4: Summary of the ecological status of the sub-quaternary catchment (SQ) reaches associated with the proposed WEF development based on the DWS RQS PES/EIS database.

	E23G-08038 (Jakkelshok River)	E23H-07869 (Brak River)	E23B-07811 (Windheuwels River)	E23G-08076 (Ongeluks River)	E22B-08134 (Muishond River)	E23A-07876 (Kleinpoorts River)
Synopsis						
PES Category Median	Unmodified	Natural/Close to natural	Natural/Close to natural	Unmodified, natural	Natural/Close to natural	Natural/Close to natural
Mean EI class	High	High	High	High	High	High
Mean ES class	Very High	Very High	Very High	Very High	Very High	High
Length	12.85	39.38	22.07	22,3	44.03	27.68
Stream order	1	1	1	1	1	1
Default EC[4]	A (Very High)	A (Very High)	A (Very High)	A	A (Very High)	B (High)
PES Details						
Instream habitat continuity MOD	None	None	None	None	None	None
RIP/wetland zone continuity MOD	Small	Small	Small	Small	Small	Small
Potential instream habitat MOD activities	None	None	None	None	None	None
Riparian/wetland zone MOD	None	None	None	None	None	None
Potential flow MOD activities	Small	Small	Small	Small	Small	Small
Potential physico-chemical MOD activities	None	None	None	None	None	None
EI Details						
Fish spp/SQ	-	-	-	-	-	-
Fish average confidence	-	-	-	-	-	-
Fish representivity per secondary class	-	-	-	-	-	-
Fish rarity per secondary class	-	-	-	-	-	-
Invertebrate taxa/SQ	25	25	25	25	28	25
Invertebrate average confidence	3	3	3	3	1	3
Invertebrate representivity per secondary class	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Invertebrate rarity per secondary class	High	High	High	High	High	High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low	Moderate	Very Low	Very Low	Very Low	Very Low
Habitat diversity class	Low	Moderate	Low	Low	Moderate	Low
Habitat size (length) class	Low	High	Moderate	Moderate	Very High	Moderate
Instream migration link class	Moderate	Very High	Very High	Very High	Very High	Very High
Riparian-wetland zone migration link	Very High	Very High	Very High	Very High	Very High	Very High

Riparian-wetland zone habitat integrity class	Very High	Very High	Very High	Very High	Very High	Very High
Instream habitat integrity class	Very High	Very High	Very High	Very High	Very High	Very High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High	Very High	Very High	Very High	Very High
Riparian-wetland natural vegetation rating based on expert rating	Very High	Very High	Very High	Very High	Very High	Very High
ES Details						
Fish physical-chemical sensitivity description	-	-	-	-	-	-
Fish no-flow sensitivity	-	-	-	-	-	-
Invertebrates physical-chemical sensitivity description	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Invertebrates velocity sensitivity	High	High	High	High	Very High	High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very High	Very High	Very High	Very High	Very High	Very High
Stream size sensitivity to modified flow/water level changes description	Very High	Very High	Very High	High	Very High	High
Riparian-wetland vegetation intolerance to water level changes description	Very High	Very High	Very High	Marginal and non-marginal species require seasonal flows	Very High	Very High

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;

[2] EI = Ecological Importance;

[3] ES = Ecological Sensitivity

[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

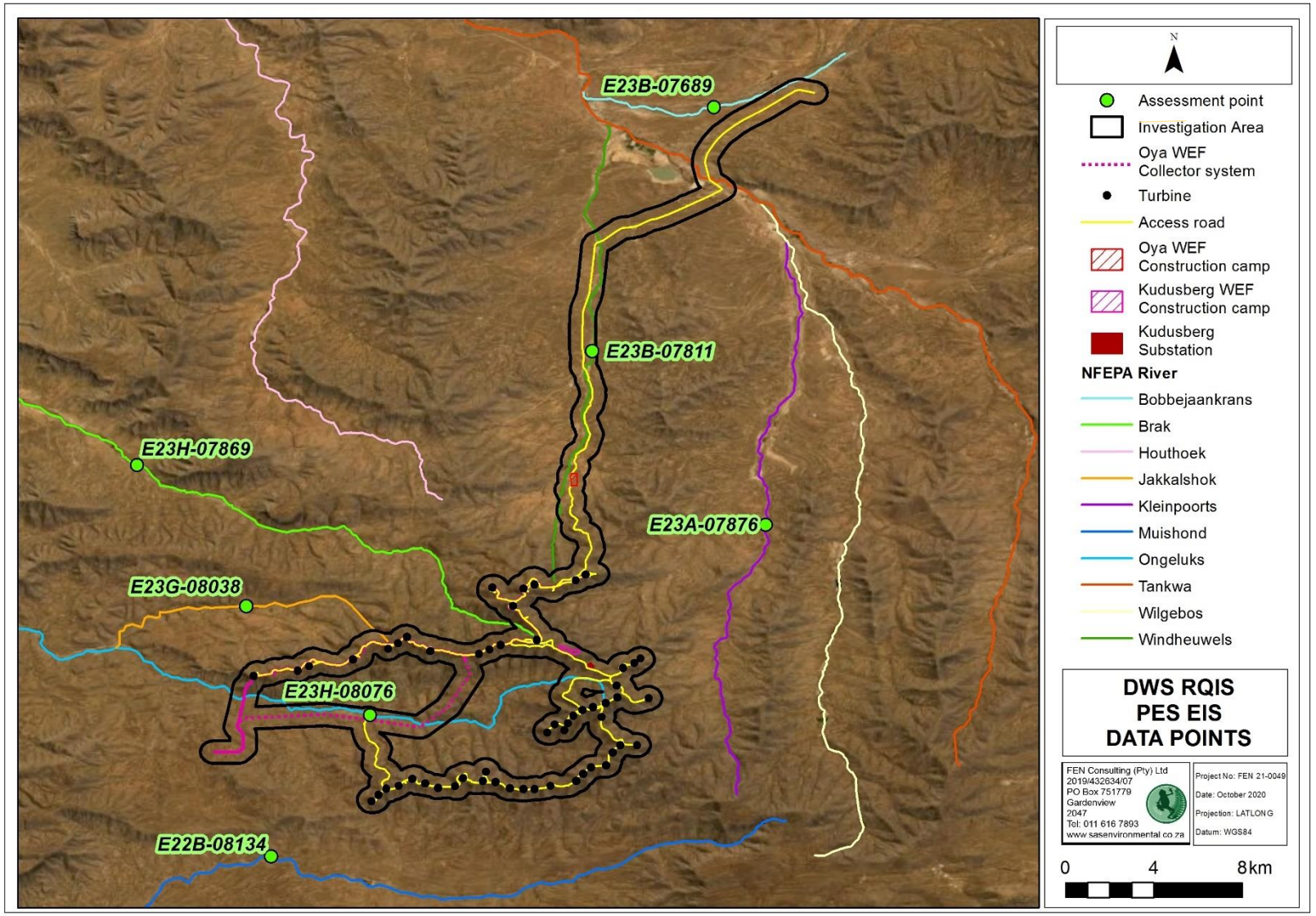


Figure 8: DWS RQIS PES/EIS sub-quaternary catchment reaches (SQRs) indicated relative to the proposed WEF development and investigation area.

5 RESULTS: WATERCOURSE ASSESSMENT

5.1 *Field verification and delineation*

In preparation for the field assessment, aerial photographs, digital satellite imagery and provincial and national watercourse databases (as outlined in Section 4 of this report) were used to identify points of interest associated with the proposed WEF development at a desktop level. In this regard, specific mention is made of the following:

- Linear features: since water flows/moves through the landscape, watercourses often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with watercourses: 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 watercourse 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, created by varying vegetation cover and soil conditions.

These points of interest were verified during the site assessment undertaken on the 22nd and 23rd of September 2020 and on the 22nd to the 24th of October (early summer season). The proposed WEF development is located largely on the higher-lying Oliviersberg and Koedoesberg Mountains between Matjiesfontein and Sutherland. The proposed wind turbines are to be placed on mountain ridges (referred to as the northern and southern ridges) that are mostly east-west orientated and form the watershed between the headwater drainage features of the Ongeluks River, Jakkelshok River (a tributary of the Ongeluks River) Brak River, Muishond, Kleinpoorts and Windheuwels River. These river systems flow in a general westerly direction, with the exception of the Windheuwels and Kleinpoorts Rivers flowing in a northerly direction.

The watercourses identified within the investigation area can best be described as headwater episodic[6] drainage lines (EDLs) without riparian vegetation which flow into larger ephemeral tributaries located outside the investigation area. Only two ephemeral tributaries with riparian vegetation were identified to be associated with the proposed WEF development; these tributaries are associated with the Windheuwels and Ongeluks Rivers. The R356 access road (existing road) traverses the Tankwa and Windheuwels Rivers and the respective smaller ephemeral drainage lines/tributaries. The R356 access road traverses the watercourses by means of current formal structures (such as bridges) and informally (by means of a low water crossing over a portion of the river consisting of solid bed rock. Although these EDLs cannot be classified as riparian resources in the traditional sense thereof due to the lack of saturated soils and riparian vegetation, they do still function as waterways, through episodic conveyance of water. However, based on the definition of a watercourse (see Section 3.1) water flows regularly or intermittently within these drainage lines, conveying water from the upgradient catchment area into the downgradient tributaries and eventually into the larger river systems. As such, they can be considered as watercourses due to their importance for hydrological functioning as they do function as waterways and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998).

[6] "Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period or may flow only once in several years." (Uys and O'Keeffe, 1997, in Rossouw *et. al*, 2006).

Additionally, a vernal pool was also identified between the Oya WEF turbine 7 and 8 (Figure 9). Several of these vernal pools were identified within the ephemeral tributaries and episodic drainage lines, however this small individual pool was located on top of the mountain area. Its characterised by a solid base, hosting a shallow layer of sediment. No obligate or facultative vegetation were found in this pool, nevertheless it may be of seasonal value to a diversity of habitat, as surface water will be present for a short period of time. These pools have a rather unique ecosystem associated with them with very specialised biota that respond quickly to periods when the pools are inundated. As per the outcome of the BlueScience (2018) study, the vernal pools can be considered n a natural ecological condition (PES = A) and of moderate ecological condition (EIS = B).

Figure 9: Photographs of the identified vernal pool. Note the bare rock base with no representative facultative vegetation.

Six (6) separate drainage systems were identified to be associated with the proposed WEF development consisting primarily of EDLs. A summary of the six (6) drainage systems identified in the investigation area relative to the proposed WEF development is provided in the Table 5 and visually depicted in Figures 10 to 15.

Table 5: Summary of the drainage systems identified relative to the proposed WEF development.

Drainage System	Locality	Proposed WEF infrastructure proximity	General description
Tankwa River system (Figure 10)	Drainage system being traverses by the R356 access road.	The existing R356 road traverses the Tankwa River and several of its smaller associated watercourses.	This river has been impacted on by small scale agricultural developments, including the development of instream impoundments, and the crossing of linear infrastructure such as roads. Despite this, is the river still considered to be largely intact.
Windheuwels River system (Figure 10 and 11).	Drainage system associated with the northern portion of the investigation area/proposed access road.	The proposed access road traverses several EDLs. Additionally, the proposed Oya WEF construction camp is located directly adjacent to (approximately 32 m from) an EDL.	The river is in a largely natural ecological condition with some modification as a result of the road, homesteads and cultivation/farming activities along the river. The small headwater EDLs of this system are in a largely natural condition.
Kleinpoorts River system (Figure 11 and 13).	Drainage system located east of the northern ridge.	No proposed WEF development infrastructure components will directly traverse any of the watercourses associated with this drainage system. The proposed Kudusberg WEF construction camp is located approximately 11	Several small headwater EDLs are located in the investigation area associated with Oya WEF Turbines 12 to 18, and Kudusberg WEF Turbines 1, 1, 23, 29 to 34, and 37.

Drainage System	Locality	Proposed WEF infrastructure proximity	General description
		m south west of an EDL, and the substation is located approximately 26 m south of an EDL.	The watercourses of this system located in the investigation area are predominantly small headwater EDLs in a largely natural condition.
Brak River system (Figure 11 and 12).	Drainage system located north east of the northern ridge.	No proposed WEF development infrastructure components will directly traverse any of the watercourses associated with this drainage system. No access roads are located within at least 41 m of an EDL.	Several small headwater EDLs are located in the investigation area associated with Oya WEF Turbines 7 to 16. The watercourses of this system located in the investigation area are predominantly small headwater EDLs in a largely natural condition.
Jakkelshok River system (Figure 12).	Drainage system located north west of the northern ridge.	The proposed internal access road directly west of the Oya WEF turbine 5 traverses an EDL of this system. The crane pad associated with Oya WEF turbine 5 is located within 45 m of the same EDL.	Several small headwater EDLs are located in the investigation area associated with Oya WEF Turbines 1 to 7. The watercourses of this system located in the investigation area are predominantly small headwater EDLs in a largely natural condition.
Ongeluks River system (Figure 11 to 15).	Drainage system located between the northern and southern ridges.	The following access road crossings are noted: - EDL crossing south of Oya WEF Turbine 12; - a long extent of the internal access road connecting Kudusberg WEF Turbine 31 to Turbine 26 is located directly adjacent and traversing through an ephemeral tributary of this system. - EDL crossing between Kudusberg WEF Turbine 35 and 25, - EDL crossing between Kudusberg WEF Turbine 23 and 28 - EDL crossing between Kudusberg WEF Turbine 14 and 15 Crane pad of Kudusberg WEF Turbine 23 within 26 m of EDL. All other surface infrastructure components associated with the proposed WEF development are located approximately 42 m from an EDL associated with this drainage system. The proposed overhead collector system of the Oya WEF will also traverse several watercourses associated with this system. It must be noted that the pylons associated with the overhead power line will be located outside of the delineated extent of the watercourses.	This is the largest drainage system associated with the proposed WEF development as a whole. The headwaters of this river system are located in the valley between the Kudusberg substation and the Kudusberg WEF Turbines 31 to 27. The watercourses of this system located in the investigation area is predominantly headwater EDLs in a largely natural condition.
Muishond River system (Figure 14)	Drainage system located south of the southern ridge.	No proposed WEF development infrastructure components will directly traverse any of the watercourses associated with this drainage system and all proposed surface infrastructure components, including the internal road, which is located at least 51 m from an EDL.	Several small headwater EDLs are located in the investigation area associated with the Kudusberg WEF Turbines 1 to 22. The watercourses of this system located in the investigation area are predominantly small headwater EDLs in a largely natural condition.

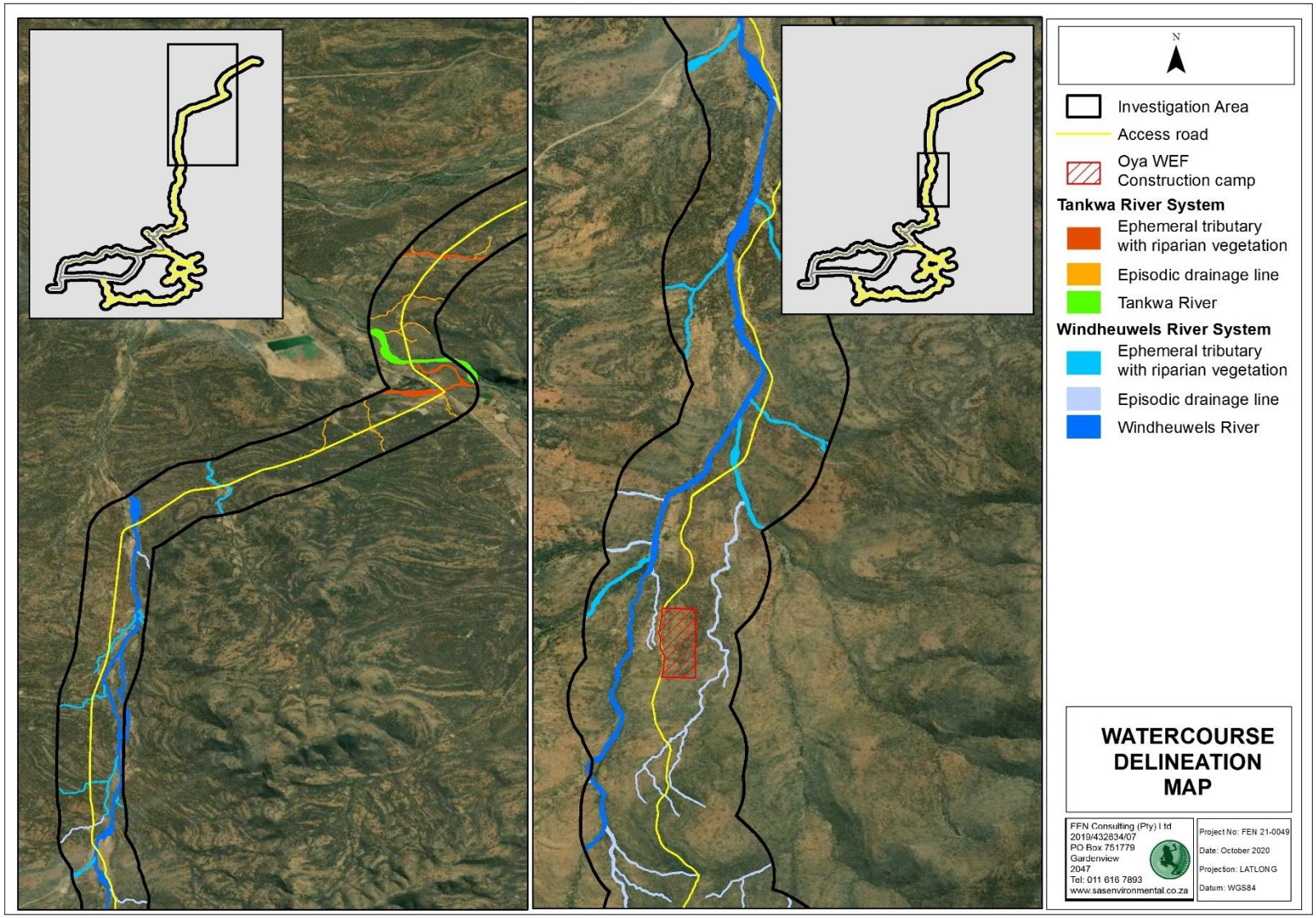


Figure 10: The locality of the delineated watercourses of the Tankwa and Windheuwels River system associated with the proposed access road and construction camp.

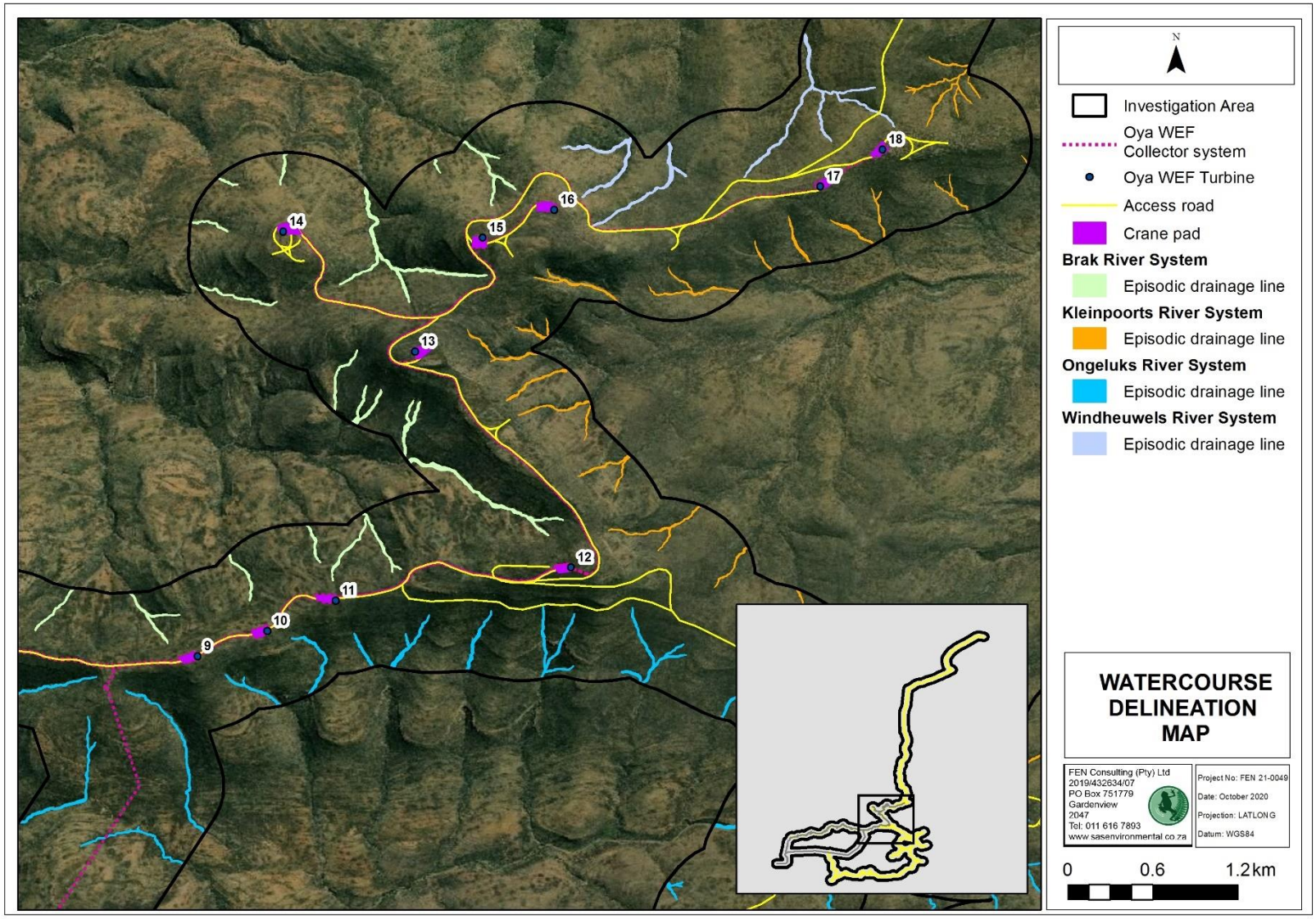


Figure 11: The locality of the delineated watercourses of the Windheuwels, Kleinpoorts, Brak and Ongeluks River system associated with the proposed internal roads, turbines and crane pads.

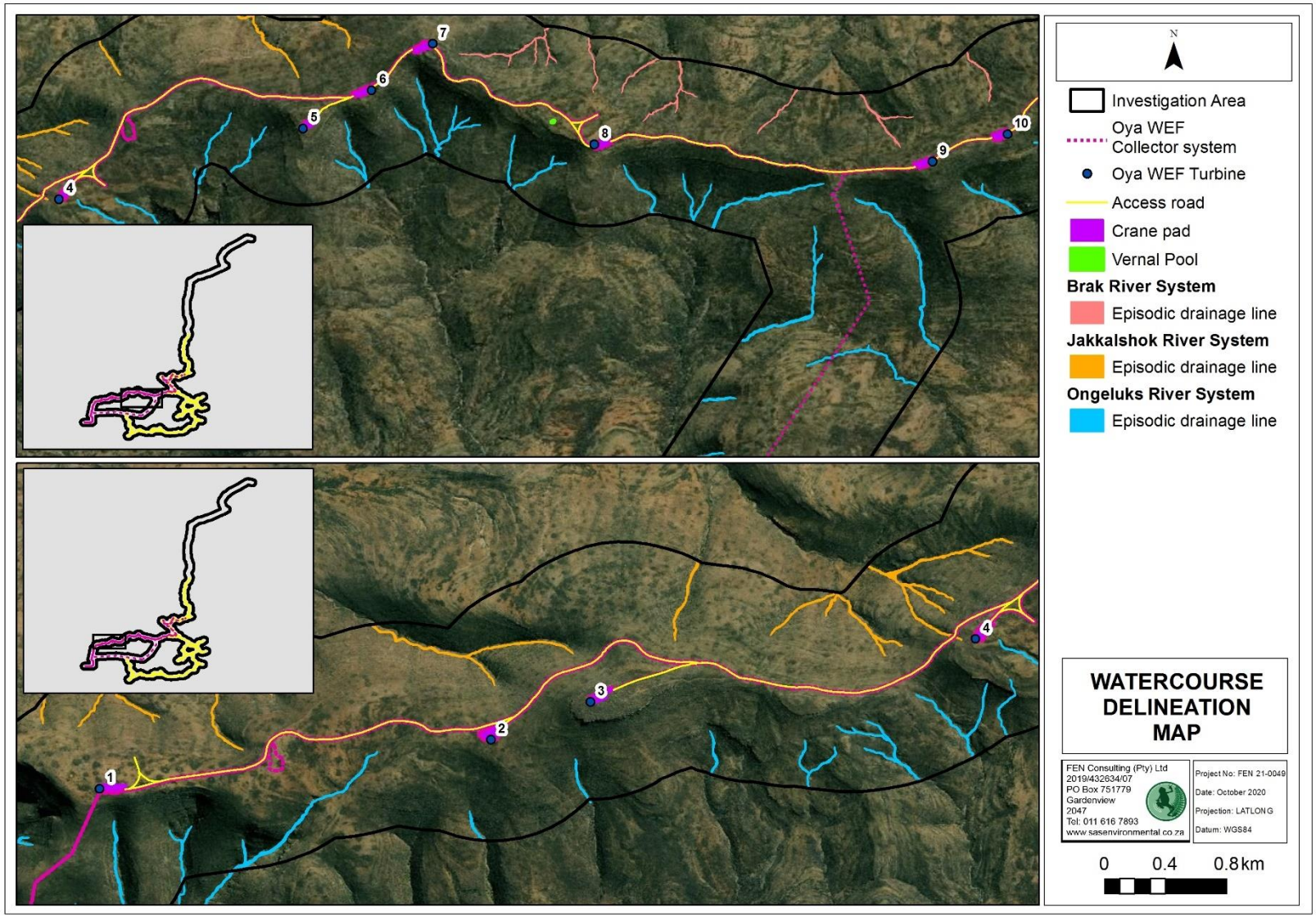


Figure 12: The locality of the delineated watercourses of the Jakkalshok, Brak and Ongeluks River systems associated with the proposed internal roads, turbines and crane pads.

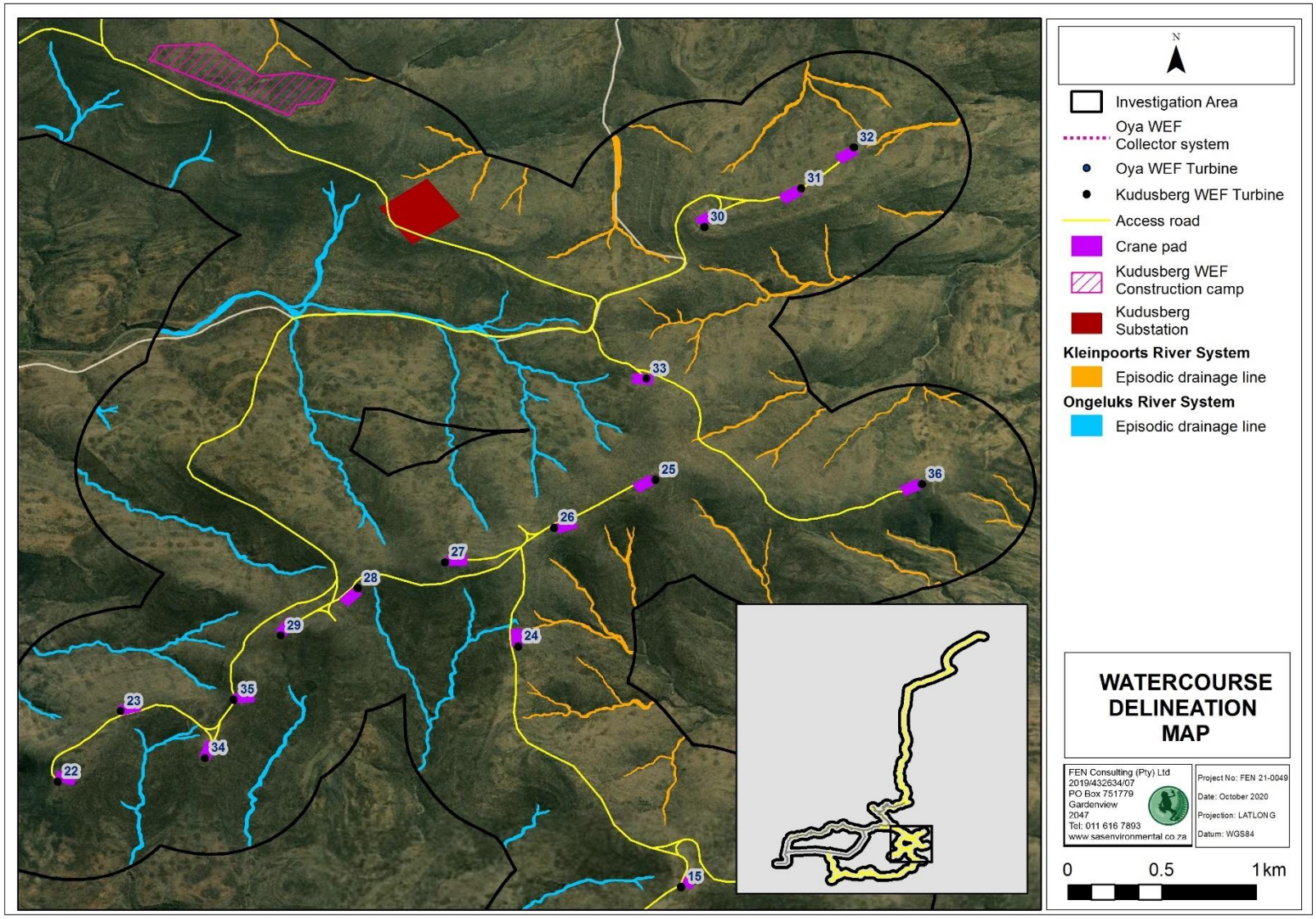


Figure 13: The locality of the delineated watercourses of the Kleinpoorts and Ongeluks River systems associated with the proposed internal roads, turbines and crane pads.

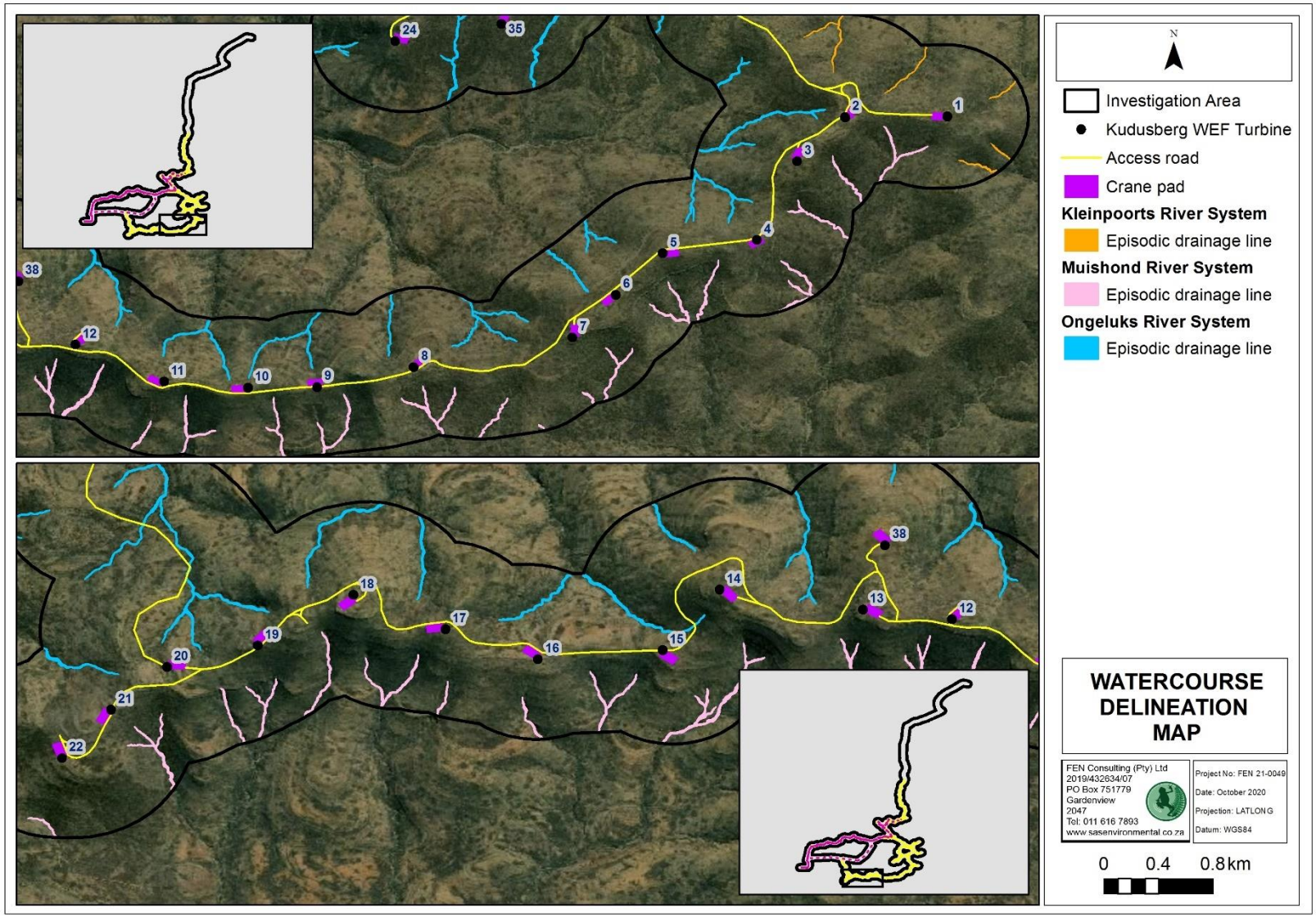


Figure 14: The locality of the delineated watercourses of the Ongeluks River and Muishond River systems associated with the proposed internal roads, turbines and crane pads.

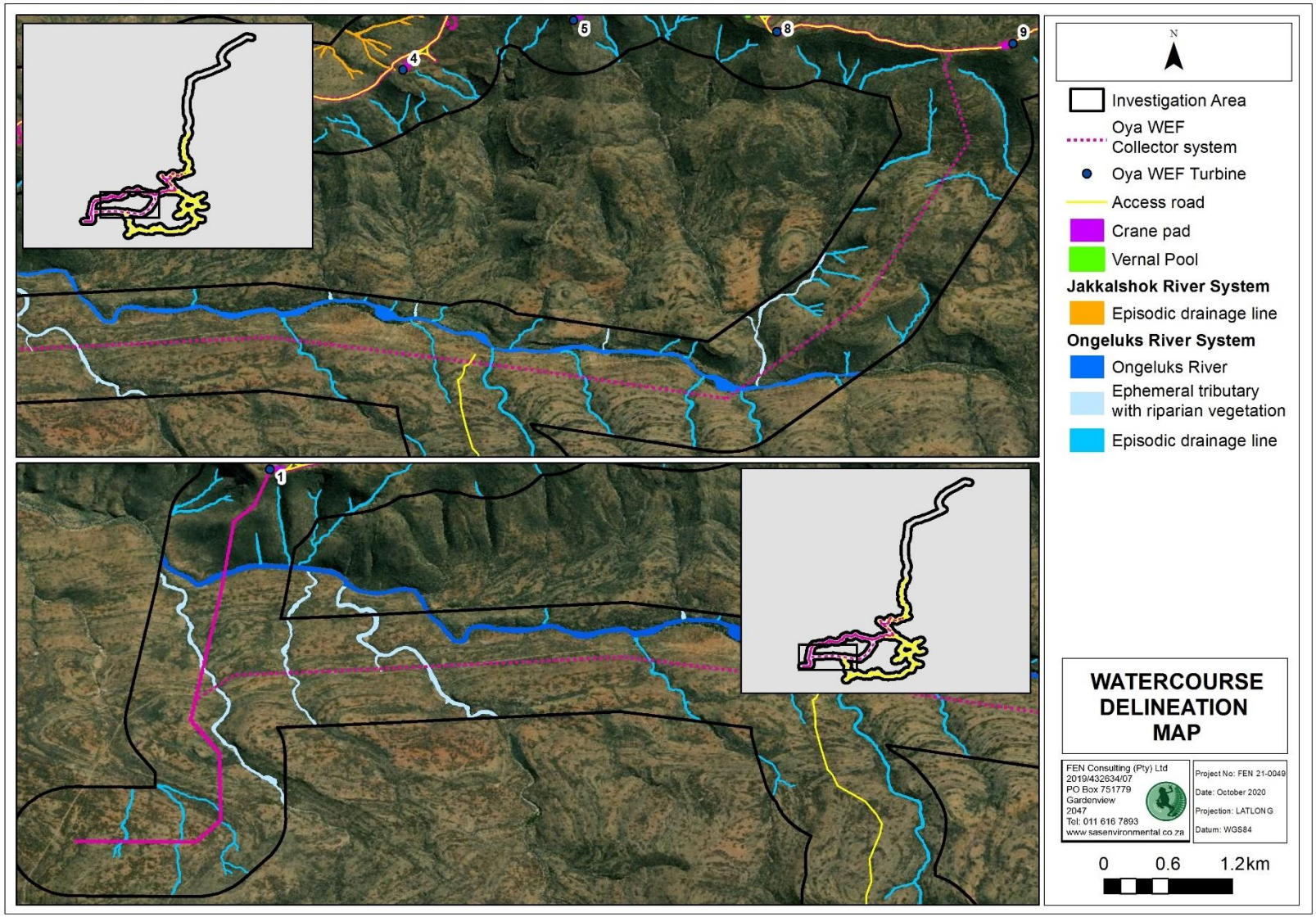


Figure 15: The locality of the delineated watercourses of the Ongeluks River system associated with the proposed overhead collector system of the Oya WEF.

5.2 *Watercourse delineation*

The outer boundary of the identified watercourses were delineated according to the guidelines advocated by DWAF (2008) taking into consideration soil characteristics as defined by Job (2009). The delineations as presented in this report are regarded as a best estimate based on the site conditions present at the time of the assessment. During the field assessment, the following indicators were used in order to determine the boundary of the riparian watercourses identified to be associated with the proposed WEF development and associated investigation area:

- **Topography/elevation** was used to determine which parts of the landscape watercourses are most likely to occur. Since watercourses occur where there is a prolonged presence of water in the landscape, the most common place one could expect to find watercourses is in the valley bottom position (DWAF, 2008). The main tributaries of the identified drainage systems are all located in the valley bottom position (Figure 16). Most other watercourses (like the smaller episodic drainage lines) are also located in valleys between undulating hills within the upslope that slopes towards the larger downstream system where concentration of flow leads to drainage towards the larger tributaries.

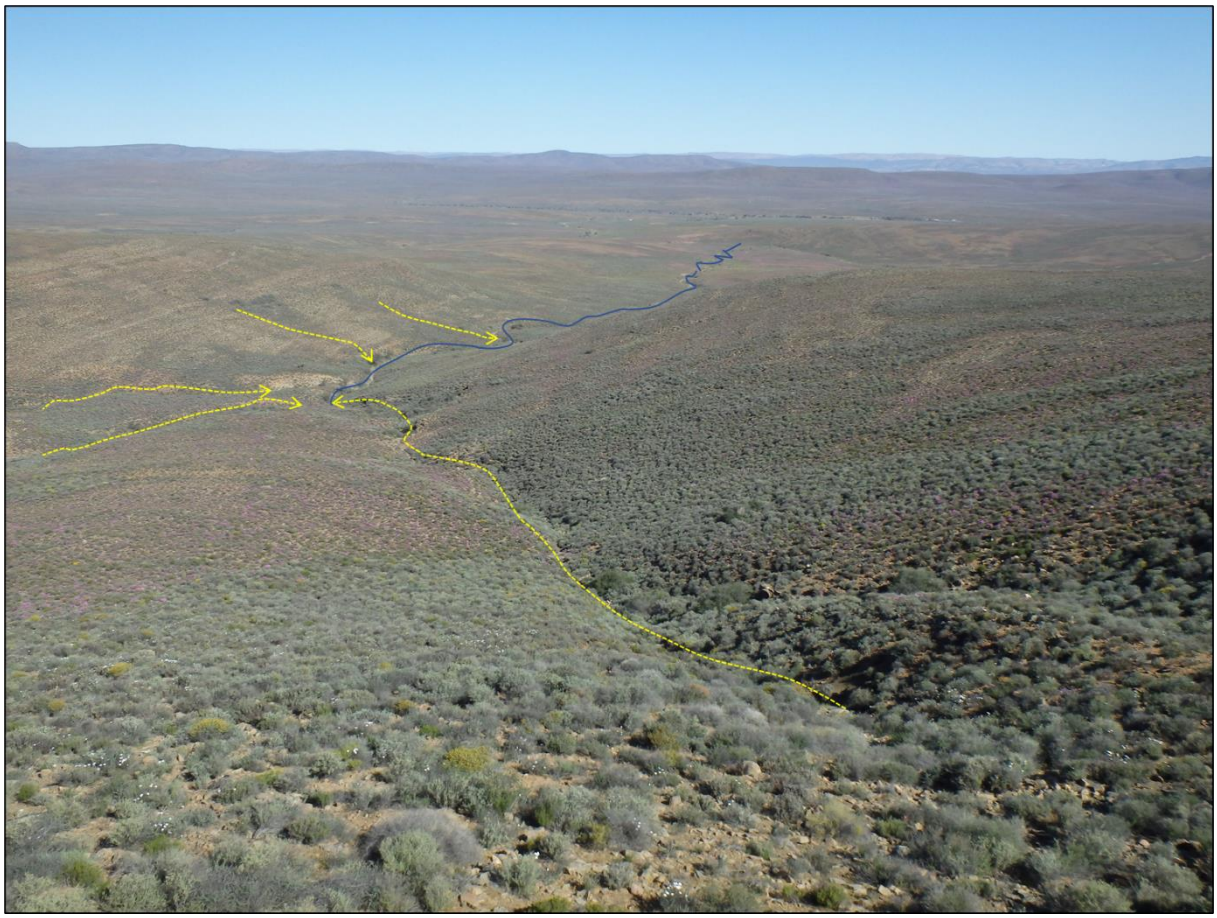


Figure 16: A photograph depicting the topographical setting of the smaller episodic drainage lines in the higher slope position (yellow dashed line) relative to the larger ephemeral tributaries or river in the valley bottom position (blue line).

- **Vegetation associated with riparian areas:** the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs:
  - in species composition relative to the adjacent terrestrial area; and
  - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, density, crowding, size, structure and/or numbers of individual plants.

  Only in the larger downstream ephemeral rivers and tributaries was a change in riparian vegetation identified from that of the terrestrial vegetation (Figure 17), where a mix of low tree and shrub species such as *Vahellia karroo, Searsia lancea, Lycium cinereum, Diospyros ausro-africana* and *Buddleja saligna* are prevalent (Ekotrust CC, 2018). Trees and shrubs are less prominent along the rocky episodic drainage lines located in the upper reaches of the drainage systems (Figure 17). Patches of *Phragmites australis* reeds, grasses such as *Stipagrostis namaquensis* with *Juncus spp* rushes were also identified in isolated patches within the ephemeral tributaries located in the valley bottom position, specifically where anthropogenic impacts have occurred, such as the construction of instream artificial impoundments.

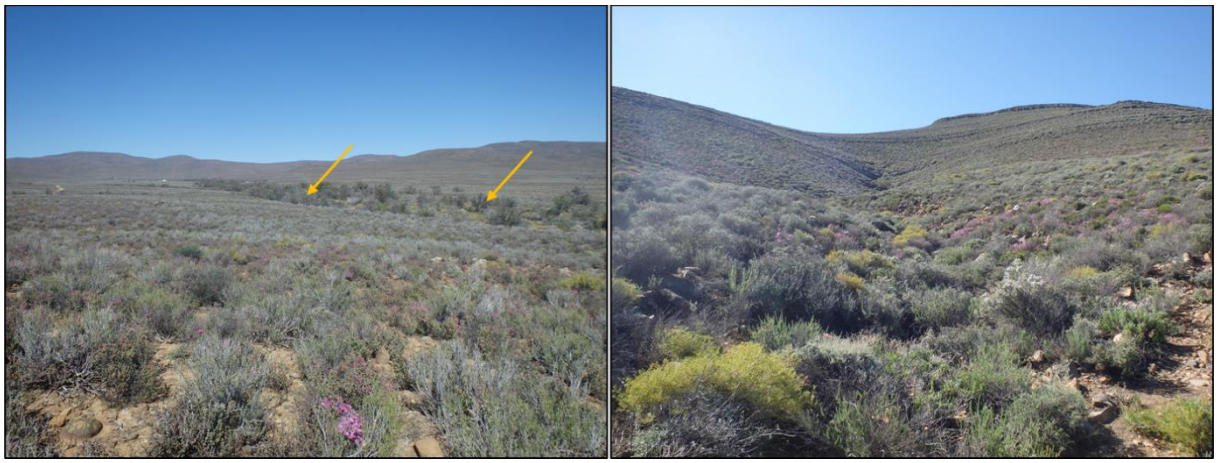


Figure 17: Photographs depicting the vegetation component of the watercourses associated with the proposed WEF development. (Left) the lower reaches of the ephemeral rivers host tree species (indicated by the yellow arrows) in its marginal zones, which can be easily distinguished from the surrounding terrestrial vegetation. (Right) the vegetation of the smaller episodic drainage line type watercourses is similar to that of the surrounding terrestrial areas.

- ***The presence of alluvial soils:*** The presence of alluvial soils was used as an indicator of riparian zones, as defined by the National Water Act, 1998 (Act No. 36 of 1998). The occurrence of alluvial deposited material adjacent to the active channel is a good indicator of the riparian zone of a riparian watercourse (such as that of the identified river, tributaries and ephemeral drainage lines). Alluvial soils are soils derived from materials deposited by flowing water, especially in the valley bottom position. Riparian areas often, but not always, have alluvial soils (Figure 18). While the presence of alluvial soils cannot always be used as a primary indicator to delineate riparian watercourses accurately, it can be used in conjunction with the topographical and vegetative indicators. Unlike wetland areas, riparian zones are usually not saturated for a long enough period of time for redoximorphic features to develop. This is because riparian watercourses are mainly driven by flow, originating from its local catchment which flows through the watercourse and does not reside in the riparian watercourse as with wetlands. This is specifically true for ephemeral and episodic systems that experience flash flooding in response to rainfall events.

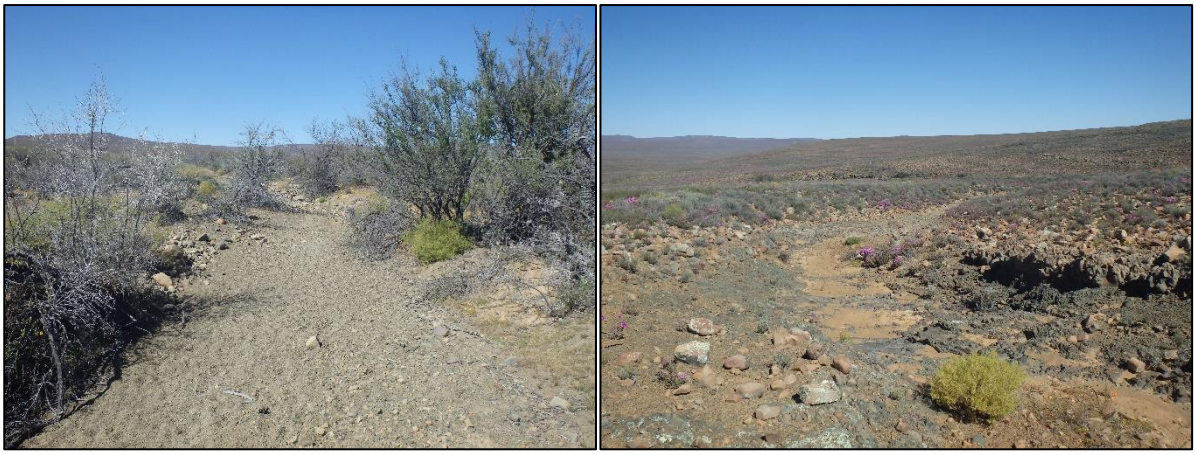


Figure 18: (Left) a shallow layer of alluvial soil is present in the active channel of this ephemeral tributary. (Right) the upper reaches of the tributaries and smaller episodic drainage lines have exposed bedrock, and only present with small isolated areas where alluvial soil is deposited.

5.3 *Watercourse classification and assessment*

The watercourses listed in Table 4 above were classified according to the Classification System outlined in **Appendix C** of this report as Inland Systems, located within the Great Karoo Ecoregion. Table 6 below presents the classification from level 3 to 4 of the Wetland Classification System (Ollis *et al.* 2013).

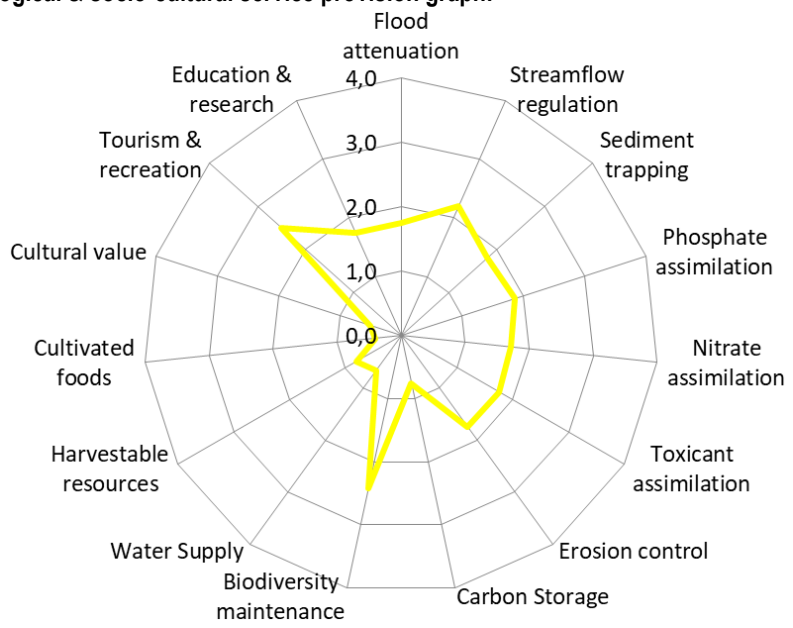
Table 6: Classification of the watercourses associated with the proposed WEF development.

Watercourse	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Windheuwels River & Tankwa River	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Ephemeral tributaries with riparian vegetation	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.	
Episodic Drainage lines		

Table 7 provides a summary of the ecological assessment of the watercourses (including the vernal pool) as assessed by BlueScience (2018) in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the watercourses. Due to the similar watercourse characteristics of the watercourses and each of these watercourse types having been subjected to the same anthropogenic impacts, the ecoservice provision, hydrological regime, geomorphological characteristics, water quality and habitat of these watercourses were assessed in a combined fashion. The details pertaining to the methodology used to assess the watercourses is contained in **Appendix C**.

Table 7: Summary of results of the assessment as obtained from Blue Science (2018) of the watercourses assocaited with the proposed WEF development.

Ecological & socio-cultural service provision graph:



Aquatic IHI discussion (as per BlueScience (2018)

IHI Riparian PES Category: A/B (Largely natural with few modifications)

Based on the assessment of the habitat integrity of the watercourses, BlueScience (2018) reports that the instream and riparian habitat integrity of the upper reaches of the watercourses are considered to be unmodified and natural. Their middle reaches and the middle reach of the Windheuwels River has seen some modification but is still reported to be in a largely natural ecological condition. The riparian habitat of the Windheuwels River is slightly more degraded as a result of direct habitat modification when compared to the reference conditions in both the marginal as well as non-marginal zones. Some disturbance from anthropogenic activity (informal road crossings and artificial instream impoundments) in the immediate surroundings of the watercourses were noted, which has resulted in some bank erosion, an increase in the presence of alien vegetation species and loss of tree diversity within the riparian zone.

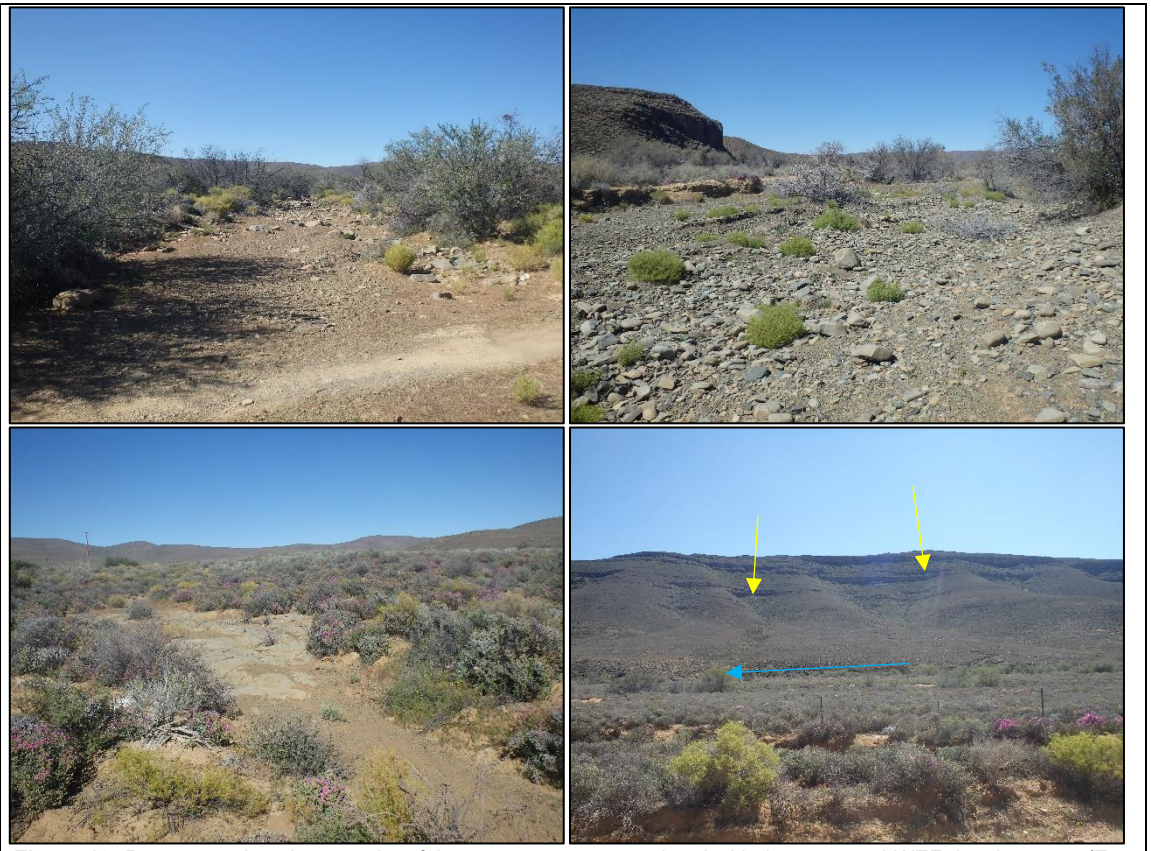


Figure 19: Representative photographs of the watercourses associated with the proposed WEF development. (Top left) a photograph of the ephemeral tributary of the Windheuwels River located east of the proposed construction camp. The active channel of these tributaries consists of a shallow layer of alluvial soil; (Top right) a photograph depicting the Ongeluks River; (Bottom left) An EDL associated with the Windheuwels River drainage system. These drainage lines are clearly defined by an unvegetated channel of exposed bedrock. No significant change between the vegetation associated with the edge of the drainage line channel to that of the surrounding terrestrial area is evident. (Bottom right) Typical topographical setting of the project area, displaying the locality of the headwater drainage lines (yellow arrow) flowing into an ephemeral tributary (blue arrow).

Ecoservice provision

Ecoservice Provisioning: 1,5 (Intermediate)

Due to the ephemeral nature of these watercourses, their capacity to provide certain ecological services is reduced, although this is counteracted by their relatively intact ecological integrity, which increases its overall functionality. These watercourses are considered important for biodiversity maintenance. As these are ephemeral watercourses, they are of seasonal importance for the supply of water for a variety of faunal species. The watercourses are not considered important for harvestable resources or cultivated foods, mainly due to them being located in a natural water scarce region.

EIS discussion (as per BlueScience (2018))

EIS Category: High (Windheuwels River & vernal pool) and Moderate (ephemeral tributaries and EDLs)

The larger watercourses located primarily downgradient of the proposed Kudusberg WEF (such as the Muishond, Ongeluks, Jakkalshok, Brak, Windheuwels, Wilgebos and Kleinpoorts Rivers), have a high ecological importance and sensitivity while the smaller tributaries/drainage features are of a moderate ecological importance and sensitivity. The larger watercourses tend to be more ecologically important but less sensitive to impacts while the smaller tributaries and drainage lines are less ecologically important but more sensitive to flow, water quality and habitat modification. Base on the outcome of the biodiversity assessment undertaken by Ekotrust CC (2018), the watercourses is also considered to be of 'High' sensitivity, due to the good ecological condition of the project site and minimal disturbance thereof. The high sensitivity ranking is attributed to the high level of protected species identified within the watercourses (Ekotrust CC, 2018).

REC Discussion (as per BlueScience (2018))

REC: Category B (Largely natural with few modifications)

Considering the natural to largely natural ecological condition of the drainage systems associated with the proposed WEF development and their moderate to high ecological importance and ecological sensitivities, the Recommended Ecological Condition (REC) of these watercourses would be that they remain in a natural ecological condition. This is with the exception of the middle reaches of the Windheuwels and Ongeluks Rivers that are in a largely natural to moderately modified ecological condition as a result of direct habitat modification from the surrounding activities. These rivers should be maintained in their current ecological condition and should not be allowed to degrade further.

Watercourse characteristics:

a) Hydraulic regime

Despite a relatively large drainage network associated with each drainage system identified, most of these watercourses only convey water during the wet season and do not consist of water bearing strata with the capacity to store and then to convey water to the downstream larger river systems. As such, discharge into the larger tributaries/rivers from the EDLs are highly variable due to the seasonal nature of the rainfall of the area. When flow occurs within the watercourses, it occurs as a high flow event, which can result in erosion of the stream banks. Notwithstanding the direct crossing of access roads and smaller informal roads, the hydrological connectivity and functionality of the watercourses are considered intact.

b) Geomorphology and sediment balance

Most of the larger tributaries and rivers are characterised by rocky embankments and a shallow layer of alluvial soils over a solid rock bed. Erosion was noted in areas where a high drop has formed, where water drops into a section of the active channel not underlain by bedrock. The geomorphology of the upstream reaches of the EDLs are considered largely intact. Some erosion of the downstream reaches of the EDLs just below the instream impoundments (where applicable) and at road crossings were noted, however, it is not considered significant. Despite erosion noted within isolated areas of the EDLs, no significant deposition of sediment was observed. As surface water is only present during and after rainfall events, sand and sediment are only transported through the EDLs into the tributaries and rivers during high flood periods. Thus, the sediment load of the tributaries and rivers is deemed to be high during flood events.

a) Water quality

No surface water was present within the watercourses during the site assessment; thus, no water quality parameters could be measured. Nevertheless, due to the relatively remote locality the watercourses (with specific mention of the headwater EDLs) and the low degree of catchment transformation, it can be concluded that when surface water is present, the water quality is likely to be good, with limited impacts from pollutants.

b) Habitat and biota

The larger watercourses (tributaries and rivers) are characterised by riverine terraces and ridges supporting a variety of macrophytic vegetation, marginal reed belts as well as riverine thickets (comprising low growing trees and shrubs). Although not necessarily large enough by themselves to support significant populations of fauna, habitat along the EDLs remains largely intact and representative of the natural vegetation type. The vegetation associated with the EDLs are predominantly short growing shrubs, but no facultative vegetation species were identified within these EDLs. Overall, the vegetation component of the watercourses assocaited with the Kudusberg WEF is considered intact (Ekotrust CC, 2018). Due to the seasonal nature of the watercourses, they do not retain water for a long enough period of time to provide breeding and foraging habitat for aquatic macro-invertebrates or avifaunal species. However, it does provide migratory connectivity as well as sheltered nesting habitat for terrestrial avifaunal species. Very few alien or invasive vegetation species were noted within the reaches of the watercourses verified during the site assessment, however within the footprint area of the Kudusberg WEF of the existing informal road crossings, alien vegetation species were noted where disturbances (such as the road crossings) had occurred.

Extent of modification anticipated	**Minimal** Some modification is anticipated to the extent of the EDLs. This is attributed to the construction of new roads through the watercourses, upgrading of the existing road crossings and the installation of underground cables along these road crossings. As such, changes to the flow pattern and timing in the watercourses and extensive erosion will need to be monitored to ensure that the hydrological connectivity of the watercourses are not adversely affected.	
Impact Significance:	**Low** (with the implementation of mitigation measures)	No proposed surface infrastructure (i.e. wind turbines or construction camps from either WEF development) will be located directly within any watercourses, however, existing roads traversing some watercourses may be upgraded or new roads may traverse these watercourses. Underground cables will be installed along existing and/or new road crossings. Such activities were identified to pose a negative moderate impact to the watercourses. Additionally, it is recommended that the proposed Kudusberg substation and Kudusberg WEF construction camp be relocated to be at least 32 m from the delineated extent of a watercourse. Should new roads be constructed during the driest period of the year (in order to ensure that no diversion of flow is required), the Kudusberg substation and Kudusberg WEF construction camp be relocated as recommended and the additional recommended mitigation measures as stipulated in Section 7 be applied, the risk significance can be reduced to a low impact. Once road watercourse crossing designs become available, with specific mention of the R356 road watercourse crossings, they should be reviewed by a freshwater ecological specialist and of the DWS Risk assessment be revised. It must be noted that the outcome of the DWS Risk assessment may thus change pending the outcome of the watercourse road crossing designs.

All comprehensive results calculated are available in **Appendix D.**

6 LEGISLATIVE REQUIREMENTS & SENSITIVITY MAPPING

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

- The Constitution of the Republic of South Africa, 1996[7];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

It is important to note that in terms of the definition of a watercourse as per the NWA (See **Appendix B**), all of the natural watercourses associated with the proposed WEF development (including the ephemeral rivers and tributaries with riparian vegetation and the episodic drainage lines with no riparian vegetation) will be regulated by Section 21(c) and (i) of the NWA as well as the applicable zones of regulation. All the natural watercourses will thus require further authorisation from the Department of Environment, Forest and Fisheries (DEFF)) and the Department of Water and Sanitation (DWS). This report aids in providing relevant information for these authorisation processes.

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on watercourses 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 definition and motivation for a regulated zone of activity for the protection of the assessed watercourses can be summarised in Table 8 that follows.

[7] 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.

Table 8: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). **Department of Water and Sanitation (DWS)**	**Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)** In accordance with GN509 of 2016 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 21c and 21i is defined as: • the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the **absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse** where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. **Department of Environment, Forestry and Fisheries**	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:* *(xii) Infrastructure or structures with a physical footprint of 100 square meters or more;* *Where such development occurs—* *a) Within a watercourse;* *b) In front of a development setback; or* *c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse.* **Activity 19:** *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from –* *(a) a watercourse* Activities of Listing Notice 3 (GN 985) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) **Activity 14:** *The development of –* *(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; or* *c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse* **Activity 23:** *The expansion of –* *(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; or* *c) If no development setback has been adopted, within **32 meters 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;*

Regulatory authorisation required	Zone of applicability
	Where such expansion occurs- *a) Within a watercourse;* *b) In front of a development setback; or* *c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse*

A 32 m Zone of Regulation (ZoR) in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) and in the absence of a defined 1 in 100 year flood line, a 100 m Zone of Regulation in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA were applied to the ephemeral river and tributaries with riparian vegetation and the episodic drainage lines with no riparian vegetation associated with the proposed WEF development (Figures 20 to 26). It must be noted that the 1:100 year floodline for the Ongeluks River and for the Windheuwels River is modelled (NatureStamp, 2020). As such all proposed infrastructure components, with specific mention of overhead power line pylons (associated with the Oya WEF development collector system) will be located above the 1:100 year floodline. However, linear infrastructure (such as road crossings) is proposed below the floodline. The proposed WEF development will encroach into the 100 m GN509 regulated area/modelled 1:100 year floodline, thus Water Use Authorisation (WUA) from the DWS is required prior to commencement of any construction. Based on the outcome of the DWS Risk Assessment as per Section 7, Water Use Authorisation by means of General Authorisation in terms of Section 21(c) and (i) water uses may potentially be obtained in consultation with the DWS.

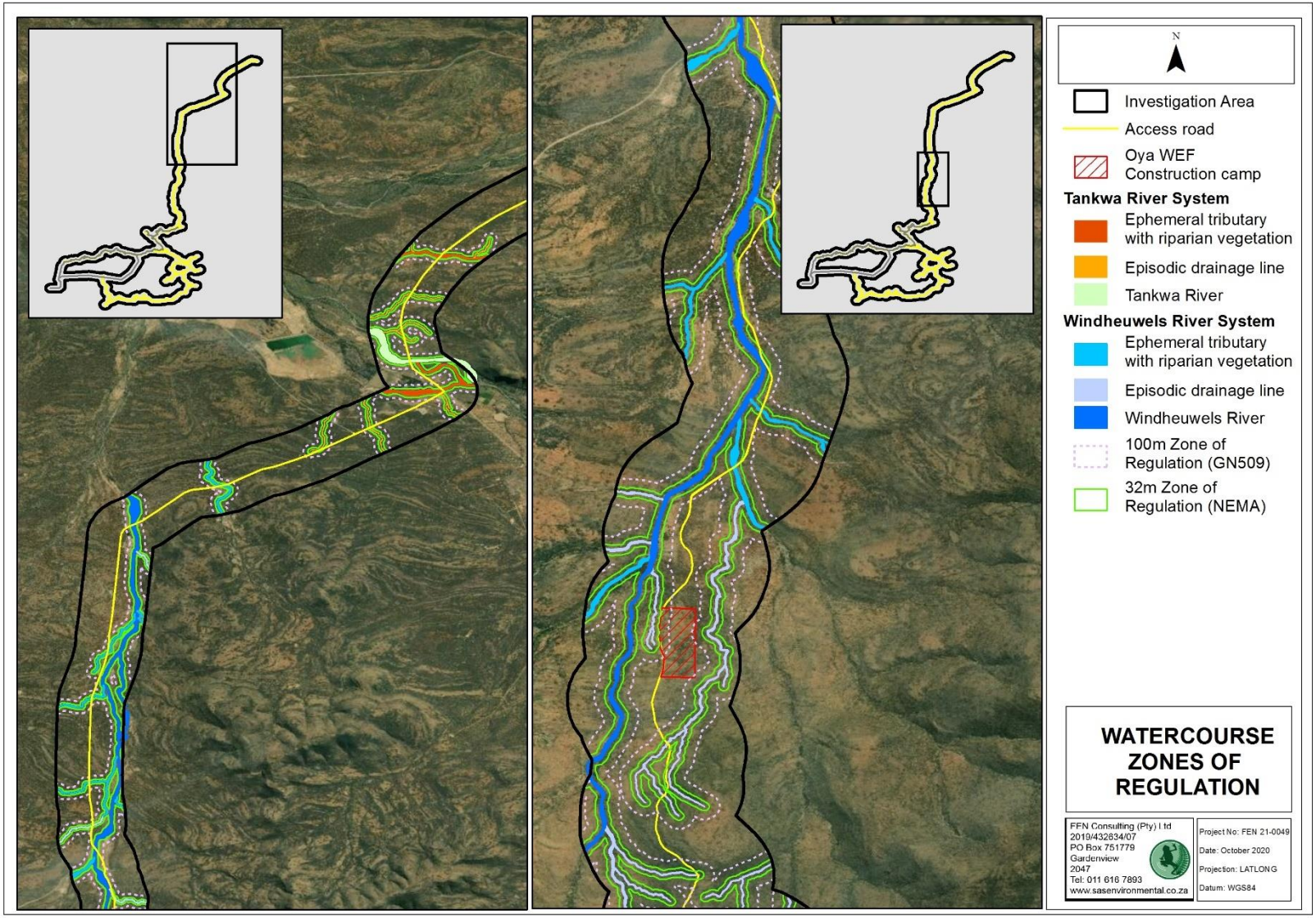


Figure 20: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the delineated watercourses that form part of the Tankwas and Windheuwels River system along the proposed access road and construction camp.

Figure 21: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the delineated watercourses that form part of the Kleinpoorts River system.

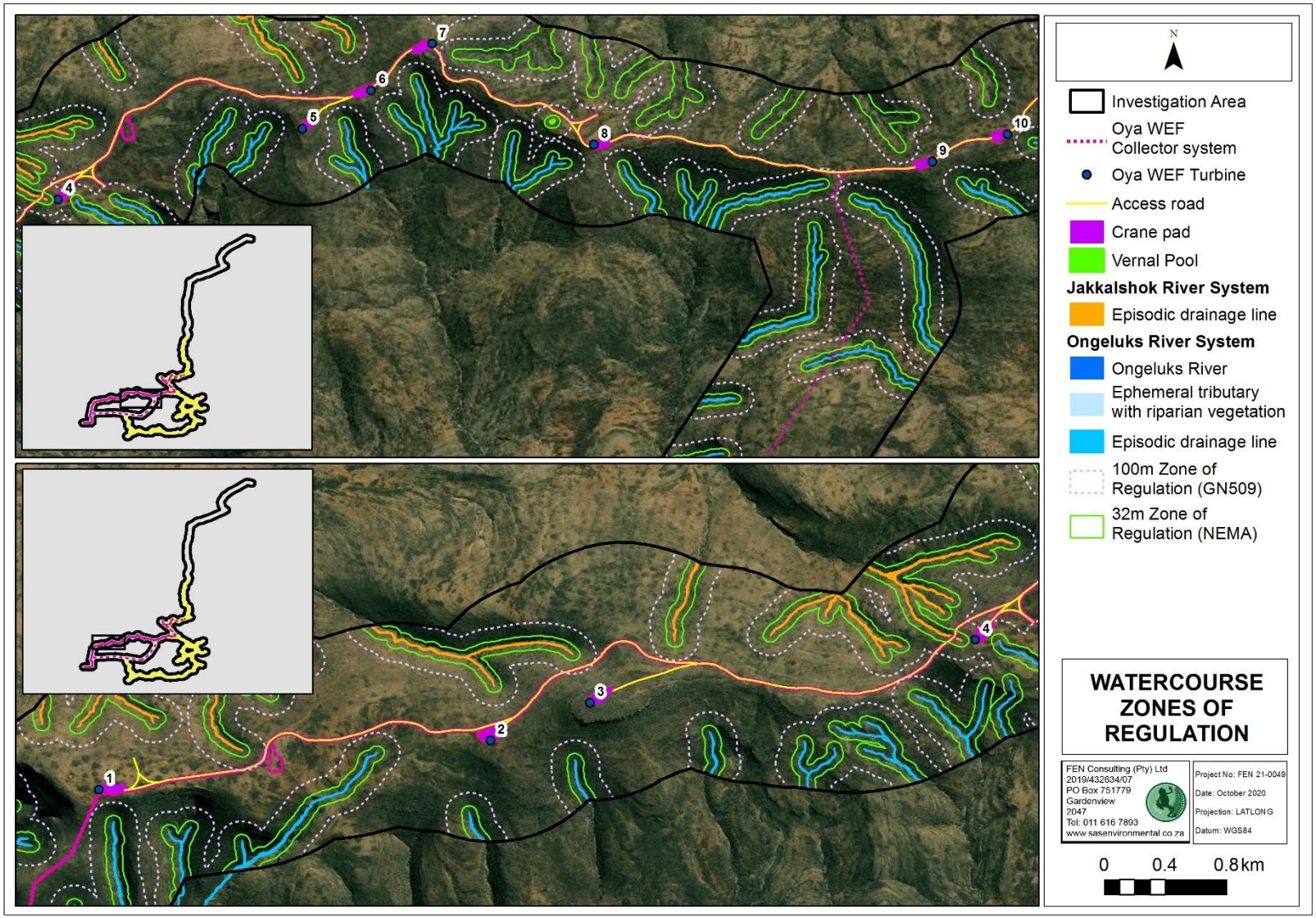


Figure 22: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the delineated watercourses that form part of the Brak River system.

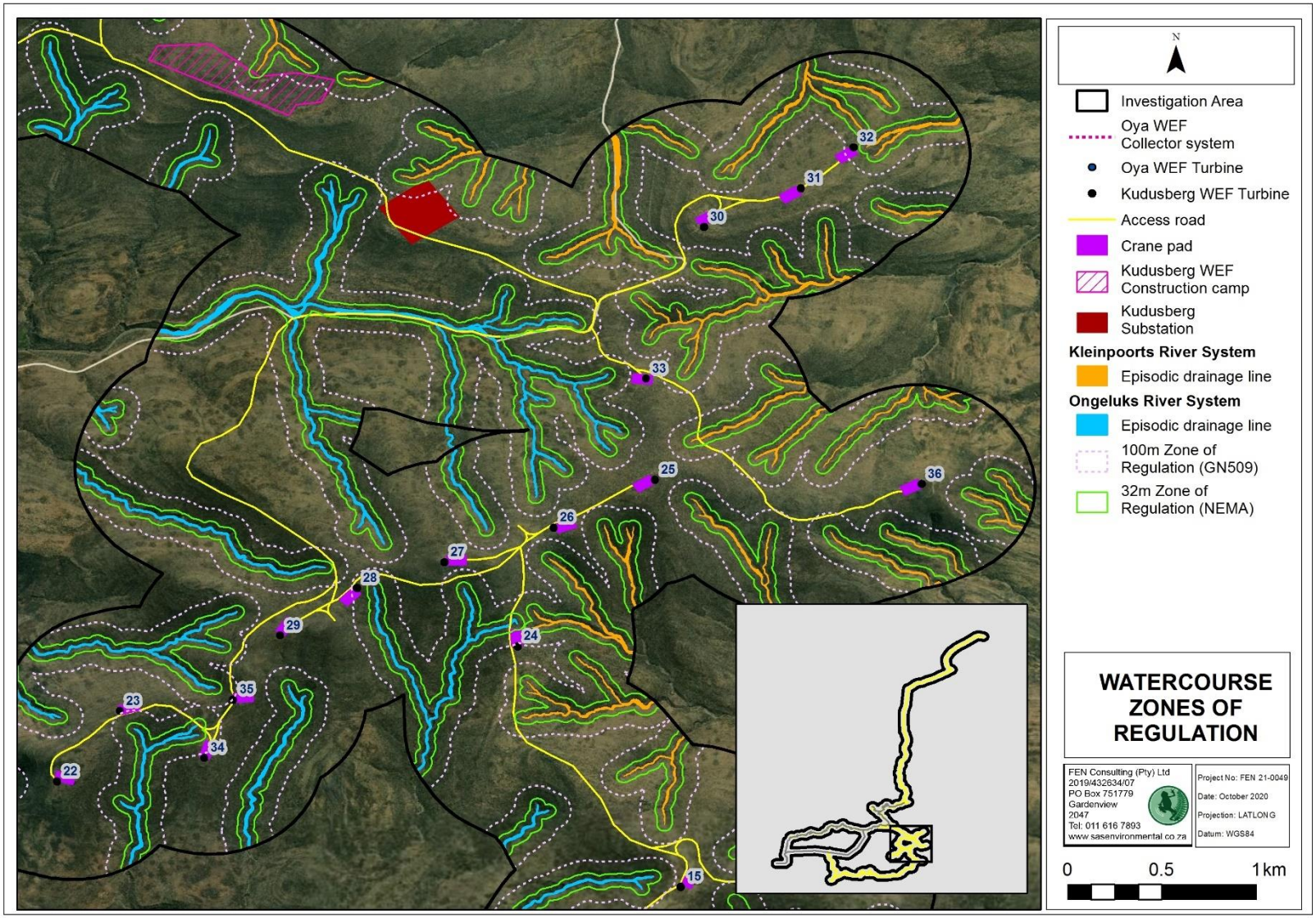


Figure 23: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the delineated watercourses that form part of the Jakkelshok and Ongeluks River systems.

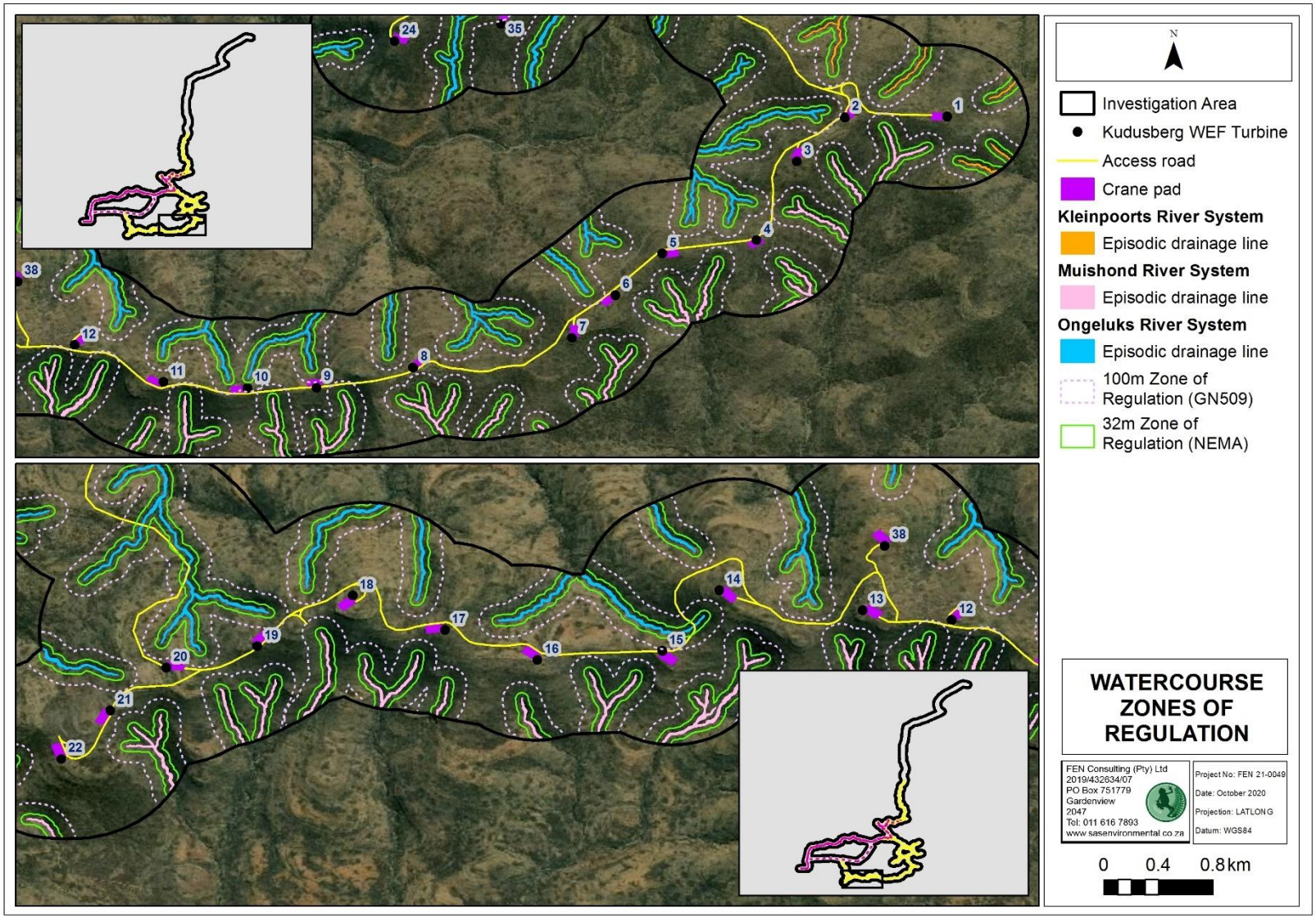


Figure 24: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the delineated watercourses that form part of the Kleinpoorts, Muishonds and Ongeluks River systems.

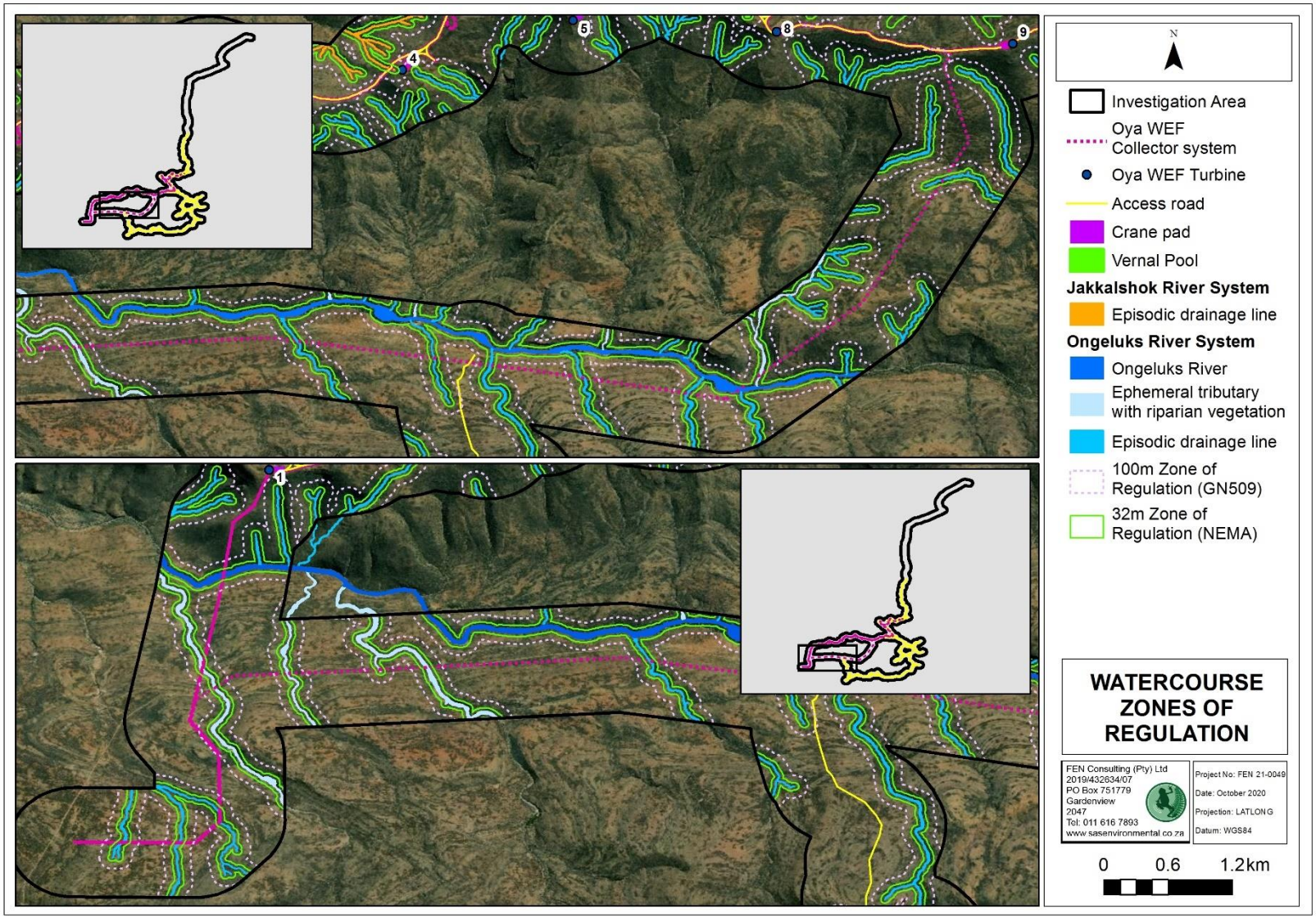


Figure 25: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the delineated watercourses that form part of the Ongeluks River system.

7 DWS RISK ASSESSMENT

This section presents the significance of potential impacts on the ecology of the identified watercourses associated with the proposed WEF development. In addition, it also indicates the recommended mitigatory measures needed to minimise the perceived impacts of the proposed WEF development and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures.

7.1 *Risk Assessment considerations and outcome*

Following the assessment of the watercourses associated with the proposed WEF development, the impact assessment was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these watercourses. The impact assessment was undertaken for the proposed layout as provided by the proponent and as described in Section 2 of this report and presented in Figures 1 and 2. The points below summarise the considerations made when applying the impact assessment:

- The risk assessment was applied considering the risk significance of the proposed surface infrastructure components, as described in Section 2 and depicted in Figure 1;
- The proposed overhead collector system of the Oya WEF and proposed access road will directly traverse watercourses (Table 9). However, it noted that all pylons will be constructed outside of the delineated extent of the watercourses and at least 32 m from its delineated extent. Additionally, several other portions of the internal roads are located within the 100 m GN509 Zone of Regulation (ZoR). Table 9 below provides a summary of all the turbines and crane pads within the 100 m GN509 ZoR that were considered as part of the risk assessment. The risk significance of roads, turbines and crane pads located outside of the 100 m GN509 ZoR were not considered as these components are considered to not pose a quantum of risk to the identified watercourses due to their distance from the watercourses (located more than 100 m from watercourses);

Table 9: Summary of the distance the proposed surface infrastructure components are located relative to a watercourse.

Proposed surface infrastructure component	Approximate distance from the closest watercourse
Oya WEF	
Construction camp	32 m from ephemeral tributary of the Windheuwels River system
Turbine 4	60 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 4	44 m from episodic drainage line of the Ongeluks River system
Kudusberg WEF	
Crane pad associated with Turbine 6	97 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 9	81 m from episodic drainage line of the Ongeluks River system
Turbine 10	70 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 10	47 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 23	26 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 25	88 m from episodic drainage line of the Ongeluks River system
Turbine 27	76 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 27	65 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 35	42 m from episodic drainage line of the Ongeluks River system
Crane pad associated with Turbine 36	77 m from episodic drainage line of the Ongeluks River system
Turbine 34	57 m from episodic drainage line of the Kleinpoorts River system
Crane pad associated with Turbine 34	51 m from episodic drainage line of the Kleinpoorts River system
Kudusberg WEF Construction camp	11 m from episodic drainage line of the Kleinpoorts River system It must be noted that the layout of the construction camp will be revised, to be constructed outside of the delineated extent of the watercourses and at least 32 m from its delineated extent.
Kudusberg substation	26 m from episodic drainage line of the Kleinpoorts River system

	It must be noted that the layout of the substation will be revised, to be constructed outside of the delineated extent of the watercourses and at least 32m from its delineated extent.
Access road crossings	
R356 access road and internal access road towards Oya WEF construction camp	Traverses the Tankwa River, the Windheuwels River and several tributaries and EDLs of the Windheuwel River system.
Access road south east of Oya WEF Turbine 16	Traverse EDL of the Windheuwel River system.
Access road between Oya WEF Turbine 14 and 15	Traverse EDL of the Windheuwel River system.
Access road between the Kudusberg Substation and Kudusberg WEF Turbines 27 to 31	Traverse ephemeral tributary of the Ongeluks River system
Access road between Kudusberg WEF Turbine 25 and 35	Traverse EDL of the Ongeluks River system
Access road between Kudusberg WEF Turbine 28 and 23	Traverse EDL of the Ongeluks River system
Access road between Kudusberg WEF Turbine 14 and 15	Traverse EDL of the Ongeluks River system
Access road from Kudusberg WEF Turbine 20 connecting to the Oya WEF collector station	Traverses several EDLs of the Ongeluks River system.
Oya WEF overhead collector system	
Overhead power line & associated pylons	Several watercourses associated with the Ongeluks River System are traversed by the overhead power line. It must be noted that all pylons will be constructed outside of the delineated extent of the watercourses and at least 32 m from its delineated extent.

- The risk assessment was applied assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report present the perceived impact significance post-mitigation;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the Department of Environment, Forestry and Fisheries (DEFF) *et a*l (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. In this regard, the risk assessment was undertaken assuming that the location of the proposed Kudusberg WEF construction camp and Kudusberg substation will be reconsidered and will be located at least 32 m (outside the 32 m regulated zone in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998)) from the delineated extent of the watercourse. This will conform to the mitigation hierarchy of the DEFF *et a*l (2013), to avoid significant impacts to the watercourses. However, it is still acknowledged that new road watercourse crossings will be constructed, and the existing roads upgraded, and thus direct impacts to the watercourses from this activity are considered inevitable;
- At the time of this assessment, no designs for the proposed watercourse road crossings (with specific mention of the proposed upgrading of the R356 access road) were available, nor were the proposed layout for underground cables for the Kudusberg WEF available. It is assumed that as far as feasible the underground cables will follow the proposed internal roads, specifically at watercourse crossings. As such, once these designs become available, they should be reviewed by a freshwater ecological specialist and the DWS Risk assessment be revised (as necessary). It must be noted that the outcome of the DWS Risk assessment may thus change pending the outcome of the watercourse road crossing designs;
- A separate risk assessment was undertaken for assessing the R356 access road risk significance on watercourses (Table 11), since this road is an existing road and entails existing large watercourse crossings via culvert and bridge crossings. As mentioned above, no specific details regarding the upgrade of this road were available at the time of this assessment, as such, the following considerations pertaining potential upgrade activities were assessed in Table 11:

  - The road will remain a gravel road, that will be re-gravelled;
  - Widening of the road will be limited to turns in the road, thus widening of watercourse crossings was not considered as part of this risk assessment;
  - Low water informal crossings will remain as such, and no formal crossings will be constructed at these crossing points.
- The default score for legal issues (for all watercourses proposed to be traversed) is '5' since some activities, as listed in Table 8, will be located within the 100 m ZoR in terms of GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The activities relating to the proposed WEF development are all considered to be highly site specific, not of a significant extent relative to the area of the watercourses assessed, and therefore have a limited spatial extent;
- While the operation of the proposed WEF development will be a permanent activity, the construction thereof is envisioned to take between 12 and 24 months. However, the frequency of the construction impacts may be daily during this time;
- Most impacts are considered to be easily detectable, with the exception of contamination of surface and groundwater (which will require some effort); and
- The considered mitigation measures are easily practicable.

Table 10 and 11 below provides a summary of the outcome of the DWS Risk Assessment for the above-listed activities, based on the method presented in **Appendix D.** All general good housekeeping mitigation measures and the full impact assessment scoring is provided in **Appendix F**.

Table 10: Summary of the results of the DWS risk assessment applied to the proposed WEF development activities.

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
1	Construction Phase	Site preparation prior to construction activities of surface infrastructure components located outside the watercourses and at least 32 m from the delineated extent of a watercourse, but still within the 100 m GN509 ZoR, which includes the Oya WEF overhead collector system, Oya WEF construction camp, Kudusberg WEF construction camp, Kudusberg Substation and the identified crane pads within the 100m GN509 ZoR.	Vehicular movement (transportation of construction materials)	• Loss of watercourse vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	1	3	12	36	L	As this activity was assessed based on the recommendation that the proposed Kudusberg WEF construction camp, Kudusberg substation an Kudusberg WEF Turbine 23 crane pad and all pylons associated with the Oya WEF overhead collector system power line would be located at least 32m from the delineated extent of a watercourse (thus outside the 32m NEMA ZoR), this in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DEFF et al. (2013). The presence of various other Kudusberg WEF crane pads (as listen in Table 9) within the 100m GN509 ZoR but at least 42m from the delineated extent of a watercourse is not considered to pose a direct negative impact to the watercourses. Since no site preparation activities associated with the construction of the surface infrastructure will be within the 32 m of these watercourses, the risk significance thereof will be "Low". The following mitigation measures should be implemented to retain a "Low" risk significance: • All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; • Retain as much indigenous vegetation as possible; • All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility; • During construction of the surface infrastructure within close proximity to a watercourse, regular spraying of non-potable water or the use of chemical dust suppressants must be implemented to reduce dust and to ensure no smothering of vegetation within the watercourses occurs from excessive dust settling. It must be noted that specifics as to what type of dust suppressant (grey water vs. chemical dust suppressant) that will be utilised as part of the proposed WEF development was not available at the time of assessment. Should this detail become available, it is recommended that the freshwater ecologist provide a statement on the suitability of the use of the proposed dust suppressant; • The watercourses 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 watercourses (except on approved road crossings); • As far as possible, existing roads must be utilised to gain access to sites; • Contractor laydown areas, and material storage facilities to remain outside of the 32 m ZoR; • All vehicle re-fuelling is to take place outside of the 32 m ZoR; and	NA
2			Removal of vegetation and associated disturbances to soils.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; • Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; • Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1	3	12	36	L		NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
										• No vegetation may be removed from the 32 m ZoR surrounding the watercourse where no infrastructure is planned, as this provides a natural buffer zone around the watercourses which disperse surface runoff into the watercourses, and thus prevents sedimentation and erosion thereof.	
3		Site preparation prior to construction activities relating to the upgrading of existing roads and installation of underground cables traversing through watercourses.	Removal of vegetation and associated disturbances to soils.	• Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1,75	3,75	14	52,5	L	• It is imperative that all construction works be undertaken during the driest period of the year when there is no flow within the watercourses, and thus no diversion of flow would be necessary; • The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas can be marked at a maximum distance of 5 m upstream and downstream of the proposed road upgrade crossing. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the watercourse crossing where the road is proposed to be upgraded; • For trenching of the cables, the topsoil has to be stored separately and may not be contaminated. Furthermore, the soil layers should be replaced in the same order and the topsoil returned last; • Contractor laydown areas, vehicle re-fuelling areas and material storage facilities are to remain outside of the watercourses and at least 32m from the delineated extent; and • The removed vegetation must be stockpiled outside of the delineated boundary of the watercourse. The footprint areas of these stockpiles should 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.	NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
4		Site preparation prior to the construction of new roads and installation of underground cables (along new roads) traversing through watercourses.	Removal of vegetation and associated disturbances to soils.	• Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	2,5	4,5	15	67,5	M	It is considered imperative that road watercourse construction works be undertaken during the driest periods of the year to limit surface water contamination and the need for any surface water diversion during the construction works (diverting the flow of water through a pipe or an excavated channel was not included as part of this risk assessment). In so doing, the severity scoring (specifically pertaining to the flow regime) will be significantly reduced as would the frequency of an impact. Should this specific mitigation measure be implemented and with implementation of the mitigation measures as per **Activity 3 above**, it is the opinion of the freshwater ecologist that the risk of the proposed road crossing construction in the watercourses be deemed 'low'.	L (-7)
5		Construction of surface infrastructure outside of the watercourses and at least 32 m from the delineated extent of a watercourse (as all proposed infrastructure will be located outside the 32m NEMA ZoR), but still within the 100 m GN509 ZoR, which includes the Oya WEF overhead collector system, Oya WEF construction camp, Kudusberg WEF construction camp, Kudusberg Substation and the identified crane pads within the 100m GN509 ZoR.	• Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Mixing and casting of concrete for construction purposes; • Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the potential to affect the watercourse habitat; • Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; • Potential impacts on the water quality of surface water runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete casting; and • Potential of backfill material entering the watercourses, increasing the sediment loads therein.	1	3	12	36	L	As this activity was assessed based on the recommendation that the proposed Kudusberg WEF construction camp, Kudusberg substation an Kudusberg WEF Turbine 23 crane pad and all pylons associated with the Oya WEF overhead collector system power line would be located at least 32m from the delineated extent of a watercourse (thus outside the 32m NEMA ZoR), this in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DEFF et al. (2013). The presence of various other Kudusberg WEF crane pads (as listen in Table 9) within the 100m GN509 ZoR but at least 42m from the delineated extent of a watercourse is not considered to pose a direct negative impact to the watercourses. Since no site preparation activities associated with the construction of the surface infrastructure will be within the 32 m of these watercourses, the risk significance thereof will be "Low". If the following mitigation measures are adhered to, the risk significance of the construction of surface infrastructure would be of Low risk significance: With regards to ground-breaking activities at least 32 m from the delineated extent of a watercourse, but within the 100 m GN509 ZoR: • During excavation activities, the topsoil and vegetation should be stockpiled separately from other material outside of the 32 m NEMA ZoR; • Excavated materials should not be contaminated, and it should 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 should 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 watercourses; • Suitable drainage should be insured along the crane pads, in order to ensure that water does not pond on the crane pad or drain in a concentrated manner into the watercourses. This must be considered as part of the stormwater management plan and be overseen by a freshwater ecologist;	NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
										• Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the watercourses which may result in the reduction of surface roughness. This can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction areas enter the watercourses by installing silt traps or placing haybales down gradient 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: • No mixed concrete may be deposited outside of the designated construction footprint; • Protective equipment should be provided, onto which any mixed concrete can be deposited while it awaits placing; and • Concrete spilt outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site. With regards to backfilling of excavated areas: • Stockpiled material should be used as backfill material; • All excavated areas should 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. Rehabilitation of the construction footprint areas: • All footprint areas which have been compacted should be ripped and revegetated within indigenous vegetation as soon as the construction activities have been completed. This will prevent soil erosion and the creation of gullies within the operational area; and • The operational area should regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.	

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
6		Upgrading of existing road crossings and trenching through the watercourses.	• Compaction of soil in the existing road crossing footprint to increase the width of the roads; and • Importation of materials to construct the roads.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1,75	3,75	14	52,5	L	• During the upgrading of existing internal roads and associate cable installation that may potentially traverse watercourses, a buffer of no more than 5 m on either side of the road crossing footprint through the watercourses may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; • Material to be used (gravel – if applicable) as part of the upgrading of the existing roads must be stockpiled outside the 32 m NEMA ZoR of the watercourses 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 should be protected from wind using tarpaulins; • Any remaining soils following the completion of backfilling of the trenches are to be spread out thinly in an area within the watercourses to aid in the natural reclamation process; • After upgrading of roads traversing watercourses, the 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; • It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; and • All existing alien and invasive vegetation should be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.	NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
7	CONSTRUCTION PHASE	Construction of new road crossings and trenches through watercourses	• Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Compaction of soil in the road crossing footprint area; • Importation of materials to construct the roads; • Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Disturbances of soils leading to increased alien vegetation proliferation within the watercourses, thus impacting on the watercourse habitat; • Altered runoff patterns within the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; and • Potential of imported materials to entering the watercourses, increasing the sediment loads therein.	2,25	4,25	15	63,75	M	It is considered imperative that watercourse road construction works be undertaken during the dry period to limit surface water contamination and the need for any surface water diversion during the construction works (diverting the flow of water through a pipe or an excavated channel was not included as part of this risk assessment). In so doing, the severity scoring (specifically pertaining to the flow regime) will be significantly reduced as would the frequency of an impact. Should this specific mitigation measure be implemented and with implementation of the below mitigation measures it is the opinion of the freshwater ecologist that the risk of the proposed road crossing construction in the watercourses be deemed 'low': • The design of the new road crossings should ensure that no erosion occurs, specifically along the embankments of the watercourse. As such, vegetation must be established in the construction footprint immediately after the construction of the road/ installation of cables is complete; • New road crossings must intersect the watercourse at a right angle (perpendicular) to minimise disturbance to the watercourse; • No road crossing designs were available at the time of this assessment. However, it is strongly advised that suitably sized culverts be installed within all road crossings and vehicles should not be allowed to cross within the riverbed. This will ensure hydrological connectivity is maintained and no hydrocarbons are not washed into the downstream watercourses from potential vehicle spills. Should road crossing designs become available, it is advised that it be revised by a freshwater ecologist; • During the construction of roads and associate cable installation that may potentially traverse watercourses, a buffer of no more than 5 m on either side of the proposed road crossing footprint through the watercourses may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; • Soils excavated from the cable trench must be stockpiled immediately upstream of the trench. Once the cable is installed the trench must be infilled with the removed material and suitably compacted to avoid any erosion and preferential flow paths from forming; and • Any remaining soils following the completion of backfilling of the trenches are to be spread out thinly in an area within the watercourses to aid in the natural reclamation process.	L (-7)

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
6	OPERATIONAL PHASE	Operation and maintenance of the surface infrastructure outside the watercourses and at least 32 m from the delineated extent of a watercourse, but still within the 100 m GN509 ZoR.	• Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; and • Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (such as from crane pads and the construction camp)	• Disturbance to soils 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.	1,5	3,5	12	42	L	• No indiscriminate movement of construction equipment through the watercourses may be permitted during standard operational activities or maintenance activities. Use must be made of the existing watercourse 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 watercourses; • 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; • Should erosion be noted at the base of the pylon that may potentially impact on a watercourse in the surrounding area, 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 receiving watercourses. Should these impacts be noted, these gullies/preferential flow paths must be infilled with *in situ* material and appropriately stabilised and/or revegetated; and • Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the road crossings and surface infrastructures. 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.	NA
7		Operation and maintenance of roads (new and existing) traversing watercourses.	• Concentrated runoff entering the watercourses; and • Disturbance to the vegetation within and surrounding the watercourses.	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	1,75	3,75	12	45	L	• 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 should be monitored (by the Operation and Maintenance (O&M) Manager), to ensure it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas); • Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the watercourses may be permitted; • During periodic maintenance activities of the roads/surface infrastructure, monitoring for erosion should be undertaken; and	NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
										• 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, as a natural dispersal mechanism.	
8	**DECOMMISSIONING PHASE**	Removal of all surface infrastructure from the project area.	• Movement of construction vehicles and personnel; and • Disturbance to the buffer zone surrounding the watercourses.	• Disturbance of soil and vegetation that established within the operational area.	1,75	3,75	13	48,75	L	• No indiscriminate movement of construction equipment in the watercourses and buffer zones surrounding the watercourses may be permitted. Use must be made of the existing roads during the decommissioning phase; • All surface infrastructure must be decommissioned. All materials must be removed from the watercourses (where applicable) and may temporarily be stockpiled outside the 32 m NEMA ZoR, where after is 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 watercourses. The velocity of surface water flow from these areas must be reduced by ensuring that the vegetation in the buffer area surrounding the watercourses are intact or by the strategic placement of silt traps of haybales 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 construction and operational phases 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 watercourses; • 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 the watercourse 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; • Watercourse embankments must be suitably rehabilitated (shaped end revegetated) to prevent any erosion from occurring; • All bare areas in the project area, specifically where vegetation was initially cleared for surface infrastructure components) must be ripped and be revegetated within suitable indigenous vegetation species; • Follow up revegetation should take place in areas where initial revegetation is not successful;	NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
										• It is recommended that a Watercourse Rehabilitation and Management Plan must be compiled and implemented. Implementation must be overseen by a suitably qualified Environmental Site Officer (ESO) and the ESO must sign off the rehabilitation before the relevant contractors leave site; and • Post-closure monitoring of the watercourses (for a period of 3 years), with specific mention of the invasion of alien vegetation species) is recommended to be undertaken.	

Table 11: Summary of the results of the DWS risk assessment applied to the upgrading of the R356 access road.

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
1	CONSTRUCTION PHASE	Site preparation prior to construction activities relating to the upgrading of the existing R356 road through watercourses (existing watercourse crossings).	Removal of vegetation and associated disturbances to soils.	• Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1,75	3,75	14	52,5	L	It is considered imperative that watercourse road construction works be undertaken during the dry period to limit surface water contamination and the need for any surface water diversion during the construction works (diverting the flow of water through a pipe or an excavated channel was not included as part of this risk assessment). In so doing, the severity scoring (specifically pertaining to the flow regime) will be significantly reduced as would the frequency of an impact. Should this specific mitigation measure be implemented and with implementation of the below mitigation measures it is the opinion of the freshwater ecologist that the risk of the proposed road upgrade activities within watercourses/over watercourses be deemed 'low. However, whenever specific details pertaining to the upgrade of the R356 road becomes available, this risk assessment should be revised'. • General mitigation measures as per Table 10, Activity 1 applies; • It is imperative that all construction works be undertaken during the driest period of the year when there is no flow within the watercourses, and thus no diversion of flow would be necessary; • The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas can be marked at a maximum distance of 5 m upstream and downstream of the proposed road upgrade crossing. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the watercourse crossing where the road is proposed to be upgraded; • Contractor laydown areas, vehicle re-fuelling areas and material storage facilities are to remain outside of the watercourses and at least 32m from the delineated extent; and • The removed vegetation must be stockpiled outside of the delineated boundary of the watercourse. The footprint areas of these stockpiles should 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.	NA

	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
2	CONSTRUCTION PHASE	Upgrading of existing road crossings	• Compaction of soil in the existing road crossing footprint to increase the width of the roads; and • Importation of materials to re-gravel the road	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1,75	3,75	14	52,5	L	• During the upgrading of the existing road that may potentially traverse watercourses, a buffer of no more than 5 m on either side of the road crossing footprint through the watercourses may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; • Material to be used (gravel) as part of the upgrading of the existing road must be stockpiled outside the 32 m NEMA ZoR of the watercourses 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 should be protected from wind using tarpaulins; • After upgrading of roads traversing watercourses, the 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; • It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; and • All existing alien and invasive vegetation should be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.	
3	OPERATIONAL PHASE	Operation and maintenance of the R356 road traversing watercourses.	• Concentrated runoff entering the watercourses; and • Disturbance to the vegetation within and surrounding the watercourses.	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	1,75	3,75	12	45	L	• 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 should be monitored (by the Operation and Maintenance (O&M) Manager), to ensure it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas); • Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the watercourses may be permitted; • During periodic maintenance activities of the roads/surface infrastructure, monitoring for erosion should 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, as a natural dispersal mechanism.	

The activities associated with the construction and operational phases of the proposed WEF development poses a moderate to low risk significance to the watercourses. Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, as recommended in Table 10, the significance of impacts arising from the construction and operation of the proposed infrastructure components located outside of the watercourses and at least 32 m from the delineated extent of a watercourse (with specific mention of the Kudusberg WEF construction camp, Kudusberg substation, Kudusberg WEF Turbine 23 crane pad and the pylons associated with the Oya WEF overhead collector system power line), but within the 100 m GN509 ZoR are likely to be of very low significance, with the implementation of mitigation measures, specifically sufficient stormwater management measures. However, the construction of watercourse road crossings will result in a Moderate risk significance to the watercourses, however, should the construction of the road crossings in the watercourses be undertaken in the driest period of the year when no surface flow is present and the recommended mitigation measures are applied, the risk significance of the proposed WEF development can be reduced and Water Use Authorisation by means of General Authorisation in terms of Section 21(c) and (i) water uses may potentially be obtained in consultation with the Department of Water and Sanitation (DWS). The DWS, the custodian of water resources in South Africa, must be consulted with regards to the outcome of this assessment. It must be noted that at the time of this assessment, no designs for the proposed watercourse road crossings were available. As such, once these designs become available, with specific mention of the R356 road watercourse crossings, they should be reviewed by a freshwater ecological specialist and f the DWS Risk assessment be revised. It must be noted that the outcome of the DWS Risk assessment may thus change pending the outcome of the watercourse road crossing designs.

It is recommended that ongoing monitoring of the surface water areas be undertaken to minimise the risk of indirect impacts on the overall watercourse integrity. Additional “good practice” mitigation measures applicable to a project of this nature are provided in **Appendix F** of this report.

8 CONCLUSION

FEN Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Kudusberg WEF and Oya WEF developments.

During the site visit undertaken on the 22nd and 23rd of September 2020 and on the 22nd to the 24th of October (early summer season), several headwater episodic drainage lines (EDLs) without riparian vegetation which flow into larger ephemeral tributaries located outside the investigation area were identified. Although these episodic drainage lines cannot be classified as rivers or streams in the traditional sense thereof due to the lack of saturated soils and riparian vegetation, they do still function as waterways, through episodic conveyance of water. Based on the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998), water does flow regularly or intermittently within these drainage lines, conveying water from the upgradient catchment area into the downgradient tributaries and the larger river systems outside the investigation area. As such, they can be considered as watercourses due to their importance for hydrological functioning and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998).

The results of the ecological assessment of the watercourses as determined by BlueScience (2018) are discussed in Section 5 of this report is summarised in the table below:

Table 12: Summary of results of the BlueScience (2018) ecological assessment as discussed in Section 5.

Watercourse	PES	Ecoservices	EIS	REC
Windheuwels River, Tankwa River, Ephemeral tributaries with riparian vegetation, and Episodic drainage lines	A/B (Largely natural with few modifications)	Intermediate (1,5)	High (Windheuwels River/Tankwa River) and Moderate (ephemeral tributaries and EDLs)	REC: Category B (Largely natural with few modifications)

No surface infrastructure components are located within any of the delineated watercourses, with the exception of road crossings (new and existing). However, the proposed Kudusberg WEF construction camp is located approximately 11 m an EDL, the Kudusberg substation is located approximately 26 m from an EDL and Kudusberg WEF Turbine 23 crane pad is located approximately 26 m from an EDL. As such it is recommended these infrastructure components be relocated at least 32 m from the delineated extent of the watercourse. The Oya WEF overhead collector power line will also traverse several watercourses, however the pylons will be constructed outside the 32m NEMA ZoR. The DWS Risk Assessment was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed watercourses and assuming that the above mentioned surface infrastructure components will be relocated as recommended.

No fatal flaws in terms of freshwater ecological aspects were identified. Should the construction of the road crossings in the watercourses be undertaken in the driest period of the year when no surface flow is present and the recommended mitigation measures are applied, the risk significance of the proposed WEF development can be reduced and Water Use Authorisation by means of General Authorisation in terms of Section 21(c) and (i) water uses may potentially be obtained in consultation with the DWS. However, the risk assessment outcome must be revised once detailed road designs becomes available and the DWS, the custodian of water resources in South Africa, must be consulted with regards to the outcome of this assessment.

Based on the findings of the freshwater ecological assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed WEF development poses a negative low risk to the integrity of the identified watercourses provided that adherence to cogent, well-conceived and ecologically sensitive construction plans are implemented and the mitigation measures provided in this report as well as general good construction practice are adhered to, the proposed WEF development is considered acceptable.

9 REFERENCES

BlueScience. 2018. Freshwater Specialist Study: Basic Assessment for the proposed development of the 325 MW Kudusberg Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces.

Bromilow, C. 2001. Revised Edition, First Impression. *Problem Plants of South Africa.* Briza Publications, Pretoria, RSA.

Dada R., Kotze D., Ellery W. and Uys M. 2007. WET-RoadMap: *A Guide to the Wetland Management Series*. WRC Report No. TT 321/07. Water Research Commission, Pretoria.

Department of Water Affairs and Forestry 2008 *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*. Report no. X. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water Affairs, 1999. South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources [Appendix W3].

De Villiers, C., Driver, A., Clark, B., Euston-Brown, D., Day, L., Job, N., Helme, N., Van Ginkel, CE., Glen, RP., Gordon-Gray, KD., Cilliers, CJ., Muasya, M and van Deventer, PP. 2011. *Easy identification of some South African Wetland Plants*. WRC Report No TT 479/10.

Ekotrust CC. 2018. Report On The Terrestrial Ecology (Flora And Fauna) Basic Assessment report for the proposed development of the 325 MW Kudusberg Wind Energy Facility located west of the R354 Between Matjiesfontein and Sutherland in the Northern and Western Cape

Henderson, L. 2001. *Alien Weeds and Invasive Plants*. Agricultural Research Council, RSA.

Job, N. 2009. Application of the Department of Water Affairs and Forestry (DWAF) wetland delineation method to wetland soils of the Western Cape.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2009. *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands*. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Malan, H.L., and Day, J.A. 2012. Water Quality and Wetlands: Defining Ecological Categories and Links with Land-Use. Water Research Commission. Report No 1921/1/12.

Mucina, L. & Rutherford, M.C. (eds) 2010. (CD set). The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

NatureStamp. 2020. Hydrological Assessment, Stormwater management & erosion control plan. for the proposed development of the 325 Mw Oya Wind Energy Facility and associated infrastructure, Witzenberg & Karoo Hoogland local municipality Cape winelands & Namakwa district municipality Western Cape & Northern Cape.

Nel, JL, Driver, A., Strydom W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J, Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. 2011a. *Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources*. Water Research Commission Report No. TT 500/11, Water Research Commission, Pretoria.

Ollis, DJ; Snaddon, CD; Job, NM & Mbona, N. 2013. *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems*. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Snaddon, K and Day, L. 2009. Prioritisation of City Wetlands. City of Cape Town Department of Environmental Resource Management, Cape Town.

The South African National Biodiversity Institute - Biodiversity GIS (BGIS) *[online].* Retrieved 2015/04/10 URL: http://bgis.sanbi.org

Van Oudtshoorn, F. 2004. Second Edition, Third Print. *Guide to Grasses of South Africa.* Briza Publications, Pretoria, RSA.

APPENDIX A: Indemnity and Terms of Use of this Report

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

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APPENDIX B: Legislative Requirements

The Constitution of the Republic of South Africa, 1996[8]	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 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 normalization 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, 1998 (Act No. 107 of 1998)	The National Environmental Management Act, 1998 (Act No. 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 Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	The objectives of this act are (within the framework of the National Environmental Management Act) to provide for: ➢ the management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity; ➢ the use of indigenous biological resources in a sustainable manner; ➢ the fair and equitable sharing among stakeholders of benefits arising from bio prospecting involving indigenous biological resources; ➢ to give effect to 'ratified international agreements' relating to biodiversity which are binding to the Republic; ➢ to provide for co-operative governance in biodiversity management and conservation; and ➢ to provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act. This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of surrounding areas is not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of benefits arising from indigenous biological resources. Furthermore, a person may not carry out a restricted activity involving either: a) a specimen of a listed threatened or protected species; b) specimen of an alien species; or c) a specimen of a listed invasive species without a permit. Permits for the above may only be issued after an assessment of risks and potential impacts on biodiversity is carried out. Before issuing a permit, the issuing authority may in writing require the applicant to furnish it, at the applicant's expense, with such independent risk assessment or expert evidence as the issuing authority may determine. The Minister may also prohibit the carrying out of any activity, which may negatively impact on the survival of a listed threatened or protected species or prohibit the carrying out of such activity without a permit. Provision is made for appeals against the decision to issue/refuse/cancel a permit or conditions thereof. ***National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (Alien and Invasive Species Regulations, 2014)*** 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. In terms of alien and invasive species. This act in terms of alien and invasive species aim 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. Alien species are defined, in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) as: (a) a species that is not an indigenous species; or

[8] 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.

	(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, 2014): ➢ **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. ➢ **Category 3**: Ornamentally used plants that may no longer be planted.
National Environmental Management: Biodiversity Act, 2004(Act No.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).
National Water Act , 1998 (Act No. 36 of 1998)	The National Water Act, 1998 (Act No. 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). A watercourse is defined as: 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.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act , 1998 (Act No. 36 of 1998)	In accordance with Government Notice (GN)509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: ➢ The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; ➢ In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or ➢ A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and storm water management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

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 watercourses and drainage line features present in close proximity of the proposed WEF development 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 feature present in the vicinity of the proposed WEF development.

1.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)*

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain 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 (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the watercourse traversed by the proposed linear development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All watercourses encountered within the study area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis et. al., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System 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) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

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

Level 1: Inland systems
From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean[9]** (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups
For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the 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) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

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

[9] 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.

- **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-Ecoservices (2009)

"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" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- 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 wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table C3: 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

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 the table below.

Table C4: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans et al. 2008]

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

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

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

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

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

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

Table C5: 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 watercourse (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C6: Recommended management objectives (RMO) for watercourses 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 watercourse fall into one of these PES categories, a REC class D is allocated by default, as the minimum acceptable PES category.**

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

Table C7: 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. Watercourse Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act, 1998 (Act No. 36 of 1998) as "land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".
The wetland zone delineation took place according to the method presented in the DWAF (2005) document "A practical field procedure for identification and delineation of wetlands and riparian areas.

An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;
- The presence of wetland vegetation species; and
- The presence of redoximorphic soil feature, which are morphological signatures that appear in soils with prolonged periods of saturation.

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 (DWAF, 2005 and 2008).
Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

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

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The 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[11].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

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

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

"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, an E or F	5
PES and EIS (sensitivity) must be considered.	

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

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

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

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

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

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

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

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

Table D8: Rating Classes

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

A low risk class must be obtained for all activities to be considered for a GA (after the application of mitigation measures)

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 develop 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[12] 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
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

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

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

APPENDIX E: Results of Field Investigation

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

Table E1: Presentation of the results of the IHI assessment applied to the watercourses as per BlueScience (2018).

Table 6. Instream Habitat Integrity assessment for the watercourses within the study area

Instream Criteria	Upper Muishond, Ongeluks, Jakkalshok, Brak, Windheuwels, Wilgebos and Kleinpoorts Rivers and unnamed tributaries & drainage features	Middle reaches of the Windheuwels and the Ongeluks Rivers
Water Abstraction	2	6
Flow Modification	3	5
Bed Modification	3	8
Channel Modification	3	4
Water Quality	2	5
Inundation	3	4
Exotic Macrophytes	0	0
Exotic Fauna	0	0
Rubbish Dumping	0	2
Instream Integrity Class	A	A/B

Table 7. Riparian Habitat Integrity assessment for the watercourses within the study area

Riparian Category	Upper Muishond, Ongeluks, Jakkalshok, Brak, Windheuwels, Wilgebos and Kleinpoorts Rivers and unnamed tributaries & drainage features	Middle reaches of the Windheuwels and the Ongeluks Rivers
Vegetation Removal	2	4
Exotic Vegetation	2	4
Bank Erosion	3	5
Channel Modification	2	4
Water Abstraction	2	5
Inundation	3	4
Flow Modification	3	6
Water Quality	2	5
Riparian Integrity Category	A/B	B/C

Table 10. Wetland habitat integd to 5=unmodified)

Criteria & Attributes	Vernal pools
Hydrological	
Flow Modification	4.8
Permanent Inundation	5
Water Quality	
Water Quality Modification	5
Sediment Load Modification	4.9
Hydraulic/Geomorphic	
Canalisation	5
Topographic Alteration	5
Biota	
Terrestrial Encroachment	4.9
Indigenous Vegetation Removal	5
Invasive Plant Encroachment	5
Alien Fauna	5
Over utilization of Biota	5
Total Mean	4.9
Category	A

Table E3: Presentation of the results of the Socio-cultural and Ecoservice provision provided by the assessed watercourses

Ecosystem service	Episodic drainage lines	Ephemeral tributaries
Flood attenuation	1,7	1,8
Streamflow regulation	1,6	2,2
Sediment trapping	1,6	1,8
Phosphate assimilation	1,9	1,9
Nitrate assimilation	1,7	1,7
Toxicant assimilation	1,8	1,8
Erosion control	2,1	1,8
Carbon Storage	0,8	0,8
Biodiversity maintenance	2,3	2,4
Water Supply	0,7	0,7
Harvestable resources	0,6	0,8
Cultivated foods	0,4	0,4
Cultural value	0,5	0,5
Tourism & recreation	2,0	2,5
Education & research	0,8	1,8
SUM	**20,3**	**22,6**
Average score	**1,4**	**1,5**

Table E4: Presentation of the EIS assessment applied to the assessed watercourses as per BlueScience (2018).

Biotic and Aquatic Habitat Determinants	Muishond, Ongeluks, Jakkalshok, Brak, Windheuwels, Wilgebos and Kleinpoorts Rivers	Unnamed tributaries & drainage features
Rare and endangered biota	1.5	2
Unique biota	2	1
Intolerant biota	2	2
Species/taxon richness	1.5	1.5
Diversity of aquatic habitat types or features	2.5	2
Refuge value of habitat type	2.5	2
Sensitivity of habitat to flow changes	2.5	3
Sensitivity of flow related water quality changes	2	2.5
Migration route/corridor for instream & riparian biota	2.5	1
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	1.5	1.5
EIS CATEGORY	High	Moderate

Ecological Importance	Vernal pools
Biodiversity support	2.33
Presence of Red Data species	3
Populations of unique species	3
Migration/breeding/feeding sites	1
Landscape scale	1.60
Protection status of the wetland	1
Protection status of the vegetation type	1
Regional context of the ecological integrity	2
Size and rarity of the wetland type/s present	2
Diversity of habitat types	2
Sensitivity of the wetland	1.67
Sensitivity to changes in floods	1
Sensitivity to changes in low flows/dry season	1
Sensitivity to changes in water quality	3
ECOLOGICAL IMPORTANCE & SENSITIVITY	2.33
Flood attenuation	0
Streamflow regulation	0
Sediment trapping	0.5
Phosphate assimilation	1
Nitrate assimilation	0
Toxicant assimilation	0
Erosion control	0
Carbon storage	0.5
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	0.25
Water for human use	0
Harvestable resources	0
Cultivated foods	0
Cultural heritage	0
Tourism and recreation	0
Education and research	1
IMPORTANCE OF DIRECT HUMAN BENEFITS	0.17
OVERALL IMPORTANCE (highest score of ecological, hydrological and direct human benefits)	2.33

APPENDIX F: Risk Analysis and Mitigation Measures

General construction management and good housekeeping practices

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

Development footprint

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

Vehicle access

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

Vegetation

- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)) Removal of species should take place throughout the construction, operational, and maintenance phases; and
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species*;* and
  - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

Soils

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

Rehabilitation

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

Risk significance on the watercourse ecology of the project area

The table below serves to summarise the anticipated impacts that might occur during the construction and operational phases as well as the mitigation measures that must be implemented in order to maintain and enhance the ecological integrity of the resource.

Table F1: DWS Risk Assessment outcomes for the proposed WEF development.

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Borderline LOW MODERATE Rating Classes
1	Construction Phase	Site preparation prior to construction activities of surface infrastructure components located outside the watercourses and at least 32 m from the delineated extent of a watercourse, but still within the 100m GN509 ZoR.	Vehicular movement (transportation of construction materials)	*Loss of watercourse vegetation, associated habitat and ecosystem services; *Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and *Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	1	1	1	1	1	1	1	3	5	1	5	1	12	36	L	NA
2			Removal of vegetation and associated disturbances to soils.	*Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; *Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; *Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and *Proliferation of alien and/or invasive vegetation as a result of disturbances.	1	1	1	1	1	1	1	3	5	1	5	1	12	36	L	NA

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Borderline LOW MODERATE Rating Classes
3		Site preparation prior to construction activities relating to the upgrading of existing roads and installation of underground cables traversing through watercourses.	Removal of vegetation and associated disturbances to soils.	Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; • Proliferation of alien and/or invasive vegetation as a result of disturbances.	2	1	2	2	1,75	1	1	3,75	5	3	5	1	14	52,5	L	NA
4		Site preparation prior to the construction of new roads and installation of underground cables (along new roads) traversing through watercourses.	Removal of vegetation and associated disturbances to soils.	Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; • Proliferation of alien and/or invasive vegetation as a result of disturbances.	2	1	4	3	2,5	1	1	4,5	5	4	5	1	15	67,5	M	L (-7)

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Borderline LOW MODERATE Rating Classes
5		Construction of surface infrastructure outside the watercourses and at least 32 m from the delineated extent of a watercourse, but still within the 100m GN509 ZoR.	• Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Mixing and casting of concrete for construction purposes; • Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the potential to affect the watercourse habitat; • Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; • Potential impacts on the water quality of surface water runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete casting; and • Potential of backfill material entering the watercourses, increasing the sediment loads therein.	1	1	1	1	1	1	1	3	5	1	5	1	12	36	L	NA
6		Upgrading of existing road crossings and trenching through the watercourses.	• Compaction of soil in the existing road crossing footprint to increase the width of the roads; and • Importation of materials to construct the roads.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; • Proliferation of alien and/or invasive vegetation as a result of disturbances.	2	1	2	2	1,75	1	1	3,75	5	3	5	1	14	52,5	L	NA

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Borderline LOW MODERATE Rating Classes
7		Construction of new road crossings and trenches through watercourses	• Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Compaction of soil in the road crossing footprint area; • Importation of materials to construct the roads; • Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Disturbances of soils leading to increased alien vegetation proliferation within the watercourses, thus impacting on the watercourse habitat; • Altered runoff patterns within the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; • Potential of imported materials to entering the watercourses, increasing the sediment loads therein.	3	1	3	2	2,25	1	1	4,25	5	4	5	1	15	63,75	M	L (-7)
6	OPERATIONAL PHASE	Operation and maintenance of the surface infrastructure outside the watercourses and the 32 m NEMA ZoR.	• Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; • Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure	• Disturbance to soils 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.	1	1	2	2	1,5	1	1	3,5	5	1	5	1	12	42	L	NA

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Borderline LOW MODERATE Rating Classes
7		Operation and maintenance of roads (new and existing) traversing watercourses.	• Concentrated runoff entering the watercourses; and • Disturbance to the vegetation within and surrounding the watercourses.	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	2	1	2	2	1,75	1	1	3,75	5	1	5	1	12	45	L	NA
8	**DECOMMISSIONING PHASE**	Removal of all surface infrastructure from the study area.	• Movement of construction vehicles and personnel; and • Disturbance to the buffer zone surrounding the watercourses.	• Disturbance of soil and vegetation that established within the operational area.	1	1	3	2	1,75	1	1	3,75	5	2	5	1	13	48,75	L	NA

APPENDIX G: Details, Expertise and Curriculum Vitae of Specialists

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

Christel du Preez	MSc Environmental Sciences (North West University)
Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Stephen van Staden	MSc Environmental Management (University of Johannesburg)

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

Company of Specialist:	SAS Environmental Gorup of Companies		
Name / Contact person:	Christel du Preez		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	074 580 6823
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	christel@sasenvgroup.co.za		
Qualifications	MSc Environmental Sciences (North West University)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)		

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

I, Christel du Preez, 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

C du Preez

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

I, Kim Marais, 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

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTEL DU PREEZ

PERSONAL DETAILS

Position in Company	Senior Scientist (Watercourse ecology)
Joined SAS Environmental Group of Companies	2016

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP)
(SACNASP – Reg No. 120240/19)
Member of the Western Cape Wetland Forum (WCF)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

MSc Environmental Sciences (North West University)	2017
BSc Hons Environmental Sciences (North West University)	2012
BSc Environmental and Biological Sciences (North West University)	2011

Short Courses

Wetland and Aquatic plant Identification presented by Carin van Ginkel (Crispis Environmental)	2019
Wetland Management: Introduction and Delineation presented by the Centre of Environmental Management University of the Free State	2018
Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	2017
Basic Principles of ecological rehabilitation and mine closure presented by the Centre for Environmental Management North West University	2015

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Limpopo, Western Cape, Northern Cape, Eastern Cape

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

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

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Senior Scientist (Water Resource Manager)
Joined SAS Environmental Group of Companies	2015

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 117137/17)
Member of the Western Cape Wetland Forum (WCWF)

EDUCATION

Qualifications

BSc (Hons) Zoology (University of the Witwatersrand)	2012
BSc (Zoology and Conservation) (University of the Witwatersrand)	2011

Short Courses

Aquatic and Wetland Plant Identification (Cripsis Environment)	2019
Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Biodiversity Action Plans (BAP)
- Alien and Invasive Control Plans (AICP)
- Faunal Eco Scans
- Faunal Impact Assessments

Freshwater Assessments

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

Aquatic Ecological Assessment and Water Quality Studies

- Riparian Vegetation Integrity (VEGRAI)
- Water quality Monitoring
- Riverine Rehabilitation Plans

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions
- Public Participation processes

SAS ENVIRONMENTAL GROUP OF COMPANIES
SPECIALIST CONSULTANT INFORMATION –

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing Member, Group CEO, Water Resource Discipline Lead, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SEGC	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of 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

CORE FIELDS OF EXPERTISE

Legislative Requirements, Processes and Assessments

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

Freshwater Assessments

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

Aquatic Ecological Assessment and Water Quality Studies

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

Biodiversity Assessments

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

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

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