



FRESHWATER ECOLOGY IMPACT ASSESSMENT AND WALKDOWN REPORT FOR THE PROPOSED ARIES-PAULPUTS-KOKERBOOM 400 kV LILO AND SUBSTATION UPGRADE PROJECT

**ZF Mgcawu and Namakwa District Municipalities,
Northern Cape Province, South Africa**

22/06/2026

Prepared by:




The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	FRESHWATER ECOLOGY IMPACT ASSESSMENT AND WALKDOWN REPORT FOR THE PROPOSED ARIES-PAULPUTS-KOKERBOOM 400 kV LILO AND SUBSTATION UPGRADE PROJECT	
Specialist Theme	Aquatic Biodiversity Theme	
Project Reference	Aries-Paulputs: Aries Kokerboom 400kV LILO	
Report Version/Date	22/06/2026	
Environmental Assessment Practitioner/Client		
Fieldwork and Report Writing	Lizaan de Necker (SACNASP 138304)	
Reviewer	Prasheen Singh (SACNASP 116822)	
Declaration	<p>The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principles of science.</p>	

Abbreviations

Abbreviation	Definition
ASPT	Average Score per Recorded Taxon
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CARA	Conservation of Agricultural Resources Act
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
DWAF	Department of Water Affairs and Forestry
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
ESA	Ecological Support Area
ES	Ecological Sensitivity
ETS	Ecosystem Threat Status
GA	General Authorisation
GIS	Geographic Information Systems
GN	Government Notice
IHI	Index of Habitat Integrity
kV, V	Kilovolt; Volt
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NEMWA	National Environmental Management: Waste Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWBEST	National Web-Based Environmental Screening Tool
OHL	Overhead Line
PAOI	Project Area Of Influence
PES	Present Ecological State
RAM	Risk Assessment Matrix
REC	Recommended Ecological Condition
RQO(s)	Resource Quality Objectives
SAIIAE	South African Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SASS5	South African Scoring System version 5
SQR	Sub Quaternary Reach
TWQR	Target Water Quality Range
W, kW, MW	Watt, Kilowatt, Megawatt
WMA	Water Management Area
WUL; WULA	Water Use License; Water Use Licence Application

Table of Contents

1	Introduction.....	1
1.1	Background	1
1.2	Project Description	2
1.3	Assessment of Scope of Work	3
1.4	Assumptions and Limitations	4
1.5	Key Legislative Requirements.....	4
1.6	National Water Act (NWA, 1998)	5
1.7	National Environmental Management Act (NEMA, 1998).....	5
1.8	Legislative Framework	6
2	Fieldwork	8
2.1	Freshwater Biodiversity Field Assessment	8
2.2	Walkdown Field Assessment	8
2.2.1	Terms of Reference.....	8
2.2.2	Spatial Data	9
2.2.3	Buffer Areas	10
2.2.4	Zones of Regulation	10
3	Results & Discussion	10
3.1	Desktop Dataset Assessment - Ecologically Important Landscape Features	10
3.1.1	Strategic Water Source Areas.....	11
3.1.2	Conservation Plan	11
3.1.3	The National Biodiversity Assessment.....	12
3.1.4	Aquatic Ecosystem Threat Status	13
3.1.5	Aquatic Ecosystem Protection Level.....	14
3.1.6	National Freshwater Ecosystem Priority Area Status	15
3.1.7	Protected Areas.....	16
3.1.8	Renewable Energy Development Zones	17
3.1.9	Renewable Energy EIA Application Database	17
3.1.10	Strategic Transmission Corridors	17
3.1.11	Freshwater Ecology.....	18
3.1.12	Resource Quality Objectives.....	19
3.2	Survey Results	20
3.2.1	Investigation Sites	20

3.2.2	Water Quality	25
3.2.3	Index of Habitat Integrity	25
3.2.4	Aquatic Macroinvertebrates	28
3.2.5	Fish Community Structure.....	29
3.2.6	Present Ecological Status	29
3.3	Water Resource Delineations, Buffer Requirements and Regulated Areas	29
3.3.1	Water Resources and Buffer Areas	29
3.3.2	Regulation Zones	36
3.4	Site Sensitivity Verification	43
3.4.1	Ecological Sensitivity	43
4	Walkdown	49
4.1	Observations	49
5	Risk and Impact Assessment.....	56
5.1	Risk Screening	56
5.2	Current Impacts on Freshwater Biodiversity	56
5.3	Alternatives Considered	56
5.4	Specialist Proposed Alternatives.....	56
5.5	Loss of Irreplaceable Resources.....	56
5.6	Quantitative Risk and Impact Assessment (DWS GN4167 Risk Assessment)	57
5.6.1	Potential Anticipated Impacts.....	57
5.7	Impact Assessment (EIMS).....	60
5.8	Unplanned Events	64
5.9	Cumulative Impacts.....	64
5.10	Mitigation and Management Measures	65
5.10.1	Substation Infrastructure	68
5.10.2	Grid Infrastructure and Road Networks	68
5.10.3	Water Quality Impairment	70
5.10.4	Erosion & Sedimentation.....	71
5.10.5	Alien Vegetation Establishment	71
5.10.6	Operation of Vehicles and Heavy Machinery	72
5.10.7	General mitigation measures	72
6	Recommendations	75
7	Conclusion.....	76

7.1	Risk and Impact Statement	76
7.2	Specialist Opinion	76
8	References	77
9	Appendices.....	80
9.1	Appendix A: Freshwater Methodology	80
9.1.1	Desktop Dataset Assessment	80
9.1.2	Water Quality.....	81
9.1.3	Habitat Assessments	81
9.1.4	Aquatic Macroinvertebrate Assessment	83
9.1.5	Fish Community Assessment.....	85
9.1.6	Present Ecological Status	86
9.1.7	Riparian Delineation	87
9.1.8	Wetland Field Survey	88
9.1.9	Buffer Requirements	90
9.1.10	Site Sensitivity Verification	90
9.2	Appendix B: Risk and Impact Assessment	90
9.2.1	Cumulative Impact Assessment.....	91
9.3	Appendix C – EIMS Impact Assessment for proposed activities	93
9.4	Appendix D – Specialist Declaration of Independence	96
9.5	Appendix E – Specialist CVs.....	97

List of Tables

Table 1-1	A list of key legislative requirements	5
Table 1-2	Aquatic Biodiversity Specialist Assessment information requirements as per the relevant protocol, including the location of the information within this report	6
Table 3-1	Summary of the relevance of the proposed project to ecologically important landscape features	11
Table 3-2	PES of systems and the SQR associated with the project (DWS, 2014)	19
Table 3-3	Photos and coordinates of representative sites assessed (November 2025).....	21
Table 3-4	Results for the Instream Habitat Integrity assessment for the associated reaches (November 2025)	26
Table 3-5	Present Ecological Status of the aquatic ecosystems in the project area	29
Table 3-6	The legislated zones of regulation	36
Table 4-1	Summary of site specific comments and recommendations on the linear footprints for the powerline towers	53
Table 5-1	Risk status of the delineated watercourses	56
Table 5-2	Summative results of the DWS Risk Assessment Matrix compiled by Dr Lizaan de Necker (Pr. Sci. Nat. 138304)	58
Table 5-3	Summative results of the EIMS Impact Assessment conducted for the proposed project (compiled by Dr Lizaan de Necker; Pr. Sci. Nat. 138304)	61
Table 5-4	Unplanned Events, Risks and their Management Measures	64
Table 5-5	Cumulative impact assessment for the development	65
Table 5-6	Suggested mitigation measures and management outcomes for the proposed development	66
Table 9-1	Criteria used in the assessment of habitat integrity (Kleynhans, 1996).....	81
Table 9-2	Descriptions used for the Ratings of the Various Habitat Criteria.....	82
Table 9-3	Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996).....	83
Table 9-4	Index of habitat integrity categories (From Kleynhans, 1996)	83
Table 9-5	Biological Bands / Ecological categories for interpreting SASS data (adapted from Dallas, 2007)	84
Table 9-6	Intolerance rating and sensitivity of fish species.....	85
Table 9-7	Present Ecological State (PES) Categories.....	86
Table 9-8	Classes for determining the likely extent to which a benefit is being supplied	89
Table 9-9	The Present Ecological Status categories (Macfarlane et al., 2009)	89
Table 9-10	Description of Ecological Importance and Sensitivity categories.....	89

Table 9-11	Recommended Ecological Category and Recommended Management Objectives for water resources based on Present Ecological State and Ecological Importance and Sensitivity scores.	90
Table 9-12	Significance ratings matrix	90
Table 9-13	Aspects and ratings considered in the cumulative impact assessment	91

List of Figures

Figure 1-1	Location of the project area and PAOI	2
Figure 1-2	Proposed network diagram for the proposed Aries-Paulputs-Kokerboom 400 kV LILO project (provided by EIMS, 2025)	3
Figure 2-1	Map illustrating the field survey sites of the PAOI	8
Figure 2-2	Map illustrating pylon and substation locations	9
Figure 2-3	Map illustrating the field tracks of the field survey within the PAOI	10
Figure 3-1	The PAOI superimposed on the Provincial Conservation Plan	12
Figure 3-2	Illustration of NBA wetlands and/or rivers within the PAOI (NBA, 2018)	13
Figure 3-3	The project area showing the regional ecosystem threat status of the associated aquatic ecosystems (NBA, 2018)	14
Figure 3-4	The project area showing the regional level of protection of aquatic ecosystems (NBA, 2018)	15
Figure 3-5	NFEPA map for the PAOI (Nel et al., 2011)	16
Figure 3-6	The project area in relation to the renewable energy database projects in the area. ...	17
Figure 3-7	The PAOI in relation to the strategic transmission corridors	18
Figure 3-8	Hydrological aspects associated with the project area	19
Figure 3-9	Impacts observed within the PAOI surrounding the NFEPA rivers and Farming drainage areas (November 2025): A) Existing powerlines; B) Erosion; C) Invasive species (Mesquite); D) Historic excavation areas; E) Agriculture and F) Dirt roads	27
Figure 3-10	Impacts observed within the PAOI surrounding the Substation drainage area (November 2025): A) Building rubble; B) Dirt roads; C) Erosion; D) Pipes; E) Infrastructure (Substation and culverts) and F) Hardened surfaces (Berms and stormwater management systems)	28
Figure 3-11	Delineations and buffer areas within the PAOI – 1	30
Figure 3-12	Delineations and buffer areas within the PAOI – 2	31
Figure 3-13	Delineations and buffer areas within the PAOI – 3	31
Figure 3-14	Delineations and buffer areas within the PAOI – 4	32
Figure 3-15	Delineations and buffer areas within the PAOI – 5	32
Figure 3-16	Delineations and buffer areas within the PAOI – 6	33
Figure 3-17	Delineations and buffer areas within the PAOI – 7	33
Figure 3-18	Delineations and buffer areas within the PAOI – 8	34
Figure 3-19	Delineations and buffer areas within the PAOI – 9	34
Figure 3-20	Delineations and buffer areas within the PAOI – 10	35
Figure 3-21	Delineations and buffer areas within the PAOI – 11	35
Figure 3-22	Riparian areas and Zones of Regulation (ZoR) within the PAOI – 1	37

Figure 3-23 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 2.....	38
Figure 3-24 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 3.....	38
Figure 3-25 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 4.....	39
Figure 3-26 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 5.....	39
Figure 3-27 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 6.....	40
Figure 3-28 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 7.....	40
Figure 3-29 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 8.....	41
Figure 3-30 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 9.....	41
Figure 3-31 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 10.....	42
Figure 3-32 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 11.....	42
Figure 3-33 Aquatic Biodiversity Theme Sensitivity for the Project Area	43
Figure 3-34 Aquatic delineated sensitivity for the PAOI – 1	44
Figure 3-35 Aquatic delineated sensitivity for the PAOI – 2	44
Figure 3-36 Aquatic delineated sensitivity for the PAOI – 3	45
Figure 3-37 Aquatic delineated sensitivity for the PAOI – 4	45
Figure 3-38 Aquatic delineated sensitivity for the PAOI – 5	46
Figure 3-39 Aquatic delineated sensitivity for the PAOI – 6	46
Figure 3-40 Aquatic delineated sensitivity for the PAOI – 7	47
Figure 3-41 Aquatic delineated sensitivity for the PAOI – 8	47
Figure 3-42 Aquatic delineated sensitivity for the PAOI – 9	48
Figure 3-43 Aquatic delineated sensitivity for the PAOI – 10	48
Figure 3-44 Aquatic delineated sensitivity for the PAOI – 11	49
Figure 4-1 Examples of the different watercourses found during the walkdown	50
Figure 4-2 Delineations of the water resources between Tower 1KOK/PAU001 and Tower 1KOK/PAU025 and Tower 1ARI/PAU231 to Tower 1ARI/PAU258	51
Figure 4-3 Delineations of the water resources between Tower 1KOK/PAU026 and Tower 1KOK/PAU052 and Tower 1ARI/PAU259 to Tower 1ARI/PAU284	51
Figure 4-4 Delineations of the water resources between Tower 1KOK/PAU053 and Tower 1KOK/PAU076 and Tower 1ARI/PAU285 to Tower 1ARI/PAU308	52
Figure 4-5 Delineations of the water resources between Tower 1KOK/PAU077 and Gantry 1 Kokerboom and Tower 1ARI/PAU309 to Gantry 1 Aries	52
Figure 5-1 The mitigation hierarchy as described by the DEA (2013)	57
Figure 5-2 Example of road margin erosion prevention.	70
Figure 5-3 Example of permeable paving for roads and habitat maintenance.....	70

Figure 9-1	The relationship between drivers and fish metric groups (Kleynhans, 2007)	86
Figure 9-2	Riparian Habitat Delineations (DWAF, 2005)	87
Figure 9-3	Cross section of a wetland, indicating how the soil wetness and vegetation indicators respond to changes in topography (Ollis et al. 2013)	88

1 Introduction

1.1 Background

The Biodiversity Company was appointed by EIMS to conduct a Freshwater Ecology Impact Assessment and Walkdown for the proposed Paulputs: Aries Kokerboom 400 kV LILO and Paulputs Substation Upgrade project which will henceforth be referred to as the project area. The project area is located within the Kail! Garib and Khâi-Ma Local Municipalities, ZF Mgcawu and Namakwa District Municipalities, Northern Cape Province, South Africa (Figure 1-1).

To achieve this, a single aquatics survey was conducted from the 3rd to 5th of November 2025 (spring) during the wet season (high flow). The survey included a site-specific tower-to-tower walkdown assessment. A 500 m area has been demarcated on both sides of the powerline for the project to facilitate the identification of watercourses within the regulatory zone. This area is referred to as the project area of influence (PAOI) (Figure 1-1).

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations (2014) (amended by GNR 326, 7 April 2017 and GNR. 517, 11 June 2021) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020) in terms of NEMA, dated 20 March and 30 October 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation" (Reporting Criteria).

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 4167 by the Department of Water and Sanitation (DWS) (previously GN 509 of 2016 and GN 3139 of 2023). The said notice was published in the Government Gazette (no. 49833) under Section 39 of the National Water Act (Act no. 36 of 1998) in December 2023, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 4167 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 4167 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM), provided the identified risks are all considered low risk, and the applicant is listed under Appendix D1 or Appendix D2 of the same notice. This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation to be dealt with in the conclusion.

The purpose of the specialist assessment and ecological walkdown was to provide relevant input into the EA process and provide a report for the activities associated with the project. The project area for the 45 km, 400 kV powerline and pylon positions were supplied by the client. The precise locations of each tower/pylon were visited and used as guidelines during the walkdown. Therefore, this report, after taking into consideration the findings and recommendations provided by the specialist herein, including the identified watercourses, their buffers, sensitive sites, and no-go areas, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision-making with regard to the ecological viability of the proposed development and related activities.

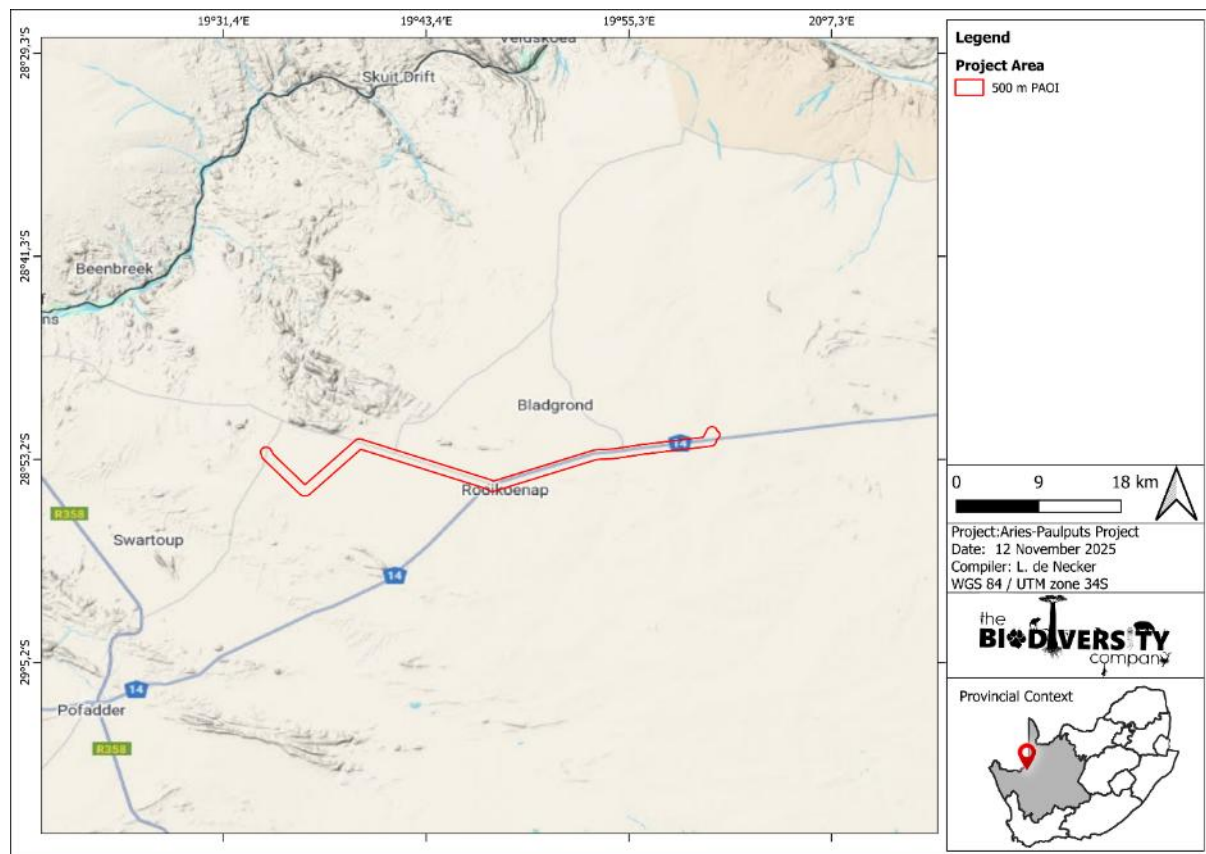


Figure 1-1 Location of the project area and PAOI

1.2 Project Description

Eskom Holdings SOC Ltd (hereafter referred to as Eskom) intends to construct a 400 kV infeed via a loop in loop out from the Aries–Kokerboom 400 kV line. The proposed powerline will be approximately 45 km in length and will be located near Pofadder in the Northern Cape Province, South Africa. Eskom is tasked to provide reliable power to meet the increasing demands of electricity users around South Africa. The installation and maintenance of powerlines are thus an essential part of Eskom's duties.

According to the Scope of Work (provided by EIMS), the project is part of a group of projects identified for the Northern Cape network strengthening requirements in meeting the IRP 2019 renewables generation integration. The installed generation capacity in the Northern Cape already exceeds the peak load in the province and is expected to increase further as a result of bulk renewable energy generation capacity allocation due to favourable sun and wind conditions. Therefore, significant network infrastructure is required to enable the integration and evacuation of power from the renewable energy plants anticipated in the province.

To provide future reliability and flexibility in the evacuation of renewable power from Paulputs Substation, an additional 400 kV infeed is proposed. Although there is uncertainty regarding the phasing of IPP integration at the various substations in the province, it is crucial that all project development activities are prioritised and advanced to a stage of execution readiness to ensure timeous integration of the expected renewable generation.

The following is the scope of work as provided by EIMS:

- Loop in loop out the Aries – Kokerboom 400 kV line into Paulputs (2 x ~50 km individual lines altogether including at least 222 individual towers or pylons);
- Establish/Equip 2 x 400 kV feeder bays at Paulputs Substation;

- Install a 100 MVA busbar reactor at Paulputs Substation.
- Paulputs-Konkoonsies 33 kV OHL Deviation
- Build new MV OHL with new switchgear and equipment
- -± 1 km of new MV OHL (±800m of 33 kV OHL & ±200m of 19 kV SWER OHL)
- -New 33 kV Recloser
- -New 33 kV CT/VT metering unit
- -New 33/19 kV SWER Transformer
- New SWER 19 kV Single Phase Recloser
- -Disconnect, Decommission & Dismantle old equipment (the existing 33kV and associated infrastructure)

The proposed layout is presented in Figure 1-2 below.

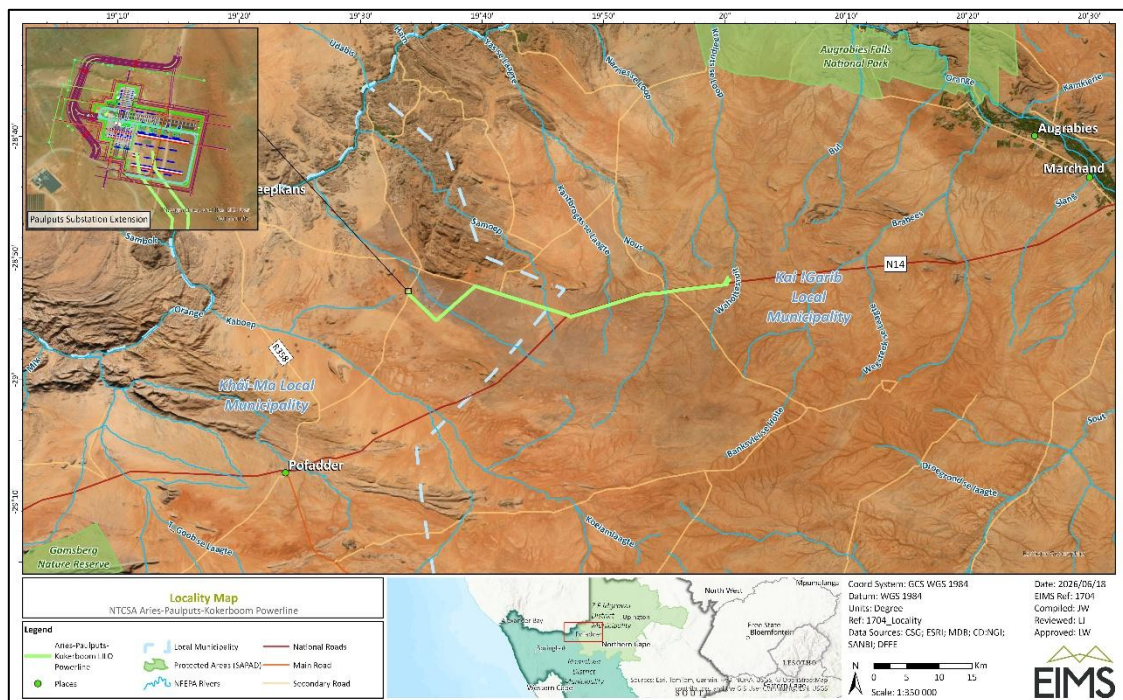


Figure 1-2 Proposed layout for the proposed Aries-Paulputs-Kokerboom 400 kV LILO project (provided by EIMS, 2025)

1.3 Assessment of Scope of Work

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- A desktop assessment of all available and related datasets;
- GIS processing to preliminarily identify water accumulation areas;
- The delineation of watercourses within the 500 m PAOI in accordance with the DWAF (2005) guidelines, whereby the outer edges will be identified;
- A functional and integrity assessment of the watercourses;
- Conduct an ecological walkdown for the planned footprint areas;

- Assessment of the 27.5 m servitude to each side of the powerlines (with a total width of 110m);
- Compilation of a report detailing the results of the walkdown;
- Detail and ecological constraints identified for the planned infrastructure;
- Provide information and recommendations for the micro-siting of relevant infrastructure; and
- Provide information to adequately inform any contractors, environmental officers and personnel pertaining to the ecological significance for the area.

1.4 Assumptions and Limitations

The following aspects were considered as limitations:

- It is assumed that the client has provided the specialist with all available data and information surrounding the project at the time of writing and it is assumed that all this information is relevant and accurate;
- The 1 km corridor was assessed using a desktop-based approach.
- It is assumed that the extent of the project area provided to the specialist is accurate;
- The specialist was not provided with an architectural plan or any engineering drawings with regard to the planned development activities and, as such, the potential impacts arising from these activities may only be assumed based on previous experience;
- All datasets accessed and utilised for this assessment are considered to be representative of the most recent and suitable data for the intended purposes;
- The assessment area was based on the footprint areas as provided by the client, and any alterations to the area and/or missing GIS information pertaining to the assessment area would have affected the area surveyed and hence the results of this assessment;
- A single-season survey was conducted for the respective study, which would constitute a wet season/high flow survey. Thus, temporal trends were not investigated. Despite this it is the specialist's opinion that the findings are conclusive, and no further fieldwork would be required; and
- All regional and site-specific environmental information are contained within the original (submitted) documents and were therefore not repeated within this document. This document focuses only on the very specific mandate and findings of the walkdown and its associated ecosystem evaluations;
- Due to the ephemeral, dry nature of the watercourses within the PAOI, standard aquatic methods could not be conducted;
- The GPS used for watercourse delineations is accurate to five metres. Therefore, the delineation plotted digitally may be offset by a maximum of five metres to either side.

1.5 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 1-1 apply to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Table 1-1 A list of key legislative requirements

Region	Legislation / Guideline	Comment
National	NEMA	Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), Appendix 6 requirements
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), Threatened or Protected Species Regulations	The protection of species and ecosystems that warrant protection
	Assessment Protocol (March 2020)	The minimum criteria for reporting.
	Assessment Protocol (October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	NEMWA;	The regulation of waste management to protect the environment.
	NWA	The regulation of water use.
	GN 1003 of GG 43726 of 18 Sept 2020	The regulation and management of alien invasive species.
Provincial	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	To provide for control over the utilisation of the natural agricultural resources, including the vegetation and the combating of weeds and invader plants.
	Northern Cape Planning and Development Act no. 7 of 1998	To provide for the management and conservation of the province's biophysical environment and protected areas.
	Northern Cape Nature Conservation act no. 9 of 2009	To inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management

1.6 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's watercourses and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of watercourses, which includes:

- The maintenance of the quality of the watercourse to the extent that the watercourses may be used in an ecologically sustainable way.
- The prevention of the degradation of the watercourse.
- The rehabilitation of the watercourse.

A watercourse means:

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake or dam into which, or from which, water flows.
- 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.

The NWA recognises that the entire ecosystem and not just the water itself, and any given watercourse 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 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) and (i).

1.7 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, state 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.

1.8 Legislative Framework

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on freshwater biodiversity, as per Government Notice 320 published in terms of NEMA, dated 20 March 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation" – the following has been assumed:

- An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of:
 - "very high sensitivity" for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment.

An Aquatic / Freshwater Biodiversity Specialist Assessment Report must contain the information as presented in Table 1-2 below.

Table 1-2 *Aquatic Biodiversity Specialist Assessment information requirements as per the relevant protocol, including the location of the information within this report*

Information to be Included (as per GN 320, 20 March 2020)	Report Section
The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of aquatic sciences	9.5
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae	9.5
A signed statement of independence by the specialist(s)	9.4
The assessment must be undertaken on the preferred site and within the proposed development footprint	3.2.1
A baseline description of the aquatic biodiversity and ecosystems on the site, including: aquatic ecosystem types; presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns.	3.1
The threat status of the ecosystem and species as identified by the screening tool	3.4.1
An indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub-catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area)	3.1
A description of the ecological importance and sensitivity of the aquatic ecosystem including: <ul style="list-style-type: none"> (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.); and (b) the historic ecological condition (reference) as well as the present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater) 	3.1.8 and 3.2.6
The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate	5.3
Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: <p>Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?</p> <p>Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?</p> <p>How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:</p>	5

<ul style="list-style-type: none"> (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) will the proposed development change the sediment regime of the aquatic ecosystem and its sub-catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. 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) to what extent will the risks associated with water use and related activities change. 	
How will the proposed development impact on the functioning of the aquatic feature? This must include:	
<ul style="list-style-type: none"> (a) base flows (e.g., too little or too much water in terms of characteristics and requirements of the 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 offstream 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) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g., waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.) 	5
How will the proposed development impact on key ecosystems regulating and supporting services especially:	
<ul style="list-style-type: none"> (a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage? 	5
How will the proposed 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?	-
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment	2.1
The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant	9.1
A description of the assumptions made, any uncertainties or gaps in knowledge or data	1.4
The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant	3.2 and 3.4
Additional environmental impacts expected from the proposed development	-
Any direct, indirect and cumulative impacts of the proposed development on-site	5
The degree to which impacts and risks can be mitigated	5
The degree to which the impacts and risks can be reversed	5
The degree to which the impacts and risks can cause loss of irreplaceable resources	5
A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies	3.3; 9.1.7 and 9.1.8
Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr)	Error! Reference source not found. and 5.9
A motivation must be provided if there were development footprints identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate	-
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; and	7.2
Any conditions to which this statement is subjected	7.2

A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

2 Fieldwork

2.1 Freshwater Biodiversity Field Assessment

In line with the minimum requirements for aquatic biodiversity surveys a single field survey for the project area was undertaken on the 3rd to the 5th of November 2025 (spring) to identify the presence and condition of watercourse(s) and to delineate their spatial extents. The survey constituted a wet season/high flow assessment. Seasonality is not considered to be a limiting factor to the assessment of which the results are conclusive. After consulting the desktop data and visiting the site, it was noted that no wetlands were indicated by the desktop data within the 500 m PAOI. However, a single temporary depression wetland was confirmed present during the site visit. A map presenting the field survey sites are presented in Figure 2-1.

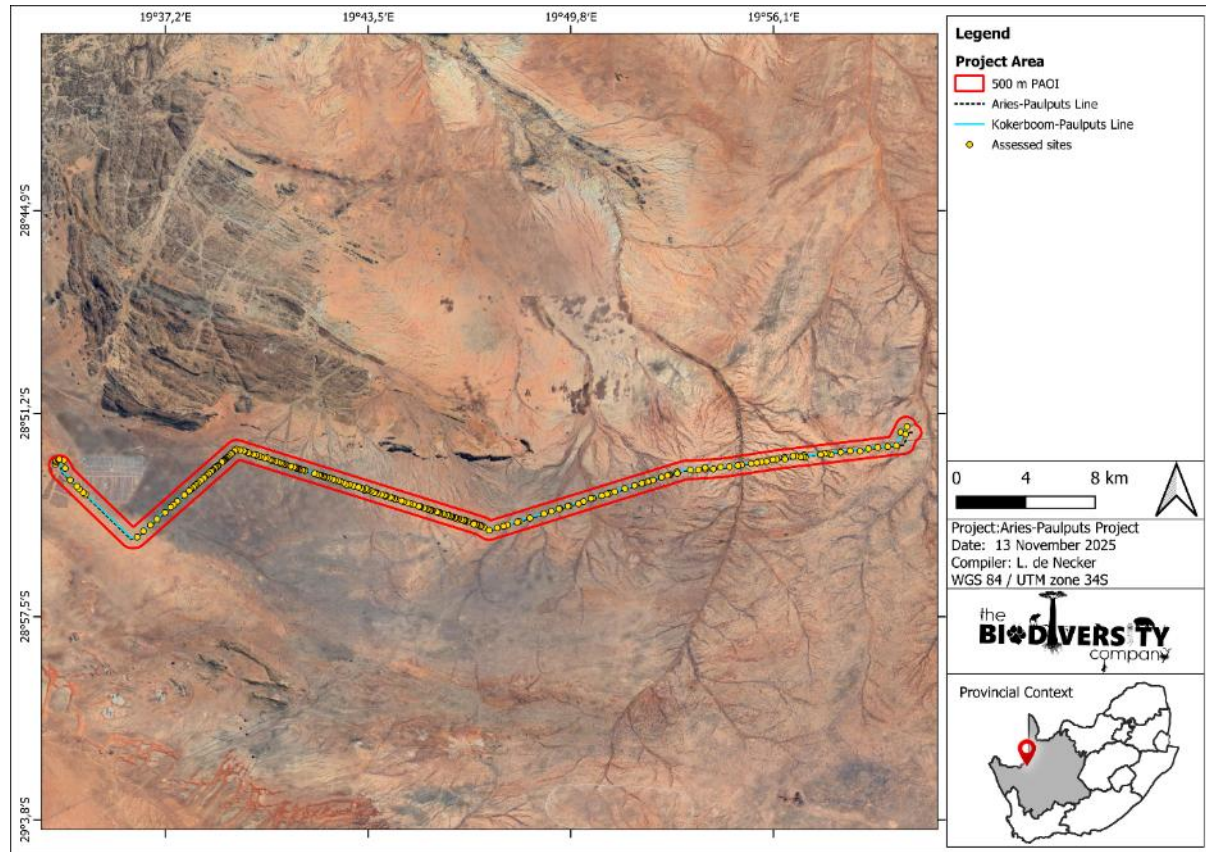


Figure 2-1 Map illustrating the field survey sites of the PAOI

2.2 Walkdown Field Assessment

2.2.1 Terms of Reference

Walkdown outcomes form part of alternatives/mitigation under the mitigation hierarchy. The aim of the assessment was to provide information to guide the proposed infrastructure upgrade with respect to the current state of the associated water resources in the project area. This was achieved through the following:

- Review of existing information related to the development;
- Conduct an ecological walkdown for the planned footprint areas;
- Compilation of a report detailing the results of the walkdown;
- Detail any ecological constraints identified for the planned infrastructure; and

- Provide information and recommendations for the micro-siting of relevant infrastructure.
- Provide information to adequately inform any contractors, environmental officers and personnel pertaining to the ecological significance for the area.

2.2.2 Spatial Data

The powerline tower positions, and substations were supplied by the client (Figure 2-2). The precise locations of each towers/pylon were visited and used as guidelines during the walkdown and ecosystem evaluation phase (Figure 2-3). GPS accuracy during the field surveys is accurate to 5 m. The findings for the towers and road are discussed in the subsequent sections.

The ecology specialists traversed the planned footprint areas searching for ecologically sensitive habitats and any species of conservation concern within the corridor. Each of the pylon positions were visited on foot and evaluated according to the potential impact on the surrounding ecosystems.

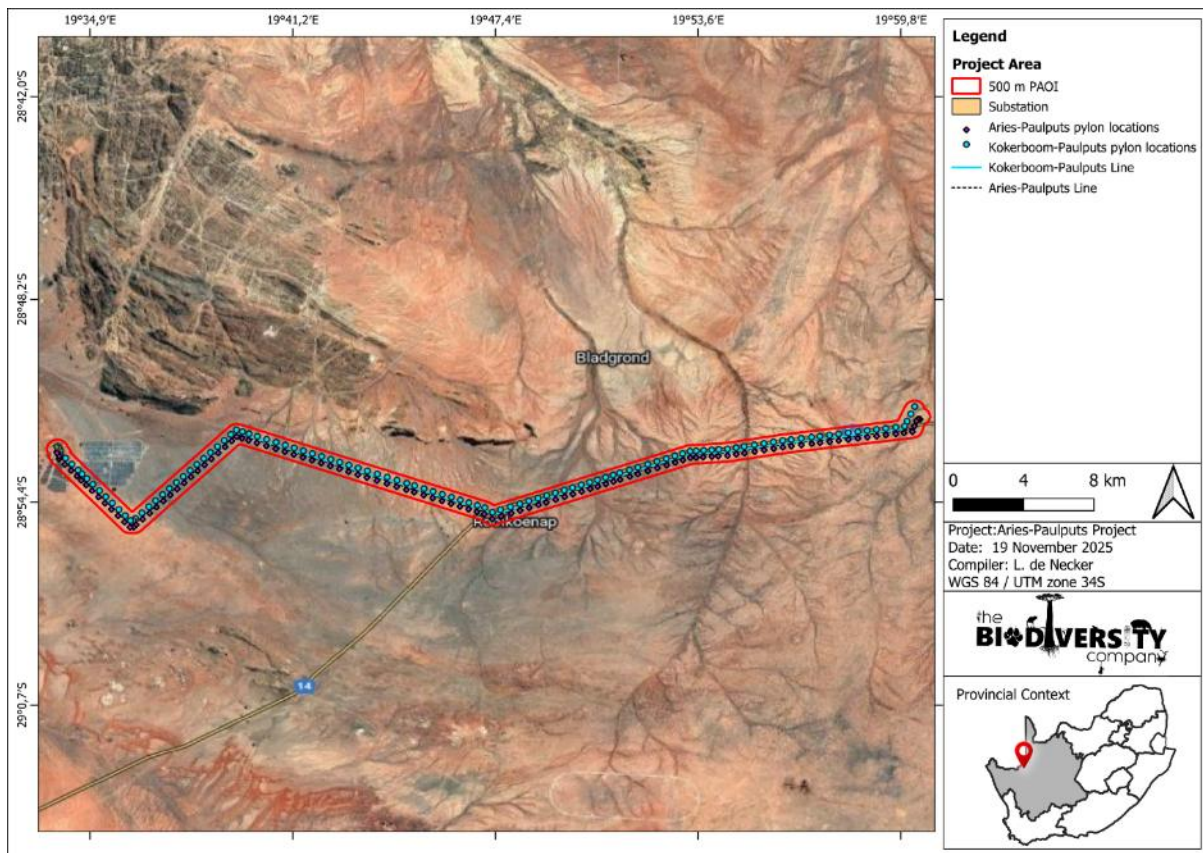


Figure 2-2 Map illustrating pylon and substation locations

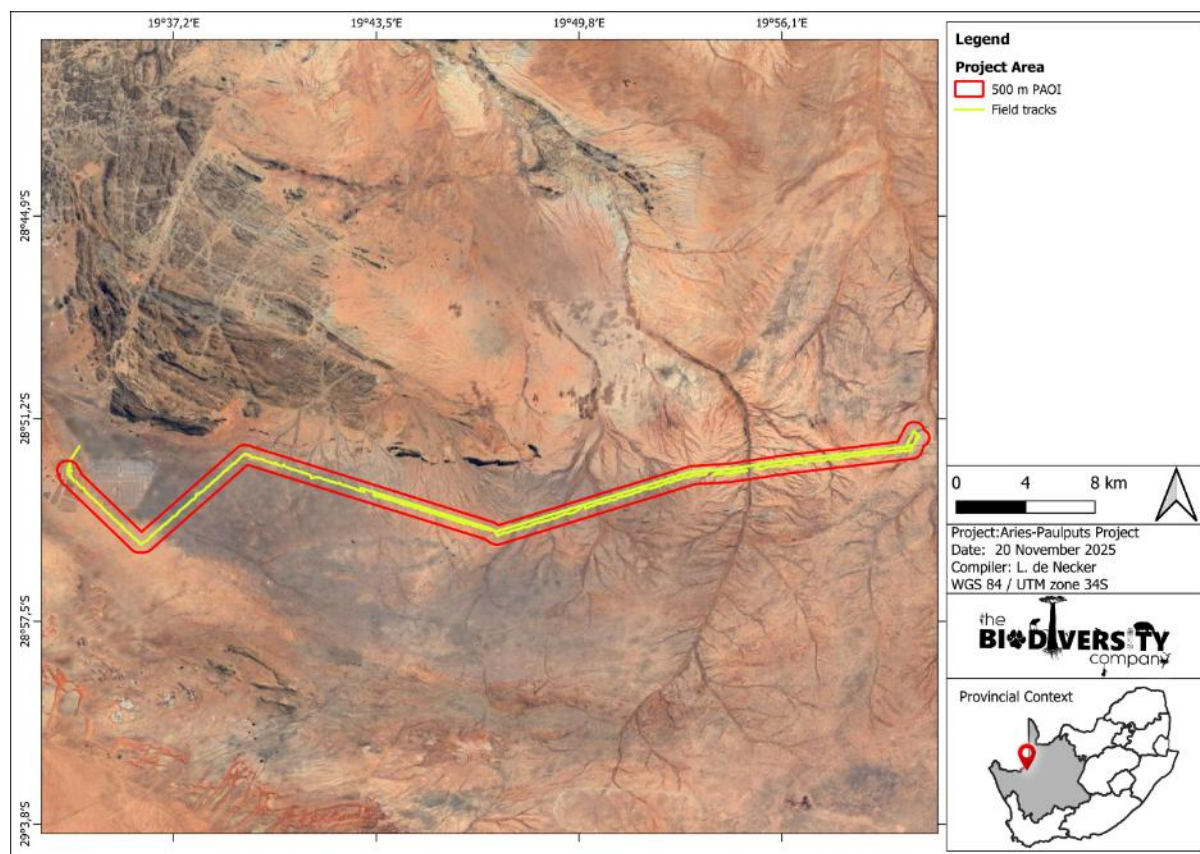


Figure 2-3 Map illustrating the field tracks of the field survey within the PAOI

2.2.3 Buffer Areas

All available aspects of a watercourse described were considered (the legal definition of the extent of a watercourse is defined and presented in Section 1.6). Riparian areas have high conservation value and can be considered most important part of a watershed for a wide range of values and resources. They provide important habitat for a large volume of wildlife and often forage for domestic animals. The vegetation they contain are an important part of the water balance for the hydrological cycle through evapotranspiration. They are crucial for riverbank stability and in preventing erosion within the channel (Elmore and Beschta, 1987). This is especially true for ephemeral systems where, due to the dry nature of the system, the habitat provided by vegetation within the riparian area are the only existing aspect of the watercourse until thunderstorm events.

The riparian areas along the assessed watercourses were delineated according to DWAF (2005), 5 m contour data, the SAI/AE dataset (NBA National Wetland Map, 2018), and the latest Google Earth aerial imagery (2024) as well as a site visit and are described and presented in Section 3.3.1 along with the required buffer areas.

2.2.4 Zones of Regulation

The regulated areas have been applied to the delineations within the PAOI and are presented in Section 3.3.2.

3 Results & Discussion

3.1 Desktop Dataset Assessment - Ecologically Important Landscape Features

The following spatial features describe the general area and associated freshwater resources (ecologically important landscape features). This assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and the South African National

Biodiversity Institute (SANBI). The desktop analysis and their relevance to this project are summarised in Table 3-1.

Table 3-1 *Summary of the relevance of the proposed project to ecologically important landscape features*

Desktop Information Considered	Relevance	Reasoning	Section
Strategic Water Source Areas	No	The PAOI and powerlines are not located within any SWSAs for groundwater or surface water.	3.1.1
Conservation Plan	Yes	The PAOI and powerlines overlap with Critical Biodiversity Areas 1 and 2 and an Ecological Support Area.	3.1.2
National Biodiversity Assessment (NBA)	Yes	The PAOI and powerlines overlap with the Nous River, Kantbrogas se Laagte River, Samoep River and Unnamed NFEPA River.	3.1.3
Aquatic Ecosystem Threat Status	Yes	The PAOI and powerlines intersect with an Endangered watercourse (Nous River).	3.1.4
Aquatic Ecosystem Protection Level	Yes	Only the PAOI intersects with a protected watercourse (Samoep River).	3.1.5
National Freshwater Ecosystem Priority Areas (NFEPA)	Yes	The PAOI and powerlines intersect four rivers (Nous River, Kantbrogas se Laagte River, Samoep River and an Unnamed NFEPA River) which are classified as NFEPA rivers.	3.1.6
Protected Areas	No	The PAOI and powerlines do not overlap with any Protected Areas.	3.1.7
Renewable Energy Development Zones (REDZ)	No	The PAOI and powerlines do not overlap with any REDZ.	3.1.8
Renewable Energy Database	Yes	The PAOI and powerlines traverse several proposed solar facilities for the Northern Cape Province.	3.1.9
Strategic Transmission Corridors (EGI)	Yes	The PAOI and powerlines overlap with the Northern Corridor.	3.1.10

3.1.1 Strategic Water Source Areas

Strategic Water Source Areas (SWSAs) are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. The areas supplying $\geq 50\%$ of South Africa's water supply (which were represented by areas with a mean annual runoff of ≥ 135 mm/year) represent national Strategic Water Source Areas (SANBI, 2013). According to Le Maitre (2018), "SWSAs are defined as areas of land that either: (a) supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important, or (b) have high groundwater recharge and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b). They include transboundary Water Source Areas that extend into Lesotho and Swaziland. According to Lötter and Le Maitre (2021), the 2018 SWSAs data set for surface water was identified based on a generalised 1.7 x 1.7 km resolution Mean Annual Runoff dataset, while the 2021 data set was delineated at a finer resolution of 90 x 90 m. The purpose of the update was to refine the spatial resolution such that SWSAs can be reliably integrated into a range of catchment- and local-level planning, management, and regulatory processes.

According to the SWSAs of South Africa, Lesotho and Swaziland, the PAOI and powerlines are not located within any SWSAs for surface water or groundwater.

3.1.2 Conservation Plan

The key output of this systematic biodiversity plan is a map of biodiversity priority areas (LCPv2, 2018). The LCPv2 CBA map delineates Critical Biodiversity Areas, Ecological Support Areas, Other Natural Areas, Protected Areas, and areas that have been irreversibly modified from their natural state ((LCPv2, 2018). The LCPv2 uses the following terms to categorise the various land used types according to their biodiversity and environmental importance:

- Critical Biodiversity Area (CBA);
- Ecological Support Area (ESA);

- Other Natural Area (ONA);
- Protected Area (PA); and
- No Natural Remaining (NNR).

The PAOI and powerlines overlap with CBA1, CBA2 and an ESA (Figure 3-1).

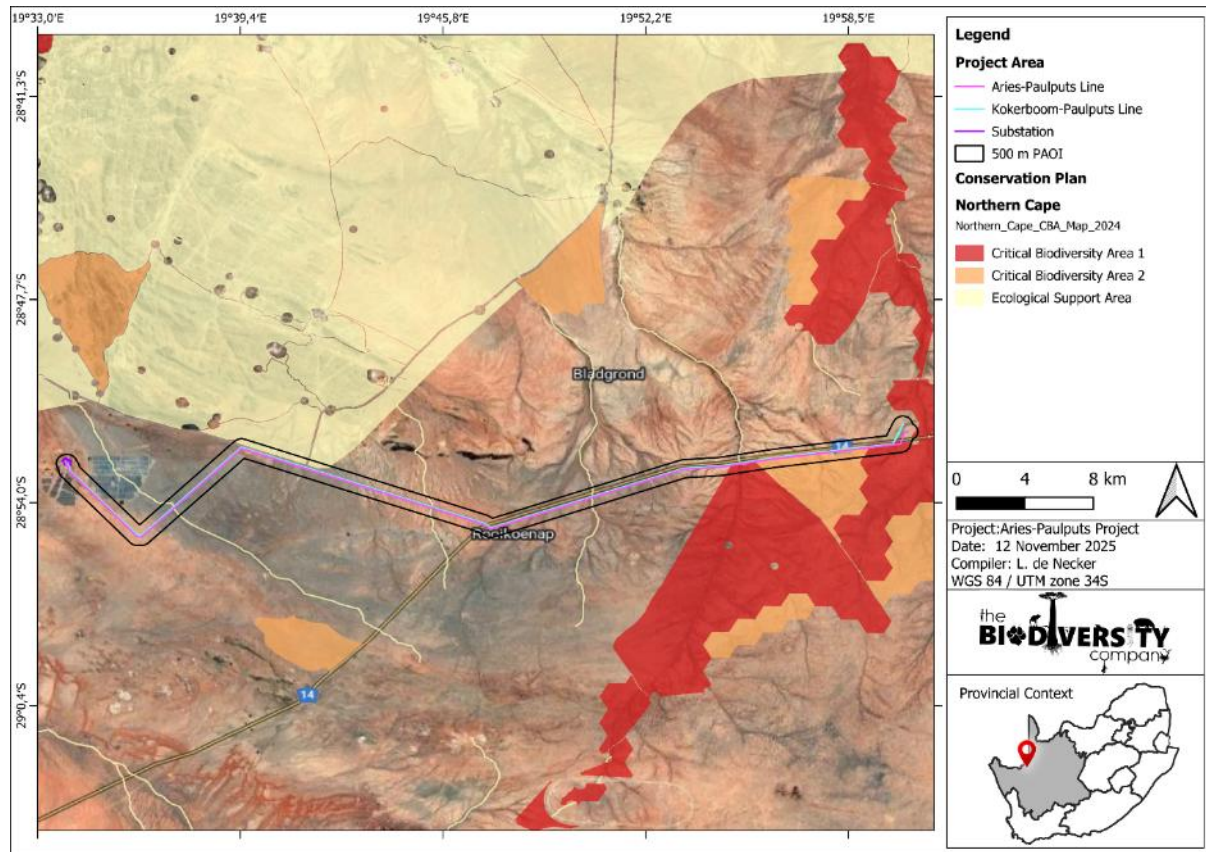


Figure 3-1 The PAOI superimposed on the Provincial Conservation Plan

3.1.3 The National Biodiversity Assessment

The National Biodiversity Assessment (NBA) was completed as a collaboration between the SANBI, the DEA and other stakeholders, including scientists and biodiversity management experts throughout the country over a three-year period (Van Deventer *et al.*, 2019). The purpose of the NBA is to assess the state of South Africa's biodiversity to understand trends over time and inform policy and decision-making across a range of sectors (Van Deventer *et al.*, 2019).

This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the NBA (2018). National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (2018).

According to the NBA, the PAOI and powerlines overlap with the Nous, Kantbrogas se Laagte, Samoep and Unnamed NFEPA rivers (Figure 3-2).

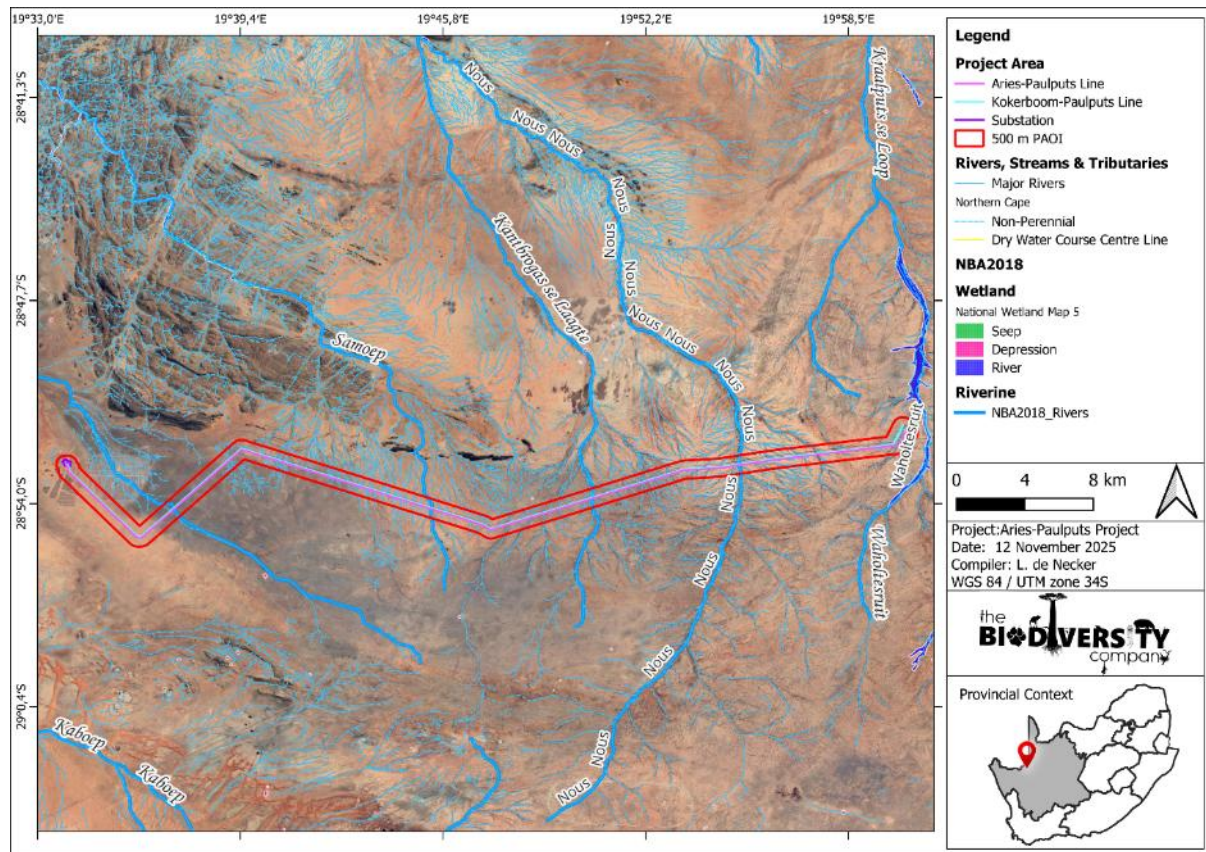


Figure 3-2 Illustration of NBA wetlands and/or rivers within the PAOI (NBA, 2018)

3.1.4 Aquatic Ecosystem Threat Status

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the NBA in 2018. The Ecosystem threat status of river and wetland ecosystem outlines the degree to which the ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Van Deventer et al., 2019). Ecosystem types are categorised as Critically Endangered, Endangered, Vulnerable or Least Threatened, based on the proportion of each ecosystem type that remains in a good ecological condition (Van Deventer et al., 2019). The Ecosystem Threat Status (ETS) of each river assessed was based on the extent to which the system had been modified from its natural condition (SANBI, 2017).

According to the SAIIAE dataset, the PAOI overlaps with one 'Endangered' watercourse (Nous River) (Figure 3-3). However, it is noted that the powerlines span the 'Least Threatened' section of the Nous River system. Thus, indicating that impacts within the regulated area could potentially result in degradation of downstream systems.

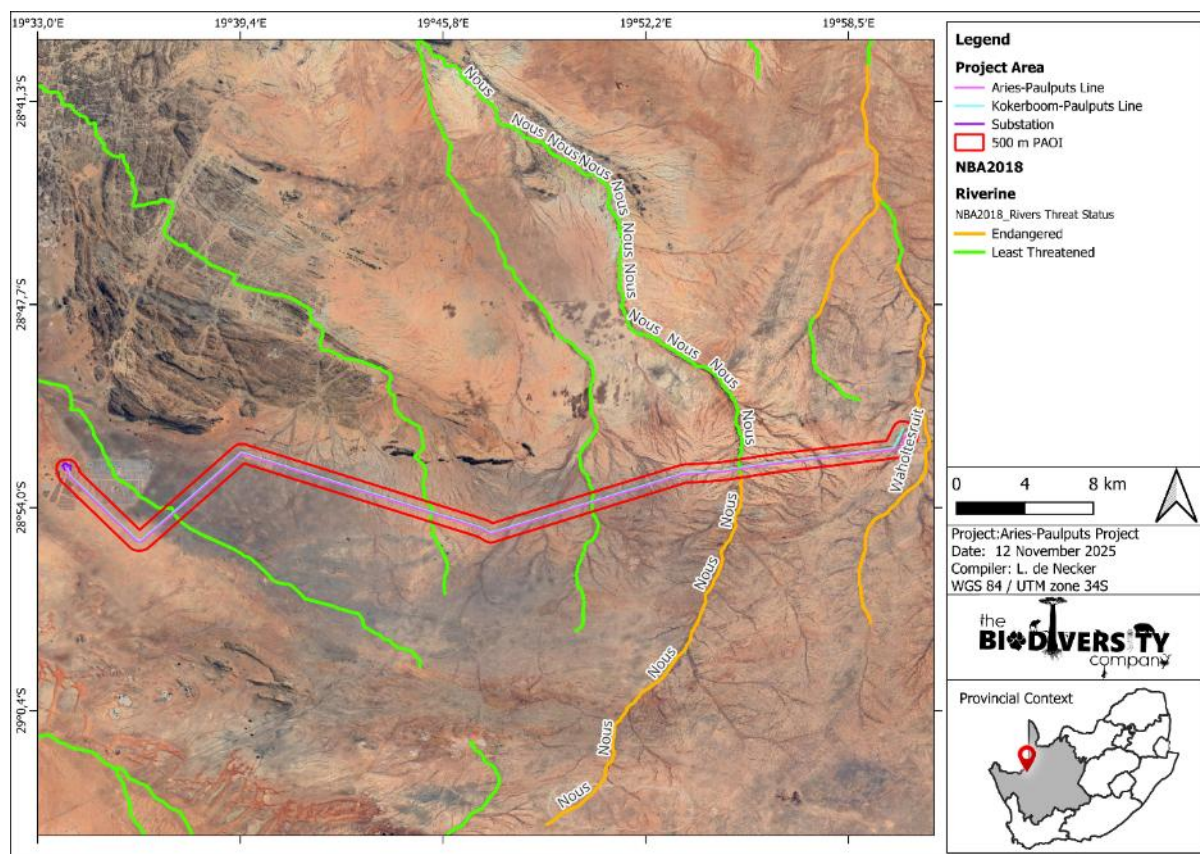


Figure 3-3 The project area showing the regional ecosystem threat status of the associated aquatic ecosystems (NBA, 2018)

3.1.5 Aquatic Ecosystem Protection Level

Ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Van Deventer et al., 2019). The Ecosystem Protection Level (EPL) of each river assessed was based on the extent (expressed as a percentage) to which the system has their biodiversity target located within protected areas and are in a natural or near-natural ecological condition. Rivers in protected areas need to be in good condition (A or B ecological category) to be considered as protected. Well protected rivers have 100% of their extent located within protected areas, while moderately protected and poorly protected river ecosystem types have at least 50% and 5% of their biodiversity target in protected areas, respectively. Not protected rivers are characterised by less than 5% (SANBI, 2022).

The project area was superimposed on the aquatic ecosystem protection level map to assess the protection status of aquatic ecosystems associated with the development. According to the SAIIE dataset, the PAOI and powerlines overlap with a 'Well Protected' watercourse (Samoep River) and three rivers classified as 'Not Protected' (Nous River, Kantbrogas se Laagte River, and an Unnamed NFEPA River) (Figure 3-4).

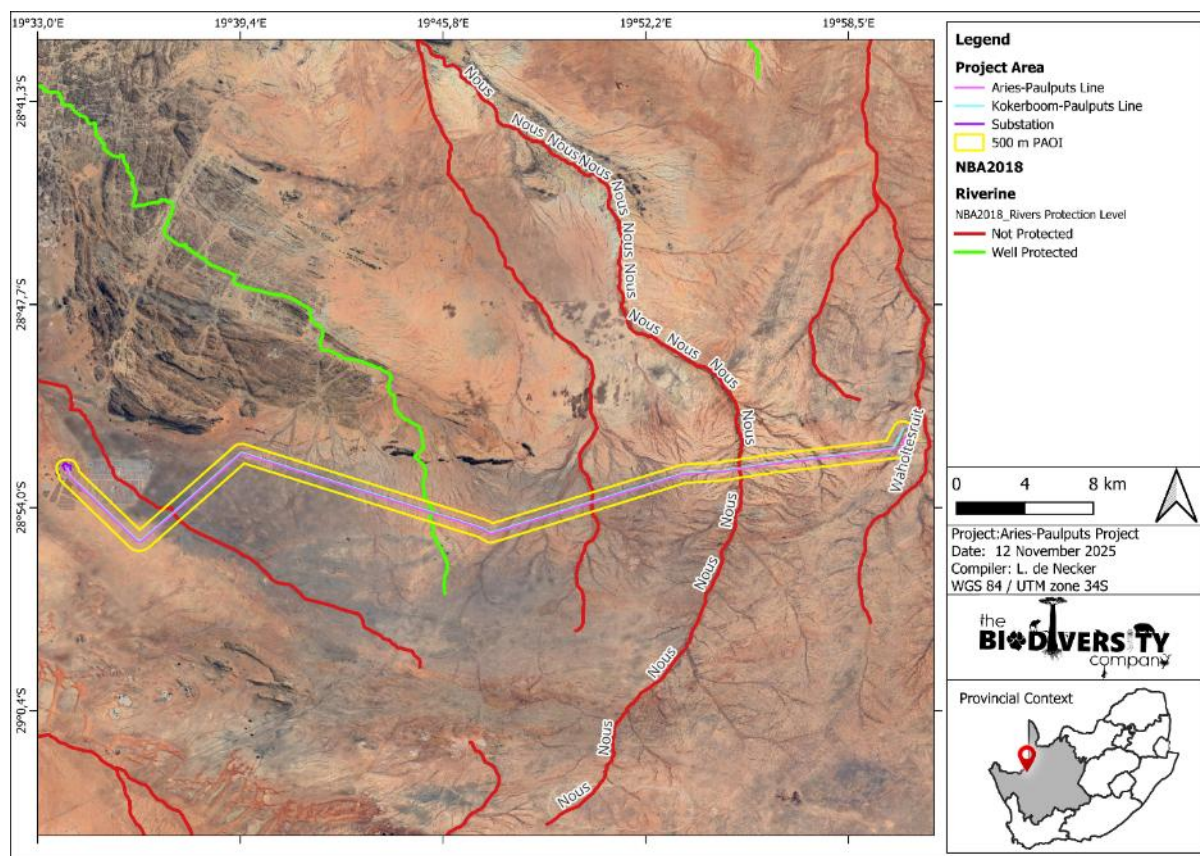


Figure 3-4 The project area showing the regional level of protection of aquatic ecosystems (NBA, 2018)

3.1.6 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al.*, 2011). The NFEPA's are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM: BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al.*, 2011).

According to the NFEPA dataset the PAOI and powerlines intersect with the Nous, Kantbrogas se Laagte, Samoep and Unnamed NFEPA rivers (Figure 3-5). Conserving the water quality, riverine and wetland habitat and associated ecological functioning within the project area and associated catchments, will aid in the protection of aquatic species occurring within the entire catchment and water quality for the aquatic and terrestrial biota downstream of the project area. The catchments in which human activities occur need to be managed to maintain water quality and prevent further degradation of local and downstream watercourses in order to contribute to national biodiversity goals and support the sustainable use of watercourses.

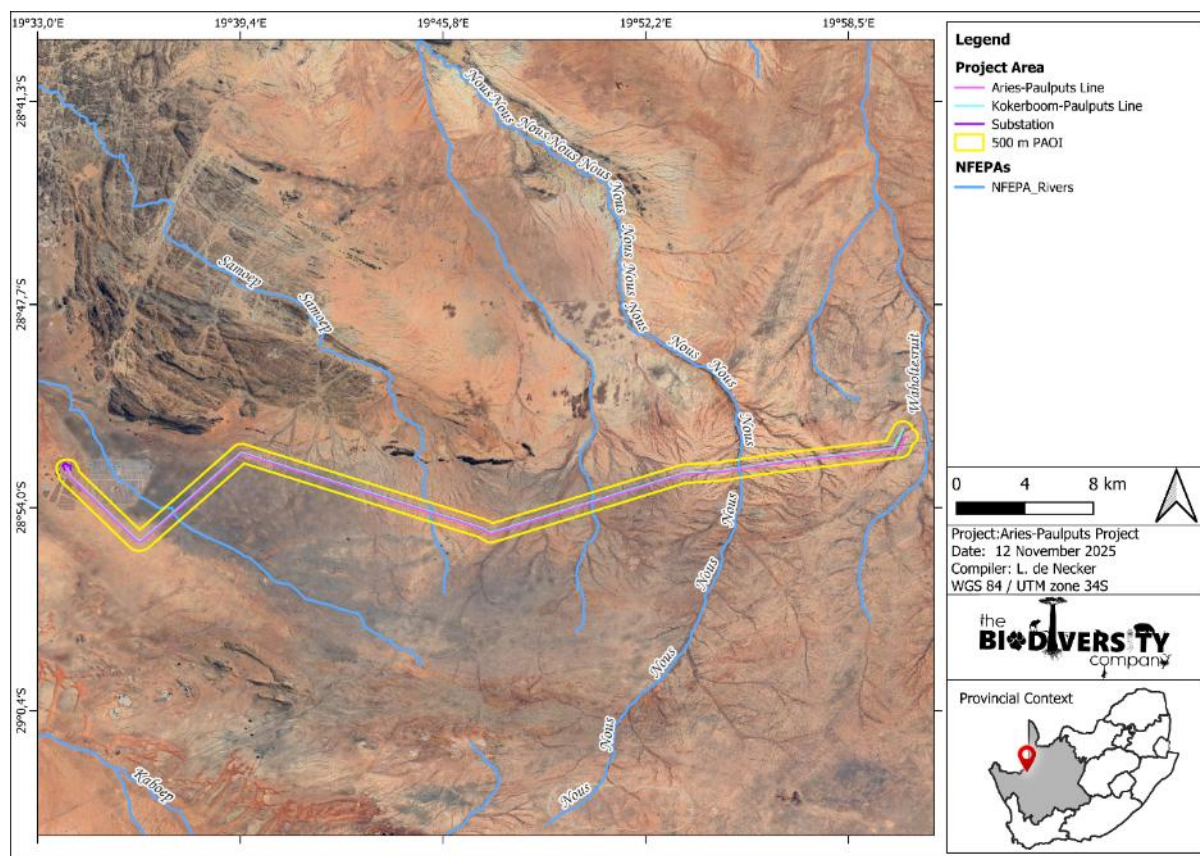


Figure 3-5 NFEPA map for the PAOI (Nel et al., 2011)

3.1.7 Protected Areas

The Department of Environmental Affairs maintains a spatial database of Protected Areas and Conservation Areas. The Protected Areas and Conservation Areas (PACA) Database scheme is used for classifying protected areas (South Africa Protected Areas Database-SAPAD) and conservation areas (South Africa Conservation Areas Database-SACAD) into types and sub-types in South Africa. The definition of protected areas used in these documents follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the “System of Protected Areas”, which consists of the following kinds of protected areas: Special nature reserves, National parks, Nature reserves, Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003), World heritage sites declared in terms of the World Heritage Convention Act, Marine protected areas declared in terms of the Marine Living Resources Act, Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998), and Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970). The types of conservation areas that are currently included in the database include: Biosphere reserves, Ramsar sites, Stewardship agreements (other than nature reserves and protected environments), Botanical gardens, Transfrontier conservation areas, Transfrontier parks, Military conservation areas, and Conservancies.

According to the protected area spatial datasets from SAPAD (2025) and SACAD (2025), the PAOI and powerlines do not overlap with any Protected Areas.

3.1.8 Renewable Energy Development Zones

On 16 February 2018, Minister Edna Molewa published Government Notice No. 114 in Government Gazette No. 41445 which identified 8 renewable energy development zones (REDZ) important for the development of large-scale wind and solar photovoltaic facilities. The Government Notice included procedure to be followed when applying for environmental authorisation for large scale wind and solar photovoltaic energy facilities when occurring in these REDZs. On 26 February 2021, Minister Barbara Dallas Creecy, published Government Notice No. 142, 144 and 145 in Government Gazette No. 44191 which identified 3 additional REDZs for implementation as well as the procedures to be followed when applying for environmental authorisation for electricity transmission or distribution infrastructure or large-scale wind and solar photovoltaic energy facilities in these REDZs. The REDZs were identified through the undertaking of 2 Strategic Environmental Assessments, the first being finalised in 2015 and the second being finalised in 2019.

According to the available dataset, the PAOI and powerlines do not overlap with a REDZ.

3.1.9 Renewable Energy EIA Application Database

The Renewable Energy Database (<http://egis.environment.gov.za/>), shows that there are approved projects in the near vicinity of the PAOI and the location of the powerlines (Figure 3-6). This will increase the overall impact on the habitats in the area.

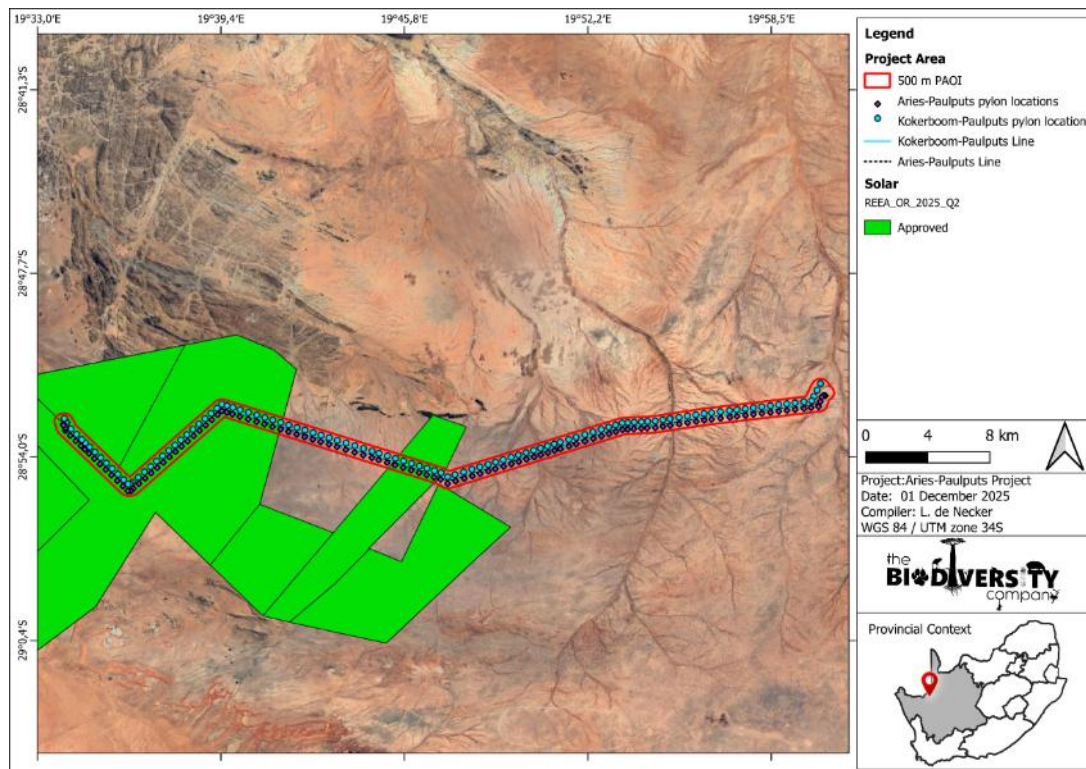


Figure 3-6 The project area in relation to the renewable energy database projects in the area.

3.1.10 Strategic Transmission Corridors

On the 16 February 2018 minister Edna Molewa published Government Notice No. 113 in Government Gazette No. 41445 which identified 5 strategic transmission corridors important for the planning of electricity transmission and distribution infrastructure as well as procedure to be followed when applying for environmental authorisation for electricity transmission and distribution expansion when occurring in these corridors. On 29 April 2021, Minister Barbara Dallas Creecy published Government Notice No. 383 in Government Gazette No. 44504, which expanded the eastern and western transmission corridors

and gave notice of the applicability of the application procedures identified in Government Notice No. 113, to these expanded corridors. More information on this can be obtained from <https://egis.environment.gov.za/egi>.

The PAOI and proposed location of the powerlines fall within the Northern Strategic Transmission Corridor (EGI) (Figure 3-7).

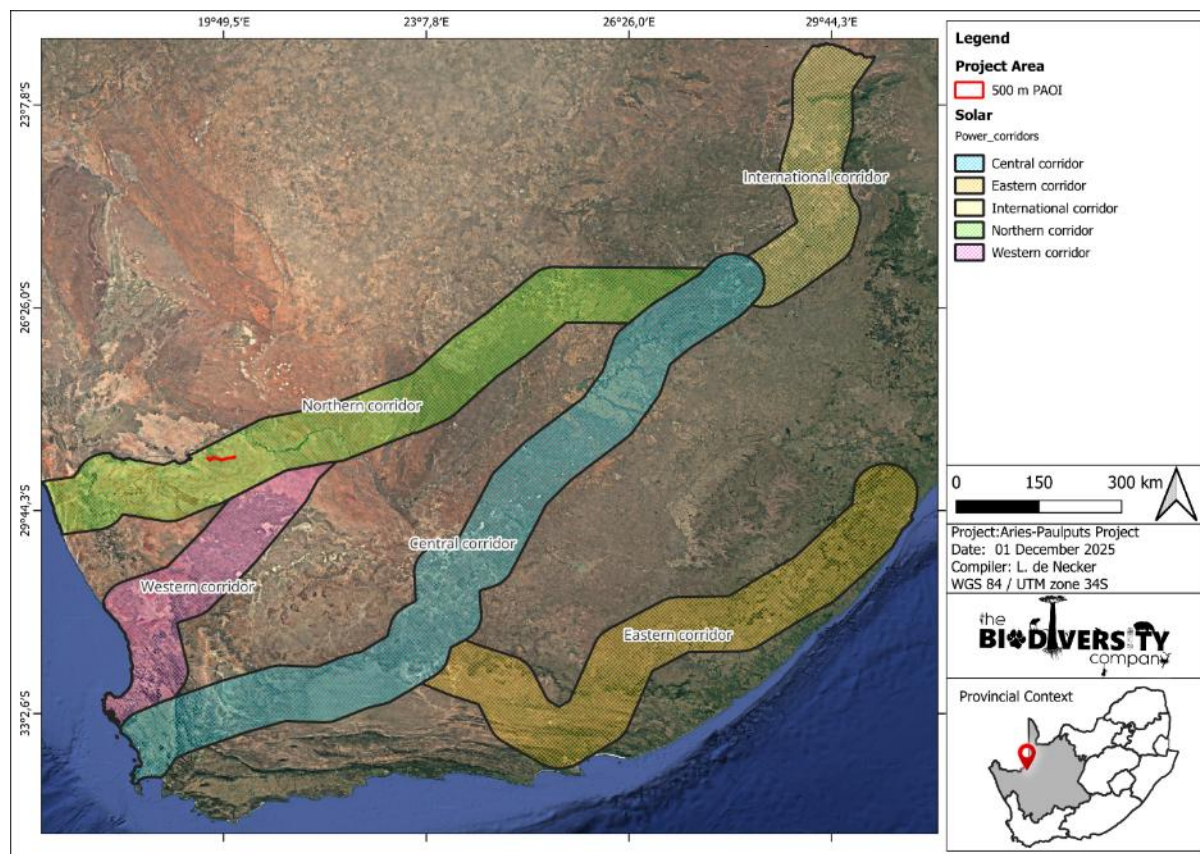


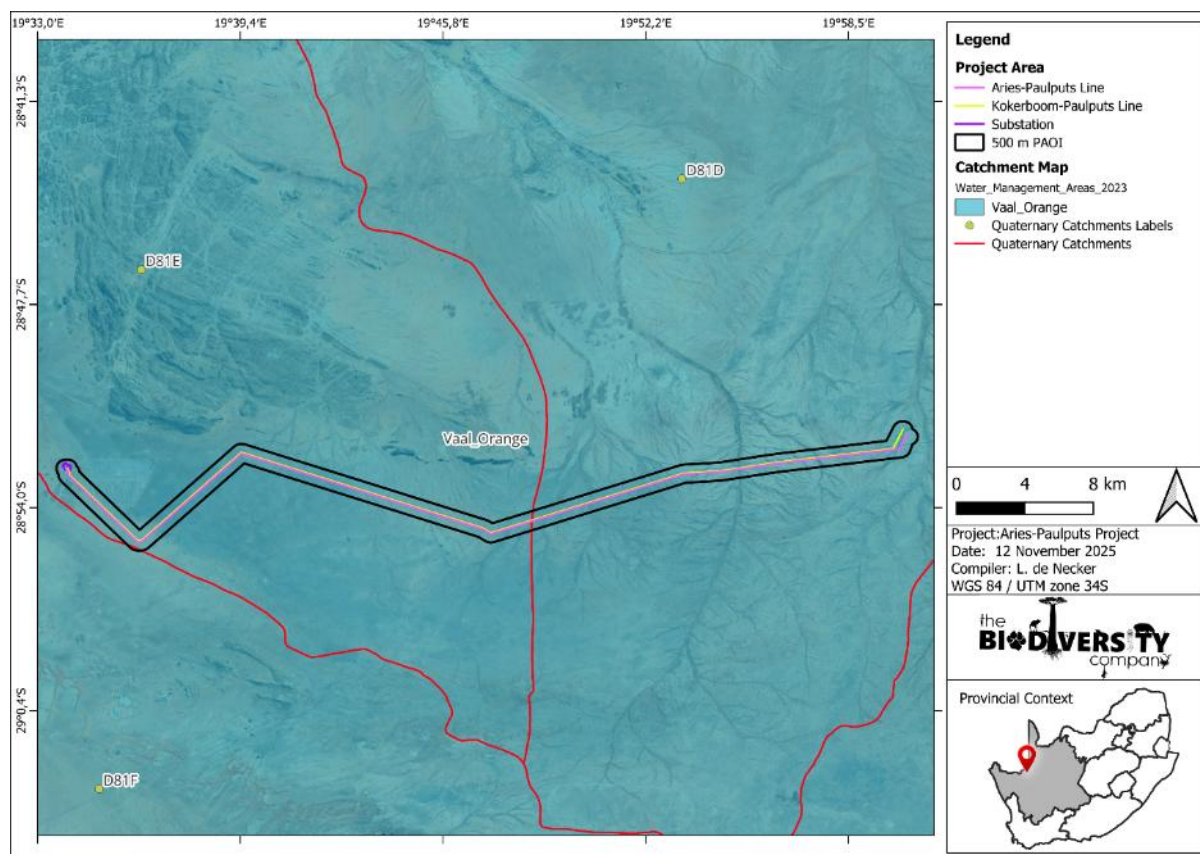
Figure 3-7 The PAOI in relation to the strategic transmission corridors

3.1.11 Freshwater Ecology

The project area falls within the Vaal-Orange Water Management Area (WMA) (previously the Orange WMA) (DWS, 2023), the Nama-Karoo and Orange River Gorge Ecoregions, and within the D81D and D81E quaternary catchments (Figure 3-8). Desktop information for the Sub-Quaternary Reaches (SQRs) associated with the PAOI was obtained from the DWS (2014). The PAOI falls within the D81D-03329 SQR, associated with the Kantbrogas se Laagte River, and the D81D-03330 SQR, associated with the Nous River. No SQR information is available for the Samoep River. The Present Ecological State (PES), Ecological Importance (EI), and Ecological Sensitivity (ES) for the available SQRs are summarised in Table 3-2. Only the Default Ecological Category was available, and this was used as a proxy for the Present Ecological State (PES) and Recommended Ecological Condition (REC). No impacts or activities were recorded for the SQR in the DWS (2014) database. However, based on field observations, the region is affected by dirt road crossings, agricultural activities (livestock), erosion, and the presence of exotic vegetation.

Table 3-2 PES of systems and the SQR associated with the project (DWS, 2014)

Component/SQR	D81D-03329 (Kantbrogas se Laagte River)	D81D-03330 (Nous River)
Default Ecological Category	Moderately Modified (C)	Moderately Modified (C)
Ecological Importance (EI)	Moderate	Moderate
Ecological Sensitivity (ES)	Low	Not Available
Recommended Ecological Category (REC)	Moderately Modified (C)	Moderately Modified (C)

**Figure 3-8 Hydrological aspects associated with the project area**

3.1.12 Resource Quality Objectives

The NWA sets out to ensure that water resources are used, managed and controlled in such a way that they benefit all users. To achieve this, the Act has prescribed a series of measures such as Resource Quality Objectives (RQOs) to ensure comprehensive protection of water resources so that they can be used sustainably (DWA, 2011b). Results from the riverine assessment are ideally compared to the Resource Quality Objectives (RQOs) for the WMA and at a finer level for specific catchments (where available). RQOs provide numerical and/or descriptive statements about the biological, chemical, and physical attributes that characterise a resource for the level of protection defined by its class. "Resource Quality Objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota". The PAOI falls within the Vaal-Orange WMA (previously the Orange WMA). No RQO information is available for the PAOI as the rivers in the region are considered ephemeral watercourses and have not been assessed.

3.2 Survey Results

3.2.1 Investigation Sites

A single high flow survey was conducted from the 3rd to the 5th of November 2025. Sampling points were selected for the study to assess the current state of the associated watercourses and identify potential risks that may result from the project. Only watercourses at an appreciable level of risk in relation to the proposed project and related activities were considered for assessment.







The following watercourses were identified within the PAOI during the field survey:









- NFEPA Rivers:
 - Nous River, Kantbrogas se Laagte River, Samoep River, Unnamed NFEPA River
- Wetlands:
 - Temporary depression wetland
- Non-perennial/ephemeral watercourses:
 - Drainage areas
 - NFEPA River tributaries









The on-site assessment of the watercourses presented dry conditions in all assessed sites. Cumulatively these systems displayed ephemeral characteristics which is typical for watercourses in a semi-arid region such as where the project area is located. Portions of the watercourses intersect terrestrial habitat, highlighting their interdependence. Despite their ephemeral nature, the watercourses are sensitive to modification as these systems do provide drinking opportunities (following rainfall) and habitat for foraging, nesting and refugia for terrestrial biota and avifauna. Therefore, the watercourses in the project area are regarded as sensitive environments in relation to changes in habitat integrity, flow and water quality (ecological drivers) requiring avoidance from the project related disturbance activities and as well as maintenance of baseline conditions. Given the extensive number of sites assessed, photographs and Global Positioning System (GPS) coordinates of representative habitat types are presented in Table 3-3, together with corresponding photographs. The examples illustrate the range of habitats encountered during the survey.





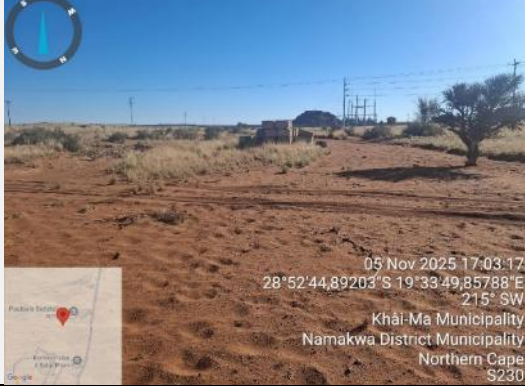

Due to the ephemeral, dry nature of the watercourses within the PAOI, standard aquatic methods could not be conducted. The Index of Habitat Integrity (IHI) model as described in Kleynhans (1996) v2 was therefore used to determine the Present Ecological State (PES) of these watercourses.

Table 3-3 Photos and coordinates of representative sites assessed (November 2025)

Site	Upstream View	Downstream View
NFEPA Rivers		
Nous River		
GPS	28°52'48.51"S 19°55'7.35"E	
Kantbrogas se Laagte River		
GPS	28°53'50.80"S 19°50'26.75"E	
Samoep River		
GPS	28°54'11.41"S 19°45'24.12"E	

Site	Upstream View	Downstream View
Unnamed NFEPA River	 <p>05 Nov 2025 12:55:02 28°54'16.24926"S 19°37'12.84078"E 168° S 218</p>	 <p>05 Nov 2025 12:55:07 28°54'16.2304"S 19°37'12.87096"E 319° NW 218</p>
GPS	28°54'16.92"S 19°37'13.12"E	
NFEPA River Tributaries		
Tributary of Nours River	 <p>04 Nov 2025 14:15:03 28°52'52.16976"S 19°54'44.49802"E 34° NE N14 ZF Mgcawu District Municipality Northern Cape S31</p>	 <p>04 Nov 2025 14:15:09 28°52'52.14124"S 19°54'44.4766"E 227° SW N14 ZF Mgcawu District Municipality Northern Cape S31</p>
Tributary of Kantbrogas se Laagte River	 <p>04 Nov 2025 10:02:49 28°53'55.68178"S 19°50'13.50975"E 217° SW S56</p>	 <p>04 Nov 2025 10:02:54 28°53'55.6507"S 19°50'13.52665"E 30° NE S56</p>
Tributary of Samoep River	 <p>04 Nov 2025 17:03:59 28°54'13.6835"S 19°45'31.63409"E 9° N S98</p>	 <p>04 Nov 2025 17:04:03 28°54'13.66554"S 19°45'31.65371"E 183° S S98</p>
Representative Drainage Areas		

Site	Upstream View	Downstream View
Site 23	 <p>03 Nov 2025 16:47:41 28°52'37.431"S 19°56'11.62459"E 149° SE S23</p>	 <p>03 Nov 2025 16:47:35 28°52'37.4227"S 19°56'11.62248"E 327° NW S23</p>
Site 50	 <p>04 Nov 2025 08:54:17 28°53'38.53885"S 19°51'11.33744"E 143° SE S50</p>	 <p>04 Nov 2025 08:54:12 28°53'38.539"S 19°51'11.38119"E 18° N S50</p>
Site 62	 <p>04 Nov 2025 11:55:13 28°54'18.80236"S 19°49'0.35324"E 30° NE N14 ZF Mgcawu District Municipality Northern Cape S62</p>	 <p>04 Nov 2025 11:55:19 28°54'18.77686"S 19°49'0.32035"E 288° W N14 ZF Mgcawu District Municipality Northern Cape S62</p>
Site 124	 <p>04 Nov 2025 18:43:26 28°53'37.97895"S 19°43'35.73792"E 219° SW N14 ZF Mgcawu District Municipality Northern Cape S124</p>	 <p>04 Nov 2025 18:44:07 28°53'37.78598"S 19°43'34.80371"E 53° NE N14 ZF Mgcawu District Municipality Northern Cape S124</p>

Site	Upstream View	Downstream View
Site 156	 <p>05 Nov 2025 07:58:33 28°52'55.60939"S 19°41'21.61372"E 177° S S156</p>	 <p>05 Nov 2025 07:58:43 28°52'55.61512"S 19°41'21.57902"E 350° N S156</p>
Site 185	 <p>05 Nov 2025 10:03:11 28°52'25.33119"S 19°39'18.87299"E 178° S S185</p>	 <p>05 Nov 2025 10:03:16 28°52'25.33586"S 19°39'18.87088"E 315° NW S185</p>
Site 230	 <p>05 Nov 2025 17:03:17 28°52'44.89203"S 19°33'49.85788"E 215° SW Khâi-Ma Municipality Namakwa District Municipality Northern Cape S230</p>	 <p>05 Nov 2025 17:04:47 28°52'45.34692"S 19°33'49.50121"E 62° NE Khâi-Ma Municipality Namakwa District Municipality Northern Cape S230</p>

Wetlands	
Temporary Depression Wetland	
GPS	28°52'22.82"S 19°58'48.07"E

3.2.2 Water Quality

Due to the ephemeral, dry nature of the watercourses within the PAOI, water quality assessments could not be conducted.

3.2.3 Index of Habitat Integrity

The condition of the watercourse and associated aquatic biodiversity are largely dependent on the condition and degree of modification of the surrounding catchment. The more intact and natural the catchment is, the greater the watercourse condition and ecosystem functioning, and the more services there will be with an associated high aquatic and terrestrial biodiversity presence. An altered catchment compromises the watercourse condition, ecosystem functioning, and services offered, with deleterious effects depending on the degree and type of catchment modification. The more modified catchment will ultimately have a low ecological value watercourse offering limited services with an absence of key services such as phytoremediation (cleaning of water by vegetation) with the cumulative loss of its original biodiversity with only the most tolerant biota remaining in the most negatively modified catchments. The IHI was conducted to determine the PES of the watercourses.

The IHI assessment was conducted for each of the four NFEPA rivers (Nous, Kantbrogas se Laagte, Samoep and Unnamed NFEPA rivers) within the project area. In addition, an overall IHI assessment was completed for the drainage areas within the project area. The drainage area adjacent to the Paulputs substation was evaluated separately from the remaining drainage areas, as it is subject to greater anthropogenic impacts, including increased erosion and disturbances from surrounding infrastructure and human activity. In contrast, the other drainage areas within the PAOI are primarily influenced by less intensive activities, such as livestock grazing and dirt roads. As a result, the drainage areas were categorised as either Farming drainage areas or the Substation drainage area, to reflect the differing nature and intensity of impacts. The results for the instream and riparian IHI assessment for the associated watercourses are presented in Table 3-4.

According to the IHI results, the instream and riparian habitat of the NFEPA rivers, NFEPA River tributaries and the Farming drainage areas were rated as Natural (class A), indicating unmodified, natural habitats. Limited anthropogenic activities within the local area include encroachment of invasive plant species (Mexican Poppy and Mesquite) into the riparian and instream habitats, agricultural activities (livestock and farm dams), erosion, historic excavation areas, dirt road crossings and existing pylon structures (Figure 3-9). These activities have led to limited flow, bed and channel modifications within the assessed habitats. The IHI results further indicated that the instream and riparian habitat of the Substation drainage area is in a Moderately Modified state (class C) indicating a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. Anthropogenic activities within the surrounding area include hardened surfaces from

buildings and infrastructure (Paulputs substation, culverts, berms), dirt roads, building rubble, pipes and fences which have resulted in flow, bed and channel modifications including severe erosion (Figure 3-10).

Table 3-4 Results for the Instream Habitat Integrity assessment for the associated reaches (November 2025)

Instream Criteria	Nous River	Kantbrogas se Laagte River	Samoep River	Unnamed NFEPA River	NFEPA River tributaries	Farming drainage areas	Substation drainage area
Water abstraction	0	0	0	0	0	0	0
Flow modification	3	3	3	3	3	3	10
Bed modification	3	3	3	3	3	3	8
Channel modification	3	3	3	3	3	3	8
Phys-chem modification	2	2	2	2	2	2	6
Inundation	3	3	3	3	3	3	6
Alien macrophytes	0	0	0	0	0	0	0
Introduced aquatic fauna	0	0	0	0	0	0	0
Rubbish dumping	0	0	0	0	0	0	4
Instream Habitat Integrity Score	93	93	93	93	93	93	80
Instream Habitat Integrity Category	A	A	A	A	A	A	C
Riparian Criteria	Nous River	Kantbrogas se Laagte River	Samoep River	Unnamed NFEPA River	NFEPA River tributaries	Farming drainage areas	Substation drainage area
Vegetation removal	0	0	0	0	0	0	6
Exotic vegetation	2	2	2	2	3	3	4
Bank erosion	2	2	2	2	3	4	12
Channel modification	3	3	3	3	3	3	10
Water abstraction	0	0	0	0	0	0	0
Inundation	3	3	3	3	3	3	6
Flow modification	3	3	3	3	3	3	8
Phys-chem	2	2	2	2	2	2	6
Riparian Zone Integrity Score	93	93	93	93	92	91	65
Riparian Zone Integrity Category	A	A	A	A	A	A	C

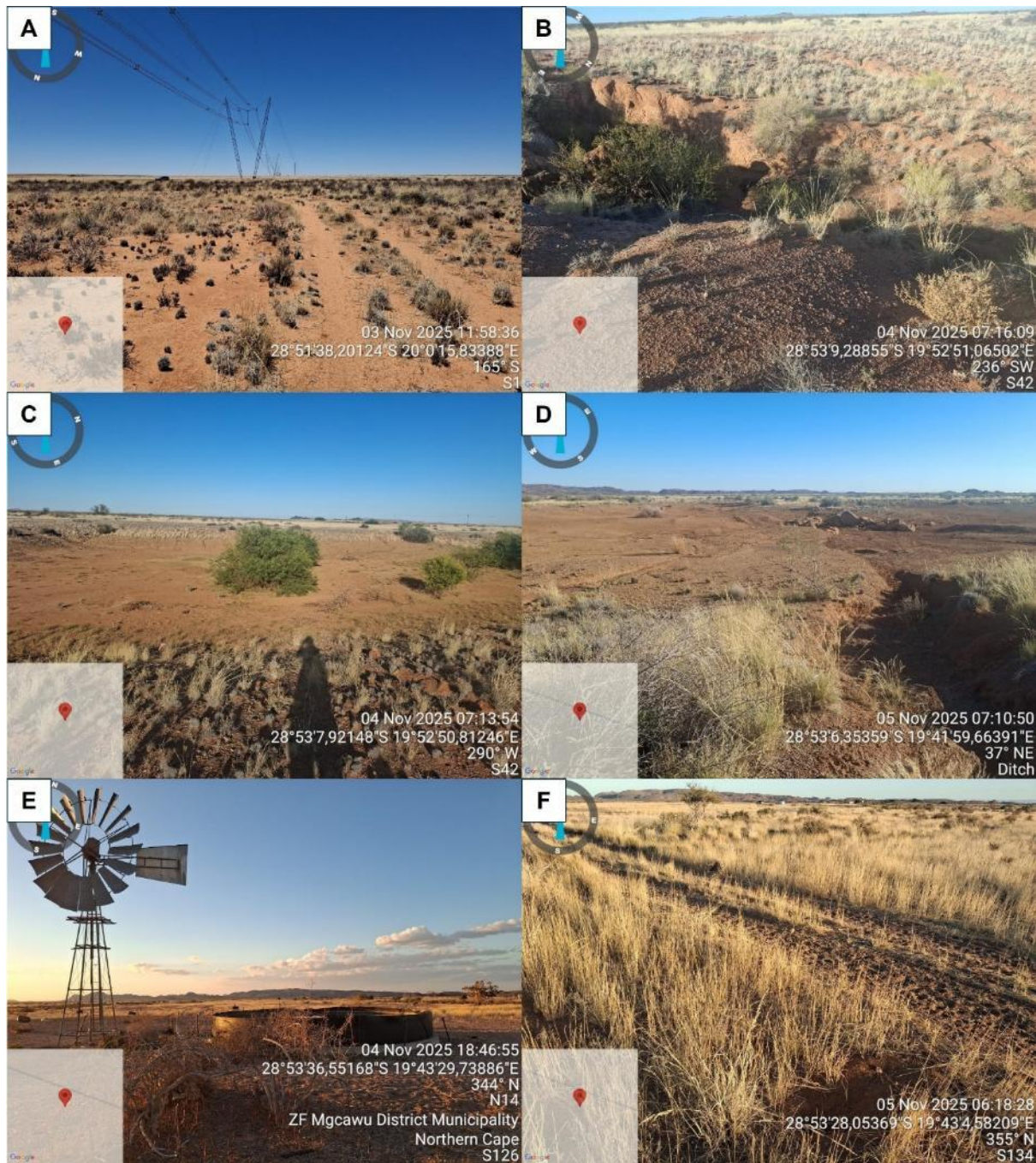


Figure 3-9 *Impacts observed within the PAOI surrounding the NFEPA rivers and Farming drainage areas (November 2025): A) Existing powerlines; B) Erosion; C) Invasive species (Mesquite); D) Historic excavation areas; E) Agriculture and F) Dirt roads*

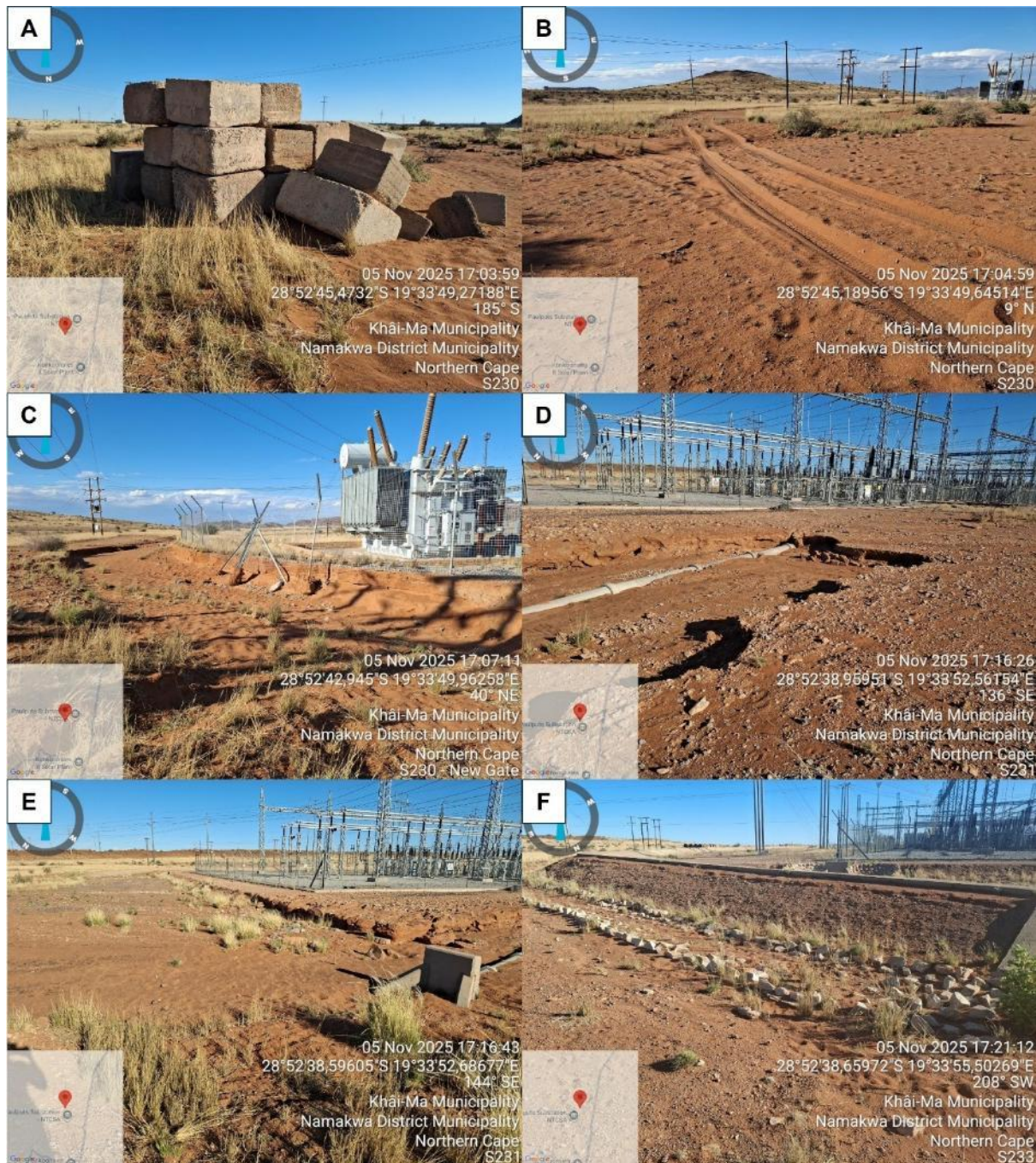


Figure 3-10 Impacts observed within the PAOI surrounding the Substation drainage area (November 2025): A) Building rubble; B) Dirt roads; C) Erosion; D) Pipes; E) Infrastructure (Substation and culverts) and F) Hardened surfaces (Berms and stormwater management systems)

3.2.4 Aquatic Macroinvertebrates

Due to the ephemeral, dry nature of the watercourses within the PAOI, aquatic macroinvertebrate assessments could not be conducted, and no information is available regarding potential macroinvertebrate species that may occur within the region.

3.2.5 Fish Community Structure

Due to the ephemeral, dry nature of the watercourses within the PAOI, fish community assessments could not be conducted, and no information is available regarding potential fish species that may occur within the region.

3.2.6 Present Ecological Status

The PES assessment for the sampled watercourses is based on the data collected during the November 2025 survey and the results are provided in Table 3-5. The PES assessment indicated that the assessed riverine (NFEPA rivers), NFEPA River tributaries and Farming drainage areas are in a class A (Natural) state, indicating unmodified, natural habitats and therefore compliant with the (REC) of class C (Moderately Modified). The PES assessment for the Substation drainage area was classified as a class C (Moderately Modified). It should be noted that the PES results represent a single survey conducted during November 2025 and is based only on the IHI results and the opinion of the specialist. These results should be interpreted accordingly.

The small temporary depression wetland located in the PAOI was classified and PES determined following the methods provided in Section 9.1.8. The temporary depression wetland is currently classified as a Category C system, indicating that it is moderately modified but still retains much of its ecological functionality. The primary impacts affecting the wetland include grazing by sheep, which can lead to trampling, soil compaction, and selective removal of vegetation, as well as the presence of dirt roads within its catchment. These disturbances have contributed to changes in vegetation structure and hydrological patterns, but the wetland continues to provide important ecosystem services such as water retention and habitat provision. Ongoing management of grazing intensity and careful planning of road placement are recommended to prevent further degradation and to maintain the wetland's ecological integrity in line with South African wetland assessment guidelines.

Table 3-5 Present Ecological Status of the aquatic ecosystems in the project area

Aspect Assessed	Nous River	Kantbrogasse Laagte River	Samoep River	Unnamed NFEPA River	NFEPA River Tributaries	Farming drainage areas	Substation drainage areas	Temporary depression wetland
Present Ecological State	A	A	A	A	A	A	C	C
Recommended Ecological Condition	C	C	Not available	Not available	Not available	Not available	Not available	Not applicable
	Maintain	Maintain	Maintain	Maintain	Maintain	Maintain	Maintain	Not applicable
Default DWS Ecstatus (DWS, 2014)	C	C	Not available	Not available	Not available	Not available	Not available	Not applicable

3.3 Water Resource Delineations, Buffer Requirements and Regulated Areas

3.3.1 Water Resources and Buffer Areas

The watercourses were delineated according to DWAF (2005), 5 m contour data, the SAIIE dataset (NBA National Wetland Map, 2018), and the latest Google Earth aerial imagery (2024) as well as a site visit and are presented in Figure 3-11 to Figure 3-21 along with the required buffer areas. According to the buffer guidelines, the maximum required buffer should be applied to a system (Macfarlane, *et al.*, 2014). Riparian areas have high conservation value and can be considered the most important part of a watershed for a wide range of values and resources. They provide important habitat for a large volume of wildlife and often forage for domestic animals. The vegetation they contain is an important part of the water balance for the hydrological cycle through evapotranspiration. They are crucial for riverbank stability and in preventing erosion within the channel (Elmore and Beschta, 1987). The implementation of a buffer zone ensures the ecological requirements needed to maintain both the ecosystem functioning and services offered by the watercourses are maintained. Additionally, the watercourses

potentially influenced by the project have sensitivity to further disturbance, requiring protection from the project activities. Therefore, they are considered as high priority areas and should be avoided at all costs.

A conservative buffer zone of **20 m** was suggested for the NFEPA rivers, a **10 m** conservative buffer for the NFEPA river tributaries and drainage areas, and a **30 m** conservation buffer zone was assigned for the temporary depression wetland (Figure 3-11 to Figure 3-21). These buffer areas serve as **No-go** zones for any unauthorised activities. The site development plan should therefore be created accordingly. Ensuring buffers are intact increases the resilience of a watercourse to future disturbances.

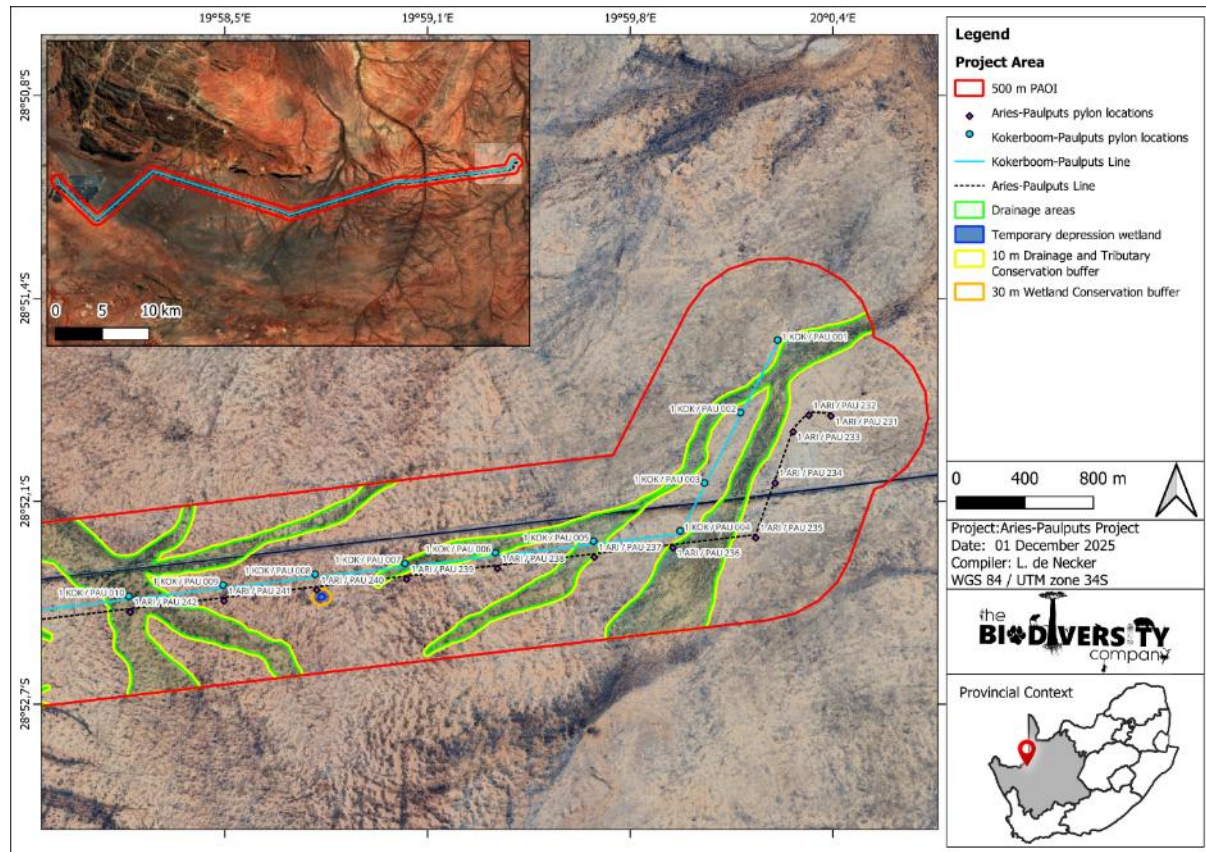


Figure 3-11 Delineations and buffer areas within the PAOI – 1

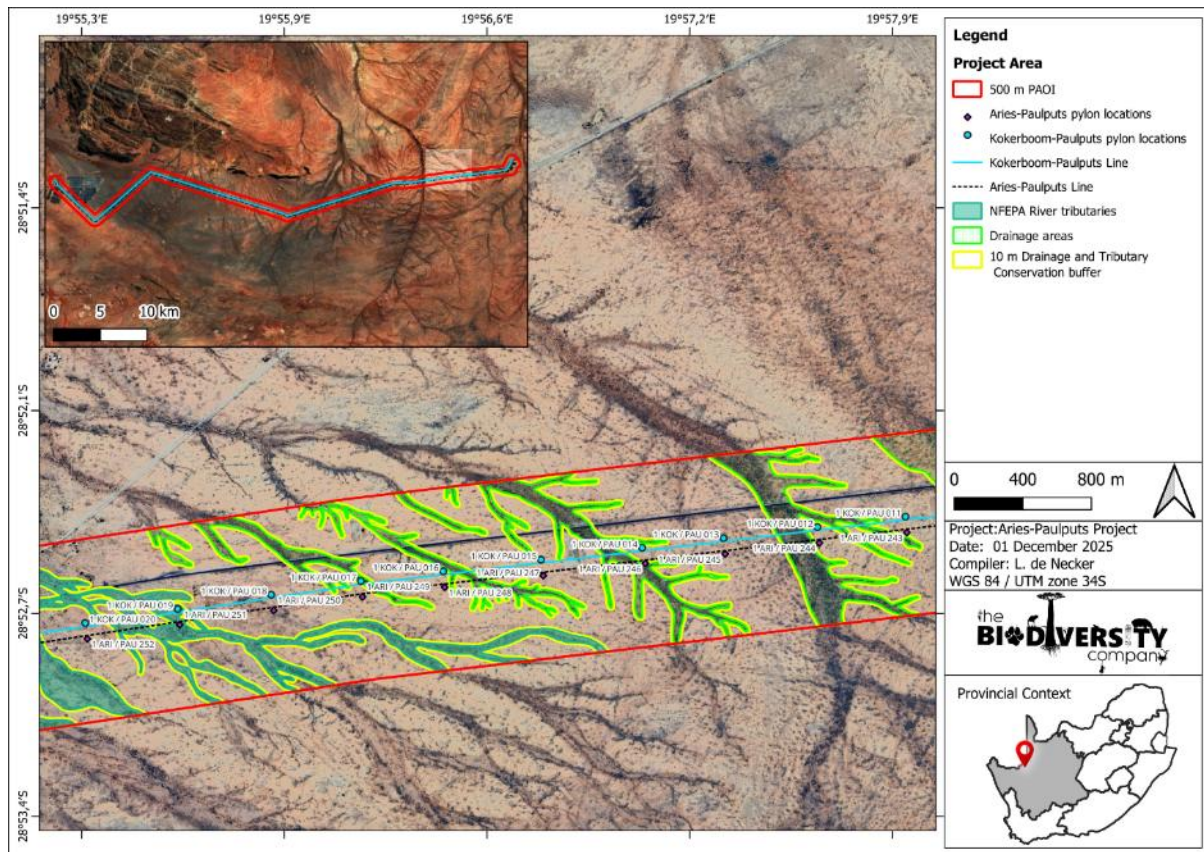


Figure 3-12 Delineations and buffer areas within the PAOI – 2

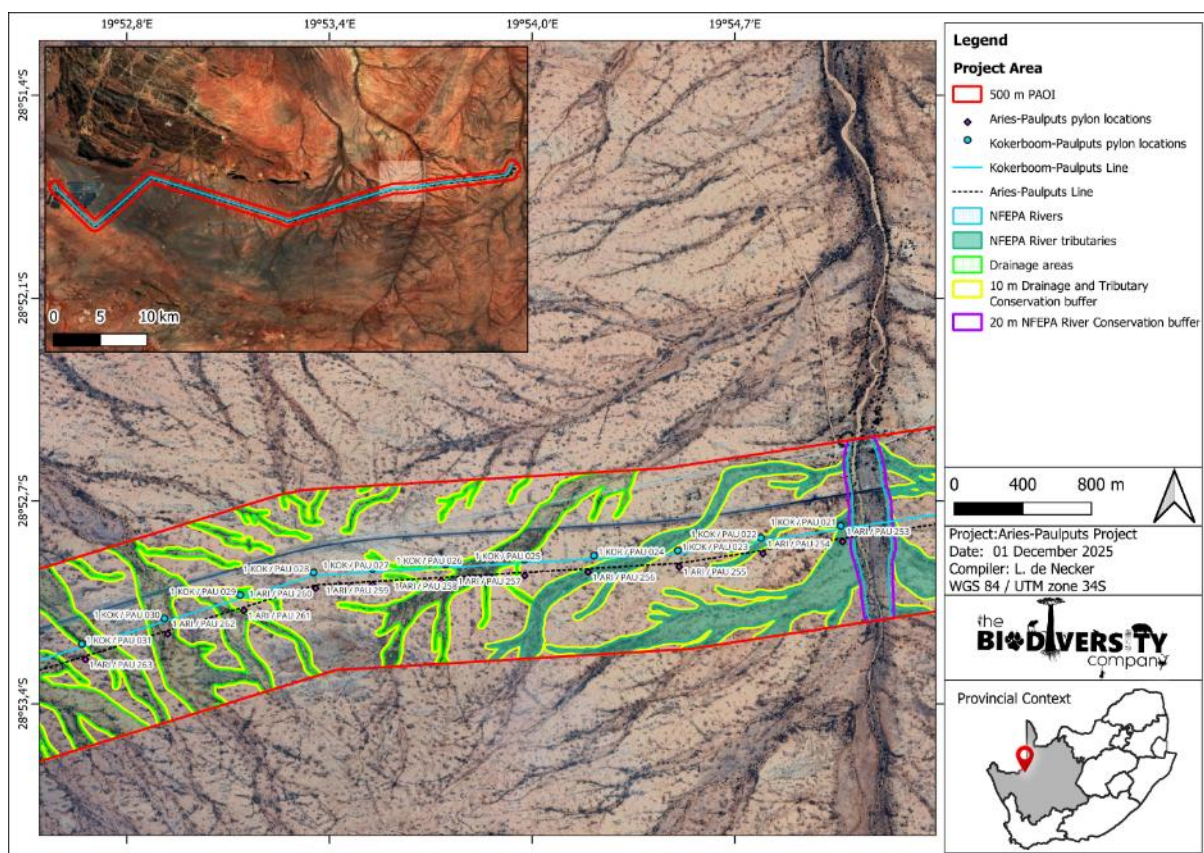


Figure 3-13 Delineations and buffer areas within the PAOI – 3

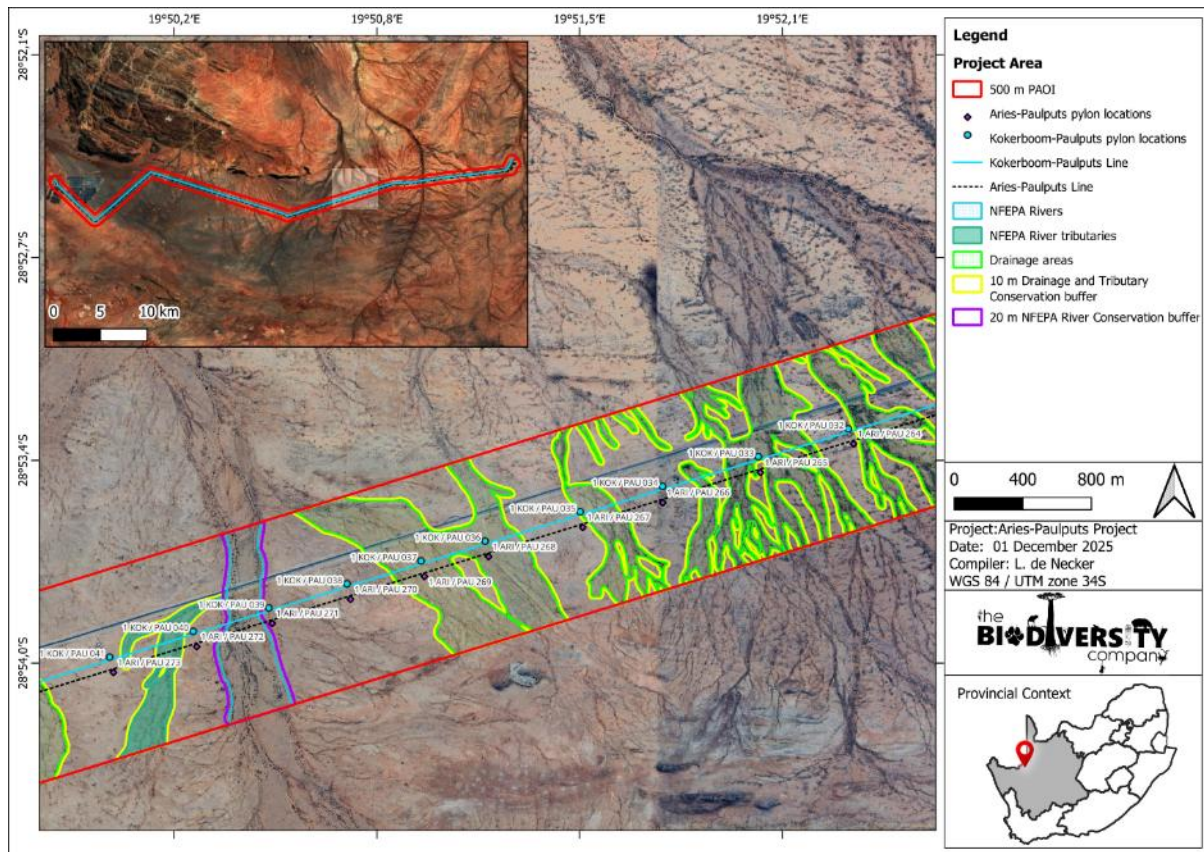


Figure 3-14 Delineations and buffer areas within the PAOI – 4

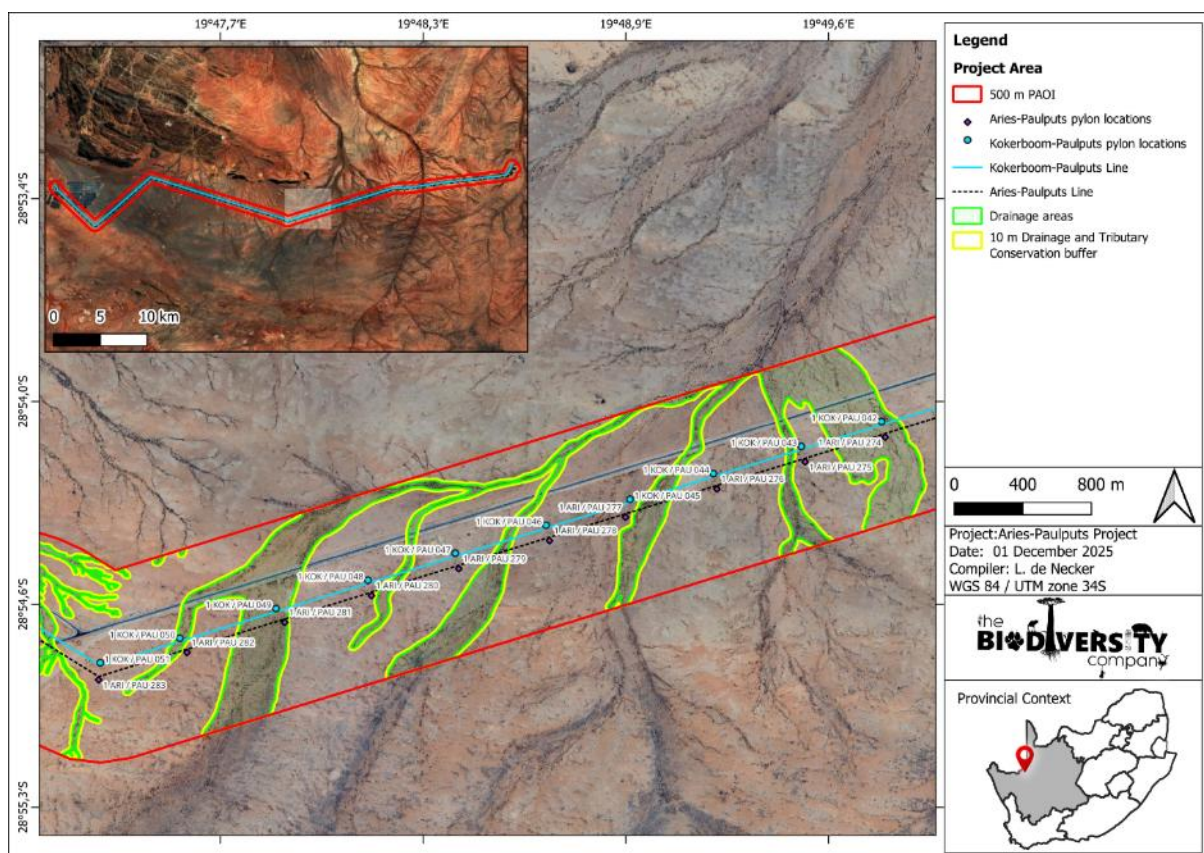


Figure 3-15 Delineations and buffer areas within the PAOI – 5

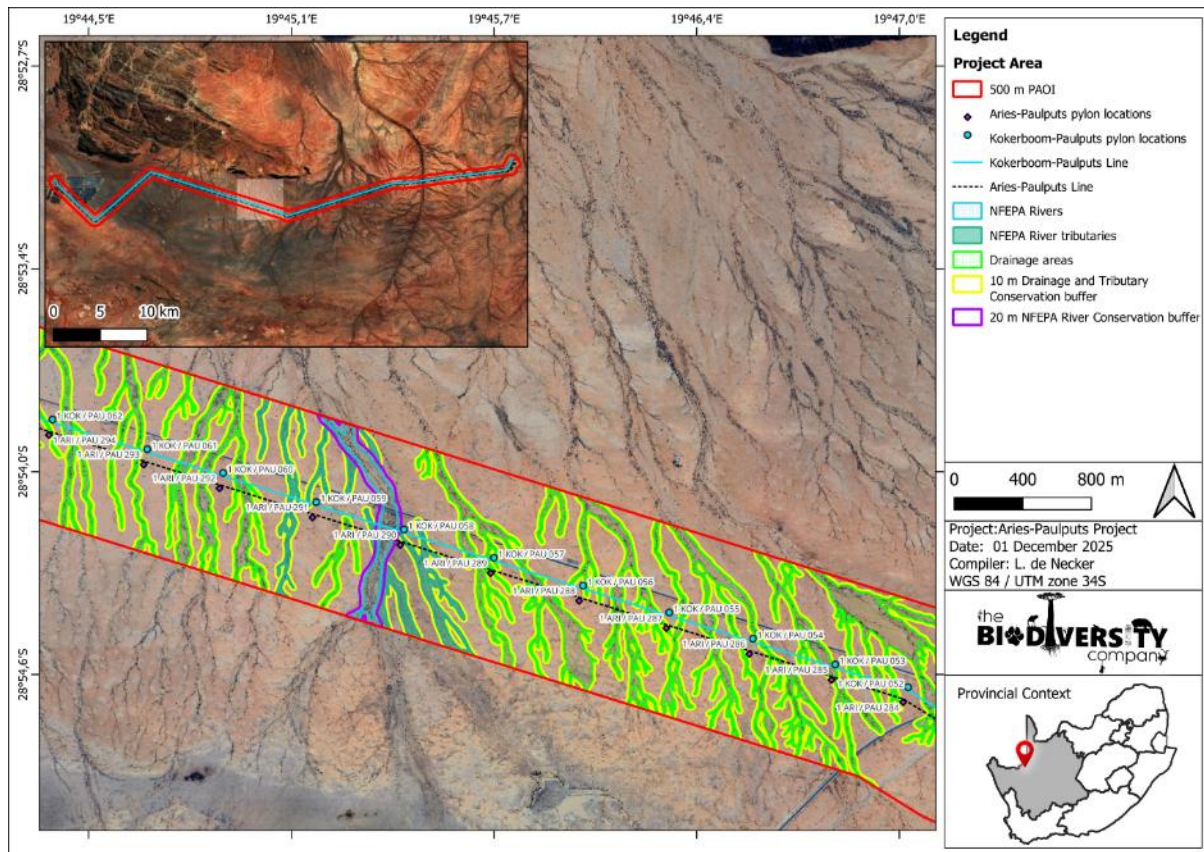


Figure 3-16 Delineations and buffer areas within the PAOI – 6

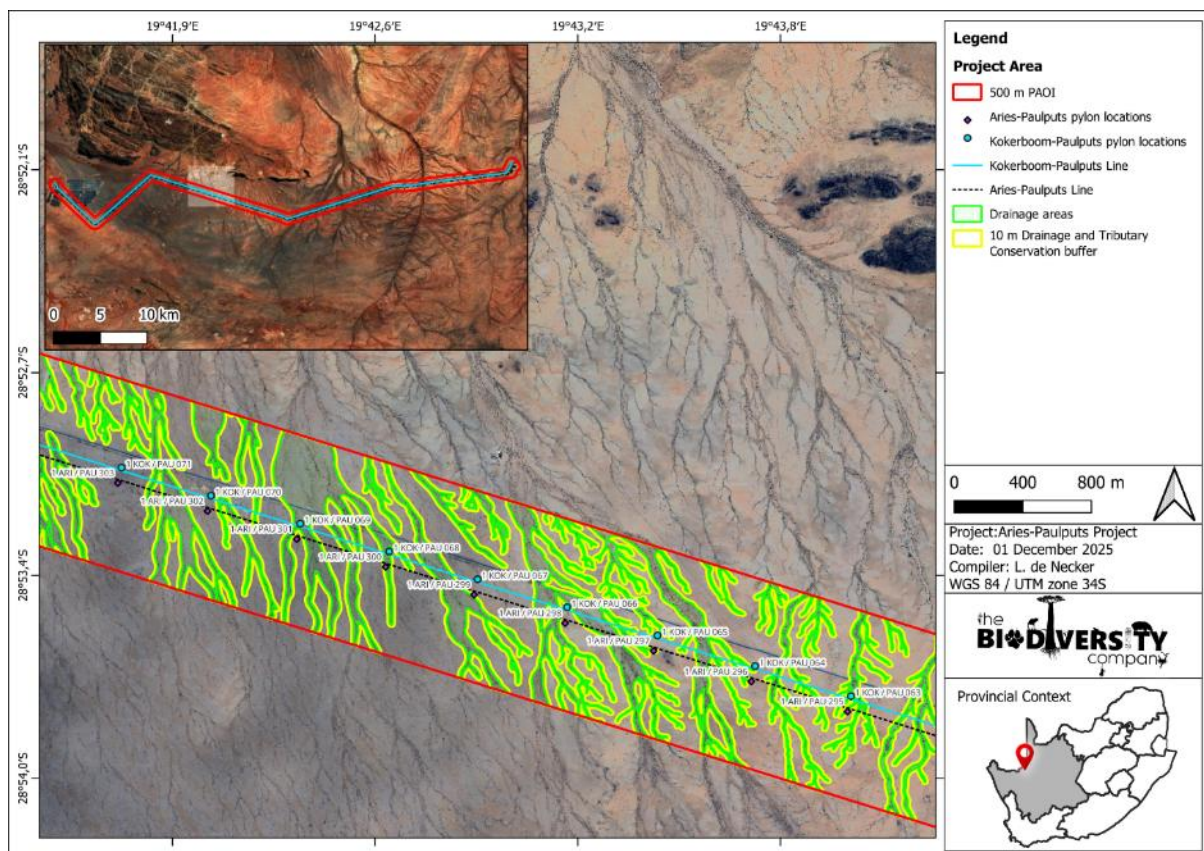


Figure 3-17 Delineations and buffer areas within the PAOI – 7

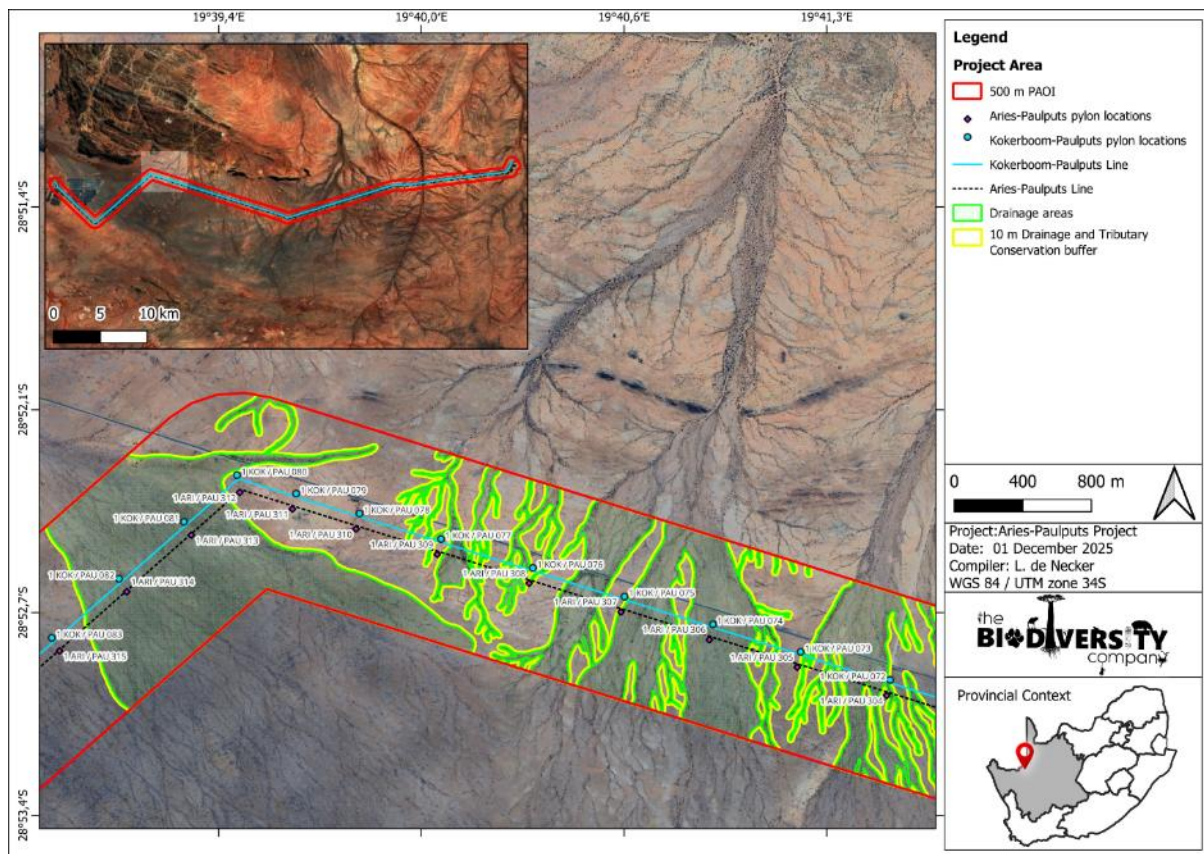


Figure 3-18 Delineations and buffer areas within the PAOI – 8

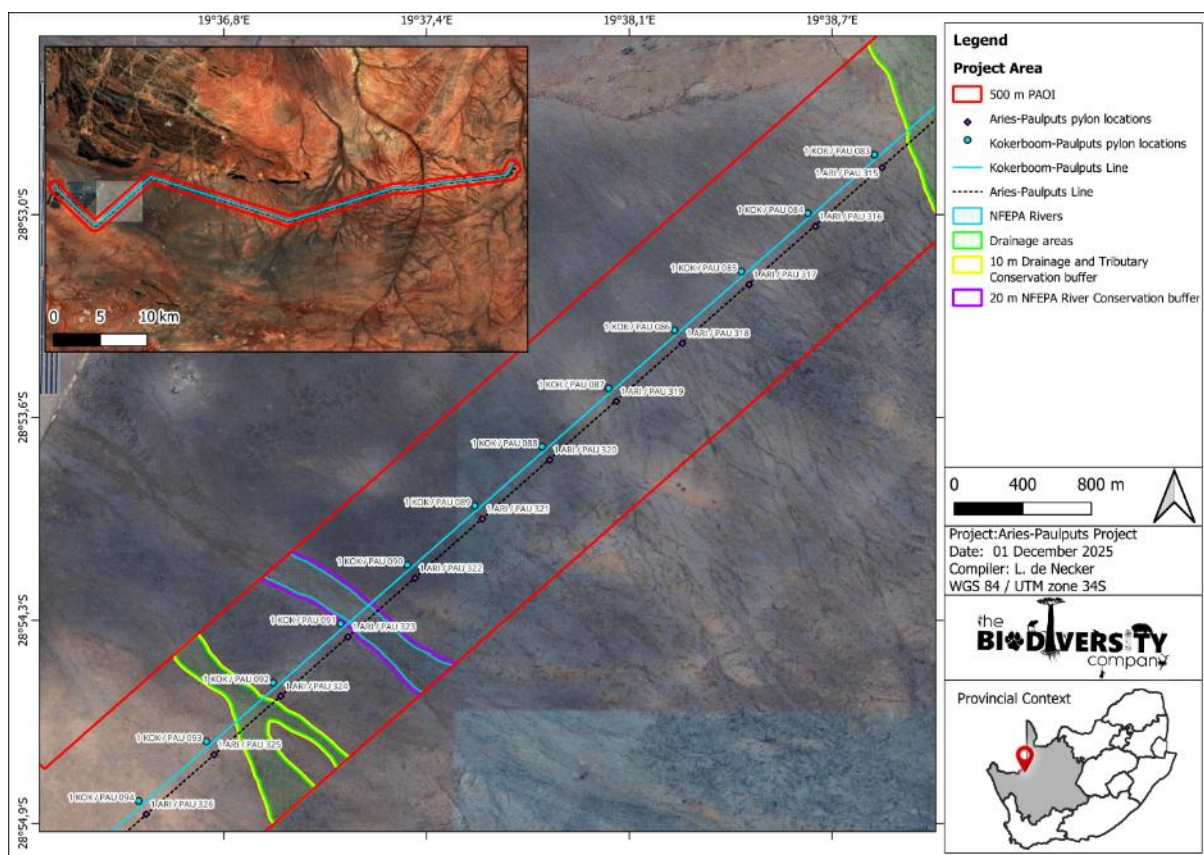


Figure 3-19 Delineations and buffer areas within the PAOI – 9

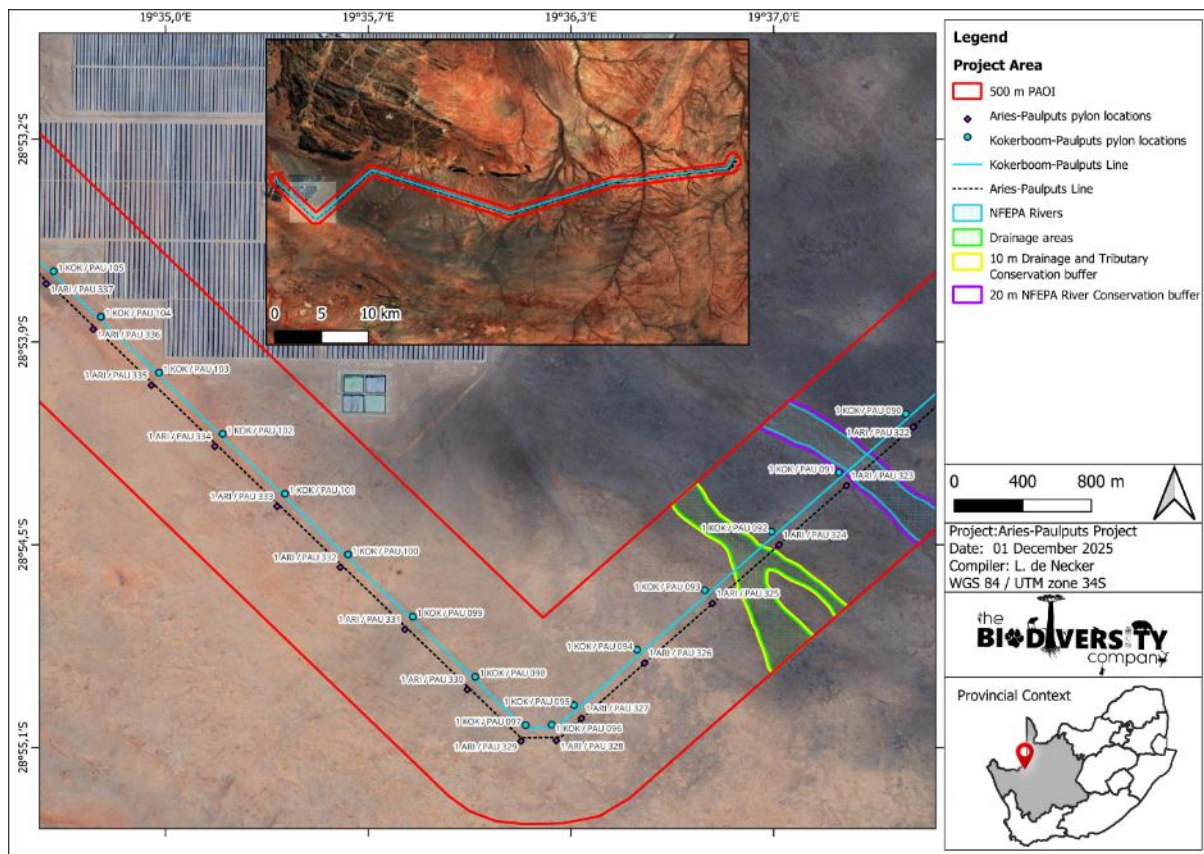


Figure 3-20 Delineations and buffer areas within the PAOI – 10

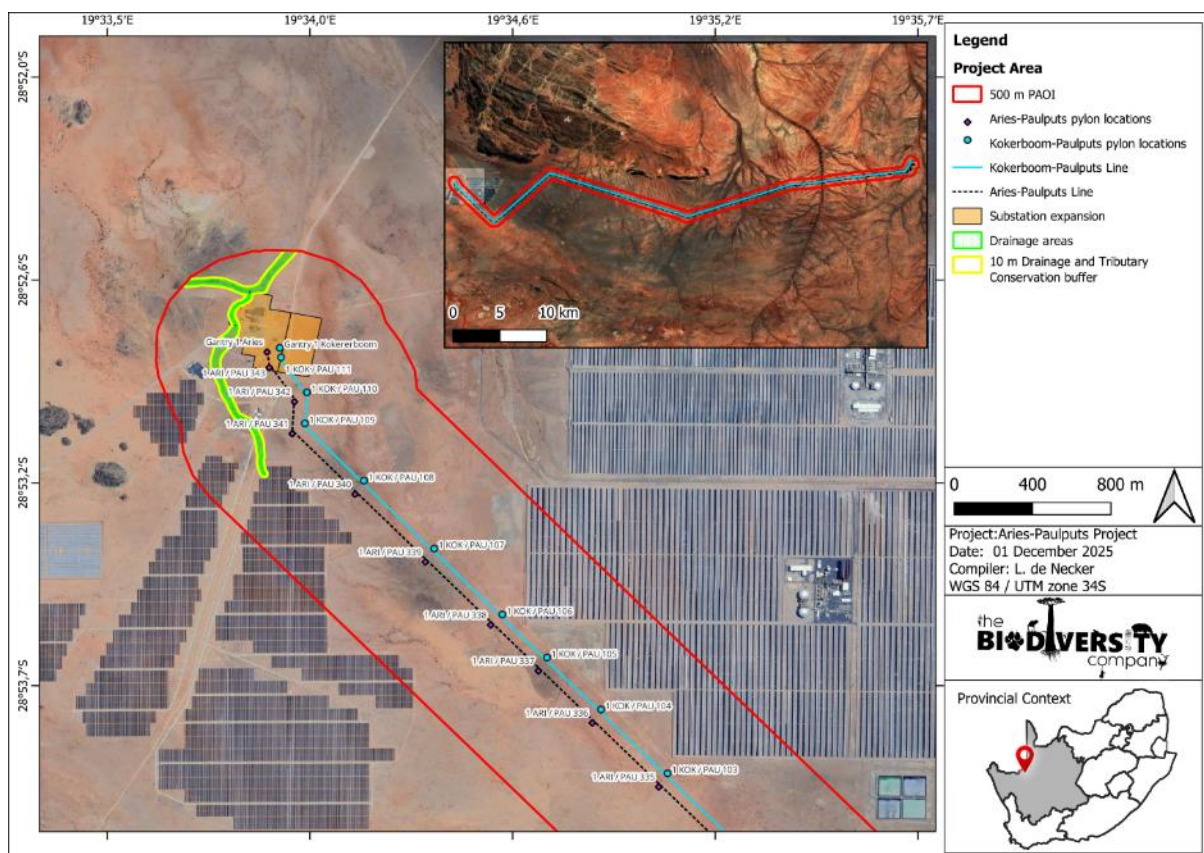


Figure 3-21 Delineations and buffer areas within the PAOI – 11

3.3.2 Regulation Zones

Table 3-6 presents the legislated zones of regulation that would be applicable to the PAOI. In accordance with General Notice (GN) 4167 of 2023 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means **100 m** from the edge of a watercourse or a **500 m** radius from the delineated boundary (extent) of any wetland or pan. Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation, which in this case is a **32 m** zone of regulation (ZoR). The PAOI includes four NFEPA rivers, NFEPA River tributaries, drainage areas and a temporary depression wetland and therefore the project falls within the NEMA Act 107 and DWS GN 4167 regulated zones. The regulated areas have been applied to the delineations within the PAOI and are presented in Figure 3-22 to Figure 3-32.

Table 3-6 The legislated zones of regulation

Regulatory authorisation	Zone of applicability
<p>Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation (DWS)</p>	<p>Government Notice 4167 as published in the Government Gazette 49833 of 08 December 2023 as it relates to the National Water Act, 1998 (Act No.36 of 1998) as amended. In accordance with GN4167, a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i) is defined as:</p> <ul style="list-style-type: none"> the outer edge of the 1 in 100-year flood line or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake, or dam; in the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench; or In respect of a wetland, a 500 m radius around the delineated boundary (extent) of any wetland, including pans.
<p>Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. Department of Environmental Affairs and Development Planning (DEA&DP)</p>	<p>Activities of Listing Notice 1 (GN 983) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended):</p> <p>Activity 12: The development of—</p> <ol style="list-style-type: none"> dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or infrastructure or structures with a physical footprint of 100 square metres or more. where such development occurs: <ol style="list-style-type: none"> within a watercourse; in front of a development setback; or if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse. <p>Excluding –</p> <p>...(dd) where such development occurs within an urban area...</p> <p>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</p> <ol style="list-style-type: none"> a watercourse; the seashore; or the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or estuary, whichever distance is the greater— <p>but excluding where such infilling, depositing, dredging, excavation, removal or moving—</p> <ol style="list-style-type: none"> will occur behind a development setback; is for maintenance purposes undertaken in accordance with a maintenance management plan; falls within the ambit of activity 21 in this Notice, in which case that activity applies;

(d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.

Activities of Listing Notice 3 (GN 985) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)

Activity 14

The development of—

(xii) 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,

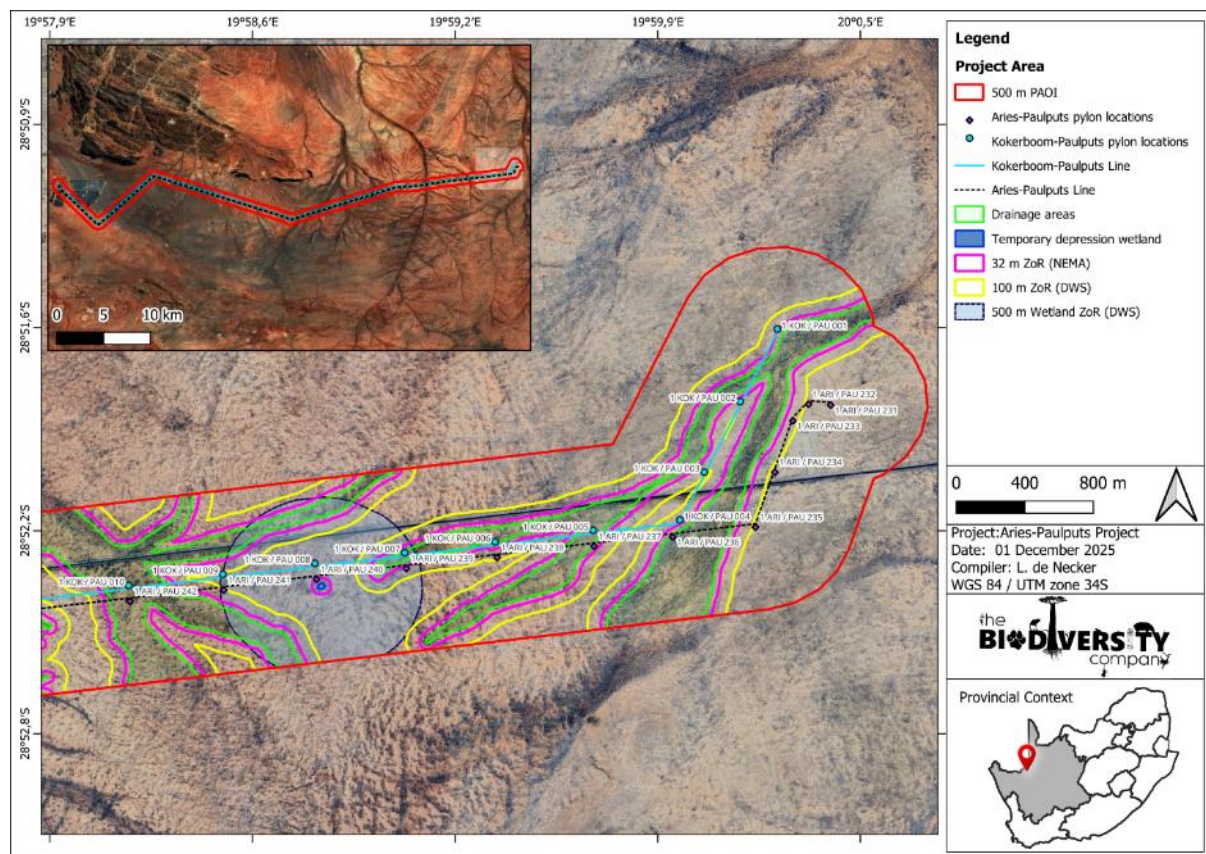


Figure 3-22 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 1

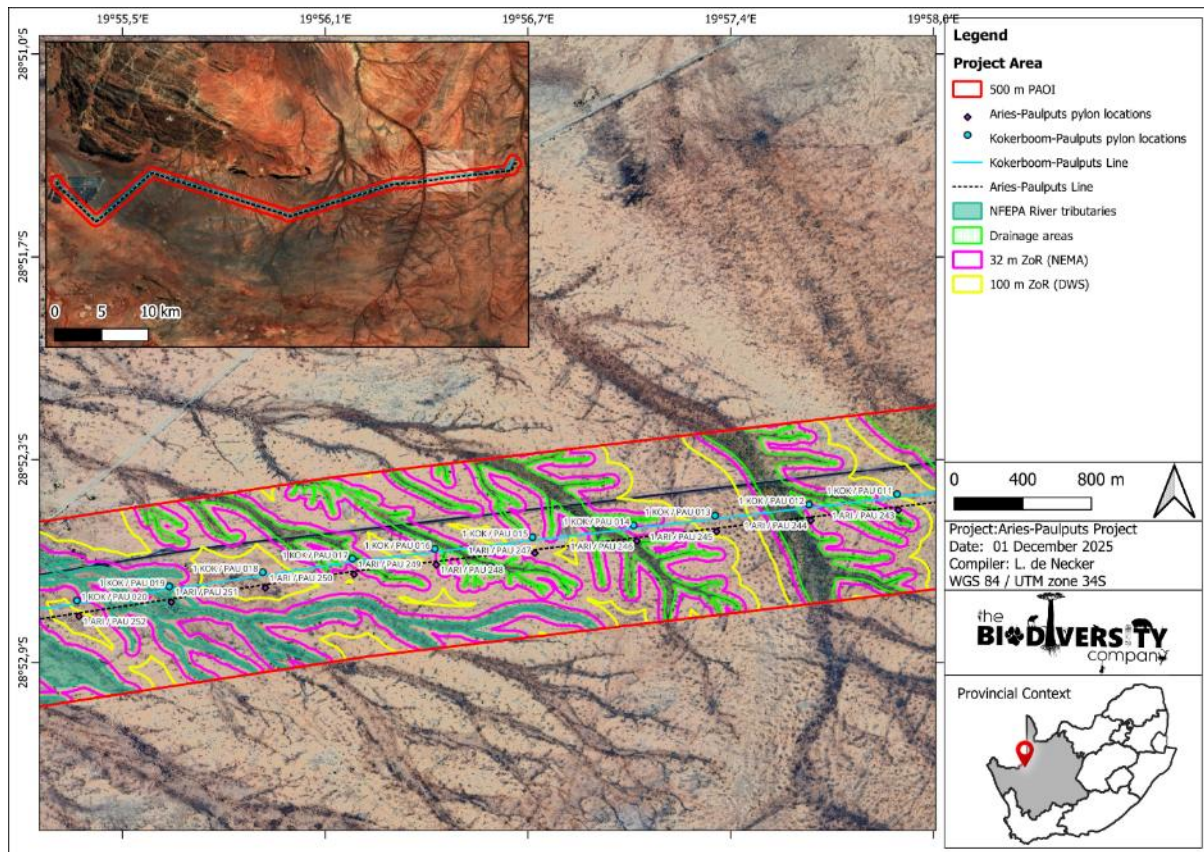


Figure 3-23 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 2

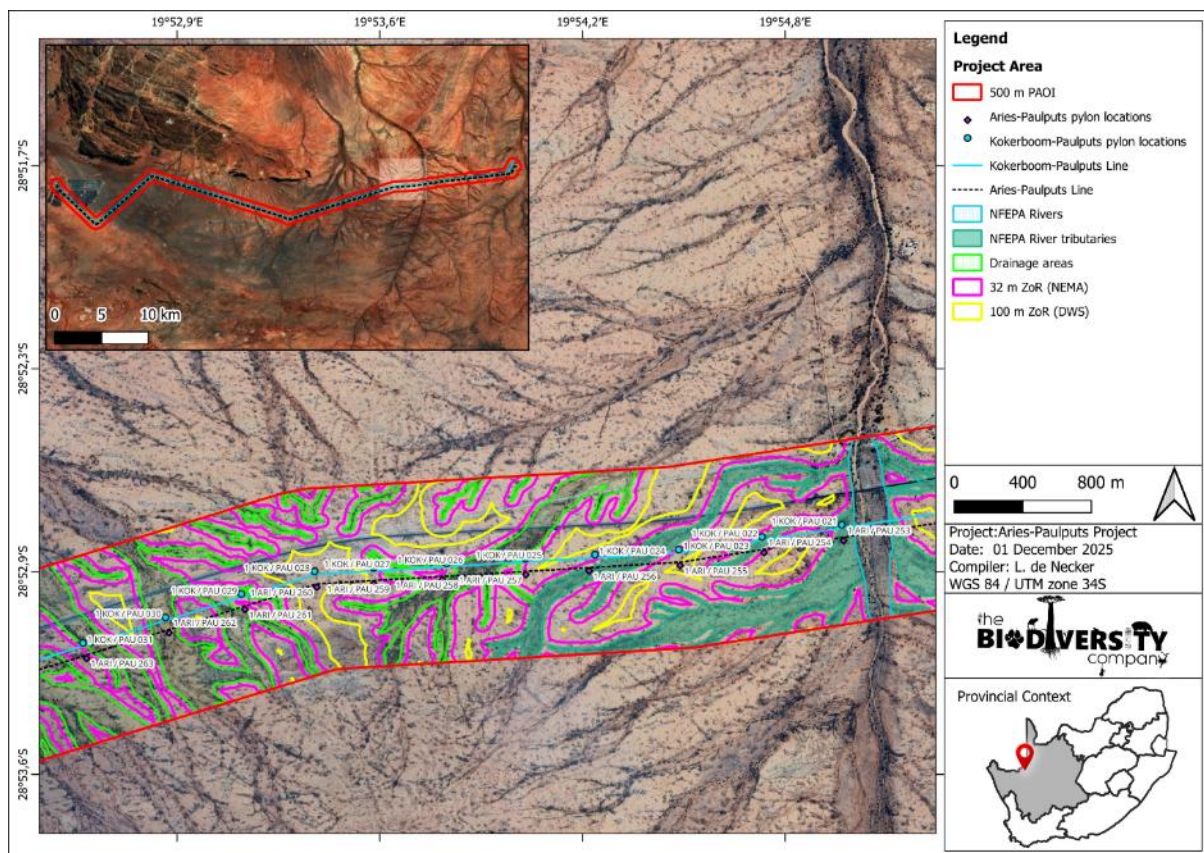


Figure 3-24 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 3

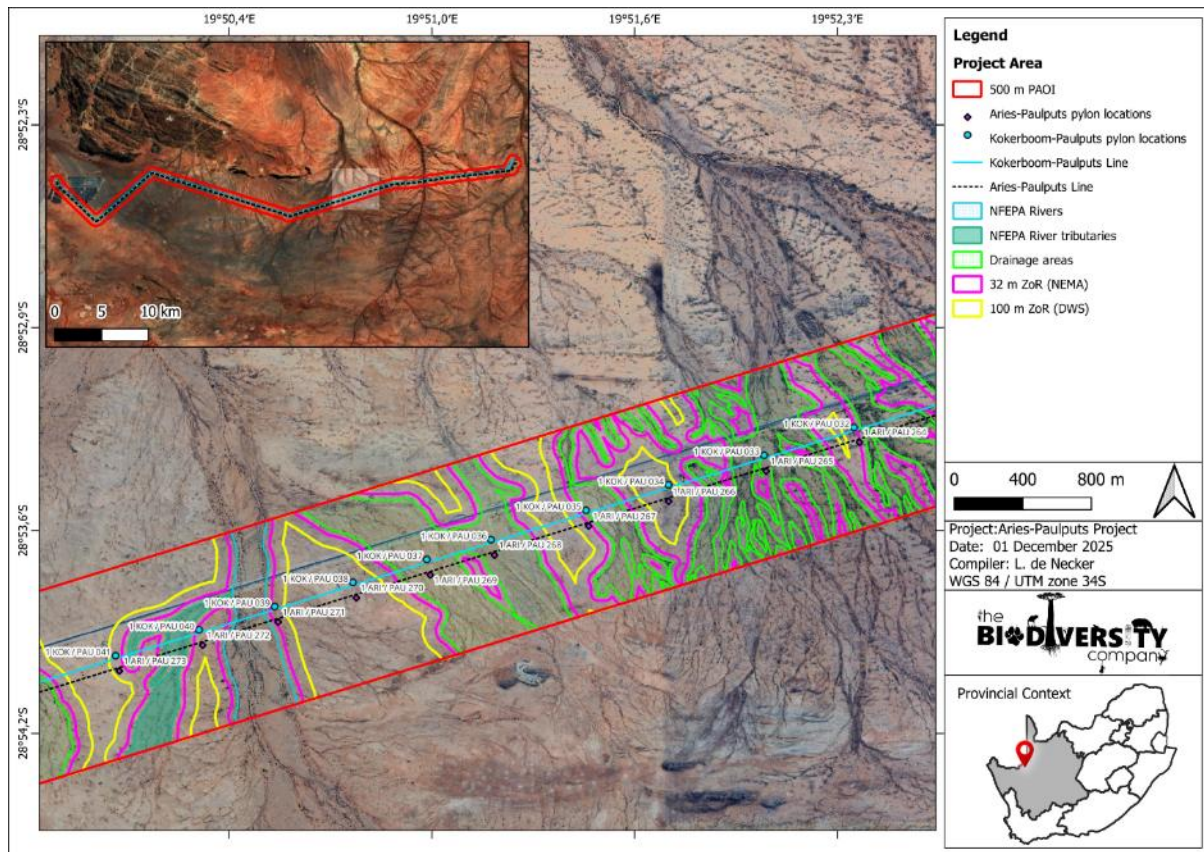


Figure 3-25 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 4

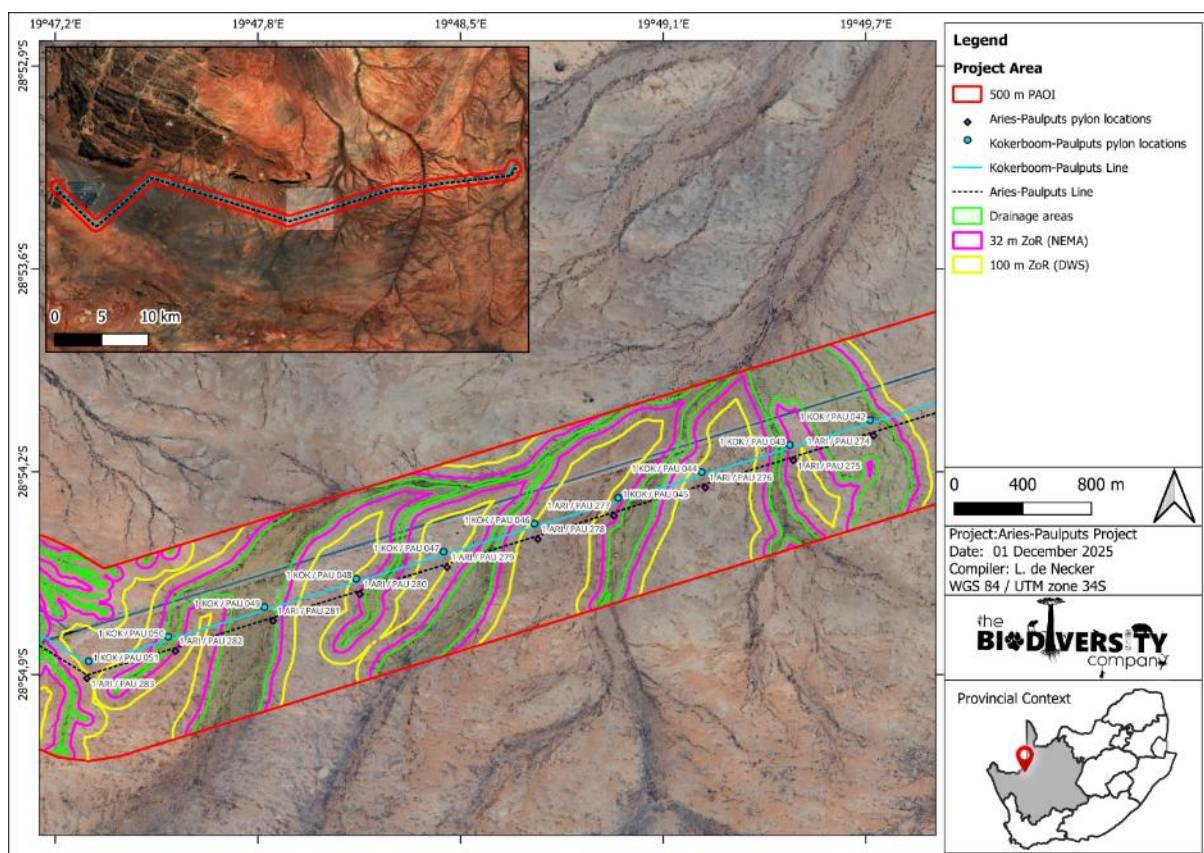


Figure 3-26 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 5

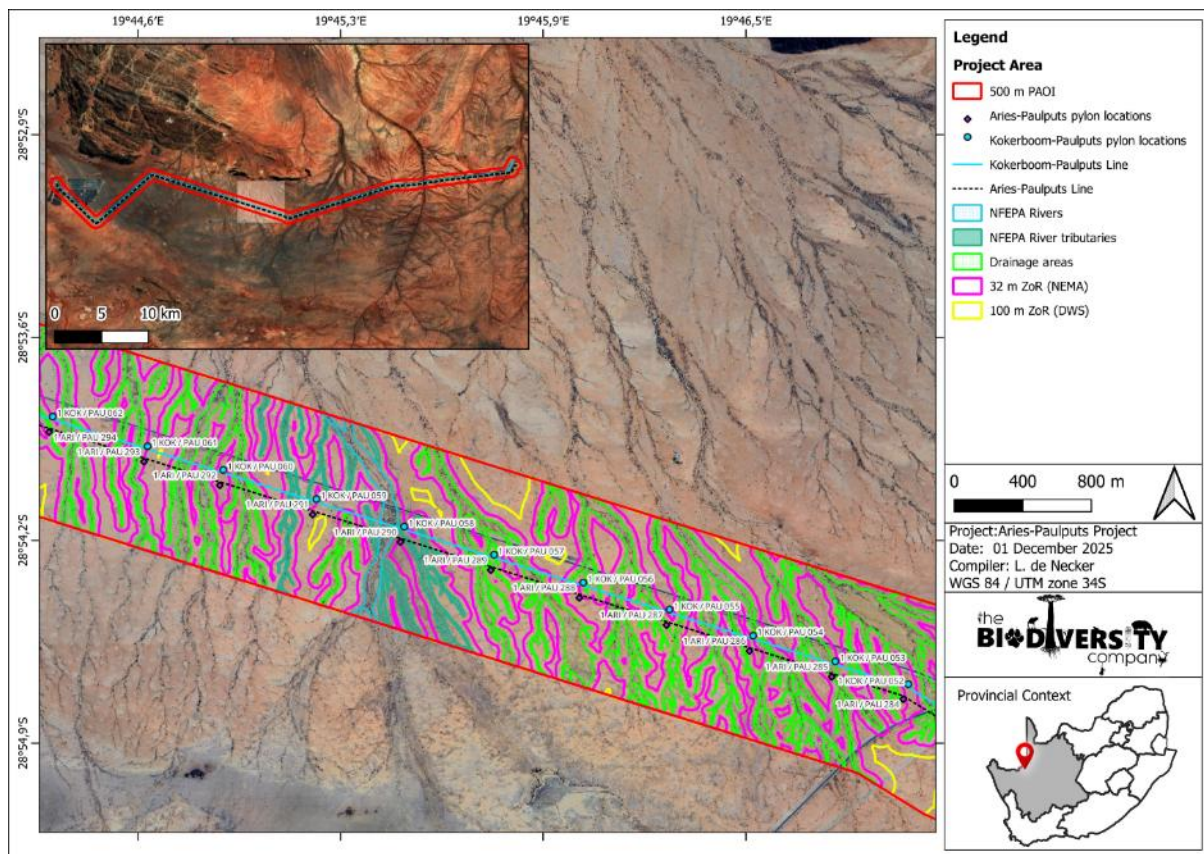


Figure 3-27 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 6

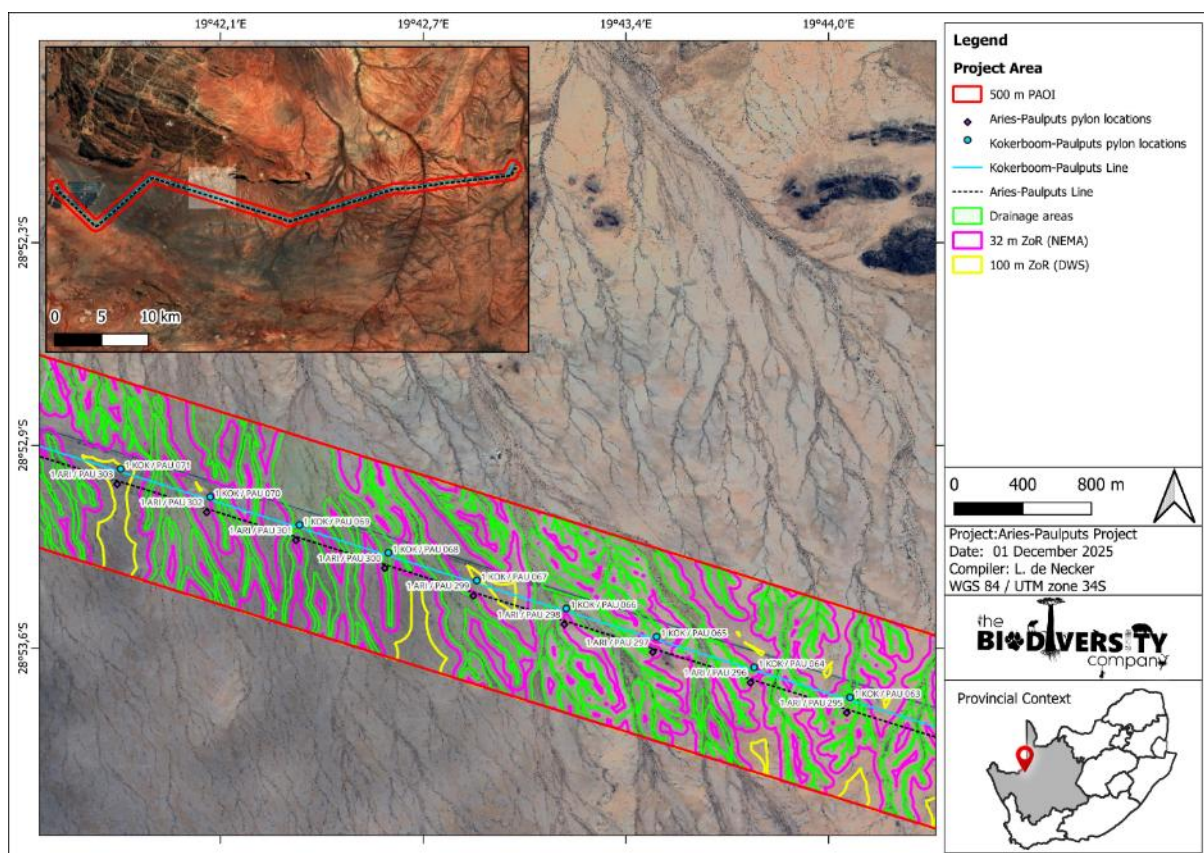


Figure 3-28 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 7

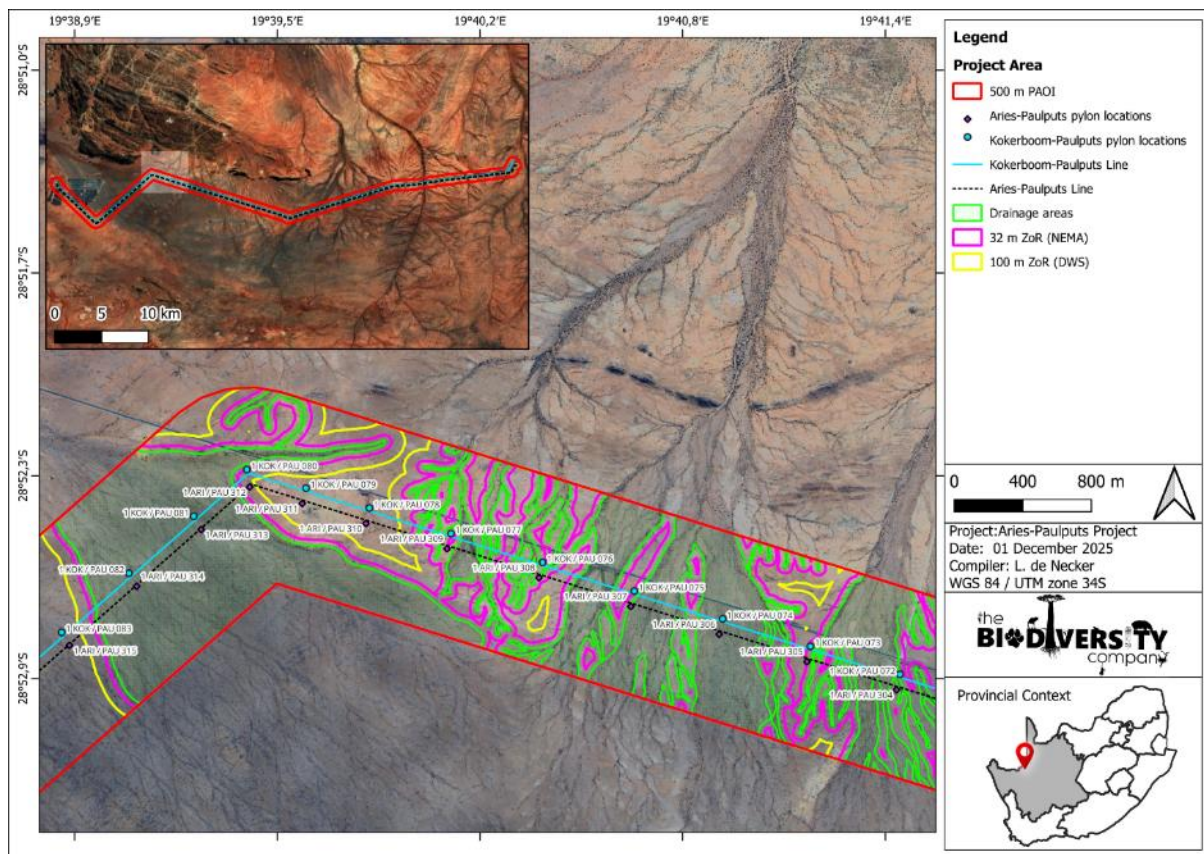


Figure 3-29 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 8

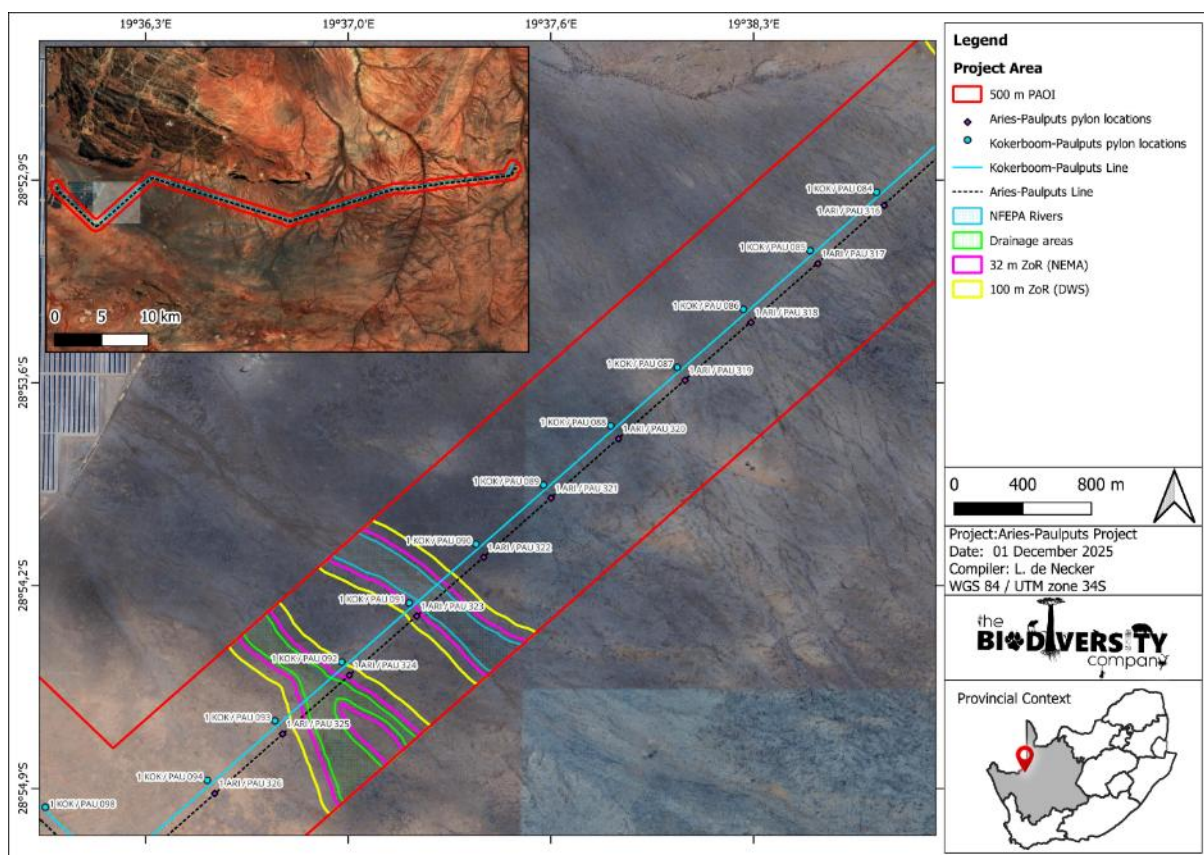


Figure 3-30 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 9

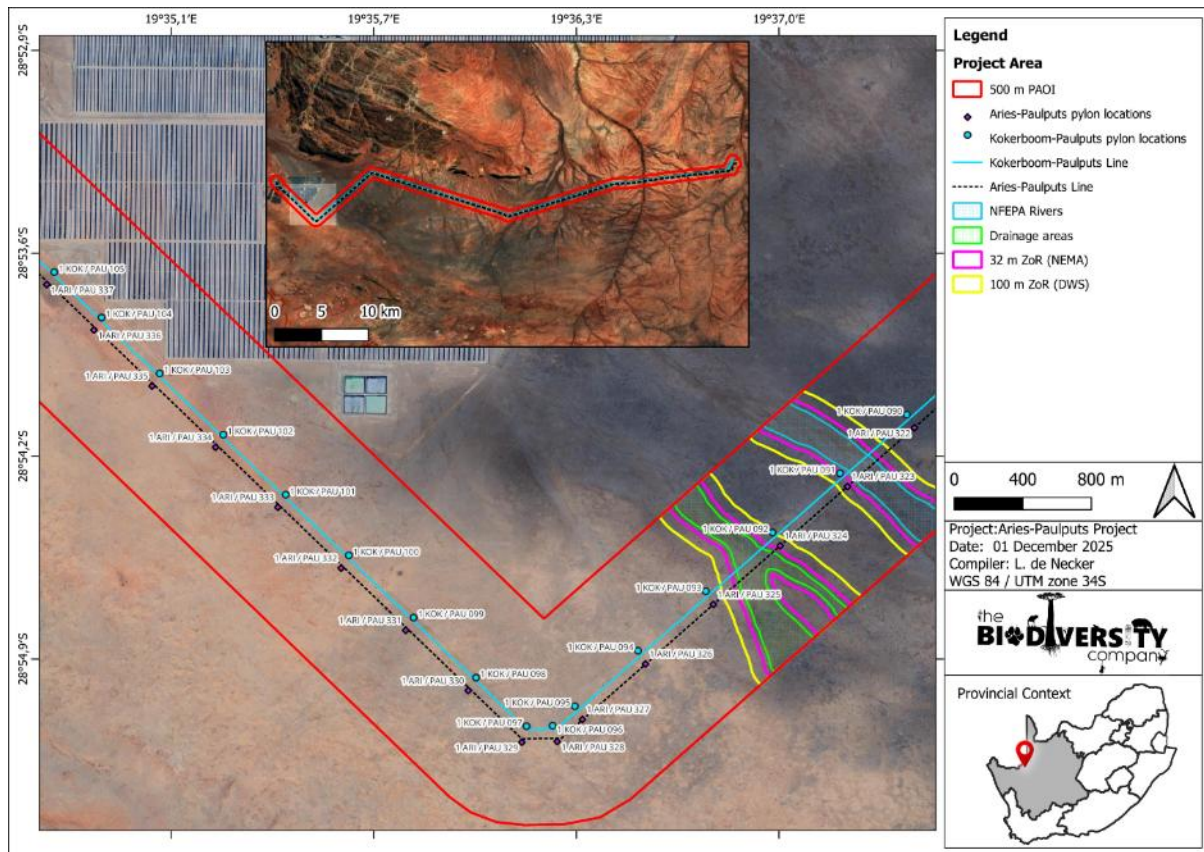


Figure 3-31 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 10

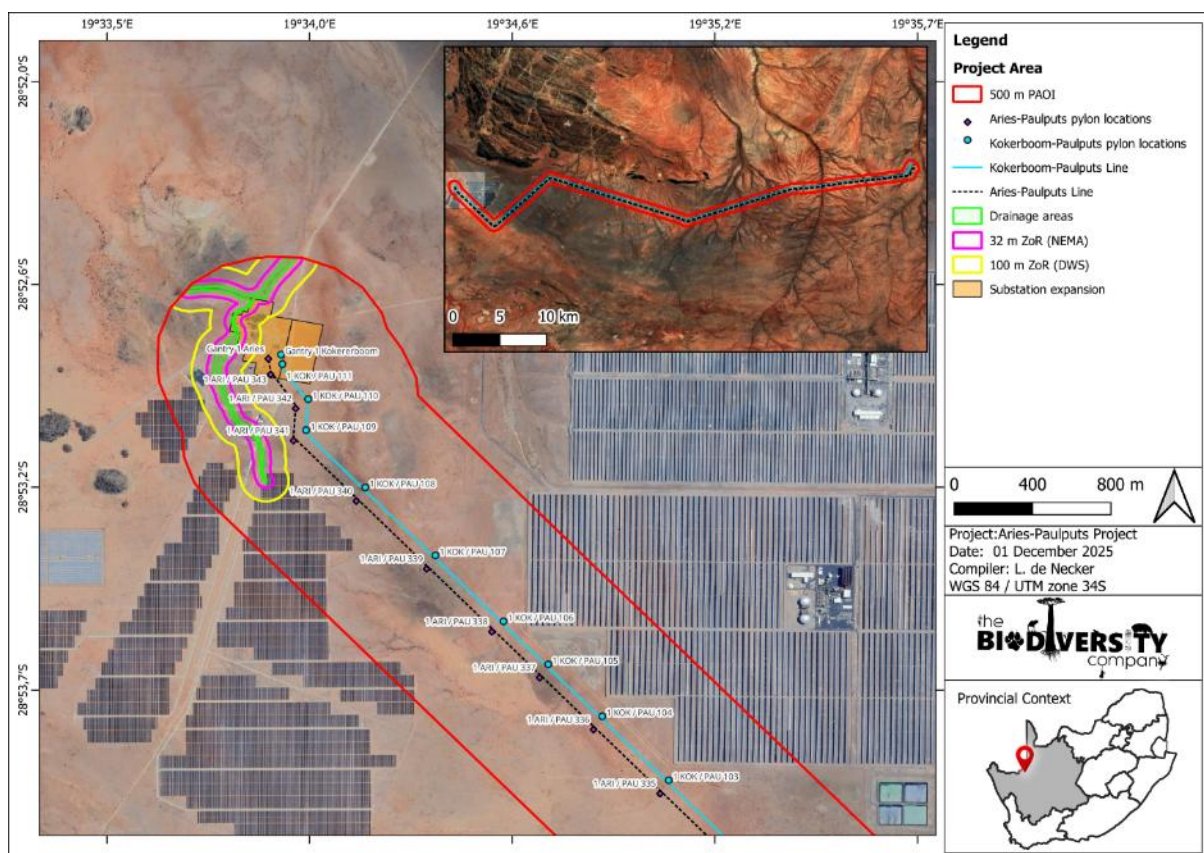


Figure 3-32 Riparian areas and Zones of Regulation (ZoR) within the PAOI – 11

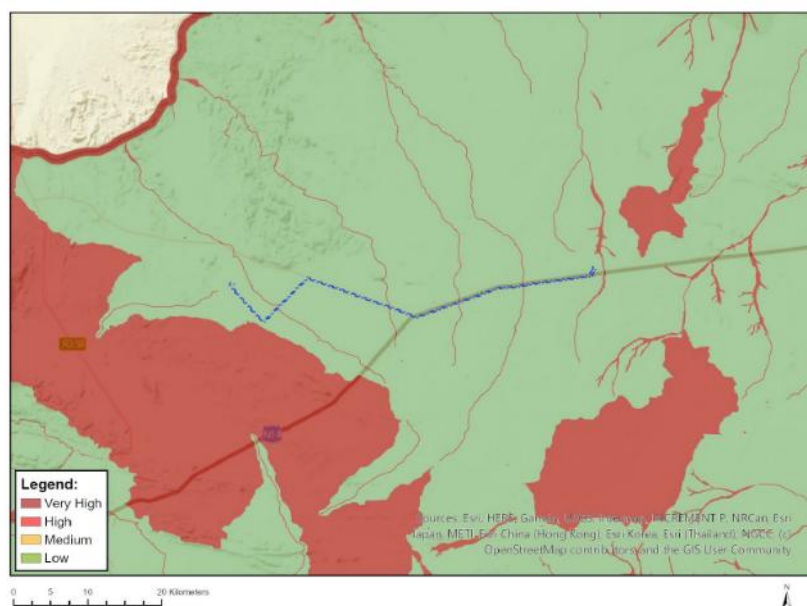
3.4 Site Sensitivity Verification

3.4.1 Ecological Sensitivity

The following is deduced from the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended) and the current assessment:

- The National Web-Based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area and the PAOI as “Very High” (Figure 3-33).
- As the project area and proposed activities are located in close proximity to several NFEPA rivers and a temporary wetland depression, the sensitivity should be regarded as “High” while the drainage areas and NFEPA River tributaries sensitivity should be regarded as “Medium” (Figure 3-34 to Figure 3-44).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Rivers

Figure 3-33 Aquatic Biodiversity Theme Sensitivity for the Project Area

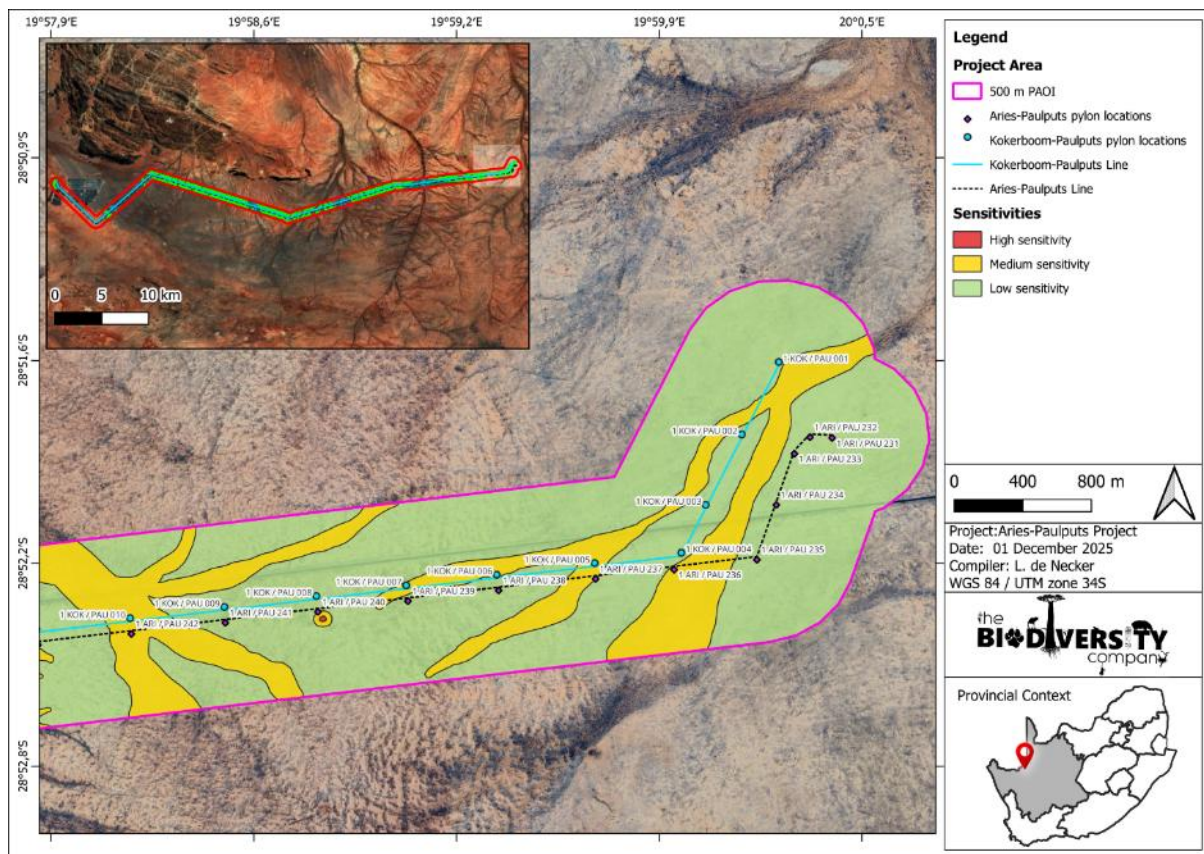


Figure 3-34 Aquatic delineated sensitivity for the PAOI – 1

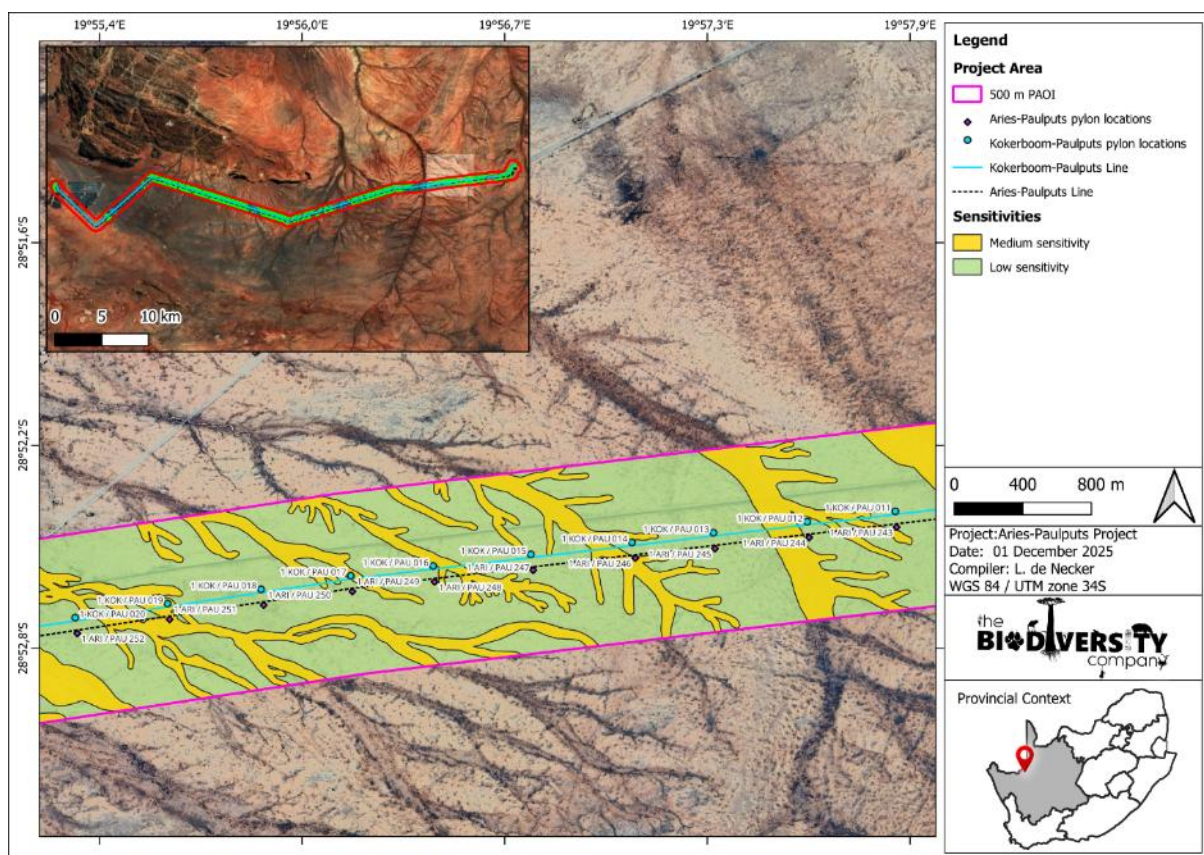


Figure 3-35 Aquatic delineated sensitivity for the PAOI – 2

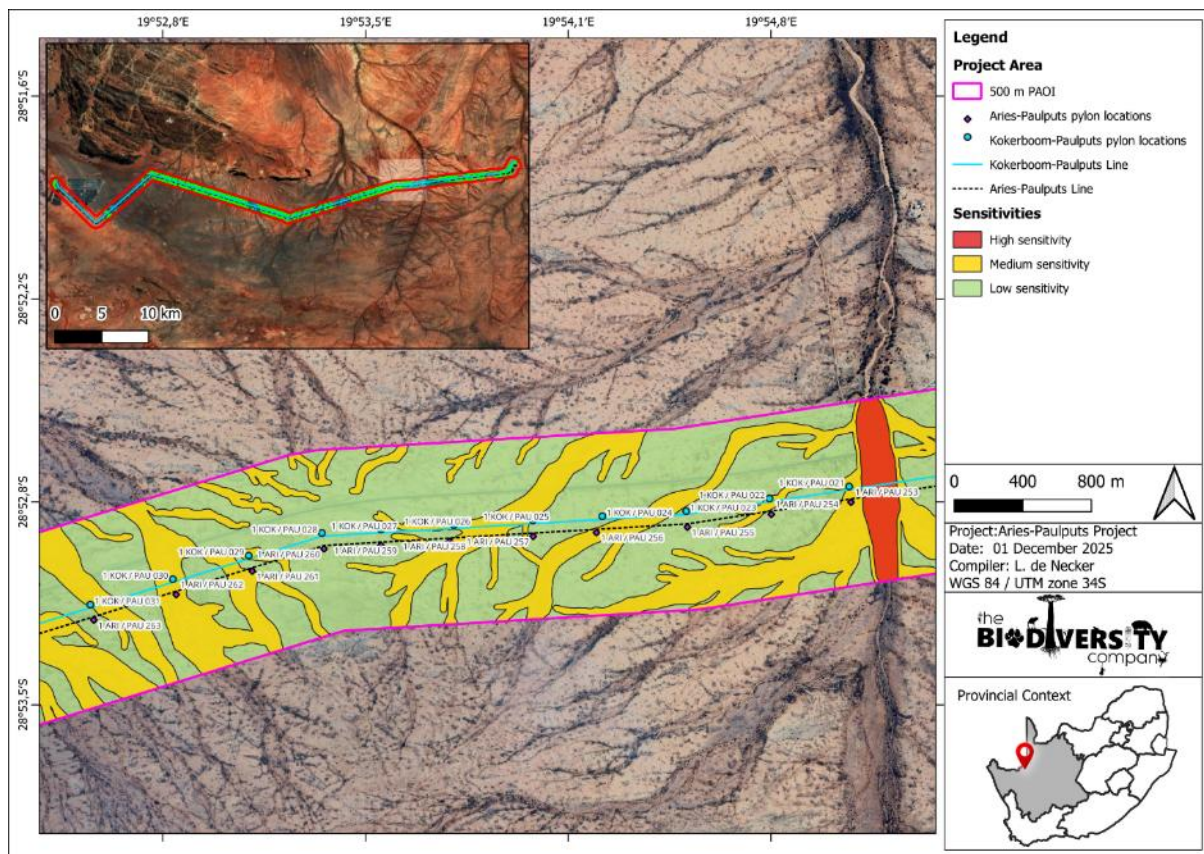


Figure 3-36 Aquatic delineated sensitivity for the PAOI – 3

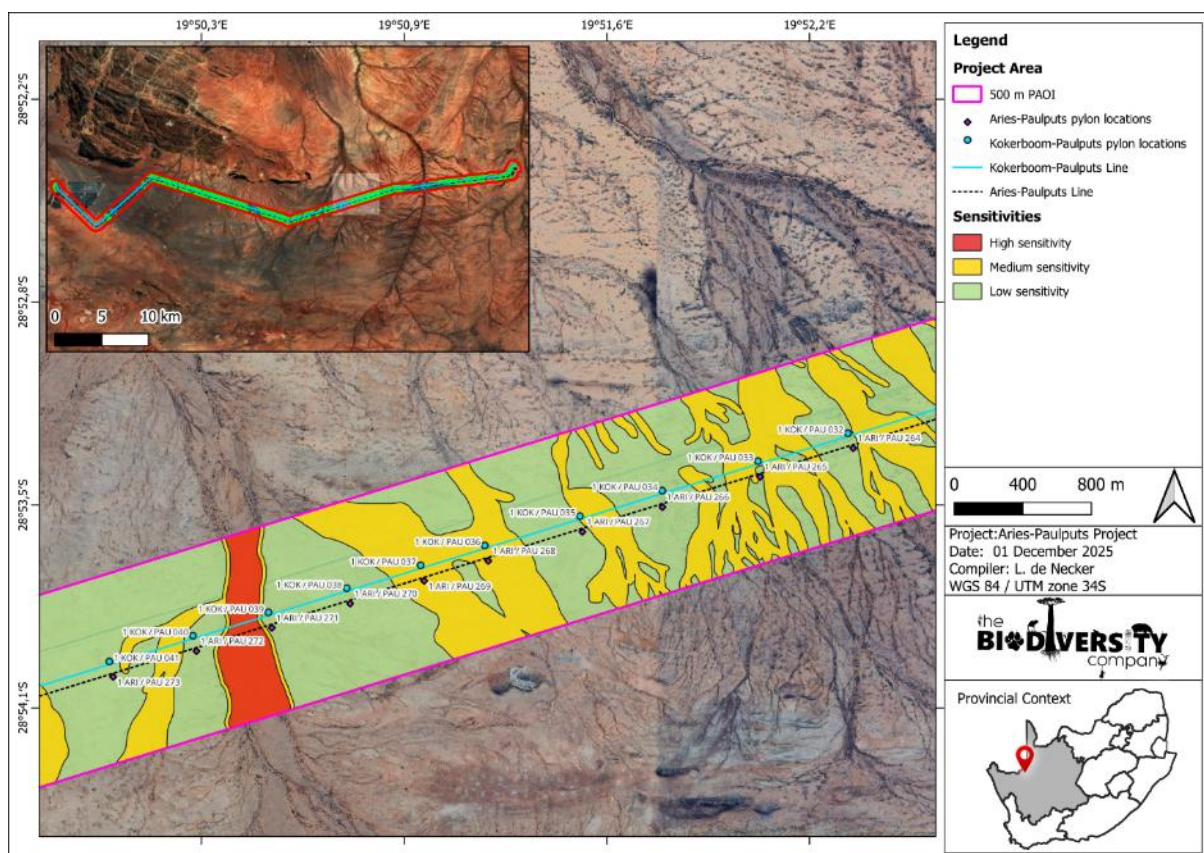


Figure 3-37 Aquatic delineated sensitivity for the PAOI – 4

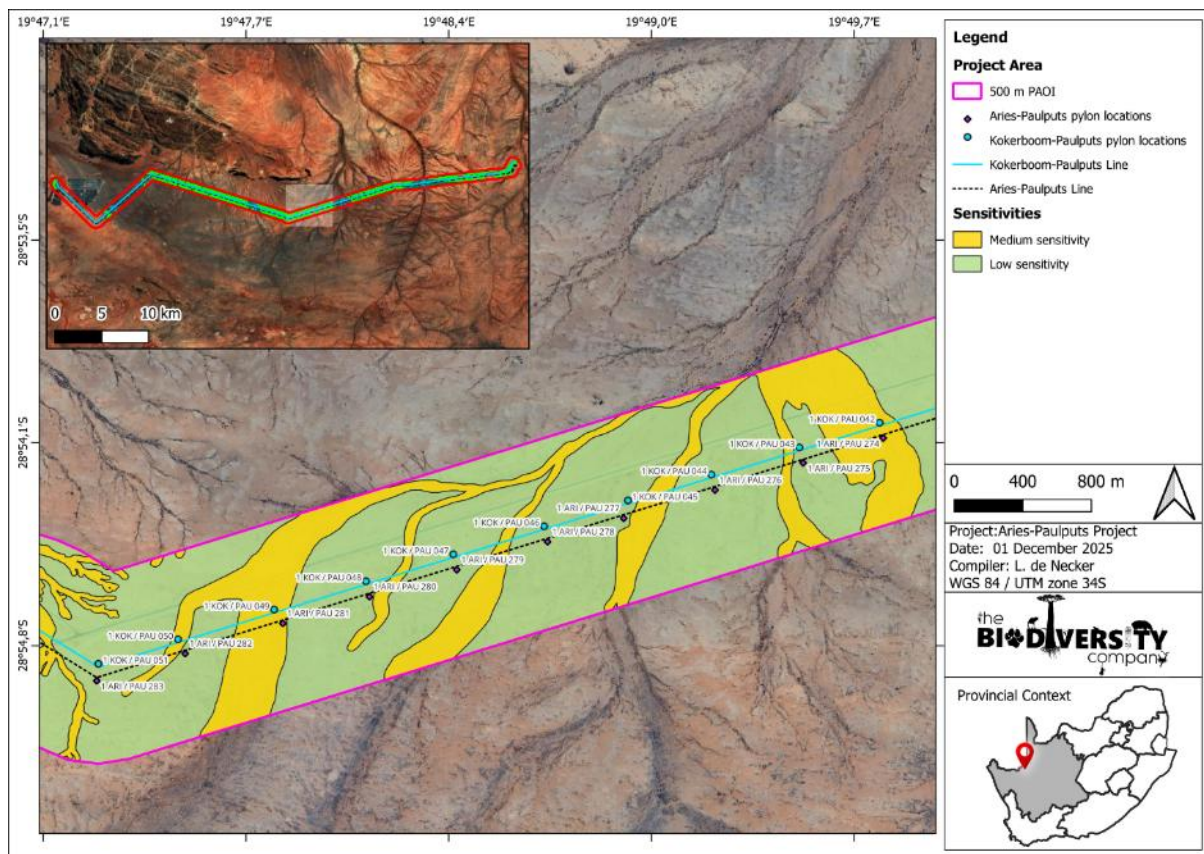


Figure 3-38 Aquatic delineated sensitivity for the PAOI – 5

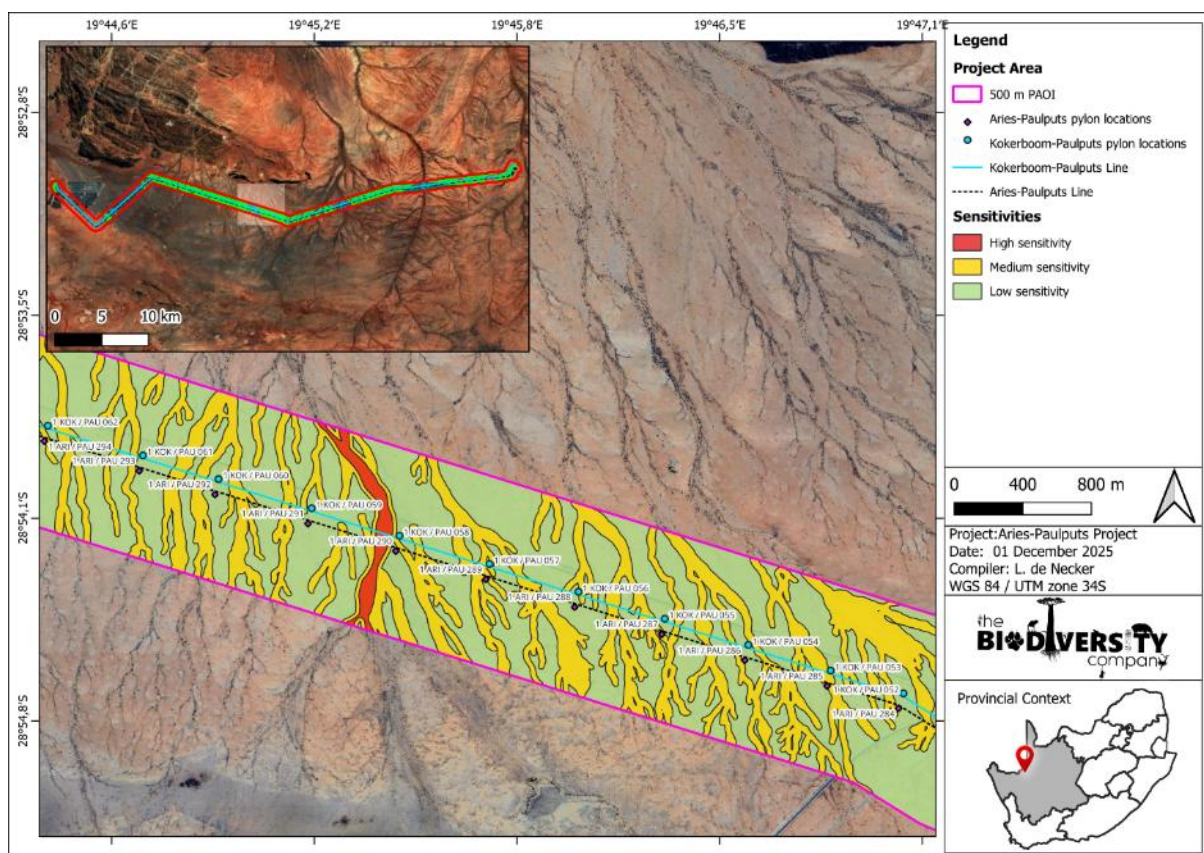


Figure 3-39 Aquatic delineated sensitivity for the PAOI – 6

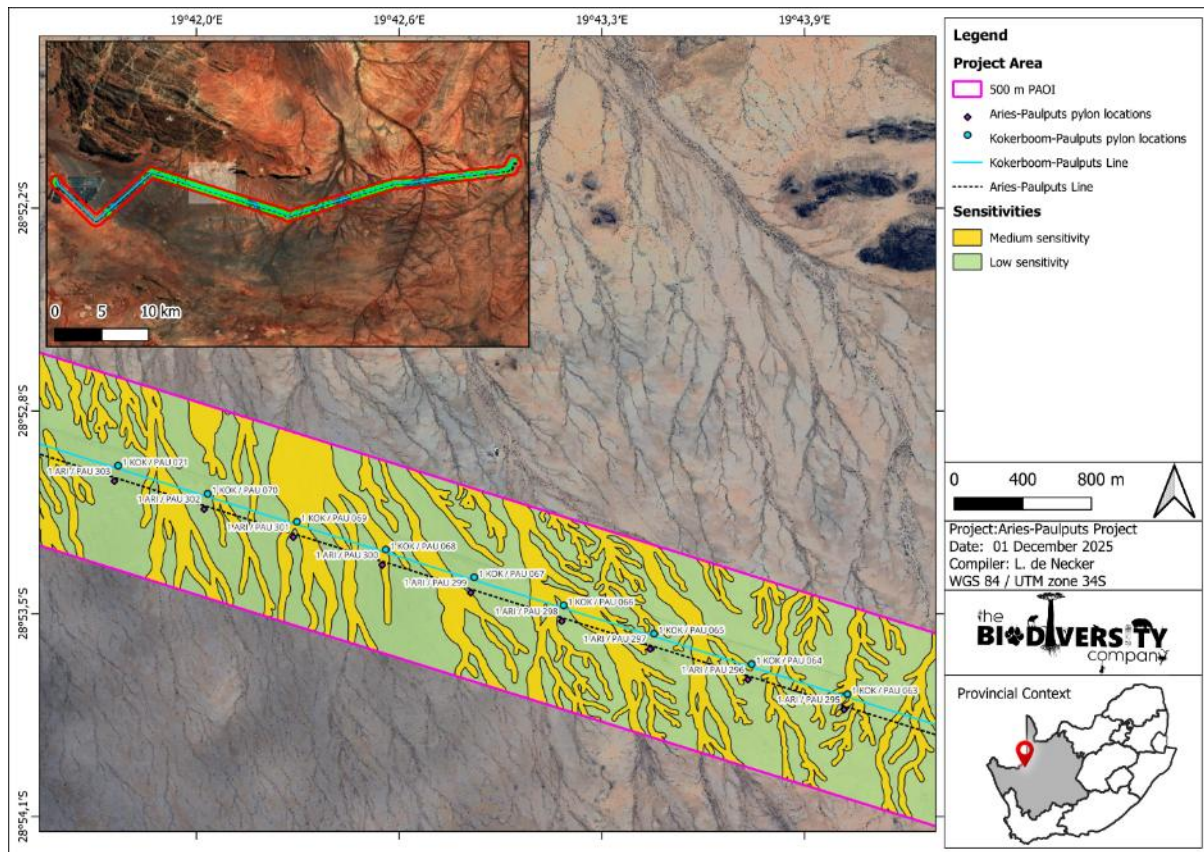


Figure 3-40 Aquatic delineated sensitivity for the PAOI – 7

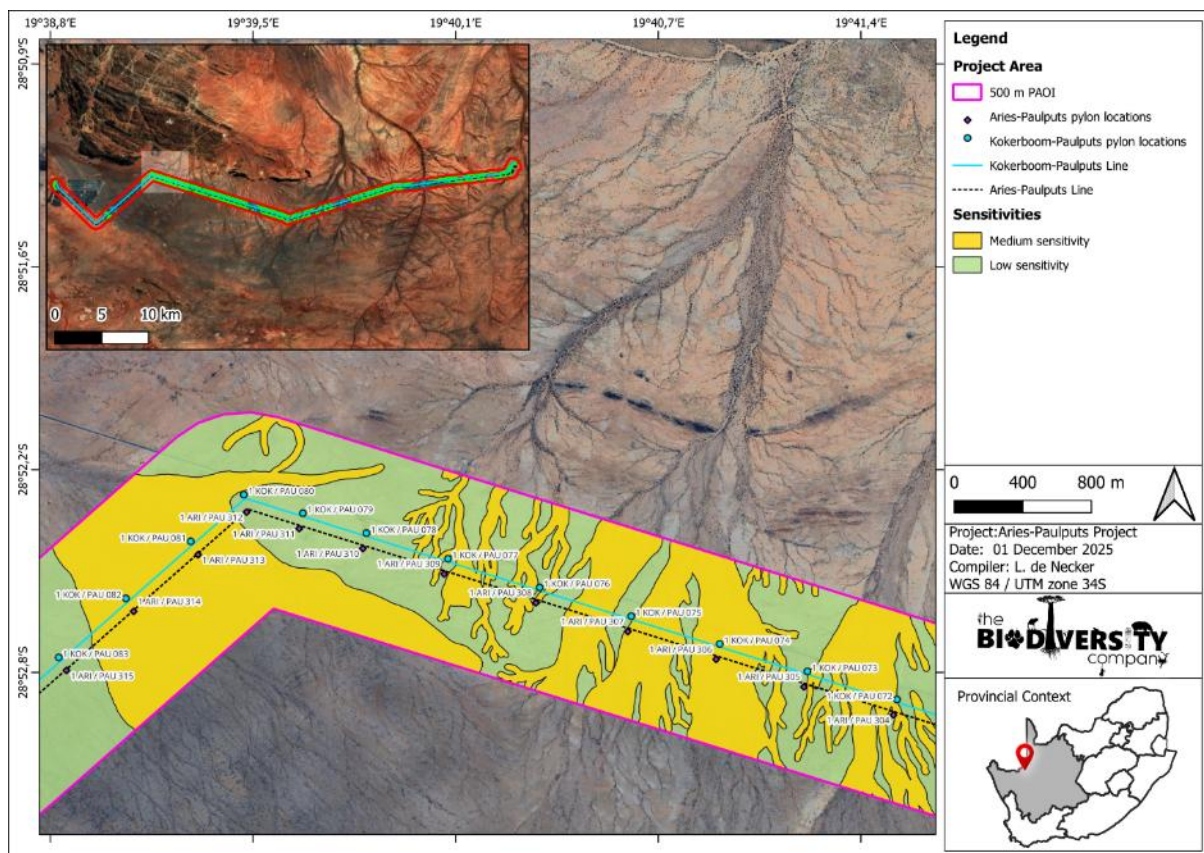


Figure 3-41 Aquatic delineated sensitivity for the PAOI – 8

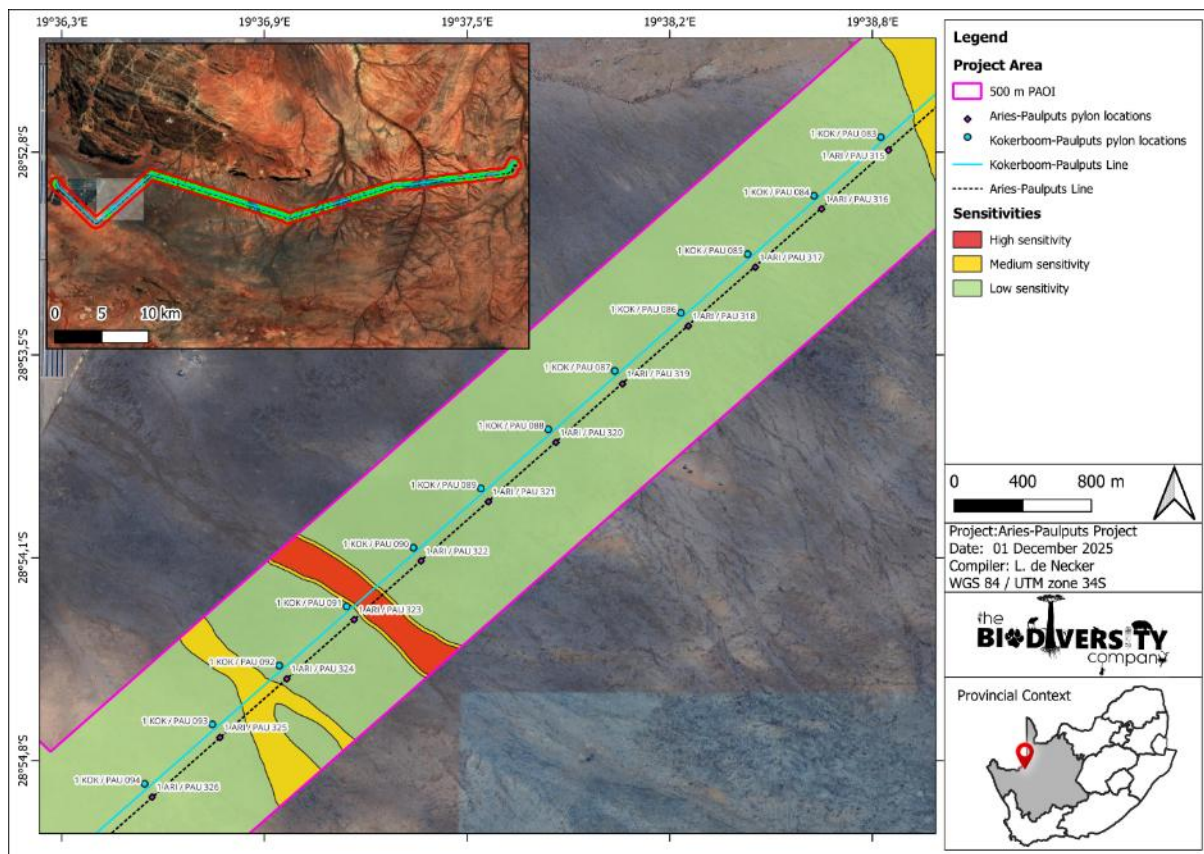


Figure 3-42 Aquatic delineated sensitivity for the PAOI – 9

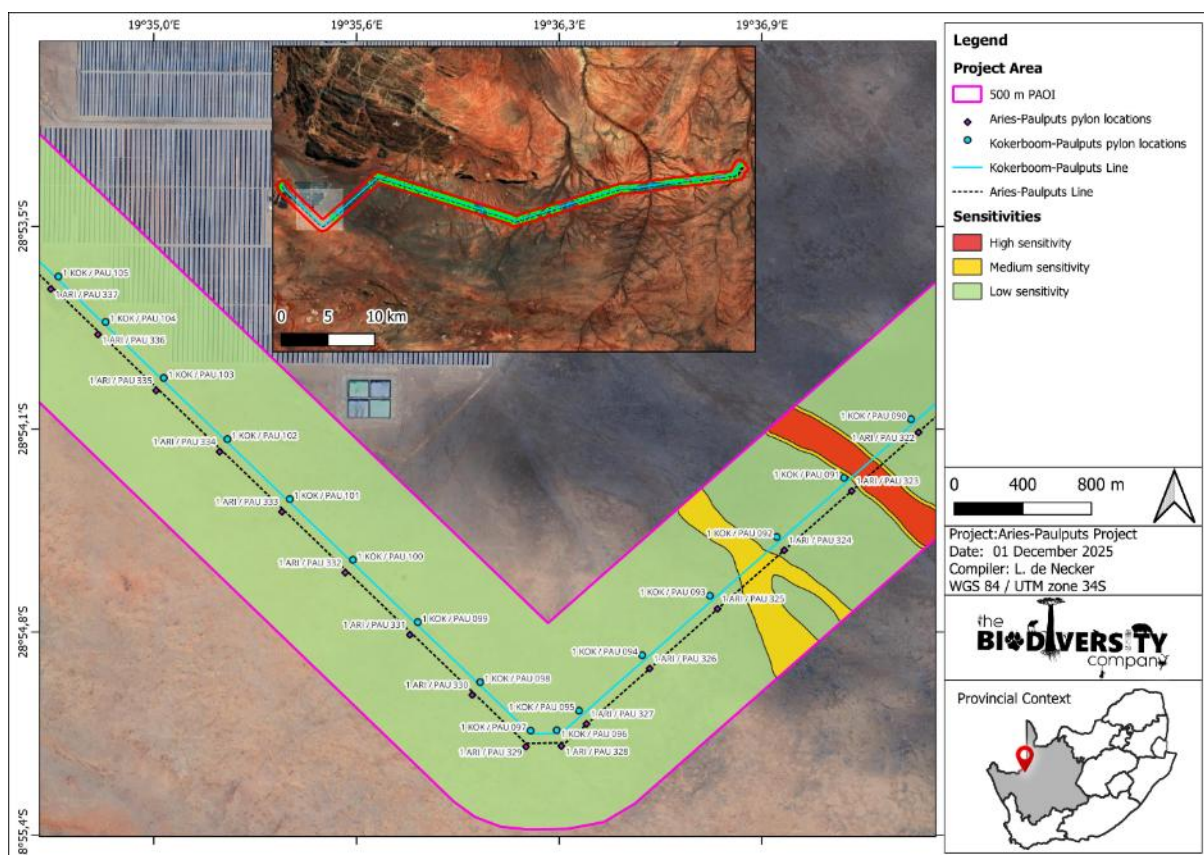


Figure 3-43 Aquatic delineated sensitivity for the PAOI – 10

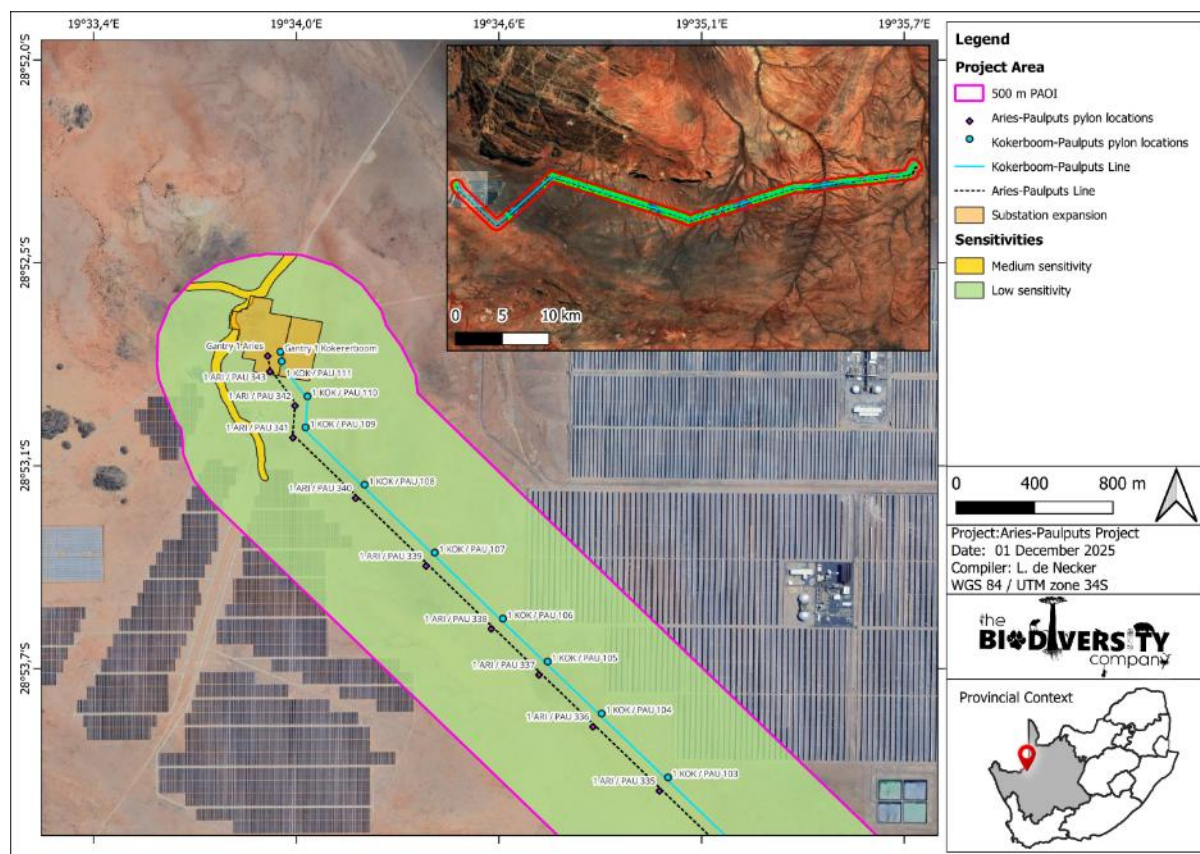


Figure 3-44 Aquatic delineated sensitivity for the PAOI – 11

4 Walkdown

During the walkdown assessment, that took place from the 3rd to the 5th of November 2025 (spring), multiple water resources were identified (examples provided in Figure 4-1) and delineated (Figure 4-2 to Figure 4-5).

Findings of the walkdown are presented in Table 4-1. The sections and towers not discussed in this report are considered viable and no specific changes to infrastructure is required. Due to fact that the substations already exist within the existing boundaries, no changes to the current locations are recommended and furthermore these are not discussed in this section.

During the walkdown it was evident that five (5) towers will be situated within an NFEPA river (1KOK/PAU019; 1ARI/PAU251; 1KOK/PAU021/1ARI/PAU253 and 1KOK/PAU022) (Table 4-1).

4.1 Observations

The following observations were made in the general area during the walkdown:

- Five (5) powerline towers were noted to be located within the watercourses or in close proximity to the watercourse or drainage lines. Therefore, alternative positions or locations were suggested. These suggestions are based solely on water resources features and layers for the project area. Therefore, other sensitivity layers (such as soils, terrestrial fauna, and flora) should be consulted prior to approval.

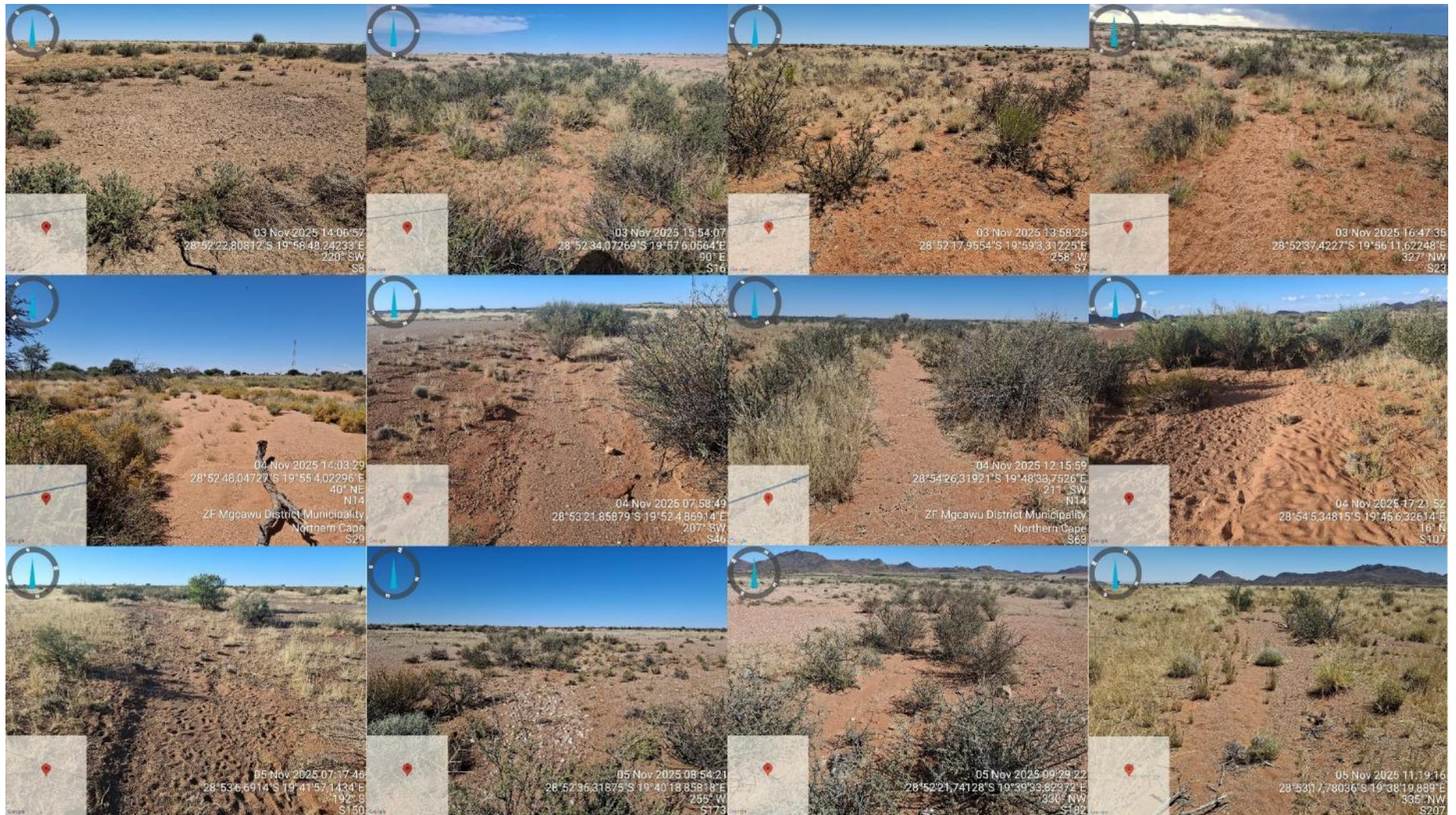


Figure 4-1 Examples of the different watercourses found during the walkdown

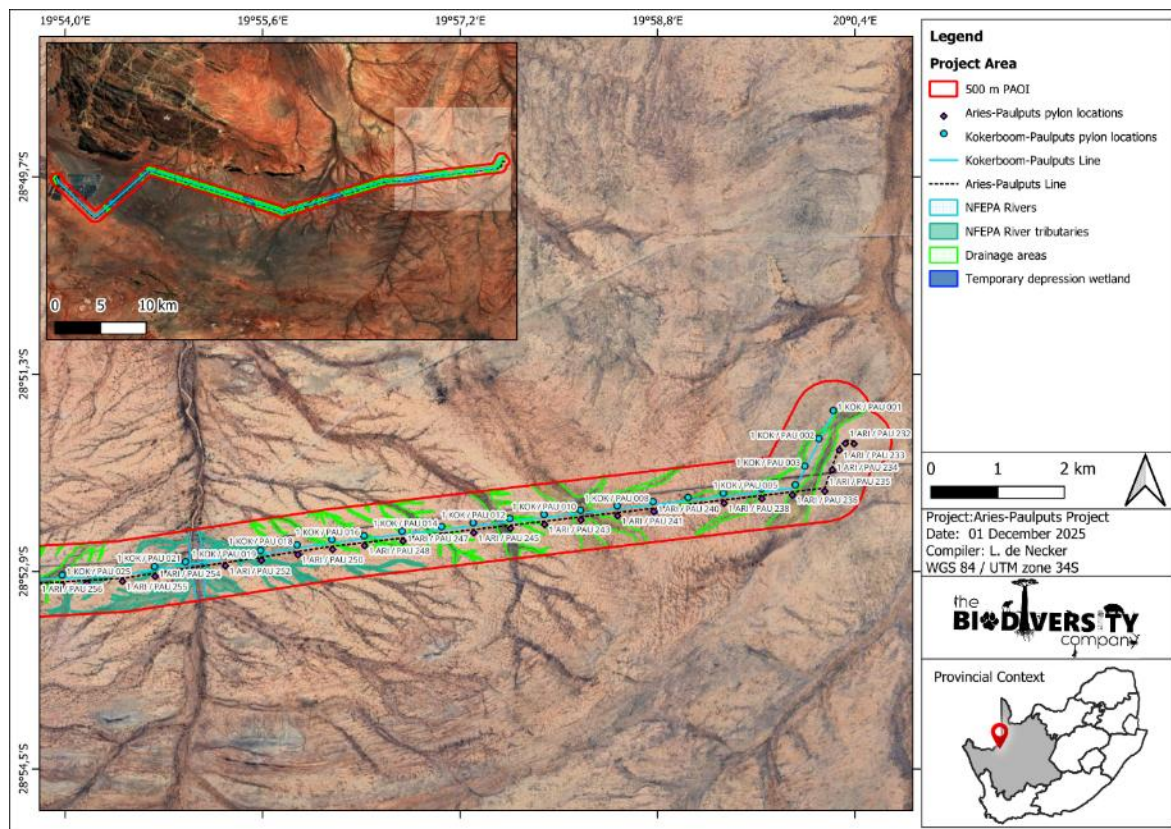


Figure 4-2 Delineations of the water resources between Tower 1KOK/PAU001 and Tower 1KOK/PAU025 and Tower 1ARI/PAU231 to Tower 1ARI/PAU258

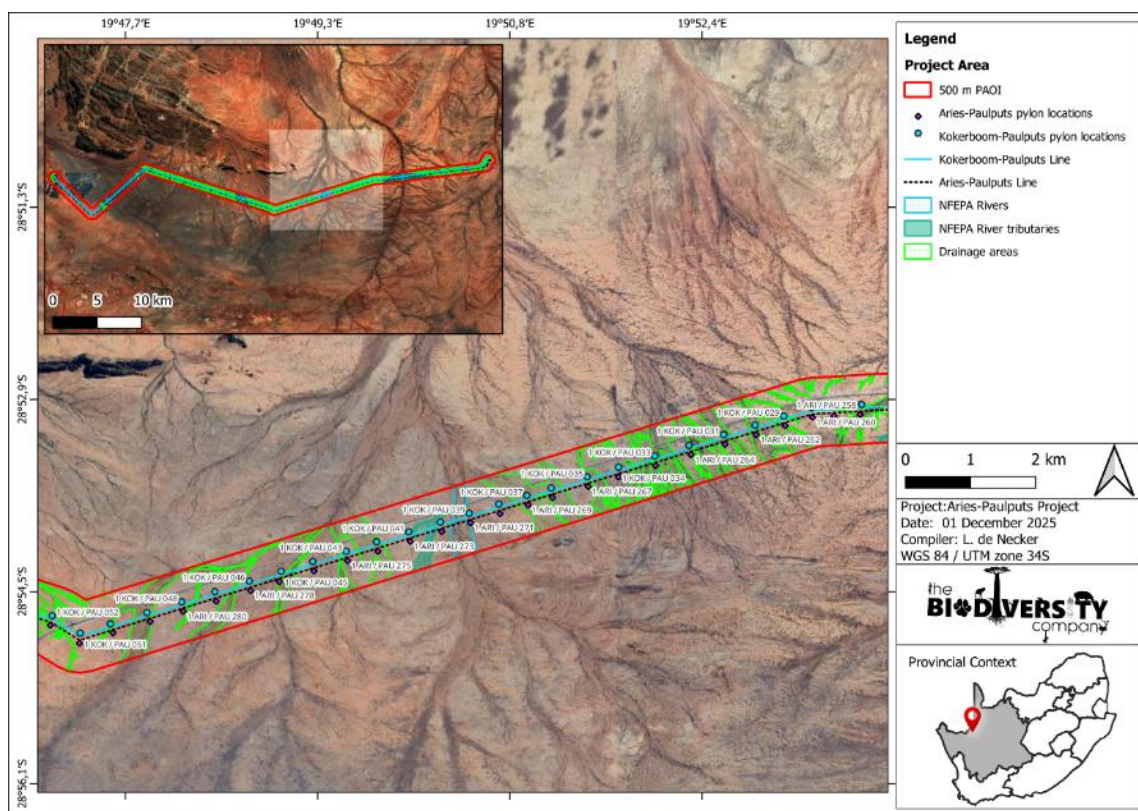


Figure 4-3 Delineations of the water resources between Tower 1KOK/PAU026 and Tower 1KOK/PAU052 and Tower 1ARI/PAU259 to Tower 1ARI/PAU284

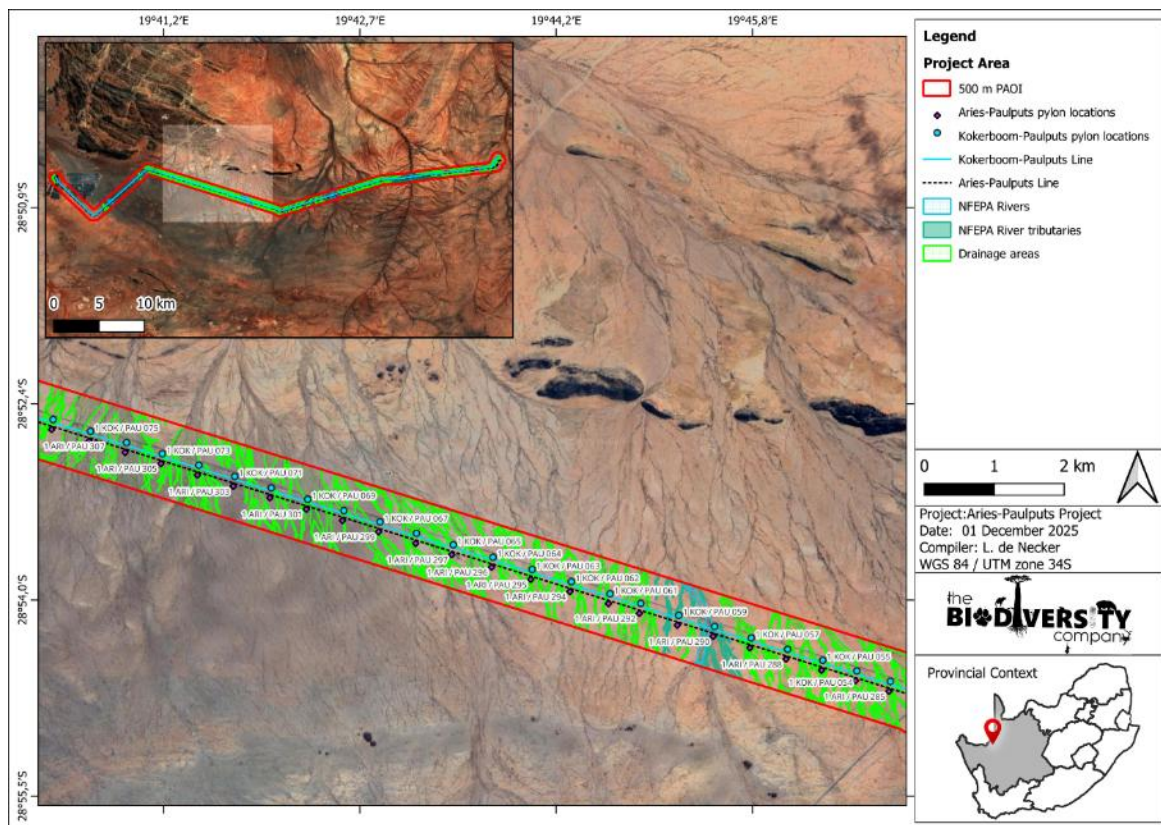


Figure 4-4 Delineations of the water resources between Tower 1KOK/PAU053 and Tower 1KOK/PAU076 and Tower 1ARI/PAU285 to Tower 1ARI/PAU308

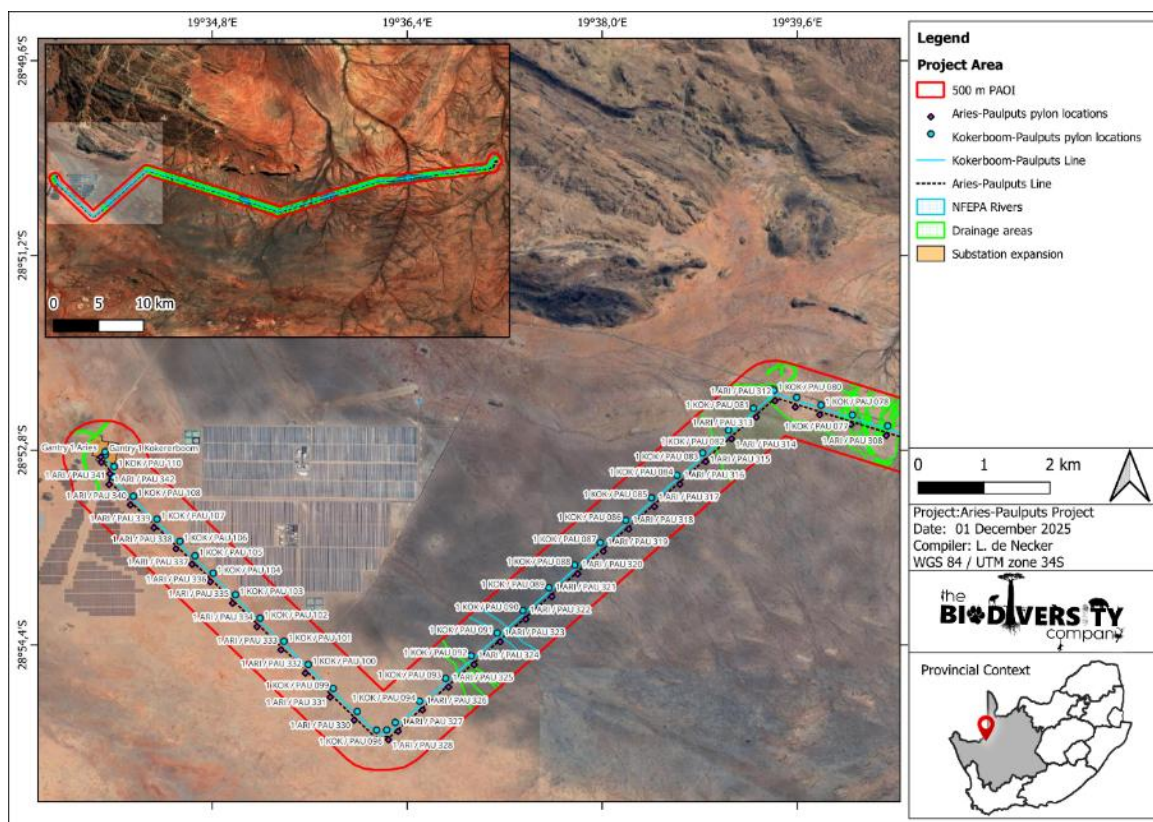
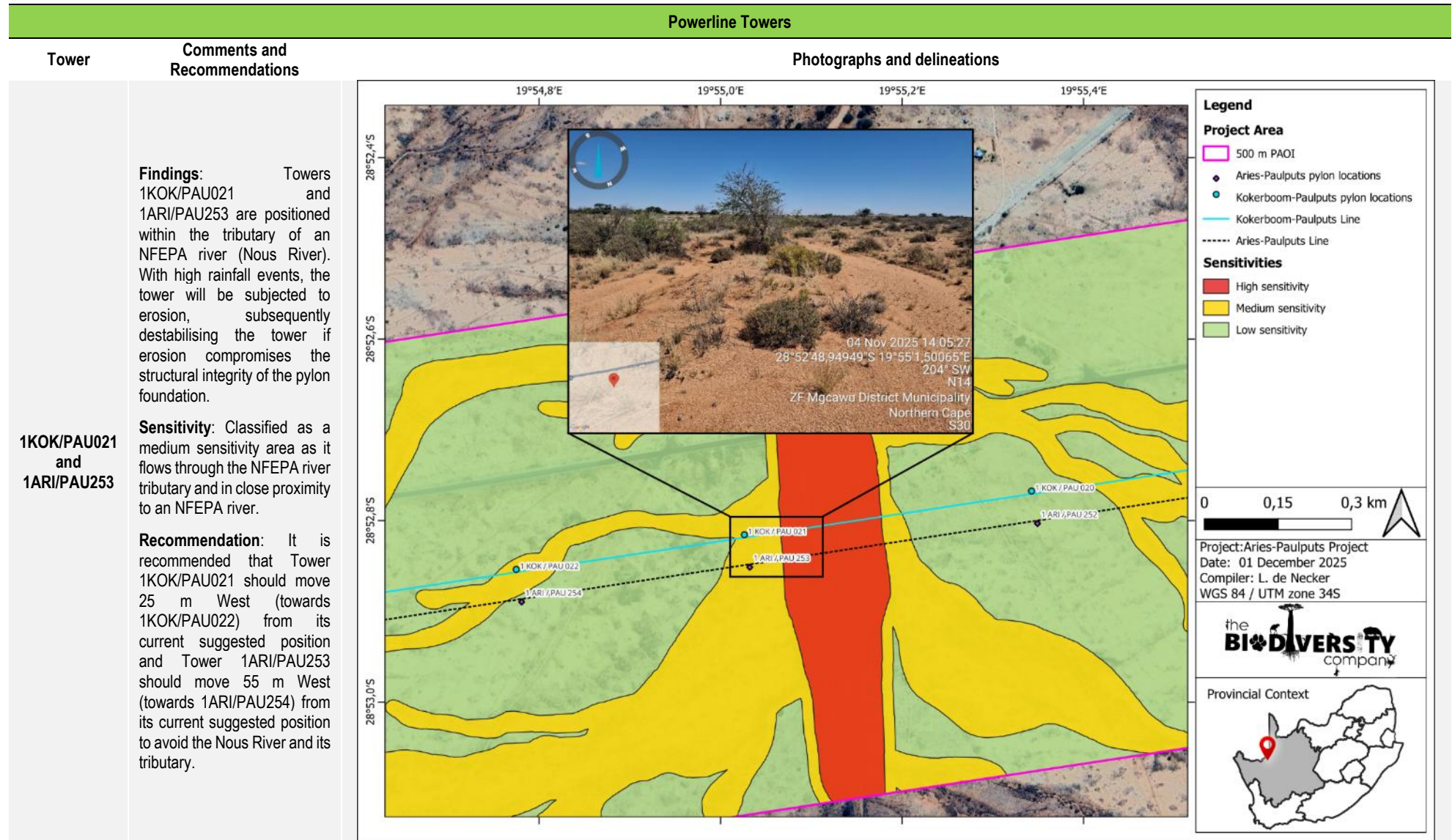
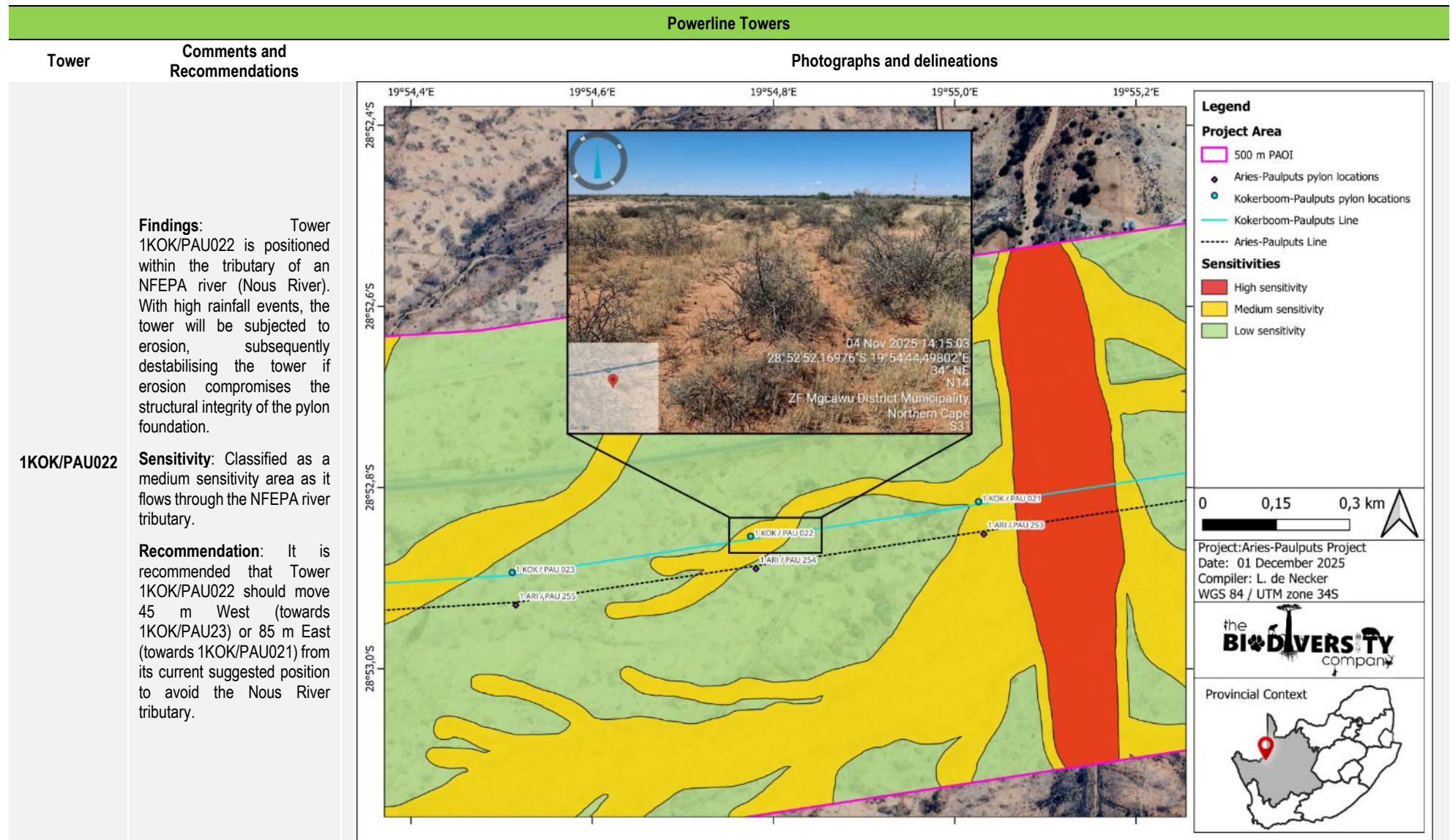


Figure 4-5 Delineations of the water resources between Tower 1KOK/PAU077 and Gantry 1 Kokerboom and Tower 1ARI/PAU309 to Gantry 1 Aries

Table 4-1 **Summary of site specific comments and recommendations on the linear footprints for the powerline towers**

Powerline Towers		
Tower	Comments and Recommendations	Photographs and delineations
1KOK/PAU019 and 1ARI/PAU251	<p>Findings: Towers 1KOK/PAU019 and 1ARI/PAU251 are positioned within the tributary of an NFEPA river (Nous River). With high rainfall events, the tower will be subjected to erosion, subsequently destabilising the tower if erosion compromises the structural integrity of the pylon foundation.</p> <p>Sensitivity: Classified as a medium sensitivity area as it flows through the NFEPA river tributary.</p> <p>Recommendation: It is recommended that Tower 1KOK/PAU019 should move 60 m East (toward 1KOK/PAU018) from its current suggested position and Tower 1ARI/PAU251 should move 100 m East (toward 1ARI/PAU250) from its current suggested position to avoid the Nous River tributary.</p>	<p>Legend</p> <p>Project Area</p> <ul style="list-style-type: none"> 500 m PAOI Aries-Paulputs pylon locations Kokerboom-Paulputs pylon locations Kokerboom-Paulputs Line Aries-Paulputs Line <p>Sensitivities</p> <ul style="list-style-type: none"> Medium sensitivity Low sensitivity <p>0 0,15 0,3 km</p> <p>Project: Aries-Paulputs Project Date: 01 December 2025 Compiler: L. de Necker WGS 84 / UTM zone 34S</p> <p>the BIODIVERSITY company</p> <p>Provincial Context</p>





5 Risk and Impact Assessment

5.1 Risk Screening

Table 5-1 provides the results of risk screening for the delineated watercourses identified to be at risk and provides motivation for each of the determined categories.

Table 5-1 Risk status of the delineated watercourses

Activity	Aquatic Feature	Risk Status	Rational
Aries- Paulputs project	Drainage Areas	At Risk	The proposed project will occur directly within the numerous non-perennial drainage areas. Therefore, direct impacts are anticipated.
	NFEPA Rivers (Nous, Kantbrogas se Laagte, Samoep, Unnamed)	At Risk	The proposed project will occur directly within the NFEPA rivers and buffer areas. Therefore, both direct and indirect impacts are anticipated.
	NFEPA River Tributaries	At Risk	The proposed project will occur directly within the NFEPA River tributaries. Therefore, direct impacts are anticipated
	Temporary depression wetland	At Risk	The proposed project will occur within the wetland buffer and regulated areas. Therefore, indirect impacts are anticipated.

5.2 Current Impacts on Freshwater Biodiversity

The assessed watercourses exhibit limited impacts on both the catchment and local scale. These impacts result from present and historical land use relating to infrastructure development and agricultural practices in proximity to watercourses. The list below refers to the present-day local impacts associated with the assessed freshwater areas:

- Encroachment of invasive plant species (Mexican Poppy and Mesquite)
- Agricultural activities (livestock and farm dams)
- Erosion resulting from historic excavation and from hardened surfaces
- Historic excavation areas,
- Dirt road crossings
- Existing pylon structures

5.3 Alternatives Considered

Alternatives were not presented at the time of report compilation. According to EIMS, alternative routes or pylon placements will be limited to the assessed 1 km corridor only. As a result, any mitigation or management efforts were focused on the current proposed project within the proposed setup/footprint (110 m servitude within the 1 km corridor).

5.4 Specialist Proposed Alternatives

Five (5) alternative locations for the proposed powerline towers were presented at the time of report compilation (Table 4-1 **Error! Reference source not found.**). The preferred alternative would be recommended as it crosses the least number of watercourses. Additionally, it is recommended that construction and operation activities maximise the use of existing roads as route alternatives as far as possible to reduce the need for road construction and therefore additional impacts on the environment.

5.5 Loss of Irreplaceable Resources

The freshwater ecology of the project area is considered moderately to highly sensitive to disturbance from a hydrological, biological and conservational perspective. This includes the four NFEPA rivers (Nous, Kantbrogas se Laagte, Samoep, Unnamed), NFEPA river tributaries, various drainage areas and the temporary depression wetland, and construction and operation activities must take cognisance

of this and avoid any unnecessary disturbance of these areas. Development within these sensitive areas will lead to modifications to the present ecological state and therefore ecosystem degradation.

5.6 Quantitative Risk and Impact Assessment (DWS GN4167 Risk Assessment)

The Risk/Impact Assessment considered the direct and indirect impacts of the activity on the freshwater systems associated with the project area. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 5-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in the project location, setting, scale, layout, technology, and phasing to avoid impacts. For this assessment, the specialist was provided with the location of the proposed activity and the study focussed on the watercourses within and close to the project area. Mitigation measures should be implemented to negate potential impacts on the watercourses associated with the project area.

A single risk assessment was compiled for the project, which relates to the Aries-Paulputs project and associated activities post-mitigation. The DWS Risk Assessment Matrix (GN 4167) was applied to identify and evaluate both the potential risks and impacts associated with the proposed activities including all the activities located within the 27.5 m servitude to each side of the powerlines. In the specialist's opinion, the outcomes of this assessment are adequate to inform an application for the required Environmental Authorisation (EA). In terms of GN 4167, Low post-mitigation risk scores would indicate that the identified Section 21(c) and (i) water uses are likely to fall within the scope of the General Authorisation, subject to DWS confirmation.

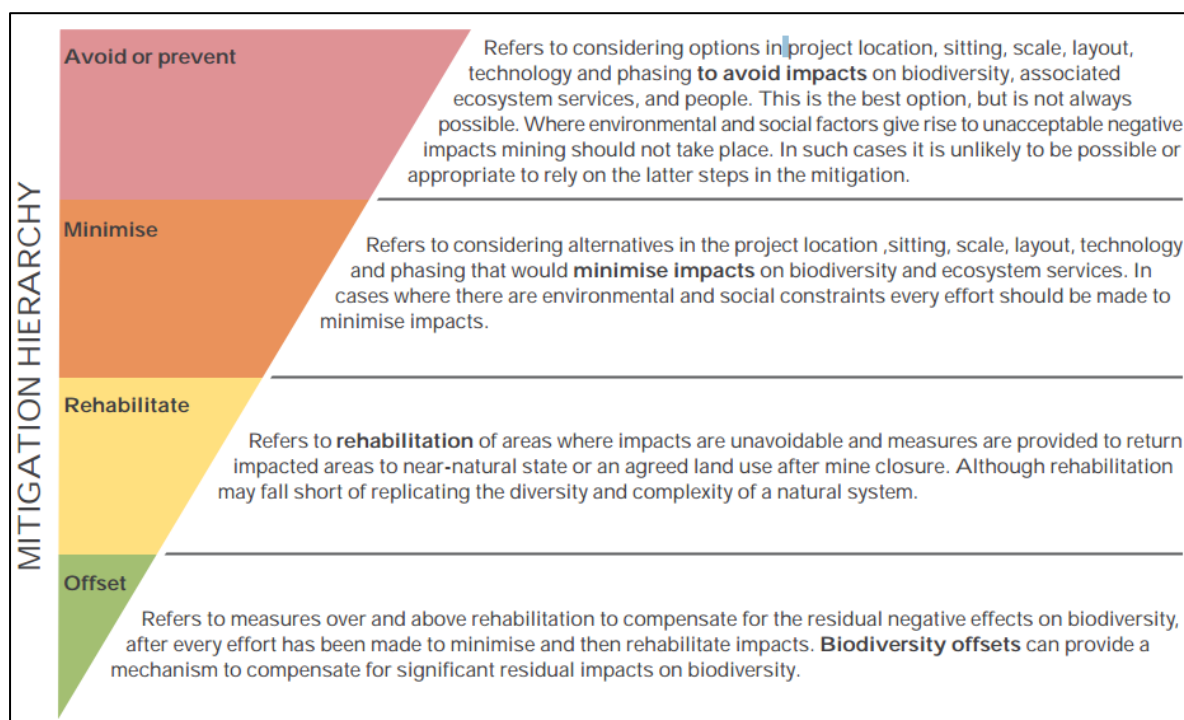


Figure 5-1 The mitigation hierarchy as described by the DEA (2013)

5.6.1 Potential Anticipated Impacts

Table 5-2 illustrates the DWS risk ratings associated with the project. The potential direct and indirect impacts are expected to threaten the integrity of sensitive receptors during the project activities if unmitigated. The post-mitigation significance ratings have been calculated considering various parameters for watercourses within the DWS zone of regulation only. The summative results are presented in the subsequent table. Kindly refer to the corresponding DWS Risk Assessment Matrix in excel format for the full assessment.

Table 5-2 Summative results of the DWS Risk Assessment Matrix compiled by Dr Lizaan de Necker (Pr. Sci. Nat. 138304)

Phase	Activity	Impact	Potentially affected watercourses	Significance (max = 100)	Risk Rating (with mitigation and avoidance)
CONSTRUCTION	Site clearing and preparation. Earthworks and Vehicle Movement. Route Construction. Civil Works. Transportation and installation of towers. Storage and Use of Hazardous substances and Equipment	Loss, disturbance and degradation of riparian areas	Nous River	10.8	L
			Kantbrogas se Laagte River	10.8	L
			Samoep River	10.8	L
			Unnamed NFEPA River	10.8	L
			NFEPA River Tributaries	10.8	L
			Drainage Areas	10.8	L
		Loss or degradation in ecosystem services	Nous River	12	L
			Kantbrogas se Laagte River	12	L
			Samoep River	12	L
			Unnamed NFEPA River	12	L
			NFEPA River Tributaries	12	L
			Drainage Areas	12	L
			Temporary Depression Wetland	14.4	L
		Altered hydrological regimes	Nous River	12	L
			Kantbrogas se Laagte River	12	L
			Samoep River	12	L
			Unnamed NFEPA River	12	L
			NFEPA River Tributaries	12	L
			Drainage Areas	12	L
			Temporary Depression Wetland	17.6	L
		Increase in erosion and sedimentation of receiving systems	Nous River	13.2	L
			Kantbrogas se Laagte River	13.2	L
			Samoep River	13.2	L
			Unnamed NFEPA River	13.2	L
			NFEPA River Tributaries	13.2	L
			Drainage Areas	13.2	L
			Temporary Depression Wetland	17.6	L
		Introduction and spread of alien and invasive vegetation	Nous River	16.2	L
			Kantbrogas se Laagte River	16.2	L
			Samoep River	16.2	L
			Unnamed NFEPA River	16.2	L
			NFEPA River Tributaries	16.2	L
			Drainage Areas	16.2	L
			Temporary Depression Wetland	21.6	L
		Increased bare surfaces, flood peaks and potential erosion	Nous River	16.2	L
			Kantbrogas se Laagte River	16.2	L

Phase	Activity	Impact	Potentially affected watercourses		Significance (max = 100)	Risk Rating (with mitigation and avoidance)	
	Excavation, levelling and installation of structures		Samoep River		16.2	L	
			Unnamed NFEPA River		16.2	L	
			NFEPA River Tributaries		16.2	L	
			Drainage Areas		16.2	L	
			Temporary Depression Wetland		21.6	L	
		Impaired water quality	Nous River		12	L	
			Kantbrogas se Laagte River		12	L	
			Samoep River		12	L	
			Unnamed NFEPA River		12	L	
			NFEPA River Tributaries		12	L	
			Drainage Areas		12	L	
			Temporary Depression Wetland		14.4	L	
			Nous River		12	L	
			Kantbrogas se Laagte River		12	L	
			Samoep River		12	L	
		Decreased flow inputs into watercourses	Unnamed NFEPA River		12	L	
			NFEPA River Tributaries		12	L	
			Drainage Areas		12	L	
			Temporary Depression Wetland		14.4	L	
			Nous River		23.4	L	
			Kantbrogas se Laagte River		21.6	L	
			Samoep River		21.6	L	
			Unnamed NFEPA River		21.6	L	
		Increased sediment loads to downstream reaches	NFEPA River Tributaries		21.6	L	
			Drainage Areas		21.6	L	
			Contamination of wetlands with hydrocarbons due to leaks and spillages from machinery, equipment & vehicles as well as contamination and eutrophication of wetland systems			16	L
				Disturbance and degradation of wetland vegetation.		14.4	L
OPERATIONAL	Operation of the Grid Corridor.	Proliferation of alien and invasive species	Nous River		18	L	
	Routine operation and maintenance of the structures		Kantbrogas se Laagte River		18	L	
			Samoep River		18	L	
			Unnamed NFEPA River		18	L	
			NFEPA River Tributaries		18	L	
			Drainage Areas		18	L	
	Established Grid Corridor Area.		Temporary Depression Wetland		24	L	

Phase	Activity	Impact	Potentially affected watercourses	Significance (max = 100)	Risk Rating (with mitigation and avoidance)
	Operation of the Substation facility. Vehicle Traffic (Security Monitoring and Maintenance). Operation of on-site Stormwater Management.	Nutrient enrichment of watercourse	Nous River	12	L
			Kantbrogas se Laagte River	12	L
			Samoep River	12	L
			Unnamed NFEPA River	12	L
			NFEPA River Tributaries	12	L
			Drainage Areas	12	L
			Temporary Depression Wetland	14.4	L
		Increase in erosion and sedimentation of receiving systems	Nous River	21.6	L
			Kantbrogas se Laagte River	21.6	L
			Samoep River	21.6	L
			Unnamed NFEPA River	21.6	L
			NFEPA River Tributaries	21.6	L
			Drainage Areas	21.6	L
			Temporary Depression Wetland	14.4	L
		Degradation of wetland vegetation	Temporary Depression Wetland	14.4	L

(L) Low Risk

Anthropogenic activities drive habitat destruction, causing displacement of aquatic and terrestrial fauna and flora. Land clearing for development/agriculture (all inclusive) destroys local wildlife habitat and can lead to the loss of local breeding grounds, nesting sites, and wildlife movement corridors as well as impacting rivers, streams and drainage lines and their associated riparian area, or other locally important features.

The planning phase activities are considered a low risk as they typically involve desktop assessments and initial site inspections. This would include compiling of stormwater, landscape and waste management plans, obtaining of necessary permits, environmental and social impact assessments, characterisation of baseline site conditions, design of project area layouts and facilities and consultation with various contractors involved with a diversity of proposed project related activities going forward.

It is anticipated that the construction and operation phases of the project poses "Moderate" pre-mitigation risks to the freshwater ecosystems, which can change to "Low" post-mitigation risks for all impacts/activities. This will be possible subject to effective mitigation that addresses stormwater management, erosion and sedimentation prevention, correct use and storage of chemicals, rehabilitation of disturbed areas, the prevention of run-off from hard surfaces into delineated water resources and their associated buffers, no operation of unauthorized heavy vehicles within delineated water resources and buffer areas, and most importantly, avoidance of watercourse and buffer areas.

A decommissioning phase for the proposed development was not considered due to the longevity of proposed activity.

5.7 Impact Assessment (EIMS)

The impacts associated with the proposed activities, was assessed in the impact matrix provided by EIMS and the results are provided in Table 5-3.

The impact assessment shows that the risks from the proposed project are generally of "Medium to High" significance prior to mitigation. With the application of mitigation measures, all impacts are

reduced to "Low" significance, indicating effective management. The results confirm that, with proper controls, the long-term impacts on aquatic ecosystem health and function are minimal.

Table 5-3 *Summative results of the EIMS Impact Assessment conducted for the proposed project (compiled by Dr Lizaan de Necker; Pr. Sci. Nat. 138304)*

Impact	Phase	Pre-Mitigation Significance	Post-Mitigation Significance	Final Significance
Loss, disturbance and degradation of watercourses	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> The recommended buffer zones must be strictly adhered to during the construction phase. Both sensitive and construction areas must be clearly demarcated. No activities should be allowed in the highly sensitive areas. Once the final line and associated pylon have been confirmed, a walkthrough is required to ensure sensitive areas are excluded for construction of pylons. The use of minimum pylons or pylons that span wide enough to avoid sensitive areas is recommended. The placement of pylons must avoid all delineated water resources and buffers. Avoid the creation of new access roads; use existing roads where possible. No vehicle or machinery is allowed to be washed within a watercourse or its buffer area. Laydown yards, camps and storage areas must be beyond the watercourse areas. Prevent uncontrolled access of vehicles through the watercourse. Heavy vehicles must be parked outside of the riparian buffer zone except where needed for construction. All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone. Rehabilitation of the riparian area, bed and banks must be budgeted for and completed as soon as construction is completed. 				
Loss or degradation in ecosystem services	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Landscape and revegetate all cleared areas as soon as possible to limit erosion potential. Implement seasonal restrictions on operations to avoid sensitive periods for wildlife. Develop a restoration and rehabilitation plan to mitigate long-term impacts. Implement measures such as revegetation of disturbed areas or habitat enhancement to restore ecological functions. An adaptive rehabilitation plan needs to be implemented from the onset of the project. Measures must be implemented at alterations to prevent detrimental changes to aquatic biota and ecosystem services. 				
Altered hydrological regimes	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Install sedimentation/erosion protection measures prior to construction (sandbags, silt traps, fences). Energy dissipation structures (stone berms or blocks) must be strategically placed along road margins. A suitably qualified Hydrologist must develop a Stormwater management plan. Erosion and sedimentation into drainage lines must be minimised through stabilisation and revegetation. All alterations or hardened surfaces must not induce sedimentation, erosion, or flooding, or cause detrimental changes in flow. 				
Increase in erosion of receiving systems	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Landscape and revegetate all cleared areas as soon as possible. Install sedimentation/erosion protection measures (sandbags, silt traps, fences). Energy dissipation structures must be placed along road margins. Signs of erosion must be addressed immediately. Temporary and permanent erosion control methods (silt fences, curtains, basins, ponds, ditches, seeding, riprap, mats, mulching). All removed soil and material must not be stockpiled within the system; stockpiles must be protected from erosion. Install sandbags around soil stockpiles. Areas exposed to erosion must be protected through sandbags, berms, and efficient construction processes. Erosion prevention and sediment control measures must be implemented. 				
Introduction and spread of alien and invasive vegetation	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Quarterly vegetation rehabilitation surveys need to be conducted. An alien invasive plant management plan needs to be compiled and implemented prior to construction. 				

<ul style="list-style-type: none"> An alien invasive plant management plan needs to be compiled and implemented post construction. Alien vegetation must not be allowed to encroach onto the sites and must be continually removed during construction. 				
Increased bare surfaces, flood peaks and potential erosion	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Landscape and revegetate all cleared areas as soon as possible. Temporary and permanent erosion control methods (silt fences, seeding, mulching, etc.). Areas exposed to erosion must be protected through sandbags, berms, and efficient construction processes. Limit the extent and duration that areas are exposed. 				
Impaired water quality	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> All construction activities must be undertaken during the low flow (dry season) period. All contractors and employees should undergo environmental awareness induction. Contractors must have spill kits available for fuel or oil spills. Action plans and training for spills, leaks, and other impacts to freshwater systems. Prefabricate as much material as possible to avoid on-site contamination. No vehicle or machinery washing within watercourses or buffer areas. All chemicals and toxicants must be stored in bunded areas. Machinery and equipment should be inspected regularly for faults and leaks; serviced off-site. No dumping of construction material on-site. All waste generated on-site must be adequately managed; support separation and recycling. All removed soil and material must not be stockpiled within the system. Install sandbags around soil stockpiles. Mixing of concrete must not take place within watercourses; clean area after use. 				
Decreased flow inputs into watercourses	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> The recommended buffer zones must be strictly adhered to. Avoid the creation of new access roads; use existing roads where possible. Placement of pylons must avoid all delineated water resources and buffers. 				
Increased sediment loads to downstream reaches	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Install sedimentation/erosion protection measures. All removed soil and material must not be stockpiled within the system. Install sandbags around soil stockpiles. Erosion and sedimentation into drainage lines must be minimised 				
Contamination of wetlands	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Contractors must have spill kits available. Action plans and training for spills, leaks, and other impacts. All chemicals and toxicants must be stored in bunded areas. Machinery and equipment should be inspected regularly for faults and leaks; serviced off-site. No vehicle or machinery washing within watercourses or buffer areas. Develop spill prevention and response plans. Have spill containment materials readily available on-site and train personnel. The contractor is responsible for cleaning up any spillages immediately. 				
Disturbance and degradation of wetland vegetation	Construction	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Both sensitive and construction areas must be clearly demarcated. Avoid the creation of new access roads; use existing roads where possible. The route for vehicles must be planned to avoid sensitive habitats, wetland/riparian vegetation, buffer areas, and other waterbodies. Operators must be trained in operating machinery in wetland/sensitive environments. Use machinery with low ground pressure to minimise soil compaction and damage. Machinery can be equipped with attachments like swamp mats or bog mats. 				

<ul style="list-style-type: none"> Develop a restoration and rehabilitation plan. Implement measures such as revegetation of disturbed areas or habitat enhancement. 				
Proliferation of alien and invasive species	Operation	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Quarterly vegetation rehabilitation surveys need to be conducted. An alien invasive plant management plan needs to be compiled and implemented prior to and post construction. Alien vegetation must not be allowed to encroach onto the sites and must be continually removed during construction. 				
Nutrient enrichment of watercourse	Operation	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> No dumping of construction material on-site. All waste generated on-site must be adequately managed; support separation and recycling. All chemicals and toxicants must be stored in bunded areas. 				
Increase in erosion and sedimentation of receiving systems	Operation	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Landscape and revegetate all cleared areas as soon as possible. Install sedimentation/erosion protection measures (sandbags, silt traps, fences). Energy dissipation structures must be placed along road margins. Signs of erosion must be addressed immediately. Temporary and permanent erosion control methods (silt fences, curtains, basins, ponds, ditches, seeding, riprap, mats, mulching). All removed soil and material must not be stockpiled within the system; stockpiles must be protected from erosion. Install sandbags around soil stockpiles. Areas exposed to erosion must be protected through sandbags, berms, and efficient construction processes. Erosion prevention and sediment control measures must be implemented. 				
Degradation of wetland vegetation	Operation	Medium to High	Low	Medium to Low
Mitigation Measures				
<ul style="list-style-type: none"> Both sensitive and construction areas must be clearly demarcated. Avoid the creation of new access roads; use existing roads where possible. The route for vehicles must be planned to avoid sensitive habitats, wetland/riparian vegetation, buffer areas, and other waterbodies. Operators must be trained in operating machinery in wetland/sensitive environments. Use machinery with low ground pressure to minimise soil compaction and damage. Machinery can be equipped with attachments like swamp mats or bog mats. Develop a restoration and rehabilitation plan. Implement measures such as revegetation of disturbed areas or habitat enhancement. 				

5.8 Unplanned Events

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and management. Table 5-4 is a summary of the findings from a watercourse ecology perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases of the project.

Table 5-4 Unplanned Events, Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Flooding during construction	Significant habitat degradation of downstream areas.	A flood emergency response plan should be drafted, with adequate stormwater management required. Construction should also take place during the dry season as far as is reasonably possible to reduce potential flooding risk during construction activities.
Spills into the surrounding environment and watercourses	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit and protocol must be available at all times. The incident must be reported on and, if necessary, an aquatic specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of downstream watercourse	Erosion control measures must be put in place. These should be adaptive to on-site conditions.
Fire	Uncontrolled/unmanaged fire that spreads to the surrounding natural bushveld and ridge.	Appropriate/Adequate fire management plan need to be implemented to protect the veld from potential damage and livestock loss.

5.9 Cumulative Impacts

Cumulative impacts are assessed in context of the extent of the proposed project area; other developments in the SQR and Quaternary catchment areas; and general habitat loss and transformation resulting from other activities in the area. The impacts of projects are often assessed by comparing the post-project condition to a pre-existing baseline condition. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for freshwater fauna and flora.

Localised cumulative impacts include the cumulative effects from anthropogenic activities that are close enough (such as nearby farming activities within the area) to potentially cause additive effects on the environment or sensitive receivers. These include disruption of ecological corridors or habitat such as watercourses, impacts to groundwater and surface water quality, and transport of soils and instream habitat smothering impacts.

Long-term cumulative impacts due to the proposed electricity transmission footprint combined with the low density agricultural activities currently present has the potential to degrade watercourse habitat across the catchment. The cumulative impact of the project was rated as 'Low' should the project go ahead and involve the implementation of mitigation. (Table 5-5).

Table 5-5 Cumulative impact assessment for the development

Impact Nature: Loss / Degradation to Local Ecology		
	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	Low	Moderate
Duration	Long term	Long term
Magnitude	Low	Moderate
Probability	Probable	Probable
Significance	Low	Moderate
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?		Yes

5.10 Mitigation and Management Measures

Mitigation measures should aim to avoid or reduce potential negative impacts to air, water, land, ecology and humans, or to introduce positive aspects to the development/activity. The focus of mitigation measures should be to reduce the significance of potential impacts associated with the crossing infrastructure, and thereby to:

- Prevent the unnecessary destruction and fragmentation of the vegetation community of the watercourses (rivers, tributaries, drainage areas and wetland) and the catchments; and
- Prevent the loss of the faunal community (including potentially occurring species of conservation concern) associated with these vegetation communities; and
- Limit the construction or working areas to the defined portions and only impact those areas where it is unavoidable to do so otherwise.

In light of the present and expected impacts from the activities, mitigation measures in relation to management outcomes have been proposed to lower the intensity of the potential impacts on the ecological integrity of the watercourses catchments and the temporary depression wetland and are presented in Table 5-6. The watercourses and their associated buffers must be avoided as far as is feasible by the proposed development to prevent riverine and wetland habitat loss, disturbance and significant changes to flow patterns which subsequently increase the risk to erosion and sedimentation.

Table 5-6 Suggested mitigation measures and management outcomes for the proposed development

No	Mitigation Measure	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
Aq01	Restrict vehicle movement to designated routes	Construction	Throughout construction	Site Manager, Contractor	Weekly	No off-route vehicle tracks	Site inspection and monitoring report findings
Aq02	Design stormwater infrastructure to mimic natural drainage patterns and incorporate energy dissipation and erosion control structures	Construction	Design & construction	Engineer, Contractor	Monthly	No evidence of unnatural flow or erosion	Engineering drawings, site inspection
Aq03	Lightly till and revegetate compacted areas	Construction	Post-construction	Contractor, Environmental Officer	Monthly until established	80% vegetation cover	Vegetation and rehabilitation monitoring survey findings
Aq04	Avoid direct discharge into watercourses during construction, use interceptor trenches and ditches	Construction	Throughout construction	Contractor, Environmental Officer	Weekly	No direct discharge observed	Site inspection, audit / monitoring report findings and incident logs.
Aq05	Stabilise exposed soils promptly with vegetation or mulch	Construction	Immediately after disturbance	Contractor	Weekly	All exposed soils stabilised within 2 weeks of construction completion	Site inspection and audit / monitoring report findings
Aq06	Schedule earthworks during dry periods where possible	Construction	Planning & construction	Project Manager	N/A	Earthworks scheduled for dry season	Construction schedule and site inspections
Aq07	Regularly inspect and maintain erosion control measures	Construction	Throughout construction	Environmental Officer	Weekly	All controls functional	Inspection checklists, site inspection and audit report findings
Aq08	Store fuels and chemicals in bunded, secure areas away from watercourses	Construction	Throughout construction	Contractor, SHE Officer	Weekly	No spills or leaks	Site inspection and audit report findings
Aq09	Refuel and maintain machinery in designated areas with spill containment	Construction	Throughout activity	Contractor, SHE Officer	Weekly	No spills outside containment	Site inspection and audit report findings
Aq10	Implement a spill response plan and train staff involved in the handling of chemicals, fuels and mixes	Construction; Operation	Prior to and during activity	SHE Officer	Annually & after incidents	100% trained staff	Training records, drills
Aq11	Regularly inspect machinery for leaks and service in a designated bunded area	Construction	Throughout construction	Contractor	Weekly	No uncontained leaks	Maintenance logs and audit report findings
Aq12	Provide adequate waste bins and collection points	Construction; Operation	Throughout activity	Contractor	Weekly	No litter on site	Site inspection and audit report findings
Aq13	Segregate and properly dispose of domestic and industrial waste	Construction; Operation	Throughout activity	Contractor	Weekly	100% waste disposed at licensed facilities	Waste disposal records and audit report findings
Aq14	Conduct regular site clean-ups	Construction; Operation	Throughout activity	Contractor	Weekly	No accumulated waste	Site inspection and audit report findings
Aq15	Educate workers on proper waste management	Construction; Operation	Induction & quarterly	Contractor, SHE Officer	Quarterly	100% trained staff	Training records

No	Mitigation Measure	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
Aq16	Monitor for invasive species and remove promptly in line with an alien invasive management plan	Construction; Operation	Throughout activity	Environmental Officer	Monthly	No established invasives	Invasive species log and monitoring report findings
Aq17	Use indigenous species for landscaping and rehabilitation	Construction	During rehabilitation	Contractor, Environmental Officer	Once-off, then monitor	100% indigenous species used	Site inspection and rehabilitation monitoring survey findings
Aq18	Restore disturbed areas rapidly with native vegetation	Construction	Immediately post-disturbance	Contractor	Monthly until established	80% cover within 6 months	Site inspection and rehabilitation monitoring survey findings
Aq19	Maintain and regularly inspect stormwater infrastructure	Operation	Throughout operation	Facility Manager	Monthly	No blockages or failures	Maintenance logs, site inspection and audit report findings
Aq20	Retrofit with green infrastructure (e.g., bioswales, rain gardens) where feasible	Operation	As needed	Facility Manager	Annually	Green infrastructure installed	Site inspection audit report findings
Aq21	Direct runoff to vegetated areas for infiltration	Operation	Throughout operation	Facility Manager	Monthly	No direct discharge to wetland	Site inspection audit report findings
Aq22	Maintain vegetative cover on all open spaces and slopes	Operation	Throughout operation	Facility Manager	Monthly	80% cover maintained	Vegetation survey
Aq23	Monitor for signs of erosion and repair promptly	Operation	Throughout activity	Facility Manager, Environmental Officer	Monthly	No active erosion	Site inspection and monitoring survey findings
Aq24	Ensure stormwater outlets are energy-dissipated	Operation	Throughout operation	Facility Manager	Monthly	No erosion at outlets	Site inspection audit report findings
Aq25	Regularly inspect and maintain sewer and stormwater systems	Operation	Throughout operation	Facility Manager	Monthly	No leaks or overflows	Maintenance logs audit report findings
Aq26	Store chemicals and fuels in bunded areas	Operation	Throughout operation	Facility Manager	Monthly	No unbunded storage	Site inspection audit report findings
Aq28	Monitor for illegal dumping and littering	Operation	Throughout operation	Facility Manager	Monthly	No illegal dumping	Site inspection and audit / monitoring report findings
Aq29	Maintain indigenous vegetation buffers around the plant boundary.	Operation	Throughout operation	Facility Manager, Environmental Officer	Quarterly	Buffer maintained	Site inspection and audit / monitoring report findings

5.10.1 Substation Infrastructure

The proposed construction and upgrades at the Paulputs Substation and construction of access roads and the expected increase in traffic along new and existing gravel roads is likely to increase erosion in this catchment.

The following mitigation measures are provided:

- The recommended buffer zones must be strictly adhered to during the construction phase of the project, with exception of any authorised activities and structures required to traverse an aquatic resource (access road). Any supporting aspects and activities not required to be within the buffer area must adhere to the buffer zone;
- Both sensitive and construction areas must be clearly demarcated. No activities should be allowed in the sensitive areas.
- Landscape and revegetate all cleared areas as soon as possible to limit erosion potential;
- It is strongly recommended that the project make use of existing road networks, before new areas are cleared for new access roads;
- Install sedimentation/erosion protection measures prior to construction in the form of several rows of sandbags, silt traps and fences, this is particularly important in the access roads leading to/in proximity of any drainage channel and around active working areas for foundations;
- Energy dissipation, such as stone berms or blocks must be strategically placed along the road margins as surface runoff leaves the roads and enters the surrounding environment with the potential for severe erosion and damage to road margins. The steeper the slope of the road, the more regular the berms should be spaced and can be as close as one meter apart where necessary;
- Mixing of concrete must under no circumstances take place within the watercourses. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished; and
- Any water resources outside of the specific project site area and PAOI must be avoided

5.10.2 Grid Infrastructure and Road Networks

The proposed OHL grid construction and operation are regarded as low risks to the aquatic resources/sensitive areas should construction occur outside of the delineated sensitive watercourse features. Any development within the sensitive areas warrants moderate to high risk and is not recommended for this project. The expected increase in traffic along new and existing gravel roads is likely to increase erosion of in this catchment.

The following grid and road network mitigation measures are provided:

- The watercourses and recommended buffer zones must be strictly adhered to during the construction phase of the project, with exception of any authorised activities and structures required to traverse an aquatic resource. Any supporting aspects and activities not required to be within the buffer area must adhere to the buffer zone;
- Both sensitive and construction areas must be clearly demarcated. No activities should be allowed in the sensitive areas.
- Landscape and re-vegetate all cleared areas as soon as possible to limit erosion potential;

- Once the final line and associated pylon have been confirmed, a walkthrough is required for these areas, to ensure that sensitive areas are excluded for construction of pylons, through 'micro siting' of the proposed pylon locations;
- The use of minimum pylons or pylons that spans wide enough to avoid sensitive areas is recommended;
- The placement of pylons must avoid all delineated water resources and buffer;
- Mixing of concrete must under no circumstances take place within the watercourses. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished; and
- Any water resources outside of the specific project site area and PAOI must be avoided.
- It is strongly recommended that the project make use of existing road networks, before new areas are cleared for new access roads;
- Install sedimentation/erosion protection measures prior to construction in the form of several rows of sand bags, silt traps and fences, this is particularly important in the access roads leading to/in proximity of any drainage channel and around active working areas for foundations;
- Energy dissipation, such as stone berms or blocks must be strategically placed along the road margins as surface runoff leaves the roads and enters the surrounding environment with the potential for severe erosion and damage to road margins (Figure 5-2). The steeper the slope of the road, the more regular the berms should be spaced and can be as close as one meter apart where necessary;
- Where passive re-establishment of vegetation along road margins is insufficient to stabilise soils and prevent erosion, hydroseeding, drought-tolerant indigenous grasses may be considered as a supplementary measure, provided it is feasible and available;
- The section of roads which will traverse the lowest lying areas/potentially wet areas or steeper slopes will be subjected to traffic from vehicles for inspections and maintenance on site with the potential for damage to habitat and erosion and may require permeable paving as a solution (Figure 5-3). The permeable paving provides a stable platform to carry the loads of service vehicles whilst the vegetation growing through the permeable pavers compliments the surrounding vegetation, preventing erosion in these key areas;
- An environmental control officer (ECO) inspection of the project area/development footprint and surrounding influenced areas must be completed during construction and within 1 month following the end of construction activities and within a week after the first rainfall event. Thereafter, routine monitoring should take place for the life of the project. Should erosion be developing this must be immediately addressed through appropriate and adaptive measures;



Figure 5-2 *Example of road margin erosion prevention.*



Figure 5-3 *Example of permeable paving for roads and habitat maintenance.*

5.10.3 Water Quality Impairment

The following water quality specific mitigation measures are provided:

- All construction activities must be undertaken during the low flow (dry season) period as much as possible to limit surface flow transporting contaminants to the surrounding watercourse habitat;

- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- During construction contractors used for the project must have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the freshwater systems;
- Where feasible, as much material must be prefabricated and then transported to site to avoid the risks of contamination associated with mixing, pouring and the storage of chemicals and compounds on site;
- No vehicle or machinery is allowed to be washed within a watercourse or its buffer area, and should preferably take place off site;
- All chemicals and toxicants during construction must be stored in bunded areas;
- All machinery and equipment should be inspected regularly for faults and possible leaks; these should be serviced off-site;
- No dumping of construction material on-site may take place; and
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

5.10.4 Erosion & Sedimentation

- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the water resources. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Install sandbags around soil stockpiles to prevent soils washing into the system;
- Document the soil profile on removal and ensure the soil is backfilled in the same horizon order in which it was removed;
- Ensure that topsoil is appropriately stored and re-applied; and
- Make sure that the soil is backfilled and compacted to appropriate geotechnical specifications for the project area.
- Signs of erosion must be addressed immediately to prevent further erosion of the upgraded infrastructure;
- Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil; and
- Landscape and revegetate all cleared areas as soon as possible to limit erosion potential.

5.10.5 Alien Vegetation Establishment

The following alien vegetation establishment specific mitigation measures are provided:

- Quarterly vegetation rehabilitation surveys need to be conducted of the vegetation within the project footprint; and

- An alien invasive plant management plan needs to be compiled and implemented prior to construction to control and prevent the spread of invasive aliens.

5.10.6 Operation of Vehicles and Heavy Machinery

- Operating heavy machinery in riparian areas require careful consideration to minimise environmental impact;
- Due to the scope of work, heavy machinery should only be operated in authorised water resource areas and under supervision of an ECO;
- Implement seasonal restrictions on operations to avoid sensitive periods such as breeding seasons for wildlife or periods of high water levels;
- Schedule operations during the dry season when ground conditions are more stable and less prone to damage;
- No heavy machinery shall be permitted within unauthorised water resource areas for any purpose, without the prior approval of the ECO (except emergency procedures);
- All construction vehicles required for the proposed activities should only be allowed to use existing roads (including dirt roads);
- The route for vehicles (including heavy machinery) must be planned to avoid sensitive habitats, wetland/riparian vegetation, buffer areas and other waterbodies as far as feasibly possible;
- Operators must be trained in operating machinery in wetland/sensitive environments and aware of the sensitivity of the area;
- Sensitive areas must be demarcated so as to guide operators, labourers and contractors;
- Use machinery with low ground pressure to minimise soil compaction and damage to wetland/riparian vegetation. Tracked vehicles or specialised low-ground-pressure tyres can be used if feasible/available;
- Machinery can be equipped with attachments like swamp mats or bog mats to distribute weight and minimise disturbance to the watercourse areas;
- Implement sediment and erosion control measures such as silt fences, erosion control blankets, or sediment traps to prevent soil runoff into waterbodies associated with vehicular movements and disturbed/hardened surfaces;
- Develop spill prevention and response plans to address potential leaks or spills of fuels, oils, or other hazardous substances;
- Have spill containment materials readily available on-site and train personnel in proper spill response procedures;
- The contractor is responsible for cleaning up any spillages (e.g. concrete, oil, fuel), immediately;
- Develop a restoration and rehabilitation plan to mitigate any long-term impacts of operating heavy machinery in wetlands and/or riparian areas; and
- Implement measures such as revegetation of disturbed areas or habitat enhancement to restore the ecological functions of the water resource(s).

5.10.7 General mitigation measures

The following general mitigation measures are provided:

- Laydown yards, camps and storage areas must be beyond the watercourse areas. Where possible, the construction of the crossings must take place from the existing road and not from within the drainage line;
- Prevent uncontrolled access of vehicles through the watercourse that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals and toxicants to be used for the construction must be stored outside the watercourses and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. These should not be placed near any water course or in buffer zones. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the watercourses;
- All removed soil and material must not be stockpiled within the watercourses. Stockpiling should take place outside of watercourses. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Erosion and sedimentation into the drainage lines must be minimised through the effective stabilisation (gabions and Reno mattresses) and the revegetation of any disturbed areas;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses that are drought tolerant) to protect the exposed soil;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported;
- Make sure all excess consumables and building materials / rubble are removed from site and deposited at an appropriate waste facility; and
- A competent Environmental Control Officer (ECO) must oversee the construction and associated rehabilitation phase of the project, with sensitive areas as a priority to limit/reduce/prevent the listed impacts on the watercourses. Two (2) follow up ECO assessments/ audits must be carried out in the first and sixth months of operation. Ideally one of these audits should take place following a rainfall event. The ECO must be supplied with a copy of this report to familiarise themselves with the mitigation and recommendations prior to construction;
- A suitably qualified Hydrologist with experience in arid/semi-arid areas must develop a suitable and adaptive Stormwater management plan to ensure no erosion takes place and that clean water enters downstream watercourses/sensitive areas;
- An adaptive rehabilitation plan needs to be implemented from the onset of the project. The key focus should be placed on stormwater and erosion prevention strategies for the development area. The plan should be adhered to for all stages of the project life;

- Therefore, an infrastructure monitoring and service plan must be compiled and implemented during the operational phase. This will include monitoring the road reserve route, all stormwater discharge points, energy dissipation structures, and stability of watercourse/general habitat in the project footprint. This service plan should be adaptive based on on-site conditions.
- This report must consider the associated TBC terrestrial biodiversity and avifaunal reports and respective mitigation and recommendations.
- An alien invasive plant management plan needs to be compiled and implemented post construction to control current invaded areas and prevent the growth of AIPs on cleared areas. Alien vegetation must not be allowed to encroach onto the sites and must be continually removed during construction. Construction must not promote further alien plant disturbances in the surrounding area.
- Heavy vehicles must be parked outside of the riparian buffer zone except where needed for the construction process.
- Erosion prevention and sediment control measures must be implemented. Temporary and permanent erosion control methods may include silt fences, interceptor ditches, seeding and sodding, riprap of exposed embankments, and mulching.
- Rehabilitation of the riparian area, bed and banks must be budgeted for and should be incorporated into the project life cycle and must be completed as soon as construction is completed. Rehabilitation must be done following an approved Rehabilitation Plan and in consultation with a suitably qualified SACNASP professional.
- All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone for the duration of the construction process. No activities or site staff are permitted to enter these areas.
- Areas exposed to erosion must be protected through the use of sandbags, berms and efficient construction processes i.e., limiting the extent (footprint) and duration period that areas are exposed.
- All alterations or hardened surfaces associated with such structures or works are structurally stable, do not induce sedimentation, erosion or flooding, do not cause a detrimental change in the quantity, velocity, pattern, timing, water level and assurance of flow in a watercourse, do not cause a detrimental change in the quality of water in the watercourse, do not cause a detrimental change in the stability or geomorphological structure of the watercourse; and does not create nuisance condition, or health or safety hazards.
- Measures must be implemented at alterations (including at existing structures or activities) to 1) prevent detrimental changes to the breeding, nesting or feeding patterns of aquatic biota, including migratory species (if present), 2) allow for the free up and downstream movement of aquatic biota, including migratory species (if present), and 3) prevent a decline in the composition and diversity of the indigenous and endemic aquatic biota.

6 Recommendations

The following recommendations have been made to ensure the conservation of the aquatic resources;

- Avoid the delineated watercourse areas where feasible (move towers where report states to do so);
- In a case where the tower is located within the delineated watercourse, try and relocate the tower at the highest point to avoid the micro-channel or preferential flow paths;
- If possible, try to avoid the wider area of the watercourse;
- All mitigation measures prescribed by EIMS during the EIA phase remains applicable and must be adhered to;
- The use of existing roads preferable used to avoid additional impact to the area;
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase.
- A competent Environmental Control Officer (ECO) must oversee the construction, operation and rehabilitation phases of the project, with watercourse areas as a priority;
- An alien invasive plant management plan needs to be implemented and conducted regularly to control current invaded riparian areas and prevent the growth of invasives on cleared areas. This will assist in improving the biotic integrity and ecosystem functioning of the delineated watercourses.
- A plan must be in place to control accidental spills into any watercourses.
- It is recommended that an adaptive Stormwater Management Plan be prepared by a specialist familiar with semi-arid conditions and ephemeral systems, and implemented to derive and manage the areas at highest risk for erosion. This is particularly the case for the Substation drainage areas that are already severely affected by erosion and improper stormwater management. These high-risk areas should then be key points for erosion management throughout the entirety of the project lifecycle.

7 Conclusion

The National Web-Based Environmental Screening Tool characterised the aquatic theme sensitivity of the PAOI as "Very High". At the desktop level, the available PES for the Kantbrogas se Laagte River and Nous River is class C (Moderately Modified) with a Moderate EI for both systems and a Low ES for Kantbrogas se Laagte River. The IHI indicated the four NFEPA rivers (Nous River, Kantbrogas se Laagte River, Samoep River, Unnamed NFEPA River), their tributaries, and the Farming drainage areas were rated as Natural (class A), indicating unmodified, natural habitats. Limited anthropogenic activities within the local area have led to limited flow, bed and channel modifications within the assessed habitats. The Substation drainage area is in a Moderately Modified state (class C) with various anthropogenic activities within the surrounding area having resulted in some flow, bed and channel modifications including erosion.

A final overall PES of the assessed NFEPA rivers, their tributaries, and Farming drainage is class A (Natural) state, indicating unmodified, natural habitats and therefore compliant with the (REC) of class C (Moderately Modified). The PES assessment for the Substation drainage area was classified as a class C (Moderately Modified). The small temporary depression wetland located in the PAOI is classified as a Category C system, indicating that it is Moderately Modified but still retains much of its ecological functionality. Ongoing management of grazing intensity and appropriate planning of road placement are recommended to prevent further degradation and to maintain the ecological integrity of the watercourse.

Water resources within the PAOI have been delineated and buffer zones have been assigned. These areas are designated as No-go zones for development, disturbance, equipment/machinery, waste dumping, and laydown yards unless otherwise authorised. A 10 m post-mitigation conservation buffer has been allocated to the drainage areas and NFEPA river tributaries, a 20 m buffer to the four NFEPA rivers, and a 30 m buffer to the temporary depression wetland. These buffers support aquatic ecosystem integrity and must be respected in site planning. Additional regulatory zones, including the NEMA 32 m, GN4167 100 m river, tributary and drainage ZoRs, and 500 m wetland ZoR, must also be fully integrated into the project layout unless otherwise authorised.

The walkdown assessment indicated five proposed powerline tower locations within medium sensitivity watercourses or close to one of the NFEPA Rivers (Nous River). Therefore, alternative positions or locations were suggested.

7.1 Risk and Impact Statement

The planning phase poses low risk but sets the foundation for higher-impact construction and operational phases. It is anticipated that the construction and operation phases of the project poses "Moderate" pre-mitigation risks to the freshwater ecosystems, which can change to "Low" post-mitigation risks for all impacts. This will be possible subject to effective mitigation that addresses stormwater management, erosion and sedimentation prevention, correct use and storage of chemicals, rehabilitation of disturbed areas, the prevention of run-off from hard surfaces into delineated watercourses and their associated buffers, no operation of unauthorised heavy vehicles within delineated watercourses and buffer areas. The proximity of proposed activities to sensitive watercourses reinforces the need to apply the mitigation hierarchy rigorously, particularly avoiding disturbance in delineated aquatic and riparian zones.

7.2 Specialist Opinion

Based on desktop analysis, field assessments, and the risk rating, it is the opinion of the specialist that the project is considered "Low Risk" and may be considered for authorisation, on condition that all prescribed mitigation measures and recommendations are implemented. This includes but is not limited to, the avoidance of sensitive freshwater habitats and their buffer zones (as far as is feasible) as well as the minimisation of development/disturbances within these areas. The activities qualify under Section 21(c) and (i) water uses and may be authorised under a General Authorisation in terms of GN 4167, assuming the applicant qualifies under Appendix D2.

8 References

Barbour, M.T., Gerritsen, J. & White, J.S. (1996). Development of a stream condition index (SCI) for Florida. Prepared for Florida Department of Environmental Protection, Tallahassee, Florida.

Barbour, M.T. (1999). Rapid bioassessment protocols for use in wadable streams and rivers: periphyton, benthic macroinvertebrates and fish. US Environmental Protection Agency, Office of Water, Washington, DC.

Dallas, H.F. (2007). River Health Programme: South African Scoring System (SASS) Data Interpretation Guidelines. Report produced for the Department of Water Affairs and Forestry (Resource Quality Services) and the Institute of Natural Resources.

Department of Water Affairs (DWA). (2011a). Planning Level Review of Water Quality in South Africa. Department of Water Affairs, Pretoria, South Africa.

Department of Water Affairs (DWA). (2011b). Procedures to Develop and Implement Resource Quality Objectives. Department of Water Affairs, Pretoria, South Africa.

Department of Water Affairs and Forestry (DWAf). (1996). South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems. Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water Affairs and Forestry (DWAf). (1999). Resource Directed Measures for Protection of Water Resources. Volume 2: Integrated Manual (Version 1). Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water Affairs and Forestry (DWAf). (2005a). A Practical Field Procedure for Identification and Delineation of Wetlands and Riparian Areas. Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water Affairs and Forestry (DWAf). (2005b). River Ecoclassification: Manual for Ecstatus Determination. First Draft for Training Purposes. Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water and Sanitation (DWS). (2014). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Compiled by RQIS-RDM, Department of Water and Sanitation, Pretoria, South Africa. <https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx>

Department of Water and Sanitation (DWS). (2016). General Authorisation in Terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for water uses as defined in Section 21(c) or Section 21(i). GN 509 of GG 40229 of 26 August 2016.

Department of Water and Sanitation (DWS). (2020). National Environmental Management Act (NEMA), Act 107 of 1998. Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation. GN 320 of GG 43110 of 20 March 2020.

Department of Water and Sanitation (DWS). (2023a). Review of the National Water Strategy. GN 3855 of GG 49225 of 1 September 2023. Department of Water and Sanitation, Pretoria, South Africa.

Department of Water and Sanitation (DWS). (2023b). General Authorisation in Terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for water uses as defined in Section 21(c) or Section 21(i). GN 4167 of GG 49833 of 8 December 2023.

Dickens, C.W. & Graham, P.M. (2002). The South African Scoring System (SASS) version 5 rapid bioassessment method for rivers. African Journal of Aquatic Science, 27(1), 1–10.

Driver, A., Holness, S. & Daniels, F. (Eds). (2017). Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning. 1st Edition. South African National Biodiversity Institute, Pretoria, South Africa.

Elmore, W. & Beschta, R.L. (1987). Riparian areas: perceptions in management. *Rangelands Archives*, 9(6), 260–265.

Fry, C. (2022). *A Field Guide to Freshwater Macroinvertebrates of Southern Africa*. Jacana Media, Johannesburg, South Africa.

Gerber, A. & Gabriel, M.J.M. (2002). *Aquatic invertebrates of South African rivers: field guide*. Department of Water Affairs and Forestry, Resource Quality Services, Pretoria, South Africa.

Kleynhans, C.J. (1996). A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Western Cape System, South Africa). *Journal of Aquatic Ecosystem Health*, 5, 41–54.

Kleynhans, C.J. & Louw, M.D. (2007). Module A: EcoClassification and EcoStatus determination in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report.

Le Maitre, D.C., Seyler, H., Holland, M., Smith-Adao, L., Nel, J.L., Maherry, A. & Witthüser, K. (2018). Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria, South Africa.

Lötter, M.C. & Le Maitre, D. (2021). Fine-scale delineation of Strategic Water Source Areas for surface water in South Africa using Empirical Bayesian Kriging Regression Prediction: Technical report. Prepared for the South African National Biodiversity Institute (SANBI), Pretoria, South Africa.

Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. & Dickens, C.W.S. (2014). Preliminary guideline for the determination of buffer zones for rivers, wetlands and estuaries. Final Consolidated Report. WRC Report No TT 610/14, Water Research Commission, Pretoria, South Africa.

Macfarlane, D.M., Dickens, J. & Von Hase, F. (2009). Development of a methodology to determine the appropriate buffer zone width and type for developments associated with wetlands, watercourses and estuaries. Deliverable 1: Literature Review. INR Report No: 400/09.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. & Goge, C. (2008). WET-Health, A technique for rapidly assessing wetland health. Water Research Commission, Pretoria, South Africa.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. & Goge, C. (2007). A technique for rapidly assessing wetland health: WET-Health. WRC Report TT 340/08, Water Research Commission, Pretoria, South Africa.

Mucina, L. & Rutherford, M.C. (Eds.). (2006). *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria, South Africa.

National Water Act (NWA). (1998). Act 36 of 1998. GN 1199 of GG 19182 of 26 August 1998.

National Water Act (NWA). (2016). Act 36 of 1998. GN 1056 of GG 40279 of 16 September 2016.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. & Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801, Water Research Commission, Pretoria, South Africa.

Ramoejane, M. (2016). Genetic diversity, evolutionary relationships and conservation of southern African fishes in relation to water management. PhD thesis, Rhodes University, Grahamstown, South Africa.

Rowntree, K.M., Wadeson, R.A. & O'Keeffe, J. (2000). The Development of a Geomorphological Classification System for the Longitudinal Zonation of South African Rivers. *South African Geographical Journal*, 82(3), 163–172.

Skelton, P.H. (2001). A complete guide to the freshwater fishes of southern Africa. Struik Publishers, Cape Town, South Africa.

Skelton, P.H. (2016). Name changes and additions to the southern African freshwater fish fauna. *African Journal of Aquatic Science*. <https://doi.org/10.2989/16085914.2016.1186004>

Skelton, P.H. (2024). *Freshwater Fishes of Southern Africa – A Complete Guide*. Struik Nature Publishers, Cape Town, South Africa.

South African National Biodiversity Institute (SANBI). (2013). GIS metadata for the Strategic Water Source Areas (SWSAs) of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria, South Africa.

South African National Biodiversity Institute (SANBI). (2017). Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning. Driver, A., Holness, S. & Daniels, F. (Eds). 1st Edition. South African National Biodiversity Institute, Pretoria, South Africa.

South African National Biodiversity Institute (SANBI). (2018). GIS metadata for the National Biodiversity Assessment (NBA) spatial rivers dataset. South African National Biodiversity Institute, Pretoria, South Africa.

Thirion, C. (2007). Module E: Macroinvertebrate Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 332/08.

United States Environmental Protection Agency (USEPA). (1998). Rapid Bioassessment Protocols for Use in Streams and Rivers. US Environmental Protection Agency, Office of Water, Washington, DC.

Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E. & Snaddon, K. (2019). South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 November 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI), Pretoria, South Africa. CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number <http://hdl.handle.net/20.500.12143/5847>.

9 Appendices

9.1 Appendix A: Freshwater Methodology

9.1.1 Desktop Dataset Assessment

The desktop assessment was undertaken using Geographic Information System (GIS) to access, view and overlay the latest available related datasets with the project area. The information represented within the datasets was used to develop the relevant digital maps used to identify potentially environmentally sensitive areas. These datasets and their respective dates of publishing are provided below:

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- The inland water dataset;
- Topographical river line data;
- Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) per Sub Quaternary Reaches (SQR) for Secondary Catchments in South Africa (DWS, 2014);
- The National Freshwater Ecosystem Priority Areas (NFEPA) (Nel *et al.*, 2011);
- Provincial Conservation Plans;
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al.*, 2019);
- National Biodiversity Assessment (NBA) (Van Deventer *et al.*, 2019);
- The SANBI National Wetland Map 5 (Van Deventer *et al.*, 2019); and
- Contour data (5 m).

9.1.1.1 Topographical River Lines and Inland Water Areas

Topographical Inland Water Areas and River Lines for South Africa are based on the topographic maps dated 1994 as per the National Geo-spatial Information. These datasets are used in this report to provide insight into potential wetland areas and serve to highlight the location and extent of rivers, drainage features, dams, wetlands, reservoirs, and other relevant inland waterbodies.

9.1.1.2 Ecologically Important Landscape Features

The datasets listed below were incorporated to establish the relation between the project and ecologically important or sensitive freshwater entities. Emphasis was placed on the following spatial datasets:

- South African Inventory of Inland Aquatic Ecosystems (SAIIAE), NBA 2018 Rivers and Wetlands (Van Deventer *et al.*, 2019).
- National Freshwater Priority Areas (Nel *et al.*, 2011).
- Strategic Water Source Areas, 2021 (Lötter & Le Maitre, 2021).
- Provincial Conservation Plans.

9.1.1.3 The South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the 2018 NBA, the SAIIAE is a collection of spatial data layers that represent the extent of river and inland wetland ecosystem types as well as the pressures on these systems. The same two headline indicators, and

their associated categorisations, are applied as with the terrestrial ecosystem NBA, namely Ecosystem Threat Status and Ecosystem Protection Level. The Ecosystem Threat Status of river and wetland ecosystem types are based on the extent to which each ecosystem type has been altered from its natural condition.

9.1.1.4 National Freshwater Ecosystem Priority Areas, Rivers and Wetlands

To better conserve aquatic ecosystems, South Africa has categorised its inland aquatic systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs). The FEPAs are intended to be conservation support tools and it is envisioned that they will guide the effective implementation of measures to achieve the National Environment Management: Biodiversity Act's biodiversity conservation goals (Nel *et al.*, 2011).

9.1.2 Water Quality

Water quality was measured *in-situ* using a handheld calibrated multi-parameter water quality meter. The constituents considered that were measured included: pH, electrical conductivity ($\mu\text{S}/\text{cm}$), water temperature ($^{\circ}\text{C}$) and Dissolved Oxygen (DO) in mg/l .

9.1.3 Habitat Assessments

Habitat availability and diversity are major attributes of the biota found in a specific ecosystem, and thus knowledge of the quality of habitats is important in an overall assessment of ecosystem health. Habitat assessment can be defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the watercourse and the condition of the resident aquatic community (Barbour *et al.*, 1996). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities (USEPA, 1998). Habitat quality and availability play a critical role in the occurrence of aquatic biota. For this reason, habitat evaluation is conducted simultaneously with biological evaluations to facilitate the interpretation of results.

9.1.3.1 Index of Habitat Integrity

The Index of Habitat Integrity (IHI) model was used to assess the integrity of the habitats from a riparian and instream perspective as described in Kleynhans (1996) v2. The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact-based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity is obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physicochemical conditions and how these changes would impact the natural riverine habitats.

The criteria and ratings utilised in the assessment of habitat integrity in the current study are presented in Table 9-1 and Table 9-2 respectively. The spatial framework for each IHI was 5 km upstream and downstream of the respective sampling points within the watercourse(s).

Table 9-1 Criteria used in the assessment of habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.

Criterion	Relevance
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in the duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon <i>et al.</i> , 1993). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993) is also included.
Channel modification	may be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Phys-chem modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon <i>et al.</i> , 1992).
Alien macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Introduced aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Rubbish dumping	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon <i>et al.</i> , 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the riverbank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 9-2 **Descriptions used for the Ratings of the Various Habitat Criteria**

Impact Category	Description	Impact Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

The habitat integrity assessment takes into account the riparian zone and the instream channel of the river. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component (Table 9-3). The relative weighting of criteria remains the same as for the assessment of habitat integrity (DWS, 1999).

Table 9-3 *Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996)*

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Vegetation removal	13
Flow modification	13	Exotic vegetation	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Phys-chem modification	14	Water abstraction	13
Inundation	10	Inundation	11
Alien macrophytes	9	Flow modification	12
Introduced aquatic fauna	8	Phys-chem	13
Rubbish dumping	6		
Total	100	Total	100

The negative weights are added for the instream and riparian facets respectively and the total additional negative weight subtracted from the provisionally determined integrity to arrive at a final habitat integrity estimate. The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific habitat integrity category (DWS, 1999). These categories are indicated in Table 9-4.

Table 9-4 *Index of habitat integrity categories (From Kleynhans, 1996)*

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

9.1.4 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.*, 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.*, 1999). The assessment and monitoring of benthic macroinvertebrate communities form an integral part of the monitoring of the health of an aquatic ecosystem.

9.1.4.1 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water

quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made at the family level (Thirion *et al.*, 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002, Fry, 2022).

Reference conditions reflect the best conditions that can be expected in rivers and streams within a specific area and reflect natural variation over time. These reference conditions are used as a benchmark against which field data can be compared. All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007). This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database. Ecological categories for the project area are based on biological banding presented in Table 9-5.

Table 9-5 *Biological Bands / Ecological categories for interpreting SASS data (adapted from Dallas, 2007)*

Class	Ecological Category	Description
A	Natural	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	Largely natural	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	Moderately modified	Moderately impaired. Moderate diversity of taxa.
D	Largely modified	Considerably impaired. Mostly tolerant taxa present.
E/F	Seriously Modified	Severely impaired. Only tolerant taxa present.

9.1.4.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) was used to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the SQR. This does not preclude the calculation of SASS5 scores if required (Thirion, 2007). Aquatic macroinvertebrate assemblages and communities offer a good understanding of the flow regime, water quality and instream habitat in a river. In addition, they form an essential component of the riverine ecosystem. Macroinvertebrates are important processors of transported organic matter in aquatic systems, perform vital functions in purifying the water and furthermore provide a food source for aquatic and terrestrial biota. Aquatic macroinvertebrate assemblages are guided by the physical-chemical tolerance of the individuals in the population to an array of environmental influences. The distribution pattern resulting from habitat selection by a given aquatic macroinvertebrate species reflects the optimal overlap between habit (mode of existence) and physical environmental conditions such as habitat and flows. Hence, the frequently intermittent distribution of aquatic macroinvertebrate populations is an outcome of the complex interaction among habitat characteristics, behavioural patterns, and the accessibility to food resources.

The major components of a stream system that determine productivity for aquatic organisms include:

- Flow regime,
- Physical habitat structure (e.g., channel form and substrate distribution);
- Water quality (e.g., temperature, dissolved oxygen); and
- Energy inputs from the watershed in the form of allochthonous and instream inputs.

According to Thirion (2007, 2016), the determination of aquatic macroinvertebrate ecological class / ecological category (EC) is done by integrating the ecological requirements of the invertebrate taxa in a community or assemblage and their response to modified habitat conditions. These are based on:

- An interpretation of the environmental requirements, preferences and intolerances of macroinvertebrate taxa constituting the natural assemblage in a particular river delineation, and their responses to changes in habitat conditions as brought about by changes in driver components.

According to Thirion (2007), two (2) methods can be used for determining the taxa expected to occur under natural (reference) conditions:

- A minimally-impacted site in the same Level II Ecoregion and geomorphological zone with similar habitat can be used as a reference site, and information from this reference site can be used to compile a reference list of taxa for the area under consideration; and
- In the absence of a suitable reference site, information from similar sites in different rivers, as well as any historical information available, can be used to compile a derived reference list of taxa expected under reference conditions. A thorough knowledge of the area under consideration is essential in order to compile a suitable referenced list. The occurrence of taxa in a different river, within the same ecoregional context, can be used to derive reference conditions in the river delineation being considered.

9.1.5 Fish Community Assessment

Fish species information can be used to develop the Fish Response Assessment Index (FRAI), which gives an indication of the PES of the river based on the fish assemblage structures observed. Ideally, fish would be captured through electroshocking techniques. Approximately, 50 m up and 50 m downstream of each sampling point would be assessed by sampling representative habitat. All fish would be identified in the field and released at the point of capture. Fish species would be identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001; 2016; 2024). The identified fish species would be compared to those expected to be present for the quaternary catchment. The expected fish species list was developed from a literature survey and included sources such as DWS (2014), (Kleynhans *et al.*, 2007) and Skelton (2001; 2016). Fish have different sensitivities or levels of tolerance to various aspects that they are subjected to within the aquatic environment. These tolerance levels are rated with a sensitivity score as presented in Table 9-6. These tolerance levels are scored to show each fish species' sensitivity to flow and physicochemical modifications.

Table 9-6 Intolerance rating and sensitivity of fish species.

Sensitivity Score	Tolerance/Sensitivity Level
0-1	Highly tolerant = Very low sensitivity
1-2	Tolerant = Low sensitivity
2-3	Moderately tolerant = Moderate sensitivity
3-4	Moderately intolerant = High sensitivity
4-5	Intolerant = Very high sensitivity

9.1.5.1 Fish Response Assessment Index

The information gained using the Fish Response Assessment Index (FRAI) gives an indication of the PES of the river based on the fish assemblage structures observed (Kleynhans, 2007). According to Kleynhans (2007), "the FRAI is an assessment index based on the environmental intolerances and

preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or drivers” as illustrated in Figure 9-1.

The expected fish species list was developed from a literature survey and included sources such as DWS RQOS PESEIS database (2014), Kleynhans *et al.* (2007) and previous studies conducted within the catchment (Lombard, 2016), spatial data from both the Global Biodiversity Information Facility (GBIF) and the Freshwater Biodiversity Information System (FBIS), as well as specialist knowledge of the catchment. The FRAI Frequency of Occurrence (FROC) ratings are calculated based on the habitat present at the sites. The Catch per unit effort (CPUE) is a common metric used in fisheries studies to assess the efficiency of fishing gear and the abundance of targeted species. Based on Hilborn and Walters (1992), the formula for CPUE is: $CPUE = \text{Total Catch} / \text{Total Effort}$. The CPUE was presented per site.

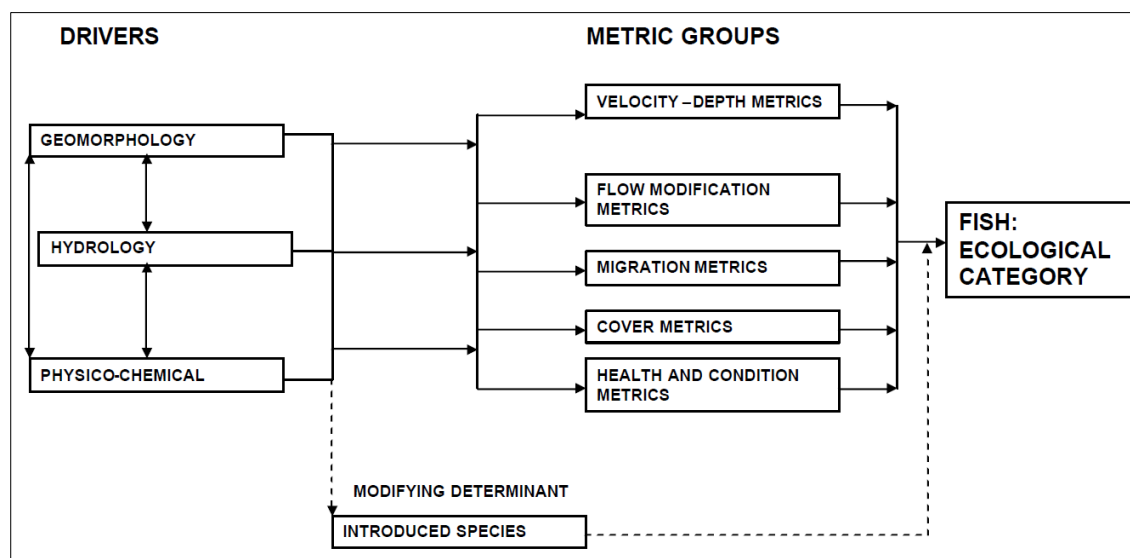


Figure 9-1 The relationship between drivers and fish metric groups (Kleynhans, 2007)

9.1.6 Present Ecological Status

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007) (Table 9-7). For this study ecological classifications have been determined for biophysical attributes for the associated water course. This was completed using the river Ecoclassification manual by Kleynhans and Louw (2007). The areas considered in the PES assessment are outlined in the description of the project area section. The combined categories were assessed to determine the reach-based PES.

Table 9-7 Present Ecological State (PES) Categories.

Category	Descriptions (Modifications)	Descriptions (Taxa)
A	Natural	
	Unmodified, natural.	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	Largely Natural	
	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	Moderately Modified	

	A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	Moderately impaired. Moderate diversity of taxa.
D	Largely Modified	
	A large loss of natural habitat, biota and basic ecosystem functions has occurred.	Considerably impaired. Mostly tolerant taxa present.
E	Seriously Modified	
	The loss of natural habitat, biota and basic ecosystem functions is extensive.	Severely impaired. Only tolerant taxa present.
F	Critically Modified	
	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	Severely impaired. Only tolerant taxa present.

9.1.7 Riparian Delineation

The riparian delineation was completed according to DWAF (2005). Typical riparian cross-sections and structures are provided in Figure 9-2. Indicators such as topography and vegetation were the primary indicators used to define the riparian zone. Elevation data obtained from topography spatial data was also utilised to support the infield assessment.

Macfarlane *et al.* (2009), and Macfarlane and Bredin (2017) were consulted to determine the appropriate watercourse buffer zones associated with the watercourse and the proposed activities. According to the buffer guidelines the maximum required buffer should be applied to a system (Macfarlane, et al., 2014).

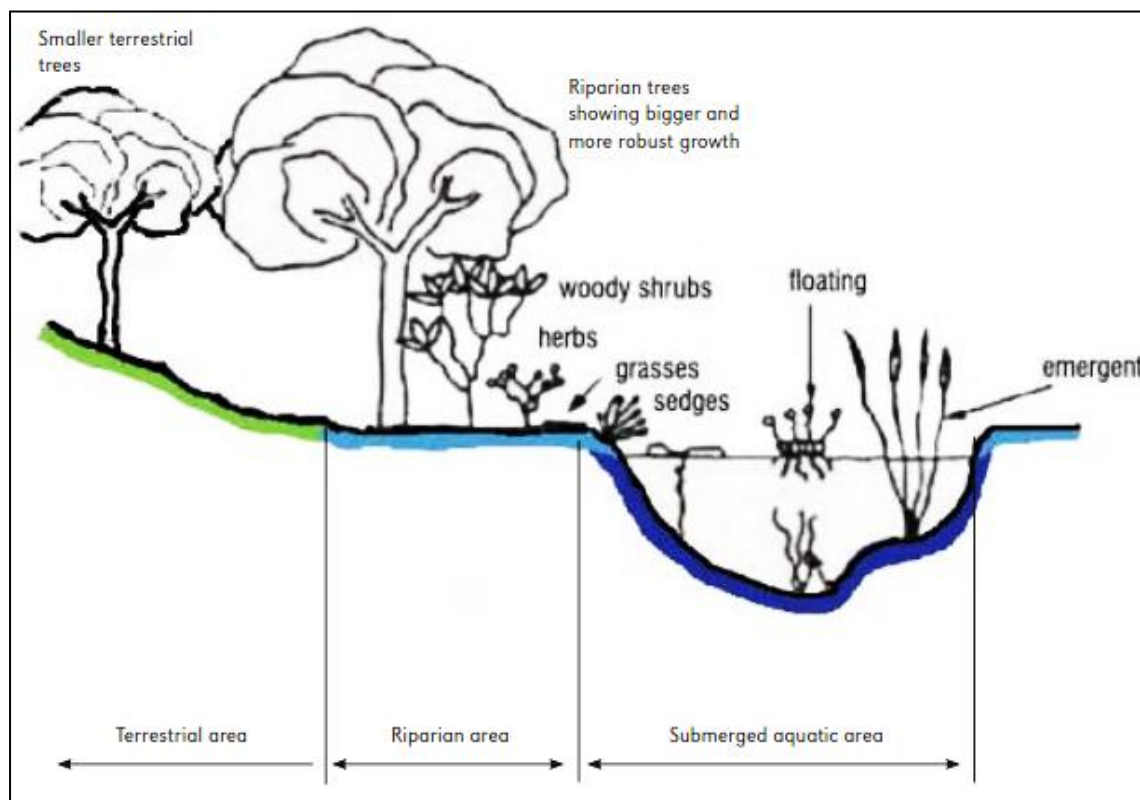


Figure 9-2 **Riparian Habitat Delineations (DWAF, 2005)**

9.1.8 Wetland Field Survey

9.1.8.1 Identification and Mapping

The wetland area was delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 9-3. The outer edges of the wetland area was identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

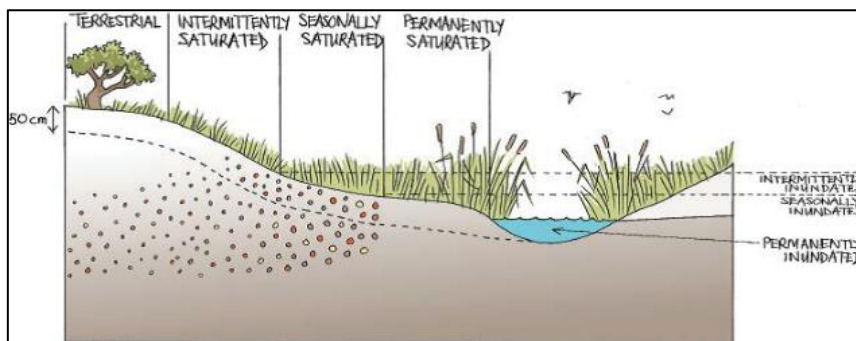


Figure 9-3 Cross section of a wetland, indicating how the soil wetness and vegetation indicators respond to changes in topography (Ollis et al. 2013)

9.1.8.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

9.1.8.3 Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and then also includes structural features at the lower levels of classification (Ollis et al., 2013).

9.1.8.4 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Ecosystem services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al.*, 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 9-8).

Table 9-8 *Classes for determining the likely extent to which a benefit is being supplied*

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

9.1.8.5 Present Ecological Status

The overall approach as described by Macfarlane *et al.*, 2009, is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 9-9.

Table 9-9 *The Present Ecological Status categories (Macfarlane *et al.*, 2009)*

Impact Category	Description	Impact Score Range	PES Score (%)	PES
None	Unmodified, natural	0 to 0.9	90-100	A
Small	Largely Natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	80-89	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	60-79	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	40-59	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	20-39	E
Critical	Critically Modified. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	0-19	F

9.1.8.6 Ecological Importance and Sensitivity

The importance and sensitivity of water resources is determined in order establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants as described by Rountree *et al.*, 2013, is used to assign the Ecological Importance and Sensitivity (EIS) category as listed in Table 9-10.

Table 9-10 *Description of Ecological Importance and Sensitivity categories*

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	A

High	2.1 to 3.0	B
Moderate	1.1 to 2.0	C
Low Marginal	< 1.0	D

9.1.8.7 Recommended Ecological Category and Recommended Management Objective

The Recommended Ecological Category (REC) and Recommended Management Objective (RMO) (Table 9-11) was determined based on the results obtained from the PES and EIS of the assessed wetlands, with the objective of recommending how a water resource should be managed. This is achieved by either maintaining or improving the ecological integrity of the wetland in order to ensure continued ecological functionality (DWA, 1999).

Table 9-11 Recommended Ecological Category and Recommended Management Objectives for water resources based on Present Ecological State and Ecological Importance and Sensitivity scores

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

9.1.9 Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane *et al.*, 2014) was used to determine the appropriate buffer zone for the proposed activity.

9.1.10 Site Sensitivity Verification

The baseline aquatic / freshwater sensitivity of the project area was obtained using the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended). The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas based on the specialist-assigned Ecological Importance and Sensitivity of the different systems (where applicable), with consideration being given to the presence of observed or likely sensitive fauna and flora.

9.2 Appendix B: Risk and Impact Assessment

The Department of Water and Sanitation (DWS) risk matrix assesses impacts in terms of consequence and likelihood. The significance of the impact is rated according to the classes presented in Table 9-12.

Table 9-12 Significance ratings matrix

Rating	Class	Management Description
1 – 29	(L) Low Risk OR (+) Positive (+ +) Highly positive	Acceptable as is or with proposed mitigation measures. Impact to watercourses and resource quality small and easily mitigated, or positive.
30 – 60	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. License required.
61 – 100	(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. License required.

9.2.1 Cumulative Impact Assessment

The following aspects as presented in Table 9-13 were considered in the cumulative impact assessment which refers to quantifying the significance of impacts in relation to the proposed development.

Table 9-13 Aspects and ratings considered in the cumulative impact assessment

Extent of impact	Description	Rating
Site specific	Very low (1)	1
Footprint & surrounding areas	Low (2)	2
Local area	Moderate (3)	3
Regional	High (4)	4
Entire habitat unit / Entire system	Very high (5)	5
Duration of impact	Description	Rating
The lifetime of the impact will be of a very short duration (0–1 years)	Very short term (1)	1
The lifetime of the impact will be of a short duration (2-5 years)	Short term (2)	2
Medium term (5–15 years)	Moderate term (3)	3
Long term (> 15 years)	Long term (4)	4
Permanent	Permanent (5)	5
Consequence/Magnitude of impact	Description	Rating
Small and will have no effect on the environment	None (0)	0
Minor and will not result in an impact on processes	Minor (2)	2
Low and will cause a slight impact on processes	Low (4)	4
Moderate and will result in processes continuing but in a modified way	Moderate (6)	6
High (processes are altered to the extent that they temporarily cease)	High (8)	8
Very high and results in complete destruction of patterns and permanent cessation of processes	Very high (10)	10
Probability of impact	Description	Rating
Very improbable (probably will not happen)	Very improbable (1)	1
Improbable (some possibility, but low likelihood)	Improbable (2)	2
Probable (distinct possibility)	Probable (3)	3
Highly probable (most likely)	Highly probable (4)	4
Definite (impact will occur regardless of any prevention measures)	Definite (5)	5
Status	Description	Rating
Positive	Positive	Positive
Negative	Negative	Negative
Neutral	Neutral	Neutral
Reversability	Description	Rating
None	None	None
Low	Low	Low
Moderate	Moderate	Moderate
High	High	High
Irreplaceable loss of resources?	Description	Rating
Yes	Yes	Yes
No	No	No
Can impacts be mitigated?	Description	Rating
Yes	Yes	Yes

No	No	No
Significance	Description	Rating
< 30 points	Low	Low
30-60 points	Medium	Medium
> 60 points	High	High

9.3 Appendix C – EIMS Impact Assessment for proposed activities

Impact	Phase	Pre-Nature	Pre-Extent	Pre-Duration	Pre-Magnitude	Pre-Reversibility	Consequence	Pre-Probability	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-Nature	Post-Extent	Post-Duration	Post-Magnitude	Post-Reversibility	Consequence	Post-Probability	Post-mitigation Significance Score	Post-Mitigation Significance	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score	Final Significance
Loss, disturbance and degradation of watercourses	Construction	-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	2	-3.5	Low -	High	2	2	1.25	-4.38	Medium to low -
Loss or degradation in ecosystem services		-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	2	2	1.25	-5.00	Medium to low -
Altered hydrological regimes		-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	2	2	1.25	-5.00	Medium to low -
Increase in erosion of receiving systems		-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	2	2	1.25	-5.00	Medium to low -
Introduction and spread of alien and invasive vegetation		-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	3	-5.25	Medium to low -	High	2	2	1.25	-6.56	Medium to low -

Increased bare surfaces, flood peaks and potential erosion		-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	3	-5.25	Medium to low -	High	2	2	1.25	-6.56	Medium to low -
Impaired water quality		-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	2	2	1.25	-5.00	Medium to low -
Decreased flow inputs into watercourses		-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	2	2	1.25	-5.00	Medium to low -
Increased sediment loads to downstream reaches		-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	3	-6	Medium to low -	High	2	2	1.25	-7.50	Medium to low -
Contamination of wetlands		-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	2	-3.5	Low -	High	2	3	1.38	-4.81	Medium to low -
Disturbance and degradation of wetland vegetation		-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	2	-3.5	Low -	High	3	2	1.38	-4.81	Medium to low -
Proliferation of alien and invasive species	Operation	-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	2	-3.5	Low -	High	2	2	1.25	-4.38	Medium to low -

Nutrient enrichment of watercourse	-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	1	2	1.13	-4.50	Medium to low -
Increase in erosion and sedimentation of receiving systems	-1	3	3	3	3	-3	4	-12	Medium to high -	-1	2	2	2	2	-2	2	-4	Low -	High	3	2	1.38	-5.50	Medium to low -
Degradation of wetland vegetation	-1	2	3	3	3	-2.75	4	-11	Medium to high -	-1	1	2	2	2	-1.75	2	-3.5	Low -	High	3	3	1.50	-5.25	Medium to low -

9.4 Appendix D – Specialist Declaration of Independence**DECLARATION**

I, Lizaan de Necker, declare that:

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020.
- 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, 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; and
- I realise that a false declaration is an offence and is punishable in terms of the NEMA Act.



Lizaan de Necker

Aquatic Ecologist

The Biodiversity Company

22/06/2026

9.5 Appendix E – Specialist CVs

Lizaan de Necker

Ph.D. Environmental Sciences

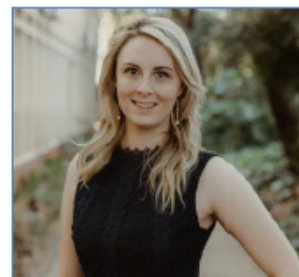
Pri. Sci. Nat (138304)

Cell: +27 72 936 4332

Email: Lizaan@thebiodiversitycompany.com

Identity Number: 9003280197083

Date of birth: 28 March 1990



Profile Summary	Key Experience	Nationality
<ul style="list-style-type: none"> Working experience across South Africa Specialist expertise in aquatic ecology, freshwater ecosystems, and environmental management. Decade of experience as a project manager, lecturer, supervisor, mentor, and researcher. Specialist research focus in climate change, invasive species, anthropogenic pressures, and natural disturbances affecting aquatic biota. Proficient in experimental design, multi-line evidence use, and advanced data analysis techniques. 	<ul style="list-style-type: none"> Aquatic Biomonitoring using fish, macroinvertebrates and diatoms Water resource baseline monitoring and impact assessments Aquatic Ecological Assessments Biomonitoring Programmes Ecological Impact Assessment Basic Assessment 	South African
Areas of Interest	Geographic Experience	Languages
Aquatic Ecology Aquatic Ecosystem Health Ecosystem Rehabilitation Habitat and Biodiversity Conservation Sustainable Development Environmental Management Water Quality	South Africa Belgium Germany	Afrikaans – Proficient English – Proficient
		Qualifications
		<ul style="list-style-type: none"> PhD (North-West University of Potchefstroom) – Environmental Science with Aquatic Ecosystem Health MSc (University of Johannesburg) – MSc (Aquatic Health) Cum Laude BSc. Hons. (Zoology) Cum Laude BSc. Zoology and Human Physiology Pri Sci Nat (138304)

Prasheen Singh

M.Sc Aquatic Health (*Pr. Sci. Nat.*)

Cell: +27 69 206 9440

Email: prasheen@thebiodiversitycompany.com

Identity Number: 8904255091089

Date of birth: 25 April 1989



Profile Summary

Prasheen Singh is a SACNASP registered Professional Scientist in the field of Aquatic Science.

He is an Aquatic Ecologist and Water Quality Specialist whose 12 years' experience comprises numerous Aquatic Scientific Studies, Peer Reviews, Research, and served as a SANAS accredited Technical Signatory at an Ecotoxicology Laboratory. He is also a Steering Committee Member for the Water Research Commission

Prasheen attained his MSc in Aquatic Health at the University of Johannesburg, and completed training courses for wetlands, river eco-status monitoring, hydropedology, and ecosystem restoration.

He has working experience throughout South Africa, specialising in water quality studies, aquatic biomonitoring, compliance audits, rehabilitation plans, monitoring plans and risk assessments. Prasheen is experienced in project management and strives to achieve and maintain scientific excellence in all specialist work.

Areas of Interest

Terrestrial and Aquatic Biodiversity.

Ecosystem Restoration, Protection and Conservation.

Environmental Awareness.

Key Experience

- Freshwater Ecological Studies
- SASS5 Macroinvertebrate Assessments, IHAS & MIRAI
- FRAI & Fish Population Structure Assessments
- Instream and Riparian Integrity Assessments
- Aquatic Impact and Risk Assessments
- DWS Risk Assessments
- Environmental Impact Assessments
- Surface water Quality
- Groundwater Quality
- Wastewater Quality
- SANS241 Drinking Water Quality
- Compliance Monitoring
- Water Use License Audits
- Aquatic Resources Rehabilitation Plans
- Aquatic Resources Monitoring Programs
- Ecotoxicity Testing
- GIS and Sensitivity Mapping (ArcGIS, QGIS)
- IFC Performance Standard 6 Reporting

Geographic Experience

Gauteng, Mpumalanga, Eastern Cape, Western Cape, Northern Cape, North West Province, Free State Province, Limpopo, KwaZulu-Natal
Angola

Nationality

South African

Languages

English – Proficient

Afrikaans – Basic

Qualifications

- MSc (University of Johannesburg) – Aquatic Health (*Cum Laude*).
- BSc Honours (University of Johannesburg) – Biodiversity and Conservation
- BSc (University of Johannesburg) – Life and Environmental Sciences
- Pr. Sci. Nat. (116822) – Aquatic Science
- SASS 5 (2017-2024) – Department of Water Affairs and Sanitation River Health Programme
- River Ecstatus Monitoring Programme Training
- Wetland Management: Introduction and Delineation - University of Free State
- Official DWS Section 21(c) and (i) Water Use Authorisation Training Course – Department of Water and Sanitation
- Hydropedology and Wetland Functioning – Water Business Academy
- Ecosystem Restoration (Part 1 and 2) – Learning for Nature

End of Report -