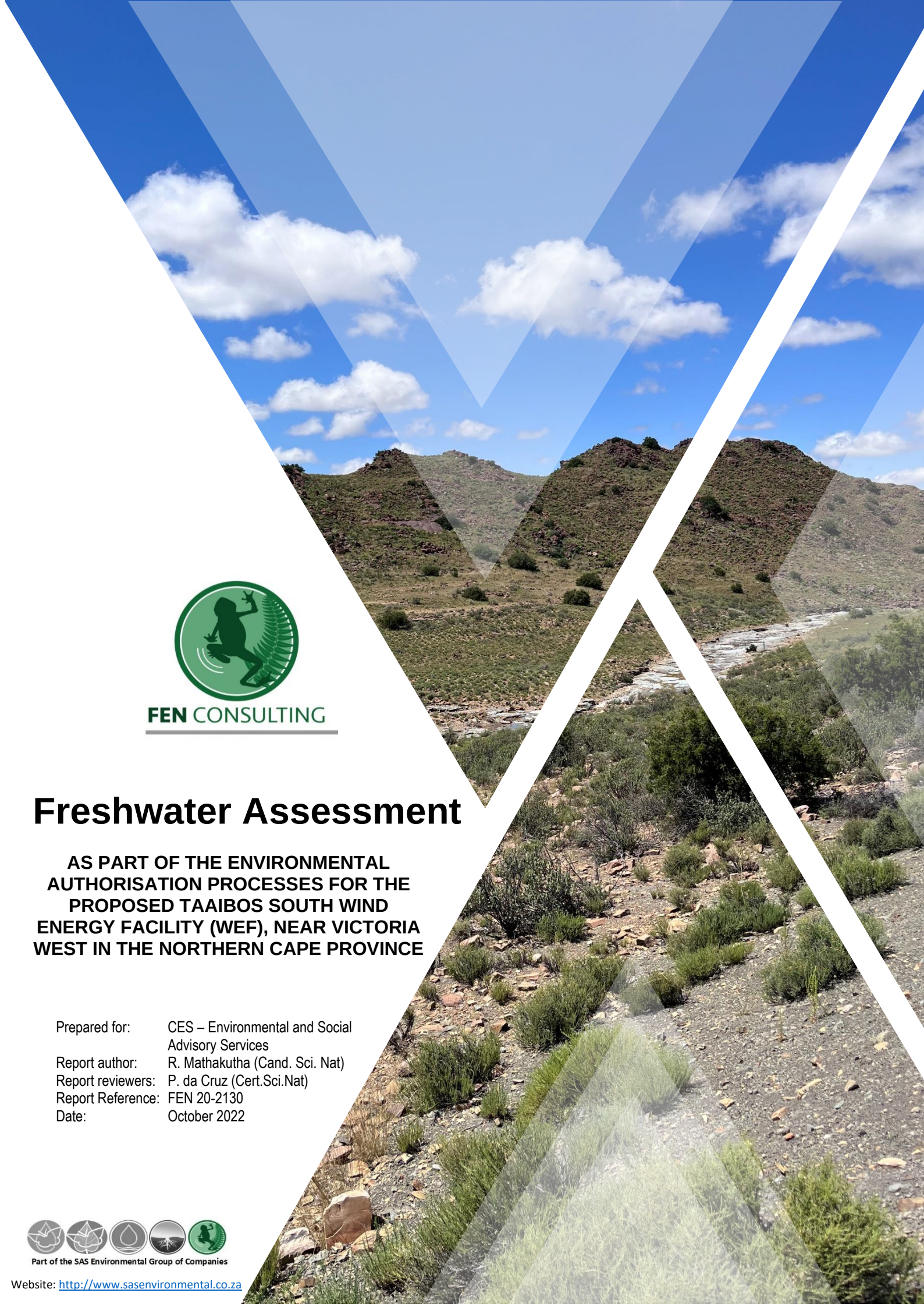

FEN CONSULTING

Freshwater Assessment

AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESSES FOR THE PROPOSED TAAIBOS SOUTH WIND ENERGY FACILITY (WEF), NEAR VICTORIA WEST IN THE NORTHERN CAPE PROVINCE

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EXECUTIVE SUMMARY

FEN Consulting was appointed to conduct a specialist freshwater ecological assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Taaibos South Wind Energy Facility (WEF) and associated infrastructure. The proposed development includes the construction of various turbines linked via underground cabling, wherever technically feasible, a laydown area, new access / internal roads and upgrading of existing roads, and an administration and operations and maintenance (O&M) building (where applicable) to be used during the operational phase.

The Klein-Brak River and several freshwater features identified as mountain stream drainage lines, upper foothill tributaries and lower foothill tributaries of the Klein-Brak River system were identified within the study area. A channelled valley bottom (CVB) wetland associated with one of the major tributaries of the Klein-Brak River system was also identified within the study area. Only the proposed access and internal roads will likely directly impact on the freshwater features within the study area. All other proposed infrastructure will be located outside of the delineated extent of the freshwater features; turbines and associated foundations are located at least 100 m from the delineated extent of the identified freshwater features and 500 m from the delineated CVB wetland.

Based on the outcome of the Department of Water and Sanitation (DWS) Risk Assessment, the proposed development was determined to pose a low risk significance on the freshwater features with implementation of mitigation measures. A manual adjustment to a Low risk significance was applied to the development of a new and potential upgrading of existing road crossings through freshwater features, with the condition that the proposed activities are undertaken during the driest period of the year when no surface water is present within the freshwater features, and in consideration of the long-term benefits of the installation and formalising of road crossings within freshwater features with appropriate through flow structures to maintain and possibly improve the hydrological functioning of the impacted freshwater features. The contractor laydown areas, material storage facilities, and the O&M building (if applicable) must remain outside of the freshwater features and their associated 100 m and 500 m regulated areas.

Based on the findings of the assessment, no fatal flaws from a freshwater resource management point of view were identified. With adherence to cogent, well-conceived and ecologically sensitive construction plans and the implementation of the mitigation measures as provided in this report, and provided that general good construction practice is adhered to, from a freshwater conservation perspective, the proposed development and associated layout is considered acceptable and should be granted Environmental Authorisation. Due to the overall low risk significance of the proposed development, a General Authorisation (GA) in terms of Sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) must be obtained from the DWS.

MANAGEMENT SUMMARY

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Taaibos South Wind Energy Facility (WEF) and associated infrastructure near Victoria West in the Northern Cape Province. The proposed WEF development will hereafter be referred to as the 'proposed development'. The proposed development entails:

- 36 turbines and associated foundations;
- Access and internal roads;
- Underground cabling / collector systems;
- Laydown area; and
- An administration and operations and maintenance (O&M) building (where applicable).

The substation associated with the proposed development was assessed as part of a separate freshwater assessment study associated with the proposed 132 kV overhead powerline of the Taaibos South WEF by FEN (2022), and was thus not included in this report.

The purpose of this report is to provide a description and assessment of the ecology of the freshwater ecosystems within the study area including mapping of the natural freshwater features, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES). 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 development and mitigatory measures were identified which aim to minimise the potential impacts.

A desktop study was conducted, in which the freshwater features 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.

During the site visit undertaken from the from the 21st to the 26th of February 2022, the Klein-Brak River and several freshwater features (best described as fluvial features) associated with the Klein-Brak River system were identified within the study area. These comprise of smaller drainage lines and minor tributaries (that drain the surrounding hilltops on which some of the turbines are proposed and were classified as mountain stream drainage lines and upper foothill tributaries based on their topographical setting and longitudinal zonation), and larger tributaries and rivers that are positioned within the lower gradient were classified as lower foothill tributaries and rivers associated with the Klein-Brak River system. A channelled valley bottom (CVB) wetland was identified within the central northern portion of the study area and is associated with one of the major tributaries of the Klein-Brak River system.

A qualitative assessment based on findings from applicable desktop databases supported by visual observations made by the freshwater ecologist in conjunction with personal experience and knowledge of the freshwater ecosystems within the surrounding area (Section 5), indicates these freshwater features as being in a largely natural ecological condition with a few modifications (i.e., the mountain stream drainage lines and upper foothill tributaries located higher in the catchment and thus not severely exposed to anthropogenic activities), to being in a moderately modified ecological condition (i.e., the Klein-Brak River, CVB wetland and lower foothill tributaries associated with the ongoing agricultural activities which are more prominent within the low lying areas). These freshwater features can be considered of high ecological importance and sensitivity due to their location within critical biodiversity areas and importance for direct human benefits such as water supply, grazing for livestock and biodiversity maintenance (particularly the CVB wetland) in a semi-arid setting.

No surface infrastructure components associated with the proposed development are located within any of the delineated freshwater features; turbines and associated foundations are located at least 100 m from the delineated extent of the identified freshwater features and 500 m from the delineated CVB wetland. Exceptions are road crossings, which would entail the construction of a new road crossings through freshwater features and potential upgrading of existing crossings through freshwater features. The proposed road layout was not available at time of this assessment, however, road crossings through freshwater features are highly probable given the existing road footprint (proposed to be upgraded) within freshwater features and were thus considered as part of this assessment (worst-case scenario). 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 identified freshwater features. Although the proposed turbines are located outside the 100 m and 500 m GN509 zone of regulation as per GN509 of the National Water Act, 1998 (Act No. 36 of 1998), indirect impacts to the receiving freshwater environment are likely during construction, particularly on the freshwater features located downgradient of the turbines, thus the turbines were considered in the risk assessment and appropriate mitigation measures provided. A summary of the outcome of the risk assessment is provided in Table A.

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

	Impact and Aspect	Risk	Borderline LOW MODERATE Rating
Construction Phase	Site preparation prior to construction activities and general movement of construction personnel within the 100 m and 500 m GN509 ZoR but outside the delineated extent of the freshwater features. • 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	NA
	Construction of surface infrastructure associated with the proposed development outside the delineated freshwater features, including turbines and associated foundations, laydown area and an administration and operations and maintenance (O&M) building (if applicable): • 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	NA
	Creation of new road crossings within freshwater features including the CVB wetland for the proposed new access/internal roads and underground cabling • Site preparation prior to construction activities including movement of construction machinery/vehicles within the freshwater features and removal of vegetation; • Ground-breaking and excavations and trenching within/adjacent to the freshwater features; and • Placement of culvert structures atop concrete base.	Moderate	55 (-28) L
	Upgrading of existing access roads within freshwater features including the CVB wetland: • Excavation within freshwater features for the removal of existing infrastructure and casting of a base (where applicable); • Placement of culvert structures atop concrete base; • Upgrading of existing roads within close proximity (within 32 m) to a freshwater feature; and • Miscellaneous activities by construction personnel.	Moderate	55 (-28) L
Operational Phase	Operation and maintenance of the surface infrastructure associated with the proposed development located outside the delineated freshwater features and outside the GN509 ZoR, including turbines and associated foundations, laydown area and an O&M building (if applicable). • Proactive monitoring to ensure structural integrity is maintained and to identify early signs of failure / erosion	Low	NA
	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater features (where applicable). • Concentrated runoff entering the freshwater features; • Disturbance to the freshwater vegetation.	Low	NA
Decommissioning Phase	Removal of all surface infrastructure from the project area: • Movement of construction vehicles and personnel; • Disturbance to the buffer zone surrounding the freshwater features	Low	NA

Only the proposed access and internal roads will likely directly impact on the freshwater features within the study area. All other proposed infrastructure will be located outside of the delineated extent of the freshwater features and at least 100 m from the delineated extent and 500 m from the delineated wetland (i.e., turbines and associated foundations). The construction of the proposed access and internal roads

and potential upgrading of existing roads within freshwater features pose a moderate risk significance to the freshwater features. However, the installation of appropriate culverts or subsurface drainage within new and existing road crossings is considered a positive long-term benefit for the maintenance and potential improvement of the hydrological functionality of the freshwater features and associated downstream systems. Therefore, also provided that the construction of the proposed development is undertaken during the driest period of the year when no surface water is present within the freshwater features and the recommended mitigation measures are applied, including minimising direct activities with the CVB wetland followed by suitable rehabilitation, the risk significance can be reduced to Low. The contractor laydown areas, material storage facilities, and the O&M building (if applicable) must remain outside of the freshwater features, and it is recommended that these be located outside of the associated 100 m (of the Klein-Brak River and associated drainage lines and tributaries) and 500 m (of the wetland) regulated areas.

With implementation and strict enforcement of cogent, well-developed mitigation measures as outlined in this report, with specific mention of ensuring all instream construction footprints are rehabilitated and the freshwater features monitored for any alien and invasive species establishment, no fatal flaws in terms of freshwater ecological aspects were identified and the proposed development can be considered acceptable.

Due to the overall low risk significance associated with the proposed development (having considered the worst-case scenario of the development of new and upgrading of existing road crossings through freshwater features), Water Use Authorisation by means of General Authorisation (GA) in terms of Section 21(c) and (i) water uses must be obtained from 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.

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 F.
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 3 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 3
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e., is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 4: Table 3
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g., movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 5:
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

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 soil, etc).	Section 7
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
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
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 more than 200 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 F
3.2	A signed statement of independence by the specialist.	Appendix F
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 E – 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

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **ii**
MANAGEMENT SUMMARY ..... **ii**
DOCUMENT GUIDE ..... **vi**
TABLE OF CONTENTS ..... **viii**
LIST OF TABLES ..... **ix**
LIST OF FIGURES ..... **ix**
GLOSSARY OF TERMS ..... **xi**
ACRONYMS ..... **xii**
1 INTRODUCTION **1**
1.1 Background 1
1.2 Structure of this report 1
1.3 Assumptions and Limitations 3
2 PROJECT DESCRIPTION **4**
3 ASSESSMENT APPROACH **9**
3.1 Freshwater Ecosystem Field Verification 9
3.2 Sensitivity Mapping 10
3.3 Risk and Impact Assessment and Recommendations 10
4 DESKTOP ASSESSMENT RESULTS **11**
4.1 National and Provincial Datasets 11
4.2 Ecological Status of Sub-Quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS Database] 16
5 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT **19**
5.1 Field verification and delineation 19
5.2 Freshwater ecosystem classification 21
5.3 Freshwater ecosystem delineation 25
6 LEGISLATIVE REQUIREMENTS & SENSITIVITY MAPPING **33**
7 RISK AND IMPACT ASSESSMENT **37**
7.1 Risk Assessment considerations and outcome 37
7.1.1 Risk Assessment Discussion 38
7.2 Impact Assessment 51
7.3 Risk and Impact Assessment discussion 57
7.4 Cumulative Impact Statement 58
8 CONCLUSION **58**
9 REFERENCES **60**
APPENDIX A: Indemnity and Terms of Use of this Report **61**
APPENDIX B: Legislative Requirements **62**
APPENDIX C: Method of Assessment **64**
APPENDIX D: Risk Assessment Methodology **68**
APPENDIX E: Risk Analysis and Mitigation Measures **76**
APPENDIX F: Details, Expertise and Curriculum Vitae of Specialists **84**

LIST OF TABLES

Table 1: Design specifications associated with the proposed Taaibos South WEF. 4
Table 2: Infrastructure associated with the proposed Taaibos South WEF and construction footprint estimates. 5
Table 3: Desktop data (from desktop databases only) relating to the characteristics of the study area and associated investigation area. 12
Table 4: Summary of the ecological status of the sub-quaternary catchment (SQ) reach associated with the study area based on the DWS RQS PES/EIS database. 16
Table 5: Classification of the freshwater ecosystem proposed to be traversed. 22
Table 6: Descriptive summary of the freshwater features identified within the study area and associated with the Klein-Brak River system. 29
Table 7: Articles of Legislation and the relevant zones of regulation applicable to each article. 33
Table 8: Summary of the results of the DWS risk assessment applied to the proposed development activities. 39
Table 9: Construction phase – impact assessment of site preparation activities prior to the construction activities. 51
Table 10: Construction of surface infrastructure associated with the proposed development. 52
Table 11: Creation of new road crossings within freshwater features. 53
Table 12: Upgrading of existing access roads within freshwater features. 54
Table 13: Operation and maintenance of surface and road infrastructure associated with the proposed development 55
Table 14: Decommissioning phase 56

LIST OF FIGURES

Figure 1: Digital satellite image depicting the location of the study and investigation areas in relation to the surrounding area. 6
Figure 2: Location of the location of the study and investigation areas depicted on a 1:250 000 topographical map in relation to surrounding area. 7
Figure 3: Layout of the proposed development as provided by the EAP (CES – Environmental and Social Advisory Services, 2022). 8
Figure 4: Natural and artificial wetlands and NFEPA listed rivers associated with the study and investigation areas as indicated by the NFEPA database (NFEPA, 2011). 13
Figure 5: Critical Biodiversity Areas associated with the study and investigation areas, according to the Northern Cape Critical Biodiversity Areas (2016). 14
Figure 6: Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment (2018). 15
Figure 7: DWS RQIS PES/EIS sub-quaternary catchment reaches (SQRs) indicated relative to the proposed development and investigation area. 18
Figure 8: (Top) Digital satellite imagery depicting broad areas of increased clay content hosting episodic preferential flow paths (yellow arrows), in relation to the south portion of the study area (blue outline) and associated turbines. (Middle and Bottom) Photographs of these areas of episodic preferential flow paths. 21
Figure 9: The freshwater features identified within the investigation area and general surrounding landscape, originate as mountain stream drainage lines (yellow line) located along a steep gradient and high in the catchment, that drain into the upper foothill tributaries (orange line) located along a moderately steep gradient, which eventually drain into lower foothill tributaries and rivers (blue dashed line) typically located along a lower gradient. 23
Figure 10: The locality of the delineated freshwater features associated with the study and investigation areas in relation to the proposed development. 24

Figure 11: (Top) The topographical setting of the Klein-Brak River in a valley bottom position in a low lying area with a gentle slope visible in the background. The vegetation of this tributary comprises of low shrub and graminoid species in its marginal zones, which can be easily distinguished (black arrows) from the surrounding terrestrial vegetation. 26
Figure 12: (Top) Topographical setting of the CVB wetland in a valley bottom position and vegetation composition of the CVB wetland, obligate wetland species such as Eragrostis bicolor and Pycreus sp. were noted to be dominant. 26
Figure 13: The upper reach of the Klein-Brak River characterised by a sandy alluvial channel. 27
Figure 14: Soil form indicators associated with the CVB wetland; (Left) sparse mottling identified within a (Right) saturated clay layer within the first 50 cm of the soil samples taken from the CVB wetland, indicating wetland soil characteristics. 28
Figure 15: (Top left) Single to multiple channels associated with the Klein-Brak River displaying moderate sinuosity; (Top middle) Lower reach of the Klein-Brak River characterised by a mixed alluvial substrate; (Top right) Topographical setting of a lower foothill tributary within a lower foothill position, with the channel (blue dashed line) and an instream artificial impoundment (as indicated by the yellow arrows) are semi-confined to the foot slope position while the riparian habitat thereof extends the entire valley floor; (Bottom left) A lower foothill tributary within the south western portion of the study area with an alluvial channel showing moderate sinuosity; (Bottom middle and Bottom right) Existing road crossings within the lower foothill tributaries in the study area; (Bottom middle) channel characterised by a bedrock substrate;and (Bottom right) channel characterised by an alluvial substrate. Blue lines indicated direction of flow. 30
Figure 16: (Left) Topographical setting of the CVB wetland in a valley bottom position; and (Right) The active channel of the CVB wetland adjacent to an existing informal road to the east. 31
Figure 17: The topographical setting of the mountain stream drainage lines (yellow dashed line) located along the higher slope position that drains towards the larger tributaries (blue line). 31
Figure 18: The upper foothill tributaries within the study area are characterised by a mixed-bed channel, alternating between (Left) exposed bedrock; (Middle) an alluvial substrate (coarse sand); (Right) The lower reach of an upper foothill tributary with an alluvial substrate (gravel and coarse sand), traversed by an existing informal road. Blue dashed line indicates direction of flow. 32
Figure 19: The conceptual presentation of the zones of regulation in terms of NEMA and GN509 as it relates to the NWA for the freshwater features associated with the study and investigation areas where the proposed development is located. 36

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 soil).
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns is 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.
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 soil, 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
CBANC	Critical Biodiversity Areas of the Northern Cape
DC	Direct Current
DFFE	Department of Forestry, Fisheries and the Environment
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
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
SAS	Scientific Aquatic Services
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 Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Taaibos South Wind Energy Facility (WEF) and associated infrastructure on Portion 1 of Farm 250, Portions 1 and 4 of Farm 145, the remaining extent (RE) of Farm 201 and RE of Farm 250, near Victoria West in the Northern Cape Province (hereafter referred to as the 'study area') (Figures 1 and 2). The proposed WEF development will hereafter be referred to as the 'proposed development'. Please refer to Section 2 for the project description.

In order to identify all freshwater ecosystems that may potentially be impacted by the proposed development, a 500 m "zone of investigation" was implemented around the study area, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) as amended, in order to assess possible sensitivities of the receiving freshwater environment. This area – i.e., the 500 m zone of investigation around the study area - will henceforth be referred to as the 'investigation area'.

The purpose of this report is to provide a description and assessment of the ecology of the freshwater ecosystems associated with the study area including mapping of the natural freshwater ecosystems, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES). 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 development and mitigatory measures were identified which aim to minimise the potential impacts. A pre-defined impact assessment methodology (as provided by the Environmental Assessment Practitioner (EAP)) was undertake fulfilment of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA).

This study further aims to provide detailed information to guide the proposed development in the vicinity of the freshwater ecosystems, 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 development from a freshwater resource management perspective.

1.2 *Structure of this report*

This report investigates the impact significance of the proposed 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 development as well as a brief summary of the proposed activities associated with the proposed 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], 2011 database; the National Biodiversity Assessment [NBA], 2018 database; the DWS Resource Quality Information System (RQIS) PES/ EIS, 2014 database and the Northern Cape Critical Biodiversity Areas database (2016)), were undertaken to aid in identifying any freshwater ecosystems.

The national web based Environmental Screening Tool by the Department of Forestry, Fisheries and Environment (DFFE) (previously the Department of Environmental Affairs (DEA)) (DEA, 2020), was undertaken to screen the proposed development for any environmental sensitivity, with specific focus on aquatic sensitivities. The results are presented in Section 4.

Section 5: Site Based Freshwater Ecosystem Assessment Results (Terms of Reference)

This section reports the following:

- A description and delineation of all freshwater ecosystems associated with the proposed development according to "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2]: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones";
- Delineation of all freshwater ecosystems (using desktop methods) within 500 m of the proposed 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 freshwater ecosystems 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 freshwater ecosystems was undertaken at a qualitative level. The Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) as indicated by the relevant desktop databases were used to inform the DWS Risk Assessment matrix. Field observations[3] on a qualitative level supported the outcomes from the relevant databases.

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 of the DWS Risk Assessment Matrix results and Impact Assessment methodology (as provided by the EAP) which highlight all potential impacts and that may affect the identified freshwater ecosystems. Management and mitigation measures are provided and an assessment on the reversibility of the impact which should be implemented during the construction and operational phases of the proposed development in order to assist in minimising the impact on the receiving environment.

[1] 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.

[2] 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.

[3] Qualitative assessment is based on visual observations made by the freshwater ecologist in conjunction with personal experience and knowledge of the freshwater ecosystems within the surrounding area.

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 delineation of the freshwater ecosystem boundaries and the assessment thereof, are confined to a site visit undertaken from the 21st to the 26th of February 2022. All freshwater ecosystems identified within the investigation area were delineated in fulfilment of GN 509 of the National Water Act, 1998 (Act No. 36 of 1998) using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs, with limited site verification. The delineations of freshwater ecosystems outside the study area must not be utilised for any purpose, other than planning for the proposed development. Any areas that may have additionally been mapped will require field-based delineation and ground-truthing as directed by applicable legislation and best practice methods;
- Due to access limitations following heavy rains in the region and damage to the roads, and the landscape in some areas being rugged and very undeveloped, some reaches of the identified freshwater ecosystems were inaccessible. Therefore, verification points for these freshwater ecosystems were located at points as close as possible to the freshwater ecosystem reach of concern to be verified and, where necessary the conditions at the exact point required were inferred or extrapolated. The delineation of the identified freshwater ecosystems associated with the proposed development, as provided in this report, is considered accurate taking into consideration the conditions at the time of assessment and variable topography of the area; the results obtained are considered sufficiently accurate to allow informed planning and decision making to take place;
- Only activities for which information was available at the time of compiling this report are considered in this report. For example, the layout of the access / internal roads and underground cabling and position of the laydown area was not available at the time of this assessment. Nevertheless, these activities were considered in the risk and impact assessments in order to quantify overall impacts to the freshwater ecosystems within the study area, by applying the worst-case scenario of assuming that there will be new (and upgrading of existing) road crossings through freshwater features. Should detailed information be made available, it is highly recommended that it be reviewed and reassessed as part of this freshwater ecological assessment. The freshwater ecologist cannot be held liable should the outcome of this report not be considered feasible by the relevant authorities due to the lack of detailed information;
- The Department of Water and Sanitation (DWS) Risk Assessment matrix requires the assessment of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the impacted freshwater ecosystems. Due to the unavailability of the layout of some of the proposed development components expected to pose a direct risk to / have a physical footprint on the freshwater ecosystems in the study area (e.g., new road crossings within the freshwater ecosystems), the PES and EIS determination for the freshwater ecosystems in the study area was undertaken at a qualitative level as there was no indication of which freshwater features would be directly impacted by the proposed development. The PES as indicated by the relevant desktop databases was thus used to inform the DWS Risk Assessment matrix. Field observations on a qualitative level supported the outcomes from the relevant databases (although not all classifications presented in the available desktop databases (Section 4, Table 3) were deemed accurate based on ground truthing, as such the ground truthed classifications took preference);
- 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 appropriately accurate to fulfil the authorisation requirements;

- Wetlands and/or riparian zones and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative wetland or riparian species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundaries may occur. However, if the Department of Water Affairs and Forestry (DWAF)4 (2008)5 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. The freshwater ecosystem delineation as presented in this report is, however, regarded as the best estimate of the boundaries based on the site conditions present at the time of the site visit and are deemed appropriately accurate to guide any future development plans.

2 PROJECT DESCRIPTION

The proposed Taaibos South WEF is situated on Portion 1 of Farm 250, Portions 1 and 4 of Farm 145, the remaining extent (RE) of Farm 201 and RE of Farm 250, which are located approximately 1.8 km south of the regional (R) 63 road and approximately 40 km west of the town of Victoria West in the Northern Cape Province (Figures 1 and 2). The proposed development will include 36 turbines (Figure 3) and associated infrastructure including turbine foundation/crane pads, underground cabling/collector systems, access roads, construction camp/laydown area and an administration and operations and maintenance (O&M) building. The substation associated with the WEF was assessed as part of a separate freshwater assessment study associated with the proposed 132 kV overhead powerline of the Taaibos South WEF by FEN (2022)[6], and is thus not included in this report.

Tables 1 and 2 below provide a summary of the WEF design specifications and construction footprint of the associated infrastructure. Only the layout of the turbines was available at the time of this assessment (Figure 3).

Table 1: Design specifications associated with the proposed Taaibos South WEF.

Number of turbines	Up to 36
Power output per turbine	Unspecified
Facility output	Up to 270 MW
Turbine hub height	Up to 200 m
Turbine rotor diameter	Up to 240 m
Turbine blade length	Up to 120 m
Turbine tip height	Up to 320 m
Turbine road width	14 m to be rehabilitated to 8 m
BESS (Battery Energy Storage System) Technology	Solid State (Li-Ion) or REDOX-Flow (High level risk assessment for both) – 10 ha / 2700 MWh

[4] 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.

[5] 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.

[6] FEN. 2022. Freshwater Assessment as Part of the Environmental Authorisation Processes for the Proposed 132 Kv Overhead Powerline and Substation associated with the Taaibos South Wind Energy Facility, Near Victoria West in The Northern Cape Province. Report reference: FEN 20-2130

Table 2: Infrastructure associated with the proposed Taaibos South WEF and construction footprint estimates.

Facility Component	Construction Footprint	Final Footprint After Rehabilitation
Permanent Laydown Area	TOTAL 3000 m^2 x 36 turbines = 108 000 m^2 which equates to 10.8 **ha**	TOTAL 3000 m^2 x 36 turbines = 108 000 m^2 which equates to 10.8 **ha**
Temporary Laydown Area	TOTAL 3000 m^2 x 36 turbines = 108 000 m^2 which equates to 10.8 **ha**	TOTAL 0 m^2 x 36 turbines = 0m^2 which equates to 0 **ha**
Turbine Foundation	TOTAL Up to 900m^2 x 36 turbines = 32 400 m^2 which equates to 3.**24 ha**	TOTAL Up to 900m^2 x 36 turbines = 32 400 m^2 which equates to 3.**24 ha**
WEF Substation	33/132kV Substation – 1.5ha Offices and parking – 0.5ha Permanent Laydown – 1ha	33/132kV Substation – 1.5ha Offices and parking – 0.5ha Permanent Laydown – 1ha
BESS	TOTAL 10ha / 2700MWh	TOTAL 10ha / 2700MWh
Temporary Laydown Area, Concrete Tower Manufacturing Facility and Construction Compound	10 ha clearance includes Temporary laydown Construction compound Concrete batching plant Crusher plant All to become area cleared for BESS (above) afterwards.	10 ha clearance includes Temporary laydown Construction compound Concrete batching plant Crusher plant All to become area cleared for BESS (above) afterwards.
New Internal Access Roads (14 m construction, rehabilitated to 8 m during operation)	TOTAL (better estimate coming with civil layout) 36 000 m x 14m = 504 000 m^2 which equates to 50.4 **ha**	TOTAL (better estimate coming with civil layout) 36 000 m x 8m = 288 000 m^2 which equates to 28.8 **ha**
Upgraded Existing Internal Access Roads	TOTAL (better estimate coming with civil layout) 36 000 m x 14m = 504 000 m^2 which equates to 50.4 **ha**	TOTAL (better estimate coming with civil layout) 36 000 m x 8m = 288 000 m^2 which equates to 28.8 **ha**
TOTAL FOOTPRINT:	**138.64 ha *of clearing needed for the construction phase of the development of the proposed Taaibos South WEF***	**84.64 ha *of clearing remaining during the post-construction operational phase (after rehabilitation) of the proposed Taaibos South WEF***

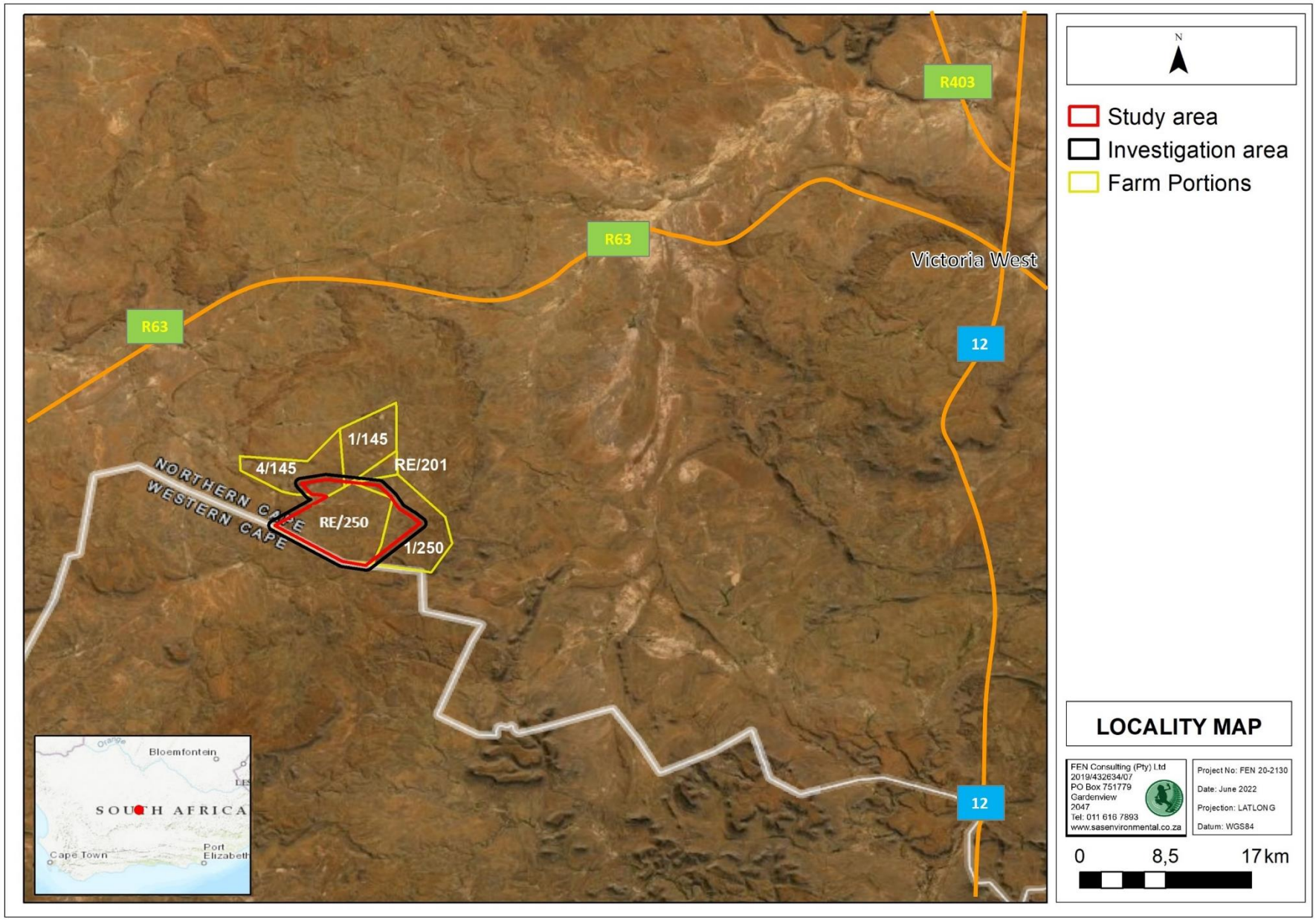


Figure 1: Digital satellite image depicting the location of the study and investigation areas in relation to the surrounding area.

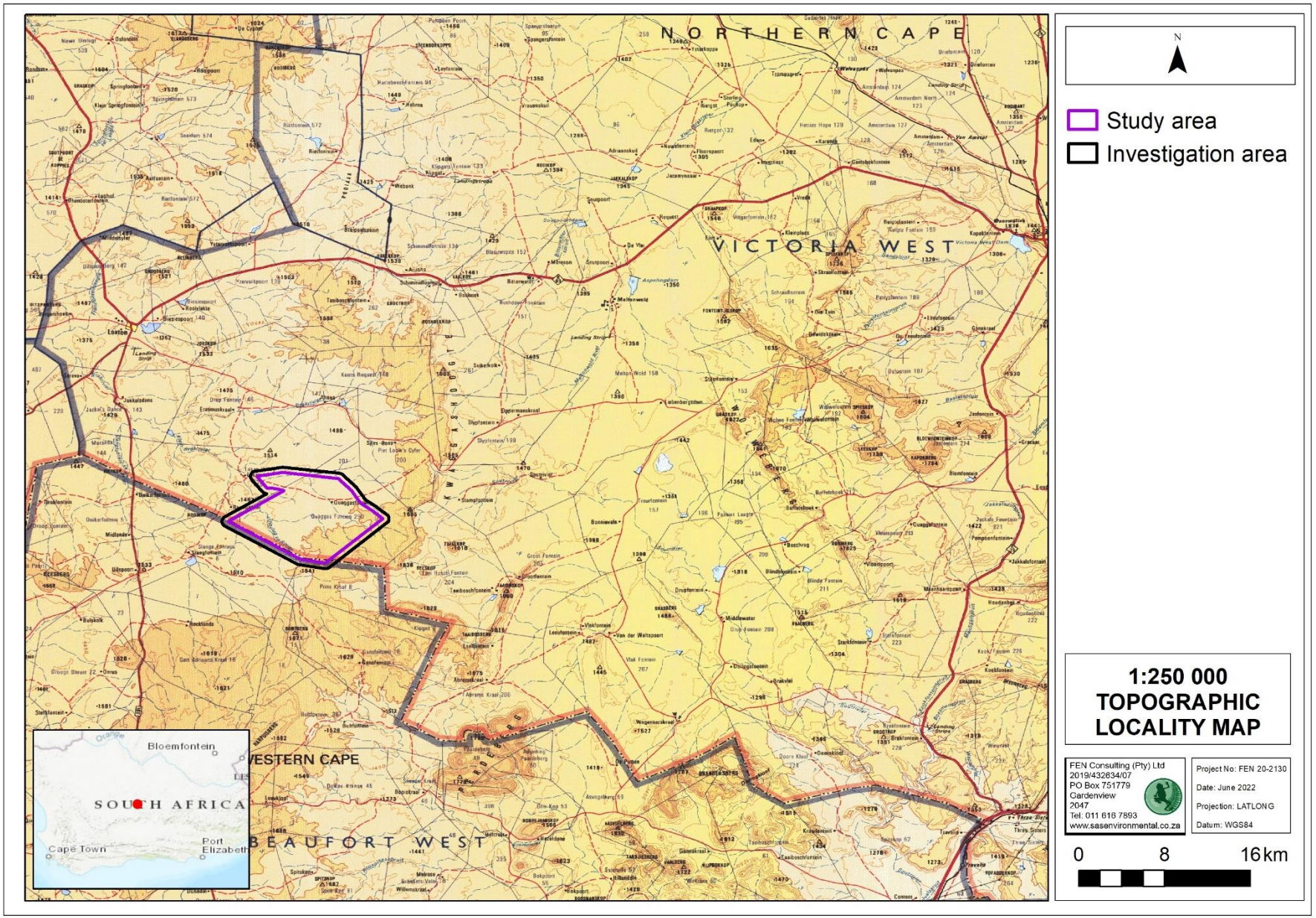


Figure 2: Location of the location of the study and investigation areas depicted on a 1:250 000 topographical map in relation to surrounding area.

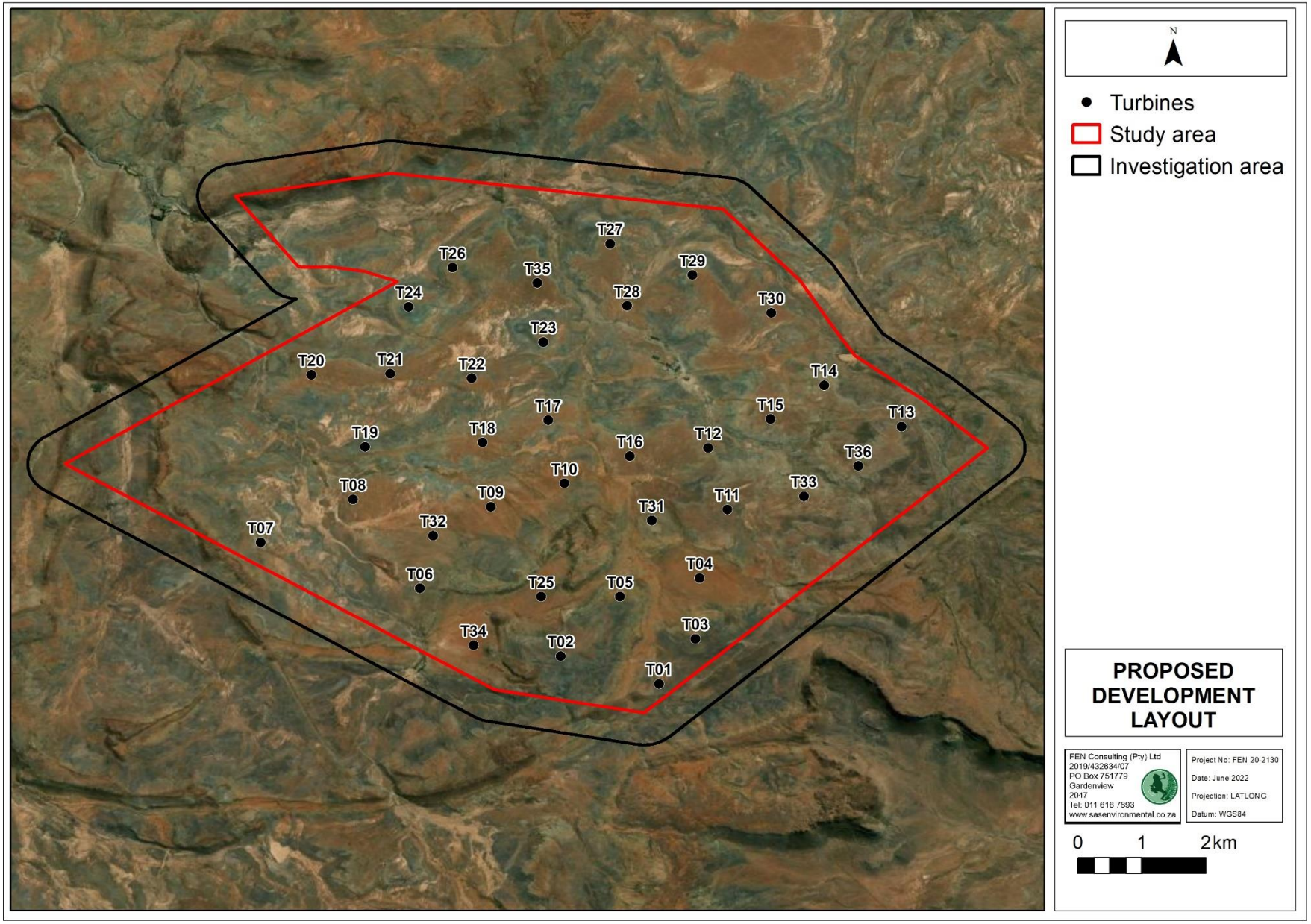


Figure 3: Layout of the proposed development as provided by the EAP (CES – Environmental and Social Advisory Services, 2022).

3 ASSESSMENT APPROACH

3.1 *Freshwater Ecosystem Field Verification*

For the purposes of this investigation, the definition of a watercourse and wetland and riparian habitat was taken as per that in the National Water Act, 1998 (Act No. 36 of 1998), as amended (NWA). The definitions are as follows:

According to the NWA a **watercourse** means:

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

It should be noted that in this report "freshwater ecosystem / feature" is used and carries the same meaning as "watercourse" as defined by the NWA.

The NWA further provides definitions of wetland and riparian habitats as follows:

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

Another widely used definition of wetlands is the one used under the Convention on Wetlands (Ramsar, 1971) '**wetlands**' are defined by Articles 1.1 and 2.1 as:

> Article 1.1: 'For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.'
>
> Article 2.1 provides that wetlands: 'may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands'.

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

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

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

Riparian habitat includes "the physical structure and associated vegetation of areas associated with a freshwater ecosystem which are commonly characterised by alluvial soil, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas".

A field verification was undertaken from the 21st to the 26th of February 2022 (Northern Cape summer period)[7], during which the presence of any wetland or riparian habitats as defined by DWAF (2008) and the National Water Act, 1998 (Act No. 36 of 1998), both of which are considered 'watercourses' according to the latter, were noted (please refer to Section 5 of this report). The freshwater ecosystem delineations 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 freshwater ecosystems have several distinguishing factors including the following:

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

3.2 *Sensitivity Mapping*

All freshwater ecosystems associated with the proposed 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 development.

3.3 *Risk and Impact Assessment and Recommendations*

Following the completion of the assessment, the DWS Risk Assessment and Impact Assessment methodology (as provided by the EAP) were conducted (please refer to **Appendix D** for the methods of approach) and recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures, which apply to the proposed construction and operational activities. Mitigation measures have been developed to address issues in all phases throughout the life of the proposed development including planning, construction, and operation. The detailed mitigation measures are outlined in Section 7 of this report, while the general management measures which are considered to be best practice mitigation applicable to this project, are outlined in **Appendix E**.

[7] 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 raining period to ensure optimised conditions for the identification of seasonal freshwater features, which may otherwise be overlooked. The site conditions at the time of the field assessment are considered acceptable as rainfall had occurred within the region weeks prior and leading up to the site assessment.

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 3). 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 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 3: Desktop data (from desktop databases only) relating to the characteristics of the study area and associated investigation area.

Aquatic ecoregion and sub-regions in which the study area is located		Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Ecoregion	Nama Karoo	FEPACODE	The entire study and investigation areas are located in a sub-quaternary catchment considered important in terms of fish or freshwater ecological conservation (FEPACODE = 1). River FEPAs are important for achieving biodiversity targets for river ecosystems and threatened fish species and should therefore remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.
Catchment	Orange		
Quaternary Catchment	D55C		
WMA	Lower Orange		
subWMA	Orange tributaries		
Dominant characteristics of the Nama Karoo Level II (26.03) (Kleynhans *et al*., 2007)		NFEPA Wetlands (Figure 4)	According to the NFEPA database (2011), no natural wetlands are located within the study area. An artificial channelled valley bottom wetland is indicated within the central northern portion and the study area. This artificial wetland feature is indicated to be in a heavily to critically modified ecological condition (Class = Z3). During the field assessment, this artificial wetland feature was confirmed to be an artificial impoundment associated with a natural watercourse.
Level II Code	26.03		
Dominant primary terrain morphology	Lowlands with Hills, Mountains and Lowlands, Hills		
Dominant primary vegetation types	Eastern Mixed Nama Karoo, Upper Nama Karoo, Bushmanland Nama Karoo, Upland Succulent Karoo, Escarpment Mountain Renosterveld		
Altitude (m a.m.s.l)	1100 - 1500	Wetland Vegetation Type	The entire study and investigation areas are located within the Upper Nama Karoo Wetland Vegetation type. This wetland vegetation type is considered least threatened according to Mbona *et al.* (2015).
MAP (mm)	0 - 500		
The coefficient of Variation (% of MAP)	30 - 40		
Rainfall concentration index	15 - 55	NFEPA Rivers (Figure 4)	As per the NFEPA database (2011), the Klein-Brak River is located within the south western portion of the study area. This reach of the Klein-Brak River within the study area is indicated to be in a largely natural ecological condition with only a few modifications (Class B).
Rainfall seasonality	Very late Summer, Late Summer, Winter		
Mean annual temp. (°C)	14 - 18		
Winter temperature (July)	0 - 18		
Summer temperature (Feb)	12 - 30		
Median annual simulated runoff (mm)	<5 - 40		
Importance of the study area according to the Northern Cape Critical Biodiversity Areas (2016) (Figure 5)			
According to the Northern Cape Critical Biodiversity Areas (2016), the majority of the study area is classified as Other Natural Areas (ONAs). ONAs are areas not currently identified as a priority, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although not prioritised, habitat and species loss should still be minimised in these areas and ensure ecosystem functionality through strategic landscape planning. The south western portion of the study area is classified as Critical Biodiversity Areas (CBA) 1. The north western and north eastern portions of the study area are classified as CBA2. CBAs are areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. CBA 1 are areas likely to be in a natural condition while and CBA 2 are those areas that are potentially degraded or represent secondary vegetation and therefore require restoration where feasible. Portions within the south western extent of the study area are classified as Ecological Support Areas (ESAs). ESAs are important in supporting the functioning of CBAs and are often vital for delivering ecosystem services.			
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA) (Figure 6)			
According to the NBA 2018: two natural depression wetlands are located within the western portion of the study area. These depression wetlands are indicated to be in a largely natural ecological condition with only a few modifications (Class A/B). These depression wetlands are also indicated to be vulnerable according to the Ecosystem Threat Status and not protected according to the ecosystem protection level (EPL). Several watercourses indicated as rivers are indicated within the southern portion of the study area. The Klein-Brak River is indicated within the south western portion of the study area, and is indicated to be in a largely natural ecological condition with only a few modifications (Class B). The Brak River is indicated to be least threatened according to the ETS and not protected according to the EPL, per the available database.			
National Web Based Environmental Screening Tool (2020): Aquatic Biodiversity sensitivity			
The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the migration hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.		The entire study and investigation areas are considered of very high aquatic biodiversity sensitivity. This is due to the presence of rivers as indicated by the NBA (2018) and the catchment thereof. Classified as a freshwater ecosystem priority area (according to NFEPA, 2011).	

CBA = Critical Biodiversity Area; EI = Ecological Importance; EN = Endangered; EPL = Ecosystem Protection Level ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres above mean sea level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Area; PA = Protected Area; PES = Present Ecological State; WMA = Water Management Area.

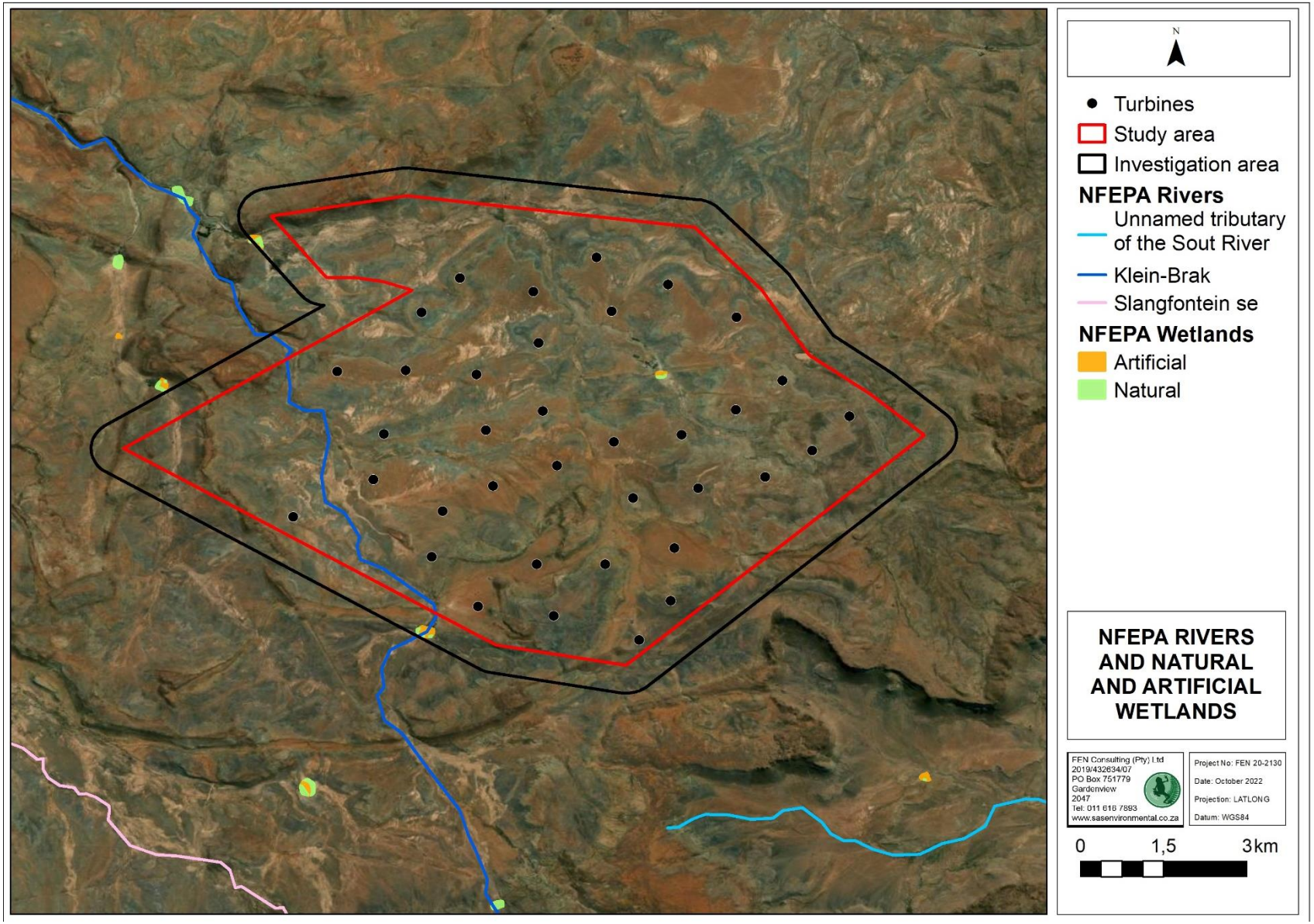


Figure 4: Natural and artificial wetlands and NFEPA listed rivers associated with the study and investigation areas as indicated by the NFEPA database (NFEPA, 2011).

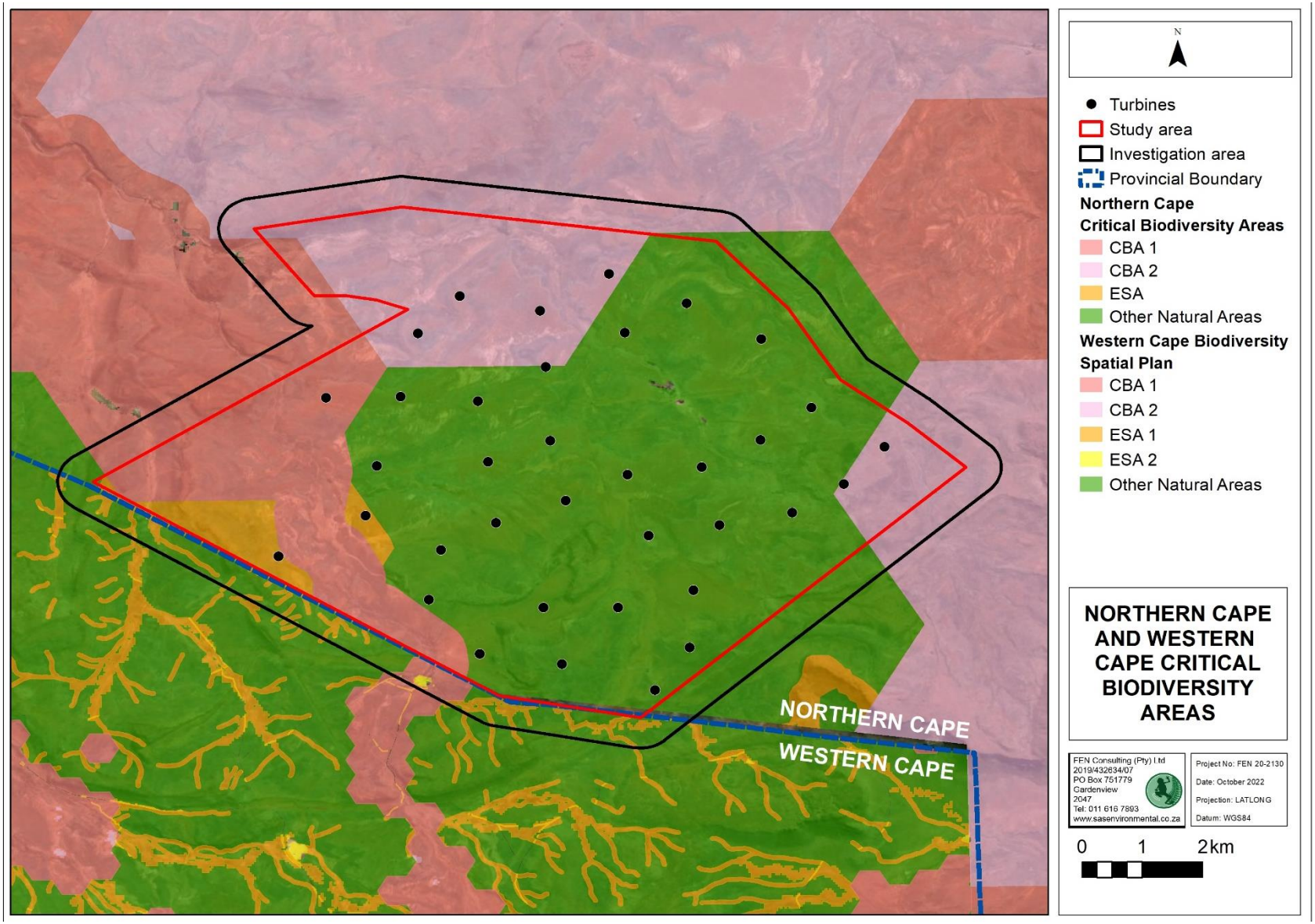


Figure 5: Critical Biodiversity Areas associated with the study and investigation areas, according to the Northern Cape Critical Biodiversity Areas (2016).

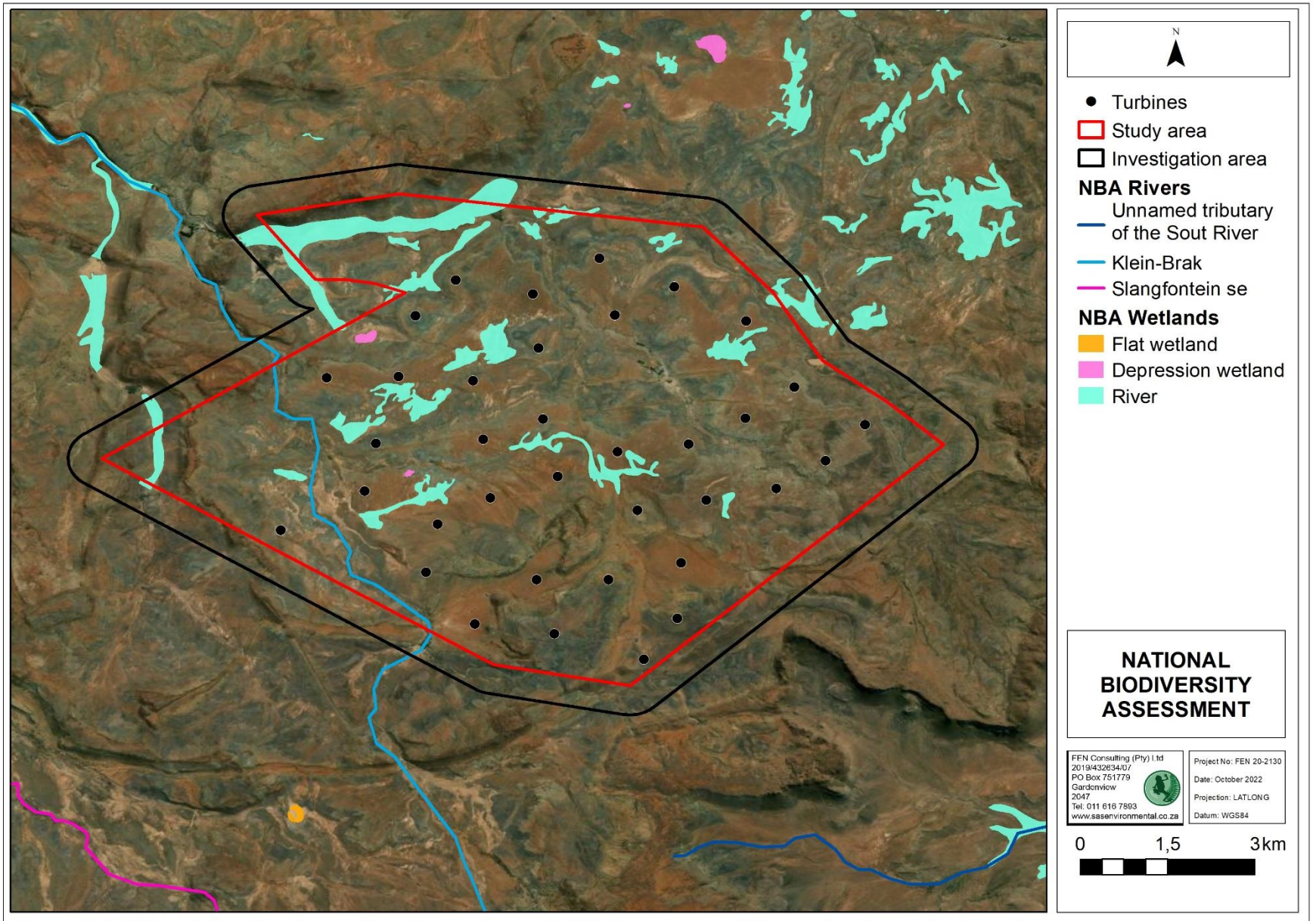


Figure 6: Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment (2018).

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 RQS 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 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 the South Africa River Health Programme (SA RHP) sites, Ecological Water Requirements (EWR) sites and Hydro Water Management System (WMS) sites.

Key information on background conditions associated with the SQR D55C-06507 (Klein-Brak River) as contained in this database and pertaining to the PES and EIS is tabulated in Table 4 and visually represented in Figure 7 that follows.

The Ecological Importance (EI) data for the SQR D55C-06507 (Klein-Brak River) indicates that the following fish species may occur at this site:

- *Labeobarbus aeneus;*
- *Barbus anoplus; and*
- *Labeo umbratus*

The EI data for SQR D55C-06507 (Klein-Brak River) indicates that the following macro-invertebrate taxa are expected to occur at these sites:

- Ceratopogonidae
- Chironomidae
- Culicidae
- Muscidae

Table 4: Summary of the ecological status of the sub-quaternary catchment (SQ) reach associated with the study area based on the DWS RQS PES/EIS database.

	D55C-06507 (Klein-Brak River)
Synopsis	
PES Category Median	Moderately Modified
Mean EI class	Moderate
Mean ES class	Low
Length	29.41
Stream order	1
Default EC[4]	C (Moderate)
PES Details	
Instream habitat continuity MOD	Large
RIP/wetland zone continuity MOD	Moderate
Potential instream habitat MOD activities	Small
Riparian/wetland zone MOD	Moderate
Potential flow MOD activities	Moderate
Potential physico-chemical MOD activities	Small
EI Details	
Fish spp/SQ	3
Fish average confidence	1.00
Fish representivity per secondary class	High
Fish rarity per secondary class	High
Invertebrate taxa/SQ	4
Invertebrate average confidence	1.00
Invertebrate representivity per secondary class	Low
Invertebrate rarity per secondary class	Moderate
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Low
Habitat diversity class	Low
Habitat size (length) class	Low

	D55C-06507 (Klein-Brak River)
Instream migration link class	Moderate
Riparian-wetland zone migration link	High
Riparian-wetland zone habitat integrity class	High
Instream habitat integrity class	Very High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High
Riparian-wetland natural vegetation rating based on expert rating	Low
ES Details	
Fish physical-chemical sensitivity description	Very low
Fish no-flow sensitivity	Moderate
Invertebrates physical-chemical sensitivity description	False
Invertebrates velocity sensitivity	Low
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very low
Stream size sensitivity to modified flow/water level changes description	Low
Riparian-wetland vegetation intolerance to water level changes description	Moderate

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

[2] EI = Ecological Importance;

[3] ES = Ecological Sensitivity

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

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

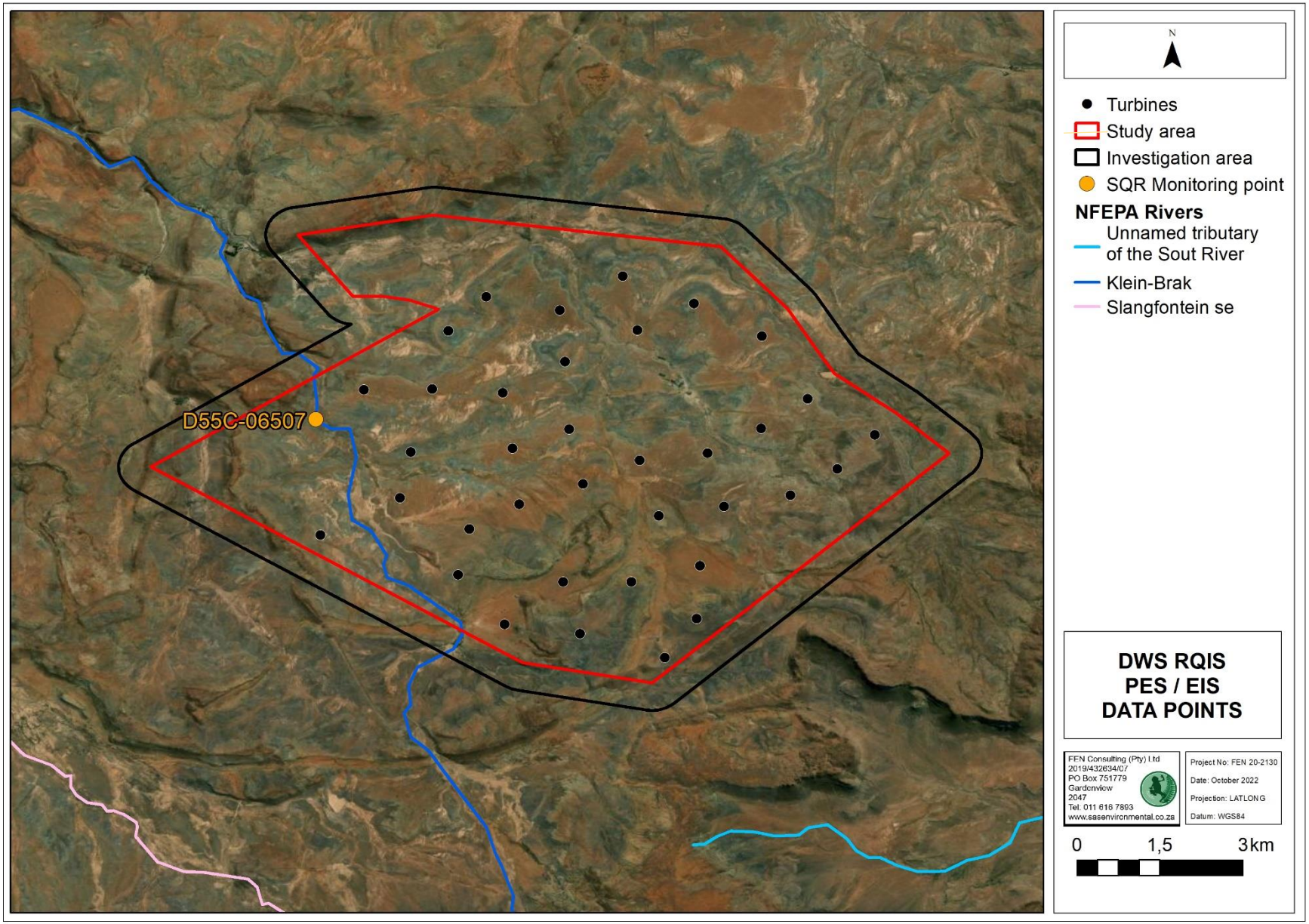


Figure 7: DWS RQIS PES/EIS sub-quaternary catchment reaches (SQRs) indicated relative to the proposed development and investigation area.

5 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

5.1 *Field verification and delineation*

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

- Linear features: since water flows/moves through the landscape, freshwater ecosystems often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with freshwater ecosystems: a distinct increase in density as well as shrub size near flow paths;
- Hue: water flow paths often showing as white/grey or black and outcrops or bare soil displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with freshwater 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.

The industry standard guidelines provided by DWAF (2008) for the identification and delineation of wetlands and riparian zones was used as a basis for the delineation of the freshwater features identified on site. However, due to the typically arid conditions of the region, additional indicators, as provided by Day *et al.* (2010) were utilised. Whilst the presence of "vegetation typically adapted to life in saturated soil" under "normal circumstances" is the key determinant in the definition of a wetland according to the National Water Act, 1998 (Act 36 of 1998), such features are not always present in wetlands in arid to semi-arid environments such as the Northern Cape (based on experience within the region). The general surrounding landscape in terms of the freshwater features identified within the general investigation area and vegetation type of the local area was noted to be uniform, presenting a transition between upper foothill to lower foothill drainage systems connected to larger river systems downstream. The freshwater features identified during the site assessment were thus categorised according to their dominant characteristics, primarily topography, vegetation and soil characteristics. The characterisation of these features is discussed in greater detail in Section 5.2 below.

During the site assessment undertaken from the 21st to the 26th of February 2022, the Klein-Brak River was identified within the southern portion of the study area and flows in a generally westerly direction as it exits the study area. Several major and minor tributaries of the Klein-Brak were also identified within the study area. These freshwater features comprise of smaller drainage lines that are minor tributaries (that drain the hilltops on which some of the turbines are proposed), and larger tributaries that are positioned within the lower gradient; these freshwater features can be best described as fluvial features associated with the Klein-Brak River system. Most of these freshwater features are episodic[8] (drainage lines and minor tributaries) to ephemeral[8] (larger tributaries and rivers) with relatively scarce rainfall events causing short-lived periods of flow. A channelled valley bottom (CVB) wetland was identified within the central northern portion of the study area and is associated with one of the major tributaries of the Klein-Brak River system. Wetland habitat associated with the lower reach of this tributary was noted outside the study area but within the north western portion of the investigation area. None of the freshwater features within the study and investigation areas were identified to be traversed

[8] "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).

by the proposed development, particularly the turbines, based on the layout as provided by the proponent (see Figure 3). The turbines are located at least 100 m from the delineated extent of the identified freshwater features and 500 m from the delineated CVB wetland. However, other components of the proposed development, particularly the access / internal roads and underground cabling (for which the layout was unavailable), will likely be located within the delineated extent of the freshwater features (see Section 7 for the consideration of these WEF components).

Other areas of increased wet response (lacking in either wetland or riparian characteristics) were noted within the study area and larger surrounding landscape. These were identified as extensive areas hosting episodic preferential flow paths (PFP), usually displaying an increase in clay content (Figure 8). These preferential flow paths may potentially only convey surface water for a short period of time after rainfall events. Thus, these features are not considered of ecological importance but contribute to the hydrological functioning of the drainage systems at large. The PFPs do not meet the definitions of a watercourse from an ecological perspective (as defined by the National Water Act, 1998 (Act No. 36 of 1998)) and may potentially only enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998) should a floodline be determined for these features. As such, these areas of PFP do not require any further assessment and were not delineated as part of this assessment; however, typical conditions of these areas are illustrated in the figure below.

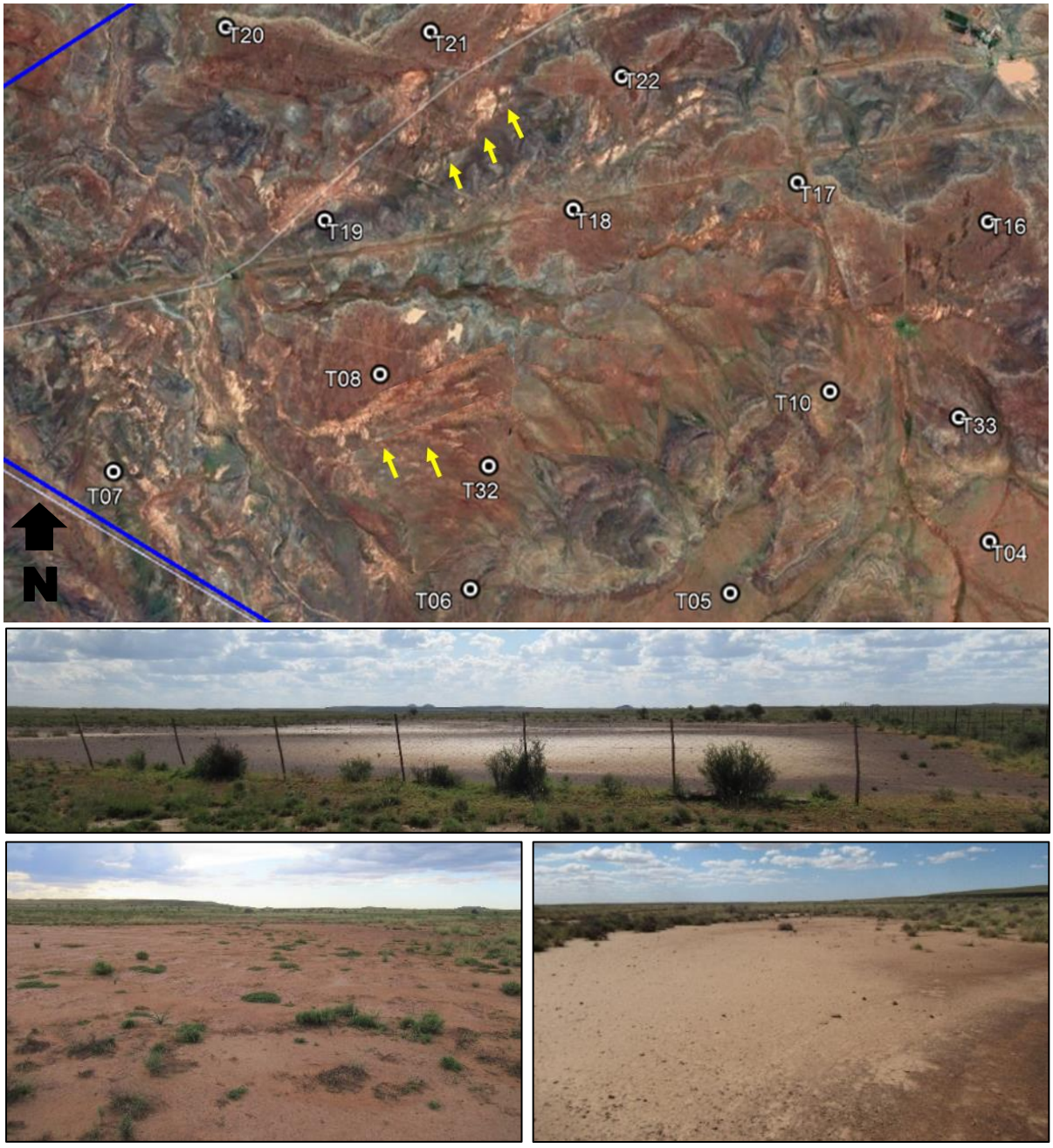


Figure 8: (Top) Digital satellite imagery depicting broad areas of increased clay content hosting episodic preferential flow paths (yellow arrows), in relation to the south portion of the study area (blue outline) and associated turbines. (Middle and Bottom) Photographs of these areas of episodic preferential flow paths.

Artificial impoundments were also identified within the investigation area, including instream artificial impoundments associated with the identified freshwater features. However, these were not assessed due their artificial nature.

5.2 *Freshwater ecosystem classification*

Classification of the freshwater feature identified within the study area was undertaken at Levels 1 - 4 of the Classification System (Ollis *et al*, 2013) as outlined in **Appendix C** of this report. These systems were classified as Inland Systems (Level 1), located within the Nama Karoo Ecoregion (Level 2). Ecoregions are groups of rivers within Southern Africa, which share similar physiography, climate, geology, soils and potential natural vegetation (see Table 3 for details on the dominant characteristics

of the Nama Karoo Ecoregion in which the identified freshwater ecosystem is located). Table 5 below presents the classification from Level 3 to 4 of the Classification System (Ollis *et al*, 2013).

Given that the Level 4 classification places the identified freshwater features into one HGM type i.e., river (Table 5), these freshwater features were further classified into sub-categories at Level 4B (longitudinal zonation / geomorphological zones) of the Classification System (Ollis *et al*, 2013) (Table 5). Longitudinal zonation (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of longitudinal zonal classification has been widely adopted by ecologists to explain variations in physical characteristics and associated biological distributions down the length of a river, to allow for the grouping of rivers into ecologically similar units and for the comparison between similar river types (Rowntree and Wadeson, 1999).

Table 5: Classification of the freshwater ecosystem proposed to be traversed.

<table>
<tr><th rowspan="2">Freshwater ecosystem</th><th rowspan="2">Level 3: Landscape Unit</th><th colspan="2">LEVEL 4: Hydrogeomorphic (HGM) UNIT</th></tr>
<tr><th>Level 4A: HGM Type</th><th>Level 4B: Longitudinal zonation / Geomorphological Zone</th></tr>
<tr><td>Mountain stream drainage lines associated with the Klein-Brak River system</td><td rowspan="2">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.</td><td rowspan="3">River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.</td><td>Mountain stream: Steep-gradient stream (characteristic gradient 0.040–0.099) dominated by bedrock and boulders, locally cobble or coarse gravels in pools. Reach types include cascades, bedrock fall, step-pool, plane bed. Approximate equal distribution of ‘vertical’ and ‘horizontal’ flow components.</td></tr>
<tr><td>Upper foothill tributaries associated with the Klein-Brak River system</td><td>Upper foothills: Moderately steep (characteristic gradient 0.005–0.019), cobble-bed or mixed bedrock-cobble bed channel, with plane bed, pool-riffle or pool-rapid reach types. Length of pools and riffles/rapids similar. Narrow floodplain of sand, gravel or cobble often present.</td></tr>
<tr><td>Lower foothill tributaries associated with the Klein-Brak River system</td><td rowspan="3">Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.</td><td>Lower foothills: Lower gradient (characteristic gradient 0.001–0.005), mixed-bed alluvial channel with sand and gravel dominating the bed, locally may be bedrock-controlled. Reach types typically include pool-riffle or pool-rapid, sand bars common in pools. Pools of significantly greater extent than rapids or riffles. Floodplain often present.</td></tr>
<tr><td>Klein-Brak River</td><td></td></tr>
<tr><td>Wetland</td><td colspan="2">Channelled valley-bottom wetland: A valley bottom wetland with a river channel running through it.</td></tr>
</table>

Considering the above, the fluvial freshwater features identified within the study area were generally classified as rivers and categorised into mountain stream drainage lines, upper foothill tributaries and lower foothill tributaries associated with the Klein-Brak River system. Figure 9 below illustrates the grouping of these freshwater features into geomorphological zones.

The identified mountain stream drainage lines describe the non-perennial systems (which comprise of episodic drainage lines without riparian vegetation) located in the shallow valleys along the undulating slopes of the surrounding mountainous area. Concentration of flow within this upslope position leads to drainage towards the larger tributaries and rivers (Figure 9). These mountain stream drainage lines are characterised by a small catchment and can be considered part of the headwaters of the larger upper foothill and lower foothill tributaries associated with the Klein-Brak River system. Although these mountain stream drainage lines cannot be classified as riparian resources in the traditional sense, due

to the lack of saturated soil 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) 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 riverine systems located within and outside of the investigation area. 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).

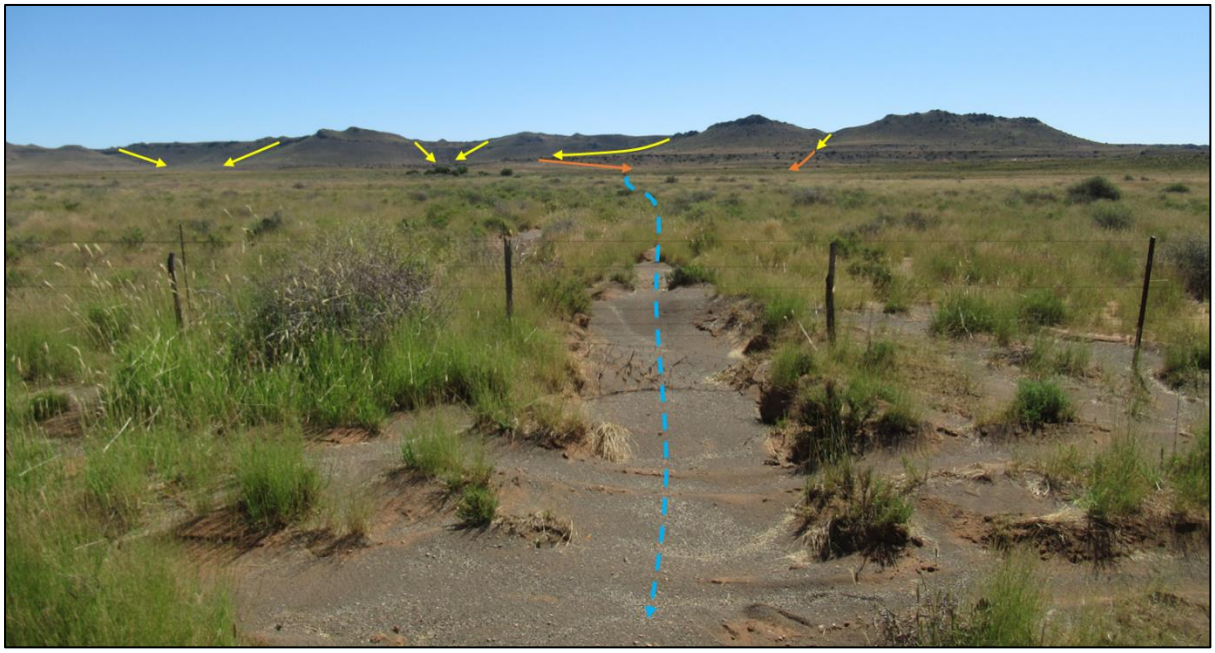


Figure 9: The freshwater features identified within the investigation area and general surrounding landscape, originate as mountain stream drainage lines (yellow line) located along a steep gradient and high in the catchment, that drain into the upper foothill tributaries (orange line) located along a moderately steep gradient, which eventually drain into lower foothill tributaries and rivers (blue dashed line) typically located along a lower gradient.

The delineated extent of the identified freshwater features is depicted on Figure 10 below in relation to the proposed development.

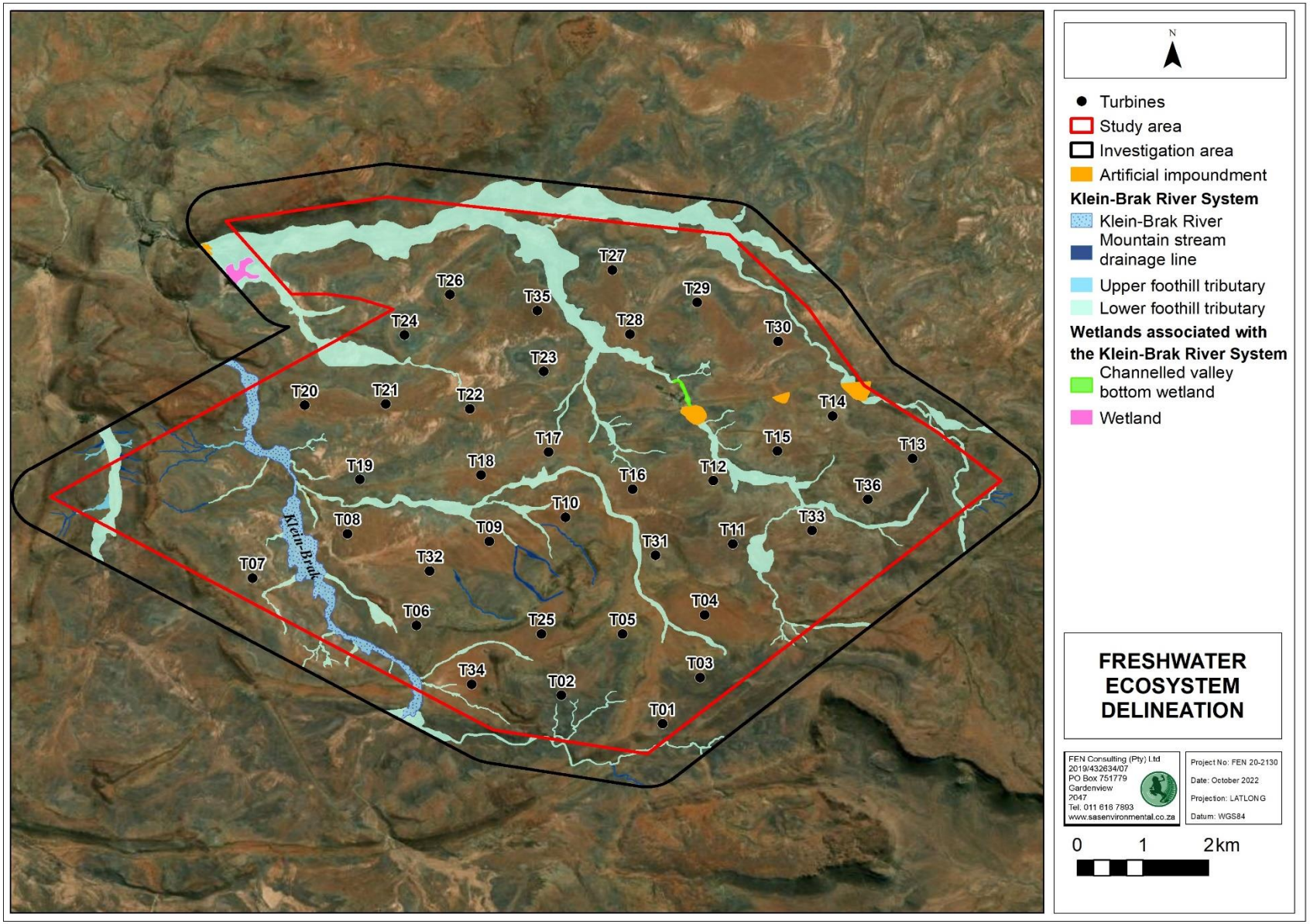


Figure 10: The locality of the delineated freshwater features associated with the study and investigation areas in relation to the proposed development.

5.3 *Freshwater ecosystem delineation*

The outer boundary of the identified freshwater features was delineated according to the guidelines advocated by DWAF (2008). 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 features identified within the study area:

- **Topography/elevation** played a significant role in determining in which parts of the landscape freshwater features are most likely to occur. Since freshwater ecosystems occur where there is a prolonged presence of water in the landscape, the most common place one could expect to find a freshwater feature is in the valley bottom position (DWAF, 2008). Freshwater ecosystems may also be generally located along the floor of a relatively wide valley with a low gradient (e.g., alongside the lower reaches of a lower foothill (DWAF, 2008)). As discussed above, the main tributaries and rivers and the identified wetlands are located in the lower foothill and valley bottom position (Figures 9, 11 and 12). Most other freshwater features including the mountain stream drainage lines and upper foothill tributaries are also located in valleys, however on relatively much steeper land between undulating hills within the upslope that slopes towards the larger downstream system where concentration of flow leads to drainage towards the larger tributaries and rivers (Figure 9).
- **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.

The topographical setting of the identified freshwater features had a strong bearing on the width and spatial distribution of the riparian corridor in relation to the main channel. The mountain stream drainage lines are typically characterised by a confined channel with the riparian zone (if any) restricted to the active channel. The upper foothill tributaries are typically characterised by a semi-confined channel, as with the mountain stream drainage lines, the riparian zone of the upper foothill was not observed to be different from the surrounding terrestrial environment, hence confined in extent. In the larger lower foothill tributaries and river systems, the riparian corridor extends beyond the confines of the primary channel, with the presence of a number of parallel-running secondary channels that are hydrologically activated when higher flows occur along the system.

Only within the larger lower foothill tributaries and rivers was a change in riparian vegetation identified from that of the surrounding terrestrial vegetation. The Klein-Brak River and associated lower foothill tributaries were noted to be dominated by low growing shrub, typically *Pentzia incana* (Sheep Bush) which is often grazed by livestock and associated with the Upper Nama Karoo vegetation type, typical of the local biome (Figure 11). However, due to the ongoing agricultural activities and more prominently within the lower foothill areas, species such as *Chloris virgata* and *Aristida sp*. (which tend to occur where additional rain water collects and in disturbed, overgrazed and trampled areas), were dominant and associated with the lower foothill tributaries. Trees and shrubs are less prominent along the rocky mountain stream drainage lines and upper foothill tributaries located in the upper reaches of the lower foothill tributaries and river systems.

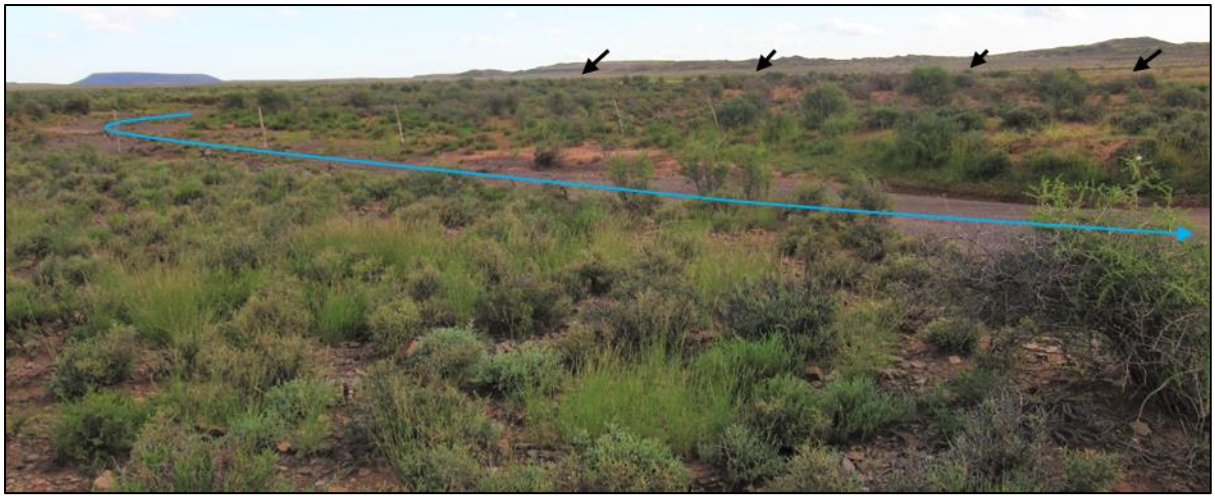


Figure 11: (Top) The topographical setting of the Klein-Brak River in a valley bottom position in a low lying area with a gentle slope visible in the background. The vegetation of this tributary comprises of low shrub and graminoid species in its marginal zones, which can be easily distinguished (black arrows) from the surrounding terrestrial vegetation.

- **Vegetation associated with wetland areas: obligate and facultative vegetation species** and vegetation associated with wetland habitats were used in conjunction with terrain units as well as the point where a distinct change in the vegetation composition is observed to determine the wetland boundary (Figure 12). Species such as *Eragrostis bicolor, Schoenoplectus decipiens* and *Pycreus sp.*, considered obligate wetland plants, were noted to be dominant within the CVB wetland in the study area (Figure 12).

Figure 12: (Top) Topographical setting of the CVB wetland in a valley bottom position and vegetation composition of the CVB wetland, obligate wetland species such as *Eragrostis bicolor* and *Pycreus sp.* were noted to be dominant.

- ***The presence of alluvial soil:*** The presence of alluvial soil 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 freshwater feature (such as that of the identified rivers and tributaries). Alluvial soil is soil derived from materials deposited by flowing water, especially in the valley bottom position. Riparian areas often, but not always, have alluvial soil (Figure 13). While the presence of alluvial soil cannot always be used as a primary indicator to delineate riparian features 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 features are mainly driven by surface flow, originating from its local catchment which flows through the freshwater feature and does not persist for significant periods of time in the riparian features as with wetlands. This is specifically true for the mountain stream drainage lines and to a certain extent, upper foothill tributaries, that experience flash flooding in response to rainfall events.

Figure 13: The upper reach of the Klein-Brak River characterised by a sandy alluvial channel.

- **Soil form indicators** were used to determine the presence of soil that is associated with prolonged and frequent saturation with key indicators including gleying, low chroma, mottling, organic streaking and increased clay content as well as alluvial soil. Soil within the CVB wetland was noted to be saturated, mottling was sparsely present within saturated clay soil (Figure 14). Mottling is indicative of a fluctuation in the level of groundwater, where the alternation between aerobic and anaerobic conditions in the soil causes dissolved iron to return to an insoluble state and be deposited in the form of patches, or mottles, in the soil (Figure 14).

Figure 14: Soil form indicators associated with the CVB wetland; (Left) sparse mottling identified within a (Right) saturated clay layer within the first 50 cm of the soil samples taken from the CVB wetland, indicating wetland soil characteristics.

Since the proposed development does not traverse any of the freshwater features within the study area based on the available layout (Figure 3), the PES and EIS determination was undertaken at a qualitative level based on the results of the available desktop databases in order to inform the DWS Risk Assessment for the activities potentially located within freshwater features (i.e., road crossings within the freshwater ecosystems), but for which the layout was not available. Observations made during the site investigation were also used to provide a qualitative description[9] of the freshwater features within the study area. Table 6 provides a summary of the ecological condition of the freshwater features identified within the study area in terms of relevant aspects (hydrology, geomorphology and vegetation components) (qualitative only). The description of the PES and EIS is based on available desktop databases, specifically from the DWS (2014), NFEPA (2011) and NBA (2018) databases (Tables 3 and 4), supported by visual observations during the site investigation.

[9] Qualitative assessment is based on visual observations made by the freshwater ecologist in conjunction with personal experience and knowledge of the freshwater ecosystems within the surrounding area.

Table 6: Descriptive summary of the freshwater features identified within the study area and associated with the Klein-Brak River system.

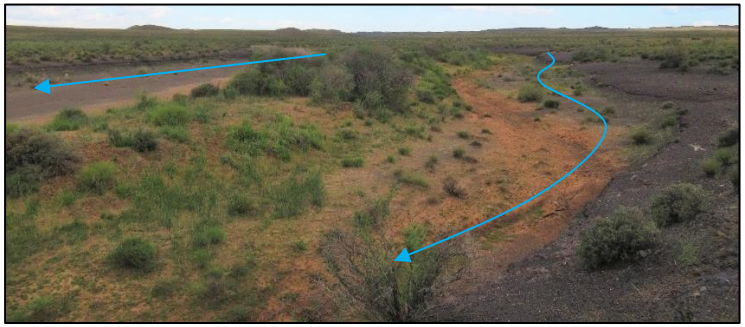
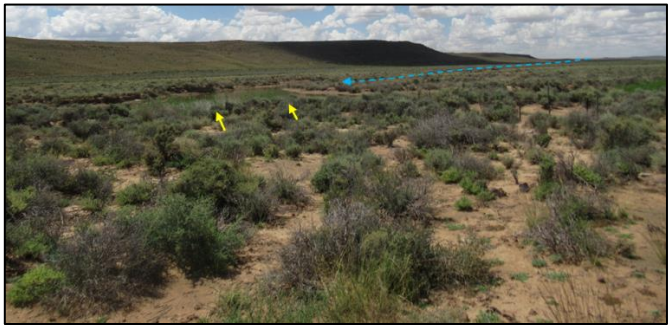
Freshwater ecosystem characteristics overview:
The freshwater features identified within the study area lower and upper foothill tributaries, mountain stream drainage lines and wetlands associated with the Klein-Brak River system. The Klein-Brak River is a tributary of the Brak River and is located within the southern portion of the study area and drains in a westerly direction. According to the National Land-Cover Datasets (2020), the catchment of the Klein-Brak River is predominantly characterised by a combination of low shrub and bare none vegetated areas with pockets of cultivated fields. Based on field observations, the catchment of this river remains largely undeveloped. The main landuse changes are associated with agricultural activities including livestock farming (mostly sheep), cultivation, artificial impoundments and linear infrastructure developments (gravel and tar roads). These were identified as the main existing anthropogenic impacts posing a threat to the Klein-Brak River and associated freshwater ecosystems. The Klein-Brak River is indicated to be in a largely natural ecological condition with only a few modifications according to the NFEPA (2011) and NBA (2018) databases (Table 3) but moderately modified according to the DWS (2014) Database (Table 4). The DWS (2014) database indicates the Klein-Brak River as of moderate ecological importance and sensitivity (Table 4). The sections below extrapolate these results for the mountain stream drainage lines, upper and lower foothill tributaries and wetlands associated with the Klein-Brak River system.
Klein-Brak River and lower foothill tributaries of the Klein-Brak River system
The lower foothill tributaries of the Klein-Brak River are located along a lower gradient where runoff from the catchment and upper foothill and mountain stream drainage lines collects, and drain south westerly towards the Klein-Brak River within the study area. The Klein-Brak River and its lower foothill tributaries are similar in terms freshwater ecological characteristics and having been subjected to the same anthropogenic impacts. The Klein-Brak River and associated lower foothill tributaries are characterised by a mixed channel bed, alternating between exposed bedrock and an alluvial substrate (gravel and coarse sand) (Figures 13 and 15). Given their location within a lower gradient, the Klein-Brak River and the lower foothill tributaries tend to be broad in extent and akin to wide floodplains with a primary channel and multiple secondary lateral channels displaying moderate sinuosity (Figure 15). These freshwater featurees are characterised by a riparian zone, with vegetation cover largely consisting of the salt-tolerant succulent shrub *Salsola aphylla* and *Pentzia incana* (Sheep Bush) associated with the Upper Nama Karoo vegetation type, typical of the local biome (Figures 11 and 15). Species such as *Juncus sp*. were noted within the marginal zone of the Klein-Brak River. The Klein-Brak River and its lower foothill tributaries have been impacted by surrounding agricultural activities (predominantly grazing by sheep), cultivation, gravel road crossings and instream artificial impoundments (Figure 15). These disturbances have resulted in some bank erosion and an increase in the presence of ruderal and alien vegetation species (albeit not considered extensive). Therefore, given the prominance of agricultural activities (grazing, cultivated fields, artificial impoundments, road crossings) and resultant impacts (disturbance to soil and vegetation and proliferation of ruderal and alien species) within the lower lying areas associated with these freshwater features, the assessed reaches of the Klein-Brak River and the lower foothill tributeries confirms the PES of the systems as described by the DWS (2014) dataset as being in a **moderately modified ecological condition** (Table 4), as opposed to a largely natural ecological condition with only a few modifications as identified by the NFEPA (2011) and NBA (2018) databases. These Klein-Brak River and its lower foothill tributaries function as migratory corridors due to their connectivity with the smaller upstream drainage lines and larger river systems located outside the investigation area e.g., the Brak River system, thus providing high hydrological connectivity in the landscape. In addition, the reach of the Klein-Brak River within the study area and the majority of the lower foothill tributaries are classified as CBA 2, and some classified as CBA 1, CBA 2, ESA and ONA as per the Northern Cape Critical Biodiversity Areas (2016), and the catchment thereof classified as a freshwater ecosystem priority area (according to NFEPA, 2011), and can thus be considered to be of ecological importance on a local scale. Even though no direct development is planned within the delineated extent of the Klein-Brak River and associated lower foothill tributaries according to the available layout of the proposed development, adequate mitigation measures to limit any potential edge effects or indirect impacts, particularly associated with the construction or upgrading of roads, are still deemed imperative to maintain the ecological functioning and condition of this river and its lower foothill tributaries.     

Figure 15: (Top left) Single to multiple channels associated with the Klein-Brak River displaying moderate sinuosity; (Top middle) Lower reach of the Klein-Brak River characterised by a mixed alluvial substrate; (Top right) Topographical setting of a lower foothill tributary within a lower foothill position, with the channel (blue dashed line) and an instream artificial impoundment (as indicated by the yellow arrows) are semi-confined to the foot slope position while the riparian habitat thereof extends the entire valley floor; (Bottom left) A lower foothill tributary within the south western portion of the study area with an alluvial channel showing moderate sinuosity; (Bottom middle and Bottom right) Existing road crossings within the lower foothill tributaries in the study area; (Bottom middle) channel characterised by a bedrock substrate;and (Bottom right) channel characterised by an alluvial substrate. Blue lines indicated direction of flow.

Channelled valley bottom wetland associated with the Klein-Brak River system

The CVB wetland identified within the study area is located within the central northern portion of the study area. This CVB wetland is located in a valley bottom position and flows in a generally north westerly direction and connected to a lower foothill tributary of the Klein-Brak River system downstream (Figure 16). An instream artificial impoundment is located upstream of the CVB wetland. The CVB wetland hosts obligate wetland plants and is characterised by soils displaying hydromorphisim (Figures 12 and 14 above). The CVB wetland has been impacted by the surrounding anthropogenic impacts including road crossings (Figure 16), agricultural activities including cultivation and grazing by livestock and instream artificial impoundments. The disturbance created by these anthropogenic activities has resulted in a change in ecosystem processes including the proliferation of alien and invasive species such as *Rumex sp*, albert not extensive as the hydrological functioning of the wetland has not been disturbed and loss of natural habitat has not taken place. No significant erosion and sediment deposition was noted within the wetland, indicating geomorphological integrity. As such, this CVB wetland can be considered to be in a **moderately modified ecological condition**, in line with the results of the DWS (2014) dataset (Table 4).

Based on site observations and considering the ecological integrity of the CVB wetland, it does still provide habitat for vegetation species associated with various wetness zones. The wetland also plays an important role in maintaining hydrological functioning and connectivity in the landscape, given the high degree of hydrological connectivity with other aquatic systems. In addition, this wetland is also likely to provide important breeding and foraging habitat for bird, invertebrate and amphibian species as it acts as an important migratory corridor due to a high level of connectivity in the landscape. Furthermore, the CVB wetland is classified as ONA as per the Northern Cape Critical Biodiversity Areas (2016), and the catchment thereof classified as a freshwater ecosystem priority area (according to NFEPA, 2011). The CVB wetland can thus be considered to be of high ecological importance on a local scale. Even though no direct development is planned within the delineated extent of the CVB wetland according to the available layout of the proposed developemtn, adequate mitigation measures to limit any potential edge effects or indirect impacts, particularly associated with the construction or upgrading of roads, are still deemed imperative to maintain the ecological functioning and condition of this CVB wetland.


Figure 16: (Left) Topographical setting of the CVB wetland in a valley bottom position; and (Right) The active channel of the CVB wetland adjacent to an existing informal road to the east.

Mountain stream drainage lines associated with the Klein-Brak River system

The mountain stream drainage lines arise from the slopes of the surrounding mountainous area where some of the proposed turbines are located (albert outside the delineated extent of these freshwater features). The identified mountain stream drainage lines can be considered part of the headwaters of the Klein-Brak River system as they are located in the landscape where runoff flows as surface water over impermeable bedrock at the point of outcropping. The vegetation composition within these mountain stream drainage lines is not different from the surrounding terrestrial environment, and indicative of the natural species composition expected of the vegetation type (Figure 17). Flow within these systems is likely episodic, following extreme rainfall events thus remaining dry most of the year. Given the limited extent of the catchment and shallow soil (Figure 17), there is insufficient water to elicit a wetness response in terms of vegetation. The local catchment of these mountain drainage lines remains largely untransformed. Thus, the upper reaches of these drainage systems are in a fairly intact ecological condition as they are not exposed to severe anthropogenic impacts given their location along a steep gradient associated with the surrounding slopes. Contrarily, the lower reaches of these mountain stream drainage lines, which transition into the upper foothill tributaries, have been exposed to anthropogenic impacts such as road and powerline crossings. These disturbances have resulted in small changes to the existing flow patterns of the mountain stream drainage lines. Therefore, due to the position of the mountain stream drainage lines in the higher lying areas where where anthropogenic activities are limited, they are considered largely intact, with limited change to the cover, abundance and species composition. As such, these mountain stream drainage lines can be considered to be in a **largely natural ecological condition with only a few modifications**.

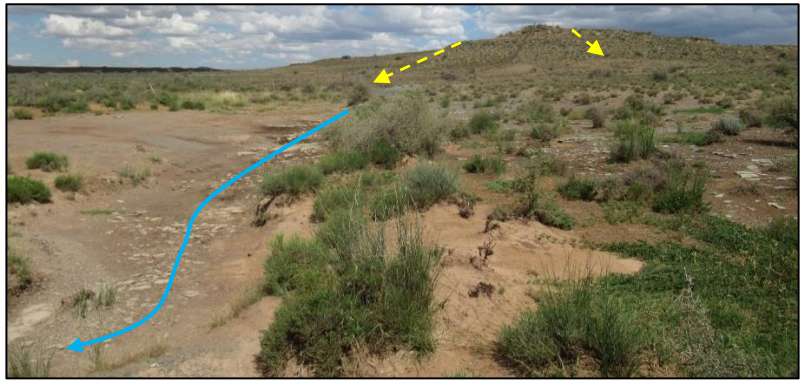


Figure 17: The topographical setting of the mountain stream drainage lines (yellow dashed line) located along the higher slope position that drains towards the larger tributaries (blue line).

The identified mountain stream drainage lines can be considered of ecological importance on a landscape scale due to their hydrological connectivity in the landscape. In addition, the majority of these mountain stream drainage lines are classified as CBA 1, CBA 2 and ESA as per the Northern Cape Critical Biodiversity Areas (2016), and the catchment thereof classified as a freshwater ecosystem priority area (according to NFEPA, 2011). Therefore, even though no direct development is planned within these mountain stream drainage lines according to the available layout of the proposed development, adequate mitigation measures to limit any potential edge effects or indirect impacts (such as dust generation) are still deemed imperative to maintain the ecological functioning and condition of these mountain stream drainage lines.

Upper foothill tributaries associated with the Klein-Brak River system

The upper foothill tributaries are located along a moderately steep gradient (but still noticeable) along the surrounding slopes. These tributaries are typically fed by runoff from the surrounding catchment including the mountain stream drainage lines to which they are connected. These upper foothill tributaries flow into the larger lower foothill tributaries located downstream and eventually into the Klein-Brak River. The upper foothill tributaries are characterised by a semi-confined channel, alternating between exposed bedrock and an alluvial substrate (gravel and coarse sand) (Figure 18). The vegetation composition within these upper foothill tributaries is not different from the surrounding terrestrial environment and is indicative of the natural species composition expected of the vegetation type (Figure 18). However, the vegetation vigour or robustness was noted to be higher within these tributaries as a result of the periodic presence of surface water. The reaches of the upper foothill tributaries identified within the study area are mostly impacted by gravel road crossings (Figure 18) and agricultural activities (including livestock grazing) and their associated edge effects encroaching into these systems, albert to a limited extent given the position of these upper foothill tributaries in a moderately steep gradient where anthropogenic activities are limited. As such, these upper foothill tributaries can be considered to be in a **largely natural ecological condition with only a few modifications**.

The upper foothill tributaries within the study area are classified as CBA 1, ESA and ONA as per the Northern Cape Critical Biodiversity Areas (2016), and the catchment thereof classified as a freshwater ecosystem priority area (according to NFEPA, 2011). Given their hydrological connectivity in the landscape, these upper foothill tributaries can be considered of ecological importance on a landscape scale. Therefore, even though no direct development is planned within these upper foothill tributaries according to the available layout of the proposed development, adequate mitigation measures to limit any potential edge effects or indirect impacts, particularly associated with the construction or upgrading of roads, are still deemed imperative to maintain the ecological functioning and condition of these upper foothill tributaries.

Figure 18: The upper foothill tributaries within the study area are characterised by a mixed-bed channel, alternating between (Left) exposed bedrock; (Middle) an alluvial substrate (coarse sand); (Right) The lower reach of an upper foothill tributary with an alluvial substrate (gravel and coarse sand), traversed by an existing informal road. Blue dashed line indicates direction of flow.

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[10];
- 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 National Water Act, 1998 (Act No. 36 of 1998) (See Appendix B), all of the natural watercourses within the investigation area will be regulated by Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) as well as the applicable NEMA zones of regulation. All of the natural watercourses will thus require authorisation from the Department of Water and Sanitation (DWS). This report aids in providing relevant information for the 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 to be 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).

Table 7: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use Authorisation Application in terms of the National Water Act, 1998 (Act No. 36 of 1998) as amended. **Department of Water and Sanitation (DWS)**	**Government Notice 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.

[10] 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.

Regulatory authorisation required	Zone of applicability
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. **Department of Forestry, Fisheries and the Environment (DFFE)**	Activities of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) **Activity 12**: *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—;* *a) within a watercourse;* *b) in front of a development setback; or* *c) if no development setback exists, within **32 metres 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* **Activity 48:** *The expansion of—* *(i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; or* *(ii) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 100 square metres or more;* *where such expansion occurs—* *a) within a watercourse;* *b) in front of a development setback; or* *c) if no development setback exists, within **32 metres of a watercourse**, measured from the edge of a watercourse.* Activities of Listing Notice 3 (GN 324) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) applicable to the Northern and Western Cape, outside of urban areas. ***Activity 10:*** *The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.* *Western Cape:* *ii. All areas outside urban areas;* *Northern Cape:* *ii. Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland;* *iii. Outside urban areas:* *(bb) National Protected Area Expansion Strategy Focus areas;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* ***Activity 14**:* *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback has been adopted, within **32 metres of a watercourse**,* *Northern Cape:* *ii. Outside urban areas:* *(bb) National Protected Area Expansion Strategy Focus areas;*

Regulatory authorisation required	Zone of applicability
	(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; *Western Cape:* *i. Outside urban areas:* *(bb) National Protected Area Expansion Strategy Focus areas;* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* ***Activity 18:*** *The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.* *Northern Cape:* *i) Outside urban areas:* *(ii) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; or* **Activity 23:** *The expansion of –* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more within (ff) critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority;* *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*

A 32 m Zone of Regulation (ZoR) in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) was assigned to all identified freshwater features within the investigation area (Figure 19). A 100 m ZoR in accordance with 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) as amended (NWA) (in the absence of a defined 1 in 100 year floodline) was applied to the Klein-Brak River and its associated mountain stream drainage lines, and upper and lower foothill tributaries, while a 500 m ZoR in accordance with the NWA was assigned to the wetlands within the investigation area (Figure 19). Additionally, in terms of the Listing Notice (LN) 3 (GN 324) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended), a 100 m ZoR also applies to these freshwater features, therefore, EA will apply to areas within 100 m of the freshwater features for certain LN3 activities (Table 7).

The proposed development does not encroach into the 100 m and 500 m GN509 regulated area. However, the proposed access / internal roads associated with the proposed development (layout unavailable) will likely be located within the 100 m and 500 m GN509 regulated area (especially considering the existing roads within freshwater features that are proposed to be upgraded as part of the proposed development), thus Water Use Authorisation (WUA) from the DWS is required prior to commencement of any construction. For the purposes of WUA, the exact alignment and position of road and cable crossings may be required to be known and assessed, a worst-case scenario approach was undertaken assuming the proposed road and cable crossings will be located within freshwater features. The outcome of the DWS Risk Assessment (Section 7) will prescribe the application of either a General Authorisation (GA) should the proposed development activities pose a low risk significance to the freshwater ecosystems or a Water Use Licence Application (WULA) should the proposed development activities pose a moderate to high risk significance to the freshwater ecosystems. Additionally, environmental authorisation (EA) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) must be obtained as the proposed development activities (access roads and underground cabling) will likely traverse through freshwater ecosystems.

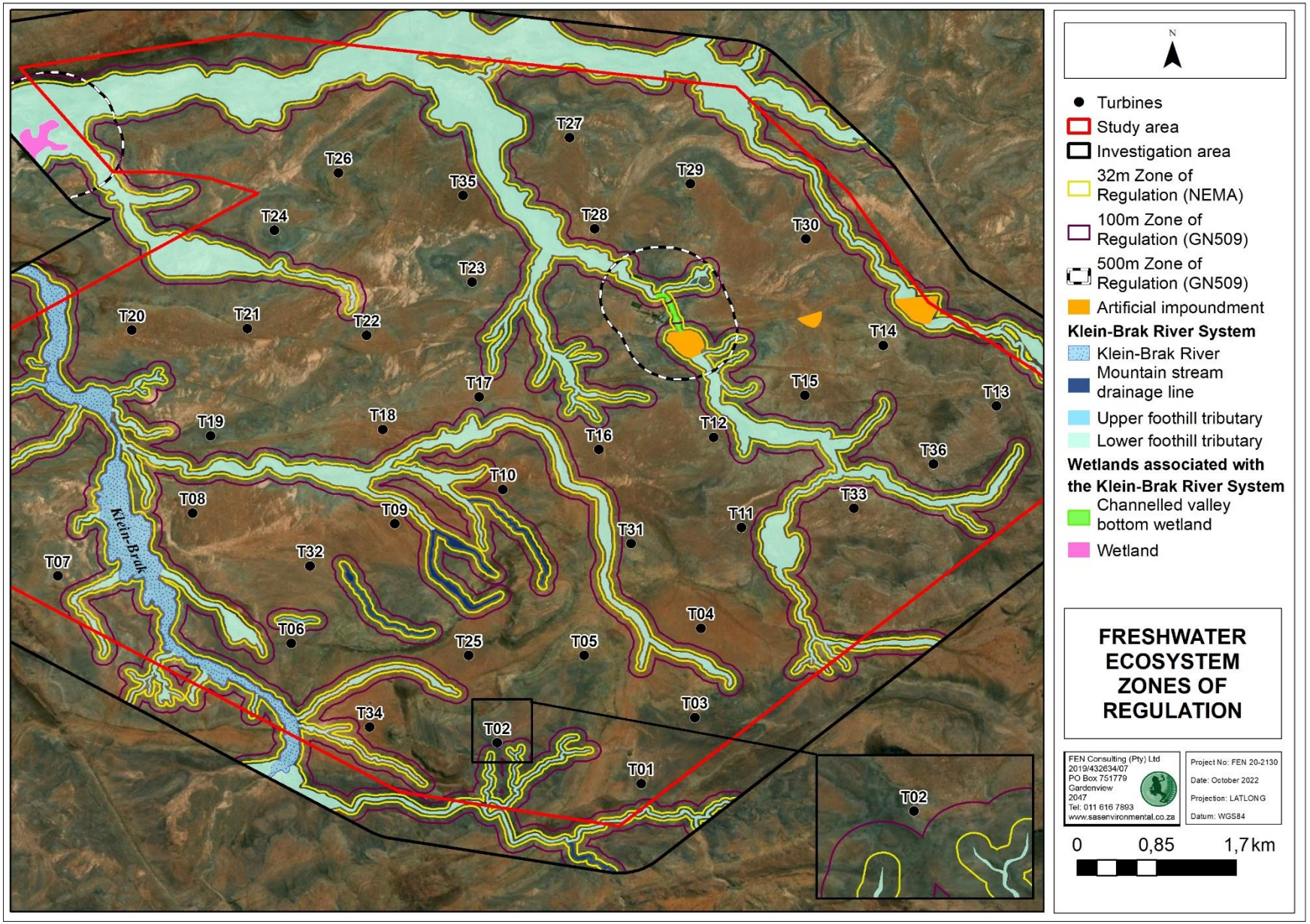


Figure 19: The conceptual presentation of the zones of regulation in terms of NEMA and GN509 as it relates to the NWA for the freshwater features associated with the study and investigation areas where the proposed development is located.

7 RISK AND IMPACT ASSESSMENT

This section provides the impact assessment outcomes and highlights all potential impacts that may affect the identified freshwater ecosystems. The risk assessment is undertaken according to the DWS specified Risk Assessment Matrix (as promulgated in GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)), and results translated into the impact assessment methodology provided by the EAP (refer to Section 7.2). Management and mitigation measures are provided which should be implemented during the various development phases to assist in minimising the impact on the receiving environment.

7.1 *Risk Assessment considerations and outcome*

Following the qualitative assessment of the freshwater features associated with the Klein-Brak River system identified within the study area, 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 the identified freshwater features. The points below summarise the considerations made when applying the impact assessment:

- The risk assessment was applied considering the risk significance of the proposed development as described in Section 2 and depicted in Figures 1 to 3;
- The proposed turbines are located outside the 100 m and 500 m GN509 Zone of Regulation. Though located outside the regulated area, these turbines and associated foundations are considered in the risk assessment and appropriate mitigation measures provided as indirect impacts to the receiving freshwater environment are likely during construction, particularly on the freshwater features located downgradient of the turbines, where construction of the turbines (without mitigation) could contribute to smothering of freshwater vegetation due to increased sedimentation and the proliferation of alien and/or invasive vegetation as a result of overall disturbances;
- The layout of the access / internal roads and underground cabling and position of the laydown area were not available at the time of this assessment. However, the existing roads within the study area (some traversing freshwater features) are proposed to be upgraded to accommodate the construction and operational phase. New internal roads are proposed and are planned to be 14 m wide during the construction phase and rehabilitated to 8 m during the operational phase (Table 2). These roads are also likely to traverse the freshwater features within the study area (this was applied as the worst-case scenario). The underground cabling/collector systems are proposed to be aligned adjacent to the access and internal roads associated with the proposed development, thus also likely to traverse through freshwater features. Although not indicated as to which freshwater features will be directly impacted by these activities, the upgrading of existing and construction of new roads was considered in the risk assessment for the overall freshwater features within the study area. A recommendation is provided for the construction of the laydown area (Table 8);
- The creation of new road crossings within freshwater features was assessed separately for the minor drainage lines and tributaries (mountain stream drainage lines and upper foothill tributaries), major (lower foothill) tributaries and the CVB wetland located in the study area and associated with the Klein-Brak River system, to account for the difference in the severity of impacts associated with the freshwater features (i.e., direct impacts to the lower foothill tributaries and wetland are expected to be of higher severity than the minor upper foothill tributaries and drainage lines). Similarly, the upgrading of existing crossings within freshwater features was assessed separately from the creation of new crossings within freshwater features;
- 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 Environmental Affairs (DEA) *et a*l (2013)[11] would be followed, i.e., the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required.
- Since it is expected that the 100 m / 500 m GN509 ZoR and 100 m ZoR in terms of NEMA (as above) cannot be avoided for the upgrading of existing and construction of new roads and underground cabling, the legal issues for the construction of support structures were scored a maximum value of "5";
- The activities relating to the proposed development are all highly site specific, not of a significant extent relative to the area of the freshwater ecosystems assessed, and therefore have a limited spatial extent;
- While the operation of the proposed development will be a permanent activity, the construction thereof is envisioned to take no more than a few months to a few years. However, the frequency of the construction impacts in a given area may be daily during this time;
- Most impacts are considered to be easily detectable; and
- The considered mitigation measures are easily practicable.

7.1.1 **Risk Assessment Discussion**

There are five key ecological risks on the freshwater features that were identified, namely:

- Loss of freshwater habitat and ecological structure resulting in impacts to biota;
- Changes to the socio-cultural and service provision;
- Impacts on the hydrology and sediment balance of the freshwater features;
- Impacts on water quality; and
- Proliferation of alien and invasive plant species.

The results of the risk assessment are summarised in Table 8 below, including key mitigation measures for each activity that must be implemented in order to reduce the impacts of the proposed activities, as described in Section 2 of this report. Kindly refer to **Appendix E** for the full risk assessment table scorings as well as reversibility scorings and good housekeeping practices that must be implemented.

According to the DWS Risk Assessment Matrix guidelines, for sensitivity ratings within a Moderate Risk range (56-80) a manual adjustment can be made to allow for a low risk. This is to be done subject to the listing of additional mitigation measures which are highlighted in red below (Table 8). This manual adjustment was applied in order to reduce the proposed development to a low risk. It is important to note, however, that should all mitigation measures not be adhered to, the risk significance will likely be a moderate. Suitable planning must thus be undertaken to ensure all works are undertaken during the dry season

[11] The Department of Forestry, Fisheries and the Environment (DFFE) was formerly known as the Department of Environmental Affairs (DEA). 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.

Table 8: Summary of the results of the DWS risk assessment applied to the proposed development activities.

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
CONSTRUCTION PHASE											
1	Site preparation prior to construction activities and general movement of construction personnel within the 100 m and 500 m GN509 ZoR but outside the delineated extent of the freshwater features.	Vehicular movement (transportation of construction materials).	• Loss of freshwater vegetation, associated habitat and ecosystem services from indirect impacts; • 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	• 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) must 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 the 100 m and 500 m GN509 Zone of Regulation (e.g., access roads), regular spraying of non-potable water or the use of chemical dust suppressants, that are approved for use near freshwater ecosystems must be implemented to reduce dust and to ensure no smothering of vegetation within the freshwater features 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 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 freshwater features outside the construction footprint not having authorised road crossings must be considered as no-go areas. No construction vehicles, nor construction personnel or vehicles may traverse through these freshwater features (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 freshwater features and their associated 100 m / 500 m GN509 and 100 m NEMA ZoR as it would also help the proponent avoid the LN3 activities triggered within 100 m of watercourses and 500 m of wetlands**;	**NA**	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
2		Removal of vegetation and associated disturbances to soils.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downgradient freshwater ecosystem areas; • Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the freshwater features; • Increased sedimentation of the freshwater features, leading to smothering of the vegetation associated with the freshwater features; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1,25	3,25	12	39	L	• All vehicle re-fuelling is to take place in specifically designated re-fuelling areas that must be located outside of the 100 m / 500 m GN509 and 100 m NEMA ZoR; and • No vegetation may be removed from the 100 m / 500 m ZoR surrounding the freshwater features where no infrastructure is planned, as this provides a natural buffer zone around the freshwater features which plays a role in dispersing surface runoff into the freshwater features, and thus prevents sedimentation and erosion thereof.	**NA**	Fully reversible
3	Construction of surface infrastructure associated with the proposed development outside the delineated freshwater features, including turbines and associated foundations, laydown area and an administration and operations	• 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;	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downgradient freshwater ecosystem areas • Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the freshwater features, with the potential to affect the freshwater habitat;	1,25	3,25	12	39	L	Though the proposed turbines are located outside the 100 m and 500 m GN509 Zones of Regulation, indirect impacts to the receiving freshwater environment are likely during construction, particularly on the freshwater features located downgradient of the turbines. As such appropriate mitigation measures are provided. • **The contractor laydown areas, material storage facilities, and the O&M building (if applicable) must remain outside of the freshwater features. It is also strongly recommended that these be located outside the 100 m / 500 m GN509 and 100 m NEMA ZoR of the freshwater features. This in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DFFE *et al*. (2013).** <u>With regards to ground-breaking activities outside the delineated extent of a freshwater feature:</u> • During excavation activities, the topsoil and vegetation must be stockpiled separately from other material outside the delineated extent of the freshwater features;	**NA**	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
	and maintenance (O&M) building (if applicable).	• Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Altered runoff patterns within the local catchment of the freshwater features, potentially leading to increased erosion and sedimentation of the receiving freshwater environment; • Potential impacts on the water quality of surface water runoff (when present) which may potentially enter the downgradient freshwater features and contamination of soils due to concrete casting; and • Potential of backfill material entering the freshwater features, increasing the sediment loads therein.						• Excavated materials must not be contaminated, and it must be ensured that the minimum surface area is taken up by any stockpiled materials. The mixture of the lower and upper layers of the excavated soil must be kept to a minimum, so as for later use as backfill material after construction has commenced; • All exposed soils must be protected from wind using tarpaulins for the duration of the construction phase to prevent potential erosion and sedimentation of the freshwater features; • Suitable drainage must be insured along the turbine foundations, in order to ensure that water does not pond or drain in a concentrated manner into the nearby freshwater features. This must be considered as part of the stormwater management plan and be overseen by the Environmental Control Officer (ECO); • Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the freshwater features 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 freshwater features 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. <u>With regards to concrete mixing on site:</u> Concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal must minimise or eliminate discharges into the freshwater features. High alkalinity associated with cement, can dramatically affect and contaminate both soil and ground water. The following measures must be adhered to:		

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
									• Fresh concrete and cement mortar must not be mixed near the freshwater features. Mixing of cement may be done within the construction camp, however, may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete; • No mixed concrete shall be deposited directly onto the ground within the freshwater features (outside of the designated area) or associated riparian habitat. A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing; • A washout area must be designated outside of the freshwater features, and wash water must be treated on-site or discharged to a suitable sanitation system; • Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream and • Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided. <u>With regards to backfilling of excavated areas:</u> • Stockpiled material must be used as backfill material; • All excavated areas must be backfilled to the natural ground level with excavated material; and • Soil must be suitably compacted, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process. <u>Rehabilitation of the construction footprint areas:</u> • All footprint areas which have been compacted must be ripped and revegetated with 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 must regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.		

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
4	Creation of new road crossings within freshwater features for the proposed new access/internal roads and underground cabling, involving: • Site preparation prior to construction activities including movement of construction machinery /vehicles within the freshwater features and removal of vegetation; • Ground-breaking and excavations and trenching within/adjacent to the freshwater features; and • Placement of culvert structures atop concrete base.	Creation of new road crossings within the CVB wetland associated with the Klein-Brak River system	• Earthworks and exposure of soil could result in sedimentation of the freshwater features, which may be transported as runoff into the downstream freshwater ecosystem areas and may smother vegetation associated with the freshwater features; • Altered water quality (if surface water is present) as a result of vehicle movement and construction activities; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	5	7	12	84	M	• It is imperative that all construction works be undertaken during the dry periods when there is no flow within the freshwater features, and thus no diversion of flow would be necessary. It is also recommended that existing crossings through freshwater features be prioritised for upgrading rather than development of new crossings, where possible; • Any works within the identified CVB wetland must be avoided and/or strictly minimised and indirect (or unavoidable direct) impacts suitably rehabilitated through erosion control, removal of alien plants and reinstatement of indigenous wetland vegetation; • The throughflow structures must be designed to ensure that the structures are geotechnically sound and that they are hydraulically stable, even if a 1:100 year flood event was to occur. The designs must include culverts installed intermittently to ensure a free draining landscape. It is recommended that a suitably qualified hydrologist be consulted to provide guidance on the relevant sizes and width requirements to ensure that hydraulic functioning of the system is maintained; • In addition, the crossings must be designed such that should they be overtopped, they remain stable and do not lead to excessive downstream erosion and incision. It must be ensured that the final design accounts for appropriate wetting frequencies and patterns are maintained in the pre-development condition (with input from the freshwater ecologist, where necessary); • The reaches of the freshwater features 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 construction Right of Way would allow for construction personal, vehicles (if applicable) to enter the freshwater feature crossing where the road is proposed to be constructed;	55 (-28) L	Fully reversible
5		Creation of new road crossings within the lower foothill tributaries associated with the Klein-Brak River system		3,5	5,5	14	77	M		55 (-21) L	Fully reversible
6		Creation of new road crossings within the mountain stream drainage lines (no riparian vegetation) and upper foothill tributaries (no riparian vegetation) associated with the Klein-Brak River system		3,25	5,25	12	63	M		55 (-7) L	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
									• The clearing of vegetation within the footprint area must be kept to a minimum to avoid unnecessary disturbance within the active channel; • The removed vegetation must be stockpiled outside of the delineated boundary of a freshwater feature. The footprint areas of these stockpiles must be kept to a minimum, and may not exceed a height of 2 m. Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site; • See Activity 6 below with regards to excavation and soil compaction activities within the freshwater features. • See Activity 3 above for control measures specific to concrete works.		
7	Upgrading of existing access roads within freshwater features: • Excavation within freshwater features for the removal of existing	Upgrading of existing access roads within the CVB wetland associated with the Klein-Brak River system	• Removal of vegetation and associated disturbances to soil; • Earthworks and exposure of soil could result in sedimentation of the freshwater features, which may be transported as runoff into the downstream freshwater ecosystem areas and may smother vegetation associated	5	7	12	84	**M**	• The construction footprint must be limited to a construction Right of Way that comprises a 5 m construction buffer (upstream and downstream of the freshwater ecosystem crossing) only. • Upgrading of the informal roads must take cognisance of the delineated extent of the freshwater feature traversed by the existing informal access road and that located within close proximity to the road. Should the road be increased in width, the road must be expanded on the side opposite of a freshwater feature, to ensure that the remaining natural buffer between the access road and the freshwater feature remains intact;	**55 (-28) L**	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
8	infrastructure and casting of a base (where applicable); • Placement of culvert structures atop concrete base; and • Upgrading of existing roads within close proximity (within 32 m) to a freshwater feature.	Upgrading of existing access roads within the upper and lower foothill tributaries associated with the Klein-Brak River system	with the freshwater ecosystem areas; • Movement of construction machinery/ vehicles within the freshwater features; • Possible spills / leaks from construction vehicles; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	2,25	4,75	12	57	**M**	• Material to be used (gravel – if applicable) as part of the upgrading of the existing roads must be stockpiled outside the delineated extent of the freshwater features (preferably at least 32 m from the freshwater feature) to prevent sedimentation thereof and to avoid any other vegetation being impacted by the construction activities. These stockpiles may not exceed a height of 2 m and must be protected from wind using tarpaulins; • The disturbed area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring; • The alien vegetation management plan as compiled by the terrestrial/botanical ecologist is highly recommended and supported by the freshwater specialist and must be implemented concurrently with the commencement of construction; and • All existing alien and invasive vegetation must be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.	**55 (-1) L**	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
									With regards to excavation and soil compaction activities within the freshwater ecosystems (including that associated with the installation of underground cabling) Although the proposed freshwater ecosystems crossings upgrades are associated with generally existing farm roads, and as such the most significant impacts have already occurred, the existing gravel roads are relatively small with no formal through flow structures in most cases. The following are applicable with regards to excavation works and any concrete related activities: • During the excavation activities, any soil/sediment or silt removed from the freshwater feature may be temporarily stockpiled in the road reserve but outside the delineated extent of the freshwater feature. These stockpiles may not exceed 2 m in height, and their footprint must be kept to a minimum. Stockpiling of removed materials may only be temporary (may only be stockpiled during the period of construction at a particular site) and must be disposed of at a registered waste disposal facility; • During trenching activities, seepage water may be present within the trench -invariably this will be filled with silt and be muddy. Therefore, any seepage must not be discharged straight into the river channel but through a silt trapping area first before entering the downstream reach; • Excavated materials must not be contaminated, and it must be ensured that the minimum surface area is taken up. Mixture of the lower and upper layers of the excavated soil must be kept to a minimum, for later usage as backfill material or as part of rehabilitation activities; • For trenching of the cables, the topsoil must be stored separately and may not be contaminated. Furthermore, the soil layers must be placed in the same order and the topsoil returned last; • Care must be taken to ensure that no scouring or erosion occurs as a result of the proposed culvert crossing. Installation of riprap or gabion mattresses and/or concrete aprons associated with any culverts; • All construction material (with specific mention of prefabricated culvert structures) must be stockpiled in the laydown area and must only be imported to the construction site when required;		

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
									• Machinery/vehicles used to install culvert structures must be parked on the existing road surface and may not enter the freshwater features; and • Reno-mattresses or riprap must be installed at the outlet side of the culvert/bridge structures to ensure energy dissipation and prevent concentrated runoff into the downstream freshwater feature. The reno mattress/riprap must be installed flush with the culvert outlet. • See Activity 3 above for control measures specific to concrete works.		
OPERATIONAL PHASE											
9	Operation and maintenance of the surface infrastructure associated with the proposed development located outside the delineated freshwater features and outside the GN509 ZoR, including turbines and associated foundations, laydown area and an O&M building (if applicable).	Proactive monitoring to ensure structural integrity is maintained and to identify early signs of failure / erosion.	No direct impacts perceived.	2	4	8	32	**L**	• No indiscriminate movement of construction equipment through the freshwater features may be permitted during standard operational activities or maintenance activities. Use must be made of the existing freshwater ecosystem crossings only; and • Vehicles used in the development site must be regularly washed (on a non-permeable surface or off-site) to avoid the dispersal of seeds on any alien or invasive species into the freshwater features.	**NA**	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
10	Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater features (where applicable).	• Concentrated runoff entering the freshwater features; and • Disturbance to the vegetation within and surrounding the freshwater features.	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the freshwater features (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the freshwater features due to reduced surface roughness in the freshwater features.	2,5	4,5	12	54	L	• Hot spots for the build-up of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure; • Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings/instream infrastructure. Such maintenance activities must specifically be undertaken after high rainfall events; • Stormwater runoff from the road crossings must be monitored (by the O&M Manager, to ensure it does not result in erosion of the freshwater features. Stormwater must be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the freshwater feature (through vegetation and rocky areas); • Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the freshwater features may be permitted; • During periodic maintenance activities of the roads, monitoring for erosion must be undertaken; and • Should erosion be observed, caused by the road crossings/instream infrastructure, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks collected from the surrounding area to infill any area prone to erosion (however, these must be sustainably sourced not taken from the surrounding freshwater features including rivers in the local area).	NA	Fully reversible
DECOMMISSIONING PHASE											
11	Removal of all surface infrastructure from the project area.	• Movement of construction vehicles and personnel; and • Disturbance to the buffer zone surrounding the freshwater features.	• Disturbance of soil and vegetation that established within the operational area.	2,25	4,25	13	55,25	L	• No indiscriminate movement of construction equipment in the freshwater features and buffer zones surrounding the freshwater features 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 freshwater features (where applicable) and may temporarily be stored/ stockpiled outside of the delineated extent of the freshwater features, whereafter it must be removed from site and disposed of at a registered disposal facility;	NA	Fully reversible

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
									• High flood peaks from the decommissioning footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure area and subsequent cleared area enters the freshwater features. The velocity of surface water flow from these areas must be reduced by ensuring that the vegetation in the buffer area surrounding the freshwater features is 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 freshwater features; • Should erosion gullies be noted, these areas must be rehabilitated by infilling them with suitable soil and ensuring the area is vegetated. The increased surface roughness will discourage concentrated flow paths to develop and ensure diffuse flow patterns; • Should road crossings be decommissioned, road footprint areas within a freshwater feature must be levelled to the same level and shape as that of the upstream and downstream reaches. This will ensure a continuous bed level and prevent any concentration of surface flow from occurring; • Channel banks associated with the freshwater features must be suitably rehabilitated (shaped end revegetated) to prevent any erosion from occurring; • All bare areas in the investigation 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 must take place where initial revegetation is not successful; and		

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating	Reversibility
									• Post-closure monitoring of the freshwater features (for a period of 3 years), with specific mention of the invasion of alien vegetation species) is recommended to be undertaken.		

7.2 *Impact Assessment*

The results of the DWS specified Risk Assessment Matrix (as promulgated in GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)) are translated into the impact assessment methodology provided by the EAP. Kindly refer to **Appendix E** for the full risk assessment table scorings

Tables 9 to 14 below provides the summary of the impact assessment outcome for the above-listed activities, based on the methods presented in Appendix D, with suitable mitigation measures provided. The mitigation measures in bold, indicate key and essential mitigation measures that allowed for the impacts to result in an overall low significance after mitigation. It is important to note, however, that should all mitigation measures not be adhered to, the risk significance will likely be a moderate or high.

Table 9: Construction phase – impact assessment of site preparation activities prior to the construction activities.

Impact 1: Site preparation prior to construction activities		
	Before mitigation	**After mitigation**
Vehicular movement (transportation of construction materials)	MODERATE NEGATIVE	LOW NEGATIVE
Removal of vegetation and associated disturbances to soil	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation measures:

- 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) must 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 the 100 m NEMA Zone of Regulation (e.g., access roads), regular spraying of non-potable water or the use of chemical dust suppressants, that are approved for use near freshwater ecosystems must be implemented to reduce dust and to ensure no smothering of vegetation within the freshwater features 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 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 freshwater features outside the construction footprint not having authorised road crossings must be considered as no-go areas. No construction vehicles, nor construction personnel or vehicles may traverse through these freshwater features (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 freshwater features and their associated 100 m NEMA ZoR** as it would also help the proponent avoid the LN3 activities triggered within 100 m of watercourses;
- All vehicle re-fuelling is to take place outside of the 100 m NEMA ZoR; and
- No vegetation may be removed from the 100 m ZoR surrounding the freshwater features where no infrastructure is planned, as this provides a natural buffer zone around the freshwater features which plays a role in dispersing surface runoff into the freshwater features, and thus prevents sedimentation and erosion thereof.

Table 10: Construction of surface infrastructure associated with the proposed development.

Impact 2: Construction of surface infrastructure associated with the proposed development outside the delineated freshwater features and outside the 100 m NEMA ZoR, including turbines and associated foundations, laydown area and an administration and operations and maintenance (O&M) building (if applicable).		
	Before mitigation	**After mitigation**
Ground-breaking and earthworks relating to foundations and trenches	LOW NEGATIVE	LOW NEGATIVE
Mixing and casting of concrete for construction purposes	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation measures:

Though the proposed turbines are located outside the 100 m NEMA Zone of Regulation, indirect impacts to the receiving freshwater environment are likely during construction, particularly on the freshwater features located downgradient of the turbines. As such appropriate mitigation measures are provided.

- It is also strongly recommended that the contractor laydown areas, material storage facilities, and the O&M building (if applicable) to remain outside of the freshwater features and their associated 100 m NEMA ZoR. This in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DFFE *et al*. (2013).

With regards to ground-breaking activities outside the delineated extent of a freshwater feature:

- During excavation activities, the topsoil and vegetation must be stockpiled separately from other material outside the delineated extent of the freshwater features;
- Excavated materials must not be contaminated, and it must be ensured that the minimum surface area is taken up by any stockpiled materials. The mixture of the lower and upper layers of the excavated soil must be kept to a minimum, so as for later use as backfill material after construction has commenced;
- All exposed soils must be protected from wind using tarpaulins for the duration of the construction phase to prevent potential erosion and sedimentation of the freshwater features;
- Suitable drainage must be insured along the turbine foundations, in order to ensure that water does not pond or drain in a concentrated manner into the nearby freshwater features. This must be considered as part of the stormwater management plan and be overseen by the Environmental Control Officer (ECO);
- Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the freshwater features 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 freshwater features 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.

Control measures for concrete mixing on site:

- No mixed concrete may be deposited outside of the designated construction footprint;
- As far as possible, concrete mixing must be restricted to the batching plant. Additionally, batter / dagga board mixing trays and impermeable sumps must be provided, onto which any mixed concrete can be deposited while it awaits placing; and
- Concrete spilled outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site.

With regards to backfilling of excavated areas:

- Stockpiled material must be used as backfill material;
- All excavated areas must be backfilled to the natural ground level with excavated material; and
- Soil must be suitably compacted, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process.

Rehabilitation of the construction footprint areas:

- All footprint areas which have been compacted must be ripped and revegetated with 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 must regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.

Table 11: Creation of new road crossings within freshwater features.

Impact 3: Creation of new road crossings within freshwater features for the proposed new access/internal roads and underground cabling		
	Before mitigation	**After mitigation**
Site preparation prior to construction activities including movement of construction machinery /vehicles within the freshwater features and removal of vegetation	HIGH NEGATIVE	LOW NEGATIVE
Ground-breaking and excavations and trenching within/adjacent to the freshwater features	HIGH NEGATIVE	LOW NEGATIVE
Placement of culvert structures atop concrete base	HIGH NEGATIVE	LOW NEGATIVE

Mitigation measures:

- **It is imperative that all construction works be undertaken during the dry periods when there is no flow within the freshwater features, and thus no diversion of flow would be necessary. It is also recommended that existing crossings through freshwater features be prioritised for upgrading rather than development of new crossings, where possible;**
- **Any works within the identified CVB wetland must be avoided and/or strictly minimised and indirect (or unavoidable direct) impacts suitably rehabilitated through erosion control, removal of alien plants and reinstatement of indigenous wetland vegetation;**
- **The throughflow structures must be designed to ensure that the structures are geotechnically sound and that they are hydraulically stable, even if a 1:100 year flood event was to occur. The designs must include culverts installed intermittently to ensure a free draining landscape. It is recommended that a suitably qualified hydrologist be consulted to provide guidance on the relevant sizes and width requirements to ensure that hydraulic functioning of the system is maintained;**
- **In addition, the crossings must be designed such that should they be overtopped, they remain stable and do not lead to excessive downstream erosion and incision. It must be ensured that the final design accounts for appropriate wetting frequencies and patterns are maintained in the pre-development condition (with input from the freshwater ecologist, where necessary);**
- The reaches of the freshwater features 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 construction Right of Way would allow for construction personal, vehicles (if applicable) to enter the freshwater feature crossing where the road is proposed to be constructed;

- The clearing of vegetation within the footprint area must be kept to a minimum to avoid unnecessary disturbance within the active channel;
- The removed vegetation must be stockpiled outside of the delineated boundary of a freshwater feature. The footprint areas of these stockpiles must be kept to a minimum, and may not exceed a height of 2 m. Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site;
- See Table 13 below with regards to excavation and soil compaction activities within the freshwater features.
- See Table 11 above for control measures specific to concrete works.

Table 12: Upgrading of existing access roads within freshwater features.

Impact 4: Upgrading of existing access roads within freshwater features and within close proximity (within 32 m) to a freshwater feature.		
	Before mitigation	**After mitigation**
Ground-breaking and excavations and trenching within/adjacent to the freshwater features	MODERATE NEGATIVE	LOW NEGATIVE
Placement of culvert structures atop concrete base	HIGH NEGATIVE	LOW NEGATIVE

Mitigation measures:

- The construction footprint must be limited to a construction Right of Way that comprises a 5 m construction buffer (upstream and downstream of the freshwater ecosystem crossing) only.
- Upgrading of the informal roads must take cognisance of the delineated extent of the freshwater feature traversed by the existing informal access road and that located within close proximity to the road. Should the road be increased in width, the road must be expanded on the side opposite of a freshwater feature, to ensure that the remaining natural buffer between the access road and the freshwater feature remains intact;
- Material to be used (gravel – if applicable) as part of the upgrading of the existing roads must be stockpiled outside the delineated extent of the freshwater features (preferably at least 32 m from the freshwater feature) to prevent sedimentation thereof and to avoid any other vegetation being impacted by the construction activities. These stockpiles may not exceed a height of 2 m and must be protected from wind using tarpaulins;
- The disturbed area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring;
- The alien vegetation management plan as compiled by the terrestrial/botanical ecologist is highly recommended and supported by the freshwater specialist and must be implemented concurrently with the commencement of construction; and
- All existing alien and invasive vegetation must be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.

<u>With regards to excavation and soil compaction activities within the freshwater ecosystems (including that associated with the installation of underground cabling)</u>

Although the proposed freshwater ecosystems crossings upgrades are associated with generally existing farm roads, and as such the most significant impacts have already occurred, the existing

gravel roads are relatively small with no formal through flow structures in most cases. The following are applicable with regards to excavation works and any concrete related activities:

- During the excavation activities, any soil/sediment or silt removed from the freshwater feature may be temporarily stockpiled in the road reserve but outside the delineated extent of the freshwater feature. These stockpiles may not exceed 2 m in height, and their footprint must be kept to a minimum. Stockpiling of removed materials may only be temporary (may only be stockpiled during the period of construction at a particular site) and must be disposed of at a registered waste disposal facility;
- Excavated materials must not be contaminated, and it must be ensured that the minimum surface area is taken up. Mixture of the lower and upper layers of the excavated soil must be kept to a minimum, for later usage as backfill material or as part of rehabilitation activities;
- For trenching of the cables, the topsoil must be stored separately and may not be contaminated. Furthermore, the soil layers must be placed in the same order and the topsoil returned last;
- Care must be taken to ensure that no scouring or erosion occurs as a result of the proposed culvert crossing. Installation of riprap or gabion mattresses and/or concrete aprons associated with any culverts;
- All construction material (with specific mention of prefabricated culvert structures) must be stockpiled in the laydown area and must only be imported to the construction site when required;
- Machinery/vehicles used to install culvert structures must be parked on the existing road surface and may not enter the freshwater features; and
- Reno-mattresses or riprap must be installed at the outlet side of the culvert/bridge structures to ensure energy dissipation and prevent concentrated runoff into the downstream freshwater feature. The reno mattress/riprap must be installed flush with the culvert outlet.
- See Table 11 above for control measures specific to concrete works.

Table 13: Operation and maintenance of surface and road infrastructure associated with the proposed development

Impact 5: Operation and maintenance of surface and road infrastructure associated with the proposed development		
	Before mitigation	**After mitigation**
Proactive monitoring to ensure structural integrity is maintained and to identify early signs of failure / erosion.	LOW NEGATIVE	LOW NEGATIVE
Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater features (where applicable).	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation measures:

- No indiscriminate movement of construction equipment through the freshwater features may be permitted during standard operational activities or maintenance activities. Use must be made of the existing freshwater ecosystem crossings only;
- Vehicles used in the development site must be regularly washed (on a non-permeable surface or off-site) to avoid the dispersal of seeds on any alien or invasive species into the freshwater features;
- Hot spots for the build-up of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure;

- Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings/instream infrastructure. Such maintenance activities must specifically be undertaken after high rainfall events;
- Stormwater runoff from the road crossings must be monitored (by the O&M Manager, to ensure it does not result in erosion of the freshwater features. Stormwater must be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the freshwater feature (through vegetation and rocky areas);
- Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the freshwater features may be permitted;
- During periodic maintenance activities of the roads, monitoring for erosion must be undertaken; and
- Should erosion be observed, caused by the road crossings/instream infrastructure, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks collected from the surrounding area to infill any area prone to erosion (however, these must be sustainably sourced not taken from the surrounding freshwater features including rivers in the local area).

Table 14: Decommissioning phase

Impact 6: Decommissioning of the WEF and associated infrastructure		
	Before mitigation	**After mitigation**
Removal of all surface infrastructure from the project area.	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation measures:

- No indiscriminate movement of construction equipment in the freshwater features and buffer zones surrounding the freshwater features 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 freshwater features (where applicable) and may temporarily be stored/ stockpiled outside of the delineated extent of the freshwater features, whereafter it must be removed from site and disposed of at a registered disposal facility;
- High flood peaks from the decommissioning footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure area and subsequent cleared area enters the freshwater features. The velocity of surface water flow from these areas must be reduced by ensuring that the vegetation in the buffer area surrounding the freshwater features is 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 freshwater features;
- Should erosion gullies be noted, these areas must be rehabilitated by infilling them with suitable soil and ensuring the area is vegetated. The increased surface roughness will discourage concentrated flow paths to develop and ensure diffuse flow patterns;
- Should road crossings be decommissioned, road footprint areas within a freshwater feature must be levelled to the same level and shape as that of the upstream and downstream reaches. This will ensure a continuous bed level and prevent any concentration of surface flow from occurring;

- Channel banks associated with the freshwater features must be suitably rehabilitated (shaped end revegetated) to prevent any erosion from occurring;
- All bare areas in the investigation 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 must take place where initial revegetation is not successful; and
- Post-closure monitoring of the freshwater features (for a period of 3 years), with specific mention of the invasion of alien vegetation species) is recommended to be undertaken.

7.3 *Risk and Impact Assessment discussion*

Based on the outcome of the DWS risk and impact assessments, the activities associated with the construction and operational phases of the proposed development pose a low to moderate risk significance to the freshwater features within the study area, with the application of the recommended mitigation measures (Table 8). The intensity of impacts pre-mitigation ranges from moderate negative to high negative (Tables 9 to 14), the latter is due to impacts to water quality which could be severe to aquatic life and have the potential to spread over a larger spatial scale, as well as activities with a direct physical footprint on the freshwater systems i.e., the construction of new and upgrading of existing roads through freshwater ecosystems. Due to the proposed access and internal roads likely to traverse the freshwater features within the study area and potential upgrading/grading of existing roads located within freshwater features, the direct impacts during the construction phase pose a Moderate (negative) risk significance to the freshwater features. Nevertheless, it is the opinion of the ecologist that formalising road crossings within freshwater features with appropriate through flow structures is considered advantageous over the long-term as existing informal crossings have resulted in erosion of the freshwater features which have caused interruption of hydrological connectivity between the upstream and downstream reaches. In consideration of the episodic / ephemeral nature of the identified freshwater features associated with the Klein-Brak River system (only flooding or flowing in response to extreme rainfall events) and remaining dry for most of the year due to the semi-arid climate of the local area, a manual amendment of the risk significance scoring was implemented to classify activities associated with the construction of new access / internal roads and potential upgrading of existing roads within freshwater features as Low risk. The following rationale supports this amendment:

- If the proposed activities are undertaken during the driest period of the year when no surface water is present within the freshwater features, impacts to the hydrological and geomorphological regime, and surface water quality of the freshwater features to be impacted can be considered ‘Low’;
- Any works with the wetland must be avoided and indirect (and unavoidable direct) impacts suitably rehabilitated;
- All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; and
- Installation of appropriate through flow structures within new and existing road crossings within freshwater features is highly recommended as this is considered a positive long-term benefit for the maintenance and potential improvement of the hydrological functionality of the freshwater features and associated downstream systems. Additionally, improvement of the hydrological connectivity associated with this would constitute improvement of the PES of these freshwater features.

With implementation of all mitigation measures, the long-terms impact can be considered low, thus the overall risk significance of the proposed development is considered low.

The proposed turbines must remain outside of the 100 m AND 500 m GN509 and NEMA regulated areas as proposed. It is also strongly recommended that the contractor laydown areas, material storage facilities, and the O&M building (if applicable) remain outside of the freshwater features and their associated 100 m and 500 m GN509 / 100 m NEMA ZoR. This in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DFFE *et al*. (2013).

Additional “good practice” mitigation measures applicable to a project of this nature are provided in Appendix E of this report.

7.4 *Cumulative Impact Statement*

Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future, both spatially and temporally, considered together with the impacts identified in Sections 7.1 and 7.2. Freshwater ecosystems within the region are under continued threat due to rapid land use transformation in the surrounding landscape, with specific mention of ongoing agricultural activities associated with livestock farming.

Direct and indirect impacts identified within the assessed freshwater features can predominantly be attributed to the construction of the new proposed access road and potential upgrading/grading of existing roads located within freshwater features, the disturbance to the hydrological connectivity and functioning of the freshwater ecosystems and alien and invasive species establishment. Considering that a majority of the proposed development will be located outside the assessed freshwater features (thus avoiding direct negative impacts), increased vehicular movement and infrastructure in the surrounding landscape may result in indirect edge effects. Such edge effects may have cumulative impacts to the freshwater features, with specific mention of alien and invasive species establishment and increased sediment loads. With management and mitigation measures implemented during the construction phase including the installation of appropriate drainage structures along road crossings through freshwater features, and monitoring of access roads, and WEF infratsructuire (turbine foundations) for any erosion during the operational phase, the direct and indirect negative impacts can be reduced, thus cumulative impact on the larger catchment can, therefore, be considered low/limited.

8 CONCLUSION

FEN Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the EA and WUA processes for the proposed Taaibos South WEF and associated infrastructure near Victoria West in the Northern Cape Province.

During the site visit undertaken from the from the 21st to the 26th of February 2022, the Klein-Brak River and several freshwater features (best described as fluvial features) associated with the Klein-Brak River system were identified within the study area. These comprise of smaller drainage lines and minor tributaries (that drain the surrounding hilltops on which some of the turbines are proposed, and were classified as mountain stream drainage lines and upper foothill tributaries based on their topographical setting and longitudinal zonation), and larger tributaries and rivers that are positioned within the lower gradient were classified as lower foothill tributaries and rivers associated with the Klein-Brak Ruver system. A channelled valley bottom (CVB) wetland was identified within the central northern portion of the study area and is associated with one of the major tributaries of the Klein-Brak River system.

No surface infrastructure components associated with the proposed development are located within any of the delineated freshwater features; turbines and associated foundations are located at least 100 m from the delineated extent of the identified freshwater features and 500 m from the delineated CVB wetland. Exceptions are the proposed access and internal roads, which may entail the construction of new road crossings through freshwater features and potential upgrading of existing crossings within freshwater features. The construction of the proposed access and internal roads and potential upgrading of existing roads within freshwater features pose a moderate risk significance to the freshwater features. However, the installation of appropriate culverts or subsurface drainage within new and existing road crossings is considered a positive long-term benefit for the maintenance and potential improvement of the hydrological functionality of the freshwater features and associated downstream systems. Therefore, with the condition that the construction of the proposed development is undertaken during the driest period of the year when no surface water is present within the freshwater features and the recommended mitigation measures are applied, including minimising direct activities with the CVB wetland followed by suitable rehabilitation, the risk significance can be reduced to Low.

Applicable legislative application processes:

The following aspects must be considered for the required approvals and/or permits by the relevant authorities:

- The freshwater features are considered 'no-go' areas for building infrastructure components. Linear infrastructure (such as roads and underground cables) must only be planned within these areas if it is absolutely unavoidable to circumnavigate these freshwater features. Therefore, the contractor laydown areas, material storage facilities, and the O&M building (if applicable) must remain outside of the freshwater features. It is also strongly recommended that these be located outside the 100 m / 500 m GN509 and 100 m NEMA ZoR of the freshwater features. This in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DFFE *et al*. (2013);
- Infrastructure may be located within the 32 m and 100 m / 500 m regulated area of a watercourse as stipulated by the National Environmental Management Act, 1998 (Act No. 107 of 1998), and GN 509 regulated areas in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA, provided that the relevant authorisations are obtained. Development within these areas can take place but should be avoided, if possible, to avoid triggering Section 21 (c) and (i) water uses (exception for specified activities as per Appendix D2 of GN 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998));
- Since it is expected that the 100 m / 500 m GN509 ZoR (and 100 m ZoR in terms of NEMA) cannot be avoided for the upgrading of existing and construction of new roads and underground cabling, WUA by means of a GA in terms of Section 21(c) and (i) water uses, therefore, must be obtained in consultation with the DWS. However, the DWS, as the custodian of water resources in South Africa, must be consulted with regards to the outcome of this assessment. It is therefore recommended that the mitigation measures as provided in this report and the good housekeeping measures as per Appendix E be implemented to prevent any direct/indirect impacts from occurring on the freshwater features.

With implementation and strict enforcement of cogent, well-developed mitigation measures as outlined in this report, with specific mention of ensuring all instream construction footprints are rehabilitated and the freshwater features monitored for any alien and invasive species establishment, no fatal flaws in terms of freshwater ecological aspects were identified and the proposed development can be considered acceptable.

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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, at their sole discretion, 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[12]	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

[12] 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 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 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 is 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)
Unchanneled 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[13]** (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;
- **Unchanneled 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

[13] 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).

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.

DWS Risk Assessment Methodology

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'[14]. 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[15].

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.

[14] The definition has been aligned with that used in the ISO 14001 Standard.
[15] 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[16] 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.

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

Ecological Impact Assessment Method of assessment (as provided by the EAP)

The CES rating scale has been updated to meet the requirements outlined in Appendix 2 of the EIA Regulations (2014, as amended). This methodology takes into consideration the following criteria, and includes the new criteria for assessing post mitigation significance (residual impacts), by incorporating the principles of reversibility and irreplaceability:

1. Nature of impact
2. Type of impact
3. Duration (previously called temporal scale by CES)
4. Extent (previously called the spatial scale by CES)
5. Probability (previously called likelihood by CES)
6. Severity or benefits

The overall significance rating for the impact is then obtained from the above six criteria.

It is recommended that we use the terminology aligned to SA regulations i.e., Duration; Extent and Probability (as opposed to temporal scale, spatial scale and likelihood).

If required or deemed necessary, you can also define the Degree of confidence or certainty that you attach to your rating.

TableD10 below provides definitions for Criteria 3,4 & 5,

Table D10: Temporal, Spatial, Likelihood Scales defined.

Duration (Temporal Scale)		**Score**
Short term	Less than 5 years	1
Medium term	Between 5-20 years	2
Long term	Between 20 and 40 years (a generation) and from a human perspective also permanent	3
Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there	4
Extent (Spatial Scale)		
Localised	At localised scale and a few hectares in extent	1
Study Area	The proposed site and its immediate environs	2
Regional	District and Provincial level	3
National	Country	3
International	Internationally	4
Probability (Likelihood)		
Unlikely	The likelihood of these impacts occurring is slight	1
May Occur	The likelihood of these impacts occurring is possible	2
Probable	The likelihood of these impacts occurring is probable	3
Definite	The likelihood is that this impact will definitely occur	4

Criteria 6: Severity Scales

- The severity of the impact - the severity/beneficial scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party. The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it, and how effective the mitigation might be. The word 'mitigation' means not just 'compensation', but includes concepts of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable (Table D11).

Table D11: Impact Severity explained

Impact Severity *(The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or affected party)*		***Score***
Very severe	**Very beneficial**	**4**
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.	
Severe	**Beneficial**	**3**
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.	
Moderately severe	**Moderately beneficial**	**2**
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing the sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.	
Slight	**Slightly beneficial**	**1**
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.	
No effect	**Don't know/Can't know**	
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.	

** In certain cases it may not be possible to determine the severity of an impact thus it may be determined: Don't know/Can't know*

Applying the criteria to ASSESS environmental significance before mitigation

The CES rating scale has been updated to meet the requirements outlined in Appendix 2 of the EIA Regulations (2014, as amended). This methodology takes into consideration the following criteria, and includes the new criteria for assessing post mitigation significance (residual impacts), by incorporating the principles of reversibility and irreplaceability:

7. Nature of impact
8. Type of impact
9. Duration (previously called temporal scale by CES)
10. Extent (previously called the spatial scale by CES)
11. Probability (previously called likelihood by CES)

12. Severity or benefits

The overall significance rating for the impact is then obtained from the above six criteria.
It is recommended that we use the terminology aligned to SA regulations i.e., Duration; Extent and Probability (as opposed to temporal scale, spatial scale and likelihood).
If required or deemed necessary, you can also define the Degree of confidence or certainty that you attach to your rating.

The scores for the three criteria in Table D12 are added to obtain a composite score. They must then be considered against the severity rating to determine the overall significance of an activity. This is because the severity of the impact is far more important than the other three criteria. The overall significance is then obtained by reading off the matrix presented in TableD12. The overall significance is either negative or positive (Criterion 1) and direct, indirect or cumulative (Criterion 2).

Table D12: Matrix used to determine the overall significance of the impact based on the likelihood and effect of the impact

SEVERITY		COMPOSITE DURATION, EXTENT & PROBABILITY SCORE									
		3	4	5	6	7	8	9	10	11	12
	Slight	3	4	5	6	7	8	9	10	11	12
	Mod severe	3	4	5	6	7	8	9	10	11	12
	Severe	3	4	5	6	7	8	9	10	11	12
	Very severe	3	4	5	6	7	8	9	10	11	12

The **environmental significance** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

It is clear that an impact that has a *slight severity* could be of MODERATE significance because it is permanent (4), has a regional affect (3) and is definite. This elevates it from a LOW to a MODERATE rating. Conversely, a *moderately severe* impact could be rated as LOW since it is short term (1), localised (1) and only probable (3). An impact rated as *severe* could be of VERY HIGH significance because it is permanent (4), of national importance (3) and is definite (4). For example, the impact on a frog species of conservation concern (SCC) might only be rated as *severe* as a result of the project actions, but because the loss is permanent and of national importance (it's a SCC) and is definite, we rate the significance as VERY HIGH and not HIGH. If the impact was long term and not permanent then it would be rated as HIGH.

The Significance Rating Scale is defined in Table D13 below.

TableD13: Description of Environmental Significance Ratings and associated range of scores

OVERALL SIGNIFICANCE *(The combination of all the above criteria as an overall significance)*	
VERY HIGH NEGATIVE	**VERY BENEFICIAL**
These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects. *Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance.* *Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.*	
HIGH NEGATIVE	**BENEFICIAL**

OVERALL SIGNIFICANCE *(The combination of all the above criteria as an overall significance)*
These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light. *Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated.* *Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.*
MODERATE NEGATIVE / **SOME BENEFITS**
These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial. *Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant*.
LOW NEGATIVE / **FEW BENEFITS**
These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect. *Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels.* *Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.*
NO SIGNIFICANCE
There are no primary or secondary effects at all that are important to scientists or the public. *Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.*
DON'T KNOW
In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information. *Example: The effect of a particular development on people's psychological perspective of the environment.*

Significance Post Mitigation[17]

Once mitigation measure is proposed, the following criteria are then used to determine the overall post mitigation significance of the impact:

- Reversibility: The degree to which an environment can be returned to its original/partially original state.
- Irreplaceable loss: The degree of loss which an impact may cause.
- Mitigation potential: The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table D14 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

[17] Note that the application of reversibility and irreplaceability must be applied for South Africa impact assessments, as it is a regulatory requirement. For projects in other geographies it is optional.

Table D14: Criteria considered post mitigation

Reversibility	
Reversible	*The activity will lead to an impact that can be reversed provided appropriate mitigation measures are implemented.*
Irreversible	*The activity will lead to an impact that is permanent regardless of the implementation of mitigation measures.*
Irreplaceable loss	
Resource will not be lost	*The resource will not be lost/destroyed provided mitigation measures are implemented.*
Resource will be partly lost	*The resource will be partially destroyed even though mitigation measures are implemented.*
Resource will be lost	*The resource will be lost despite the implementation of mitigation measures.*
Mitigation potential	
Easily achievable	*The impact can be easily, effectively and cost effectively mitigated/reversed.*
Achievable	*The impact can be effectively mitigated/reversed without much difficulty or cost.*
Difficult	*The impact could be mitigated/reversed but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs.*
Very Difficult	*The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly.*

Degree of Confidence

If you wish, you may also mention the confidence you have in your impact ratings, but this is not a legislative requirement. It does, however, assist in determining the level of certainty of our impact predictions.

Degree of Confidence *(The confidence with which one has predicted the significance of an impact)*	
Certain	I am more than 90% sure of the facts that underpin my assessment, my data is current and the information I have is comprehensive enough for me to be *certain* of my impact rating.
Confident	I am more than 70% sure of the facts that underpin my assessment, my data is current and the information I have, although not comprehensive, is enough for me to be *confident* in my impact rating.
Undecided	I am between 40% and 70% sure of the facts that underpin my assessment, but my data is scant and the information I have is outdated, not very site specific and/or has other limitations so I am *undecided if* my impact rating is correct. I have therefore adopted a precautionary approach when rating this impact.
Unconvinced	I am less than 40% sure of the facts that underpin my assessment, my data is scant and the information I have is very outdated. I lack site specific information and details on the nature of the impact, as its effect is not well researched. I am therefore *unconvinced* that my impact rating is correct. I have therefore adopted a precautionary approach when rating this impact.

APPENDIX E: 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.

Soil

- 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 soil;

- 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 soil 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 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 E1: DWS Risk Assessment outcome for the proposed development.

No.	Phases	Activity	Aspect	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
1	Construction Phase	Site preparation prior to construction activities and general movement of construction personnel within the 100 m and 500 m GN509 ZoR but outside the delineated extent of the freshwater features.	• Vehicular movement (transportation of construction materials).	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.	1	1	1	2	1,25	1	1	3,25	5	1	5	1	12	39	L	**NA**
3		• Construction of surface infrastructure associated with the proposed development outside the delineated freshwater features, including turbines and associated foundations, laydown area and an administration and operations and maintenance (O&M) building (if applicable).	• 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.	1	1	1	2	1,25	1	1	3,25	5	1	5	1	12	39	L	**NA**
4		Creation of new road crossings within freshwater features from the proposed new access/internal roads and underground cabling, involving: • Site preparation prior to construction activities including movement of construction machinery	• Creation of new road crossings within the CVB wetland associated with the Klein-Brak River system	4	4	5	4	4,3	1	1	6,3	5	3	5	1	14	87,5	M	**55 (- 31,5) L**

No.	Phases	Activity	Aspect	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
5		/vehicles within the freshwater features and removal of vegetation; • Ground-breaking and excavations and trenching within/adjacent to the freshwater features; and; • Placement of culvert structures atop concrete base.	• Creation of new road crossings within the lower foothill tributaries associated with the Klein-Brak River system	3	3	5	3	3,5	1	1	5,5	5	3	5	1	14	77	M	**55 (-21) L**
6			• Creation of new road crossings within the mountain stream drainage lines (no riparian vegetation) and upper foothill tributaries (no riparian vegetation) associated with the Klein-Brak River system	3	2	5	3	3.25	1	1	5.25	4	2	5	1	12	63	M	**55 (-7) L**
7		Upgrading of existing access roads within freshwater features: • Excavation within freshwater features for the removal of existing infrastructure and casting of a base (where applicable); • Placement of culvert structures atop concrete base; and • Upgrading of existing roads within close proximity (within 32 m) to a freshwater feature.	• Upgrading of existing access roads within the CVB wetland associated with the Klein-Brak River system	4	4	5	4	4,3	1	1	6,3	4	2	5	1	12	75		**55 (-7) L**
8			• Upgrading of existing access roads within the upper and lower foothill tributaries associated with the Klein-Brak River system	3	2	4	2	2.75	1	1	4.75	4	2	5	1	12	57	M	**55 (-19) L**

No.	Phases	Activity	Aspect	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
9	Operational Phase	Operation and maintenance of the surface infrastructure associated with the proposed development located outside the delineated freshwater features and outside the GN509 ZoR, including turbines and associated foundations, laydown area and an O&M building (if applicable).	• Proactive monitoring to ensure structural integrity is maintained and to identify early signs of failure / erosion.	2	2	2	2	2,0	1	1	4,0	1	1	5	1	8	32	L	**NA**
10		Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater features (where applicable).	• Concentrated runoff entering the freshwater features; and • Disturbance to the vegetation within and surrounding the freshwater features.	3	1	3	3	2,5	1	1	4,5	5	1	5	1	12	54	L	**NA**
11	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 freshwater features.	2	1	3	3	2,25	1	1	4,25	5	2	5	1	13	55,25	L	**NA**

Table E2: Impact Assessment outcome for the proposed development.

	Nature	Duration	Extent	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Impact 1: Construction Phase: Site preparation prior to construction activities										
Vehicular movement (transportation of construction materials);	Negative	Short term	Study Area	Moderately severe	Probable	MODERATE NEGATIVE	Reversible	Resource will not be lost	Easily achievable	LOW NEGATIVE
Removal of vegetation and associated disturbances to soil	Negative	Short term	Study Area	Moderately severe	Probable	MODERATE NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Impact 2: Construction Phase: Construction of surface infrastructure associated with the proposed development outside the delineated freshwater features and outside the 100 m NEMA ZoR, including turbines and associated foundations, laydown area and an administration and operations and maintenance (O&M) building (if applicable).										
Ground-breaking and earthworks relating to foundations and trenches	Negative	Short term	Study Area	Slight	Probable	LOW NEGATIVE	Reversible	Resource will not be lost	Easily achievable	LOW NEGATIVE
Mixing and casting of concrete for construction purposes	Negative	Short term	Study Area	Severe	Probable	MODERATE NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Impact 3: Creation of new road crossings within freshwater features from the proposed new access/internal roads and underground cabling										
Site preparation prior to construction activities including movement of construction machinery	Negative	Long term	Study Area	Severe	Probable	HIGH NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE

	Nature	Duration	Extent	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
/vehicles within the freshwater features and removal of vegetation										
Ground-breaking and excavations and trenching within/adjacent to the freshwater features	Negative	Long term	Study Area	Severe	Probable	HIGH NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Placement of culvert structures atop concrete base	Negative	Long term	Study Area	Severe	Probable	HIGH NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Impact 4: Upgrading of existing access roads within freshwater features and within close proximity (within 32 m) to a freshwater feature.										
Ground-breaking and excavations and trenching within/adjacent to the freshwater features	Negative	Long term	Study Area	Moderately severe	Probable	MODERATE NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Placement of culvert structures atop concrete base	Negative	Long term	Study Area	Severe	Probable	HIGH NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Impact 5: Operation and maintenance of surface infrastructure associated with the proposed development and road infrastructure										
Proactive monitoring to ensure structural integrity is maintained and to identify early signs of failure / erosion.	Positive	Short term	Localised	Slight	Probable	LOW NEGATIVE	Reversible	Resource will not be lost	Easily Achievable	LOW NEGATIVE

	Nature	Duration	Extent	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Operation and maintenance of the proposed main access roads and other existing roads traversing freshwater features (where applicable).	Negative	Medium term	Study Area	Moderately severe	Probable	MODERATE NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE
Impact 6: Decommissioning phase										
Removal of all surface infrastructure from the project area.	Negative	Medium term	Study Area	Moderately severe	Probable	MODERATE NEGATIVE	Reversible	Resource will not be lost	Achievable	LOW NEGATIVE

APPENDIX F: Details, Expertise and Curriculum Vitae of Specialists

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

Rabia Mathakutha MSc Plant Science (University of Pretoria)
Paul da Cruz BA (Hons) Geography and Environmental Studies (University of the Witwatersrand)

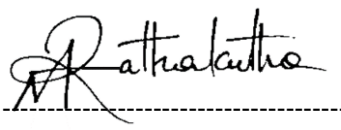
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services (Pty) Ltd		
Name / Contact person:	Rabia Mathakutha		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	083 739 2284
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	rabia@sasenvgroup.co.za		
Qualifications	MSC Plant Science		
Registration / Associations	Registered Candidate Member of the South African Council for Natural Scientific Professions (SACNASP)		

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

I, Rabia Mathakutha, declare that -

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

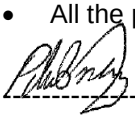


Signature of the Specialist

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

I, Paul da Cruz, declare that -

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



SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF RABIA MATHAKUTHA

PERSONAL DETAILS

Position in Company	Field Ecologist Wetland ecology
Joined SAS Environmental Group of Companies	2020

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate member of the South African Council for Natural Scientific Professions (SACNASP – Reg. No. 120040)
Member of the Western Cape Wetland Forum (WCWF)
South African Association of Botany (SAAB)

EDUCATION

Qualifications

MSc Plant Science (University of Pretoria)	2018
BSc (Hons) Environmental Science (Biogeography) (University of KwaZulu-Natal)	2015
BSc Environmental Science (Life Science stream) (University of KwaZulu-Natal)	2014

Short Courses

Tools for Wetland Assessment (Rhodes University)	2021
Official DWS Section 21 (c) and (i) Water Use Authorisation Course	2018
Basic and Applied Statistics in R	2016

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Western Cape, Northern Cape, Eastern Cape
Africa – Lesotho, Mozambique

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 Plan

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF PAUL DA CRUZ

PERSONAL DETAILS

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

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Certificated Scientist at South African Council for Natural Scientific Professions (SACNASP)
Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA)
Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

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

Short Courses

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

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy (Wind and solar)
2. Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
3. Nature Conservation and Ecotourism Development
4. Commercial development
5. Residential development
6. Environmental and Development Planning and Strategic Assessment
7. Industrial/chemical; Non-renewable power Generation

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

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

Freshwater Assessments

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

Biodiversity Assessments

- Avifaunal Assessments
- Strategic Biodiversity Assessment

Visual Impact Assessment

- Visual Impact Assessments

GIS / Spatial Analysis

- GIS Spatial Analysis and Listing Notice 3 mapping