AQUATIC BIODIVERSITY SPECIALIST ASSESSMENT REPORT FOR THE PROPOSED MAKOPPA SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY

Makhado Local Municipality, Vhembe District Municipality, Limpopo Province, South Africa

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Report Name	**AQUATIC BIODIVERSITY SPECIALIST ASSESSMENT REPORT FOR THE PROPOSED MAKOPPA SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY**	
Specialist Theme	Aquatic Biodiversity Theme	
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Declaration	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.	

Abbreviations

Abbreviation	Definition
ASPT	Average Score per Recorded Taxon
CBA	Critical Biodiversity Area
DO	Dissolved Oxygen
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ECO	Environmental Control Officer
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EN	Endangered
ESA	Ecological Support Area
ETS	Ecosystem threat status
IHI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
LC	Least Concerned
MASL	Meters Above Sea Level
NEMA	The National Environmental Management Act
NFEPA (FEPA)	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
NWA	National Water Act
NWBEST	National Web-Based Environmental Screening Tool
PAOI	Project Area Of Influence
PES	Present Ecological State
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
SCC	Species of Conservation Concern
SQR	Sub Quaternary Reach
TBC	The Biodiversity Company
TWQR	Target Water Quality Range
VU	Vulnerable
WMA	Water Management Area

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Background

The Biodiversity Company was appointed to conduct an Aquatic Biodiversity Specialist Assessment for proposed Tabor Solar Photovoltaic (PV) Energy Facilities. Four (4) facilities are proposed for the Tabor Solar cluster, with associated grid connection lines for each facility. This report assesses the **Makoppa Solar PV Energy Facility**. The other facilities and associated gridlines are assessed separately. The proposed Project Area is located approximately 40 km south of Makhado, and 8.5 km southwest of Bandelierkop, Limpopo Province, South Africa (Figure 1-1).

In order to achieve this a single aquatics survey was conducted on the 6th to 9th of January 2025, which constituted a wet season/high flow survey. A 500 m area has been demarcated for the project to facilitate the identification of water resources 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.

The purpose of the specialist assessment is to provide relevant input into the EA process and provide a report for the activities associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, 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.

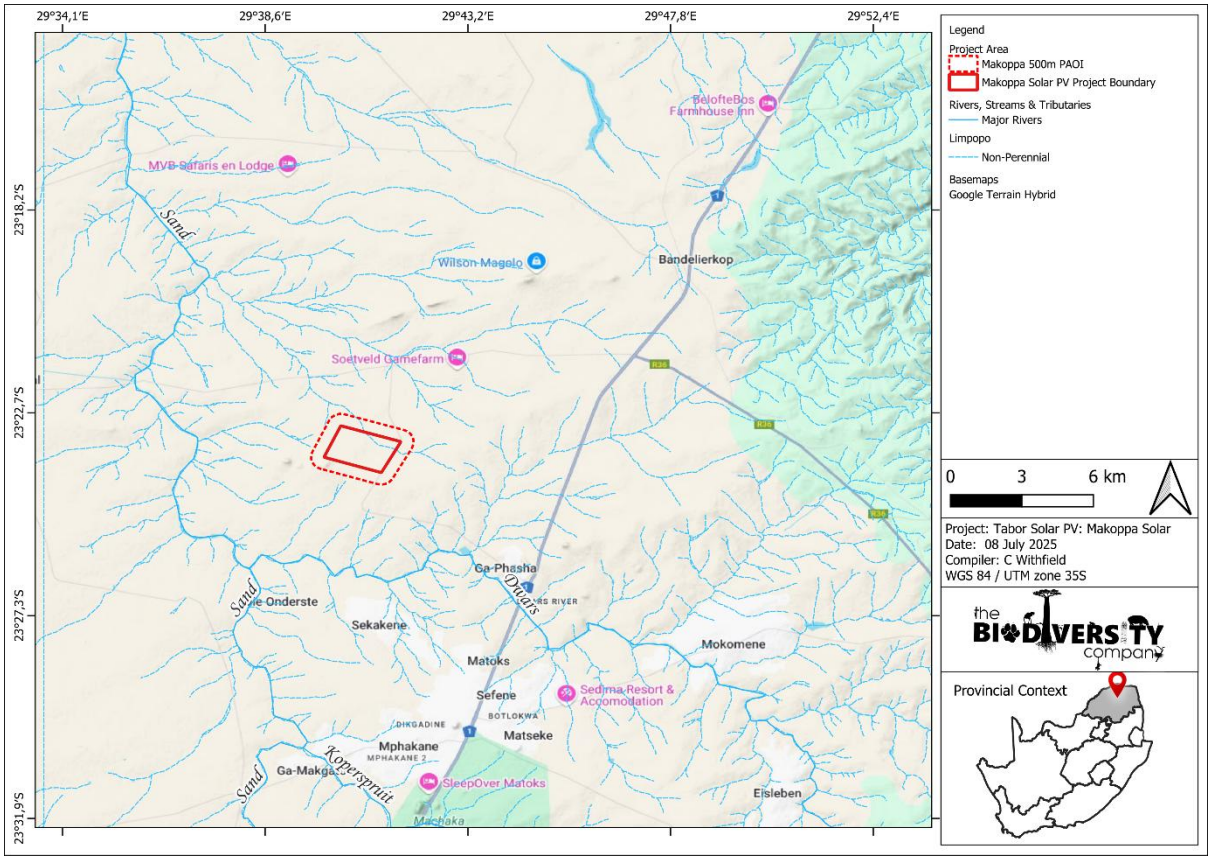

Figure 1-1 Location of the project area and PAOI

1.2 Project Description

The applicant Makoppa Solar PV (Pty) Ltd are proposing the construction of a Solar Photovoltaic (PV) Energy Facility and associated infrastructure, known as the Makoppa Solar PV Energy Facility, on Portion 1 of Farm 465 located South of Louis Trichardt in the Makhado Local Municipality, Vhembe District, Limpopo Province.

A study site of approximately 341 ha is being assessed as part of this Environmental Process and the infrastructure associated with an up to 75 Megawatt (MW) PV facility.

The proposed Makoppa Solar PV Energy Facility will include the following components and is presented in Figure 1-2:

- Solar Field
    - Solar Arrays: PV modules;
    - Single axis tracking technology maximum height of 5 m (aligned north-south);
    - Solar module mounting structures comprised of galvanised steel and aluminium;
    - Foundations which will likely be drilled and concreted into the ground;
    - Solar measurement and weather stations;
    - Central/string Inverters and MV transformers in in field;
    - DC coupled Battery Energy Storage system (BESS) containers distributed through PV field located adjacent to inverters ;
        - Lithium Ion battery Cells, Modules, Racks and containers.
        - Power Conversion Equipment.

        - Battery Management System.
        - Energy Management System.

- Associated Infrastructure
    - Medium Voltage (MV =22/33 kV) overhead powerlines and underground cables;
    - MV Collector stations;
    - Access road;
    - Internal gravel roads;
    - Fencing;
    - General maintenance area;
    - Storm water channels and berms;
    - Water storage tanks and pipelines;
    - Temporary work area during the construction phase (i.e. laydown area) (up to 7 ha);
    - O&M buildings (up to 1 ha);
    - Storerooms;
    - Diesel storage area (up to 0.25 ha).
- Project IPP Substation (up to 1ha);
    - 132 kV substation
    - HV transformer;
    - Substation Control Building;
    - HV metering, Scada and protection building;
    - MV collector switchgear buildings;
    - Compensation equipment (Filters capacitors reactors statcoms).
- AC coupled BESS installation at project substation and laydown area (up to 6 ha);
    - Solid Sate Battery technology - either Lithium-Ion or Sodium Sulphide (NaS)
        - Battery Cells, Modules, Racks and containers;
        - Power Conversion Equipment;
        - Battery Management System;
        - Energy Management System;
        - MV transformers;
        - MV cabling and collector stations;
        - Fencing;
        - Offices, workshop;
        - Fire Protection systems

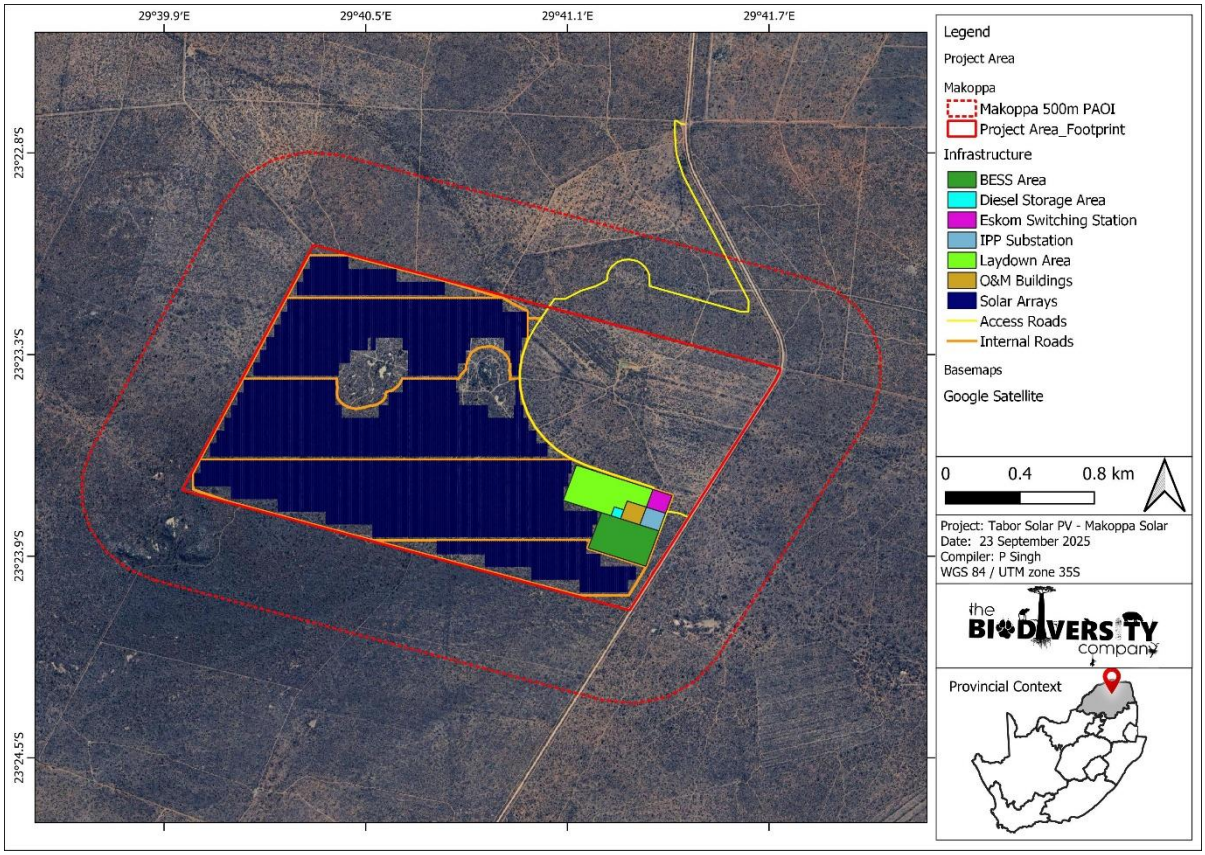

Figure 1-2 Spatial layout of the proposed project infrastructure

This report specifically addresses the proposed Makoppa Solar PV Energy Facility and its associated infrastructure located within the defined facility boundary. It is important to note that the electrical grid connection infrastructure, linking the facility to the Tabor Main Transmission Substation (MTS), is being assessed under a separate Assessment Report, compiled by The Biodiversity Company. The report will provide detailed information on the proposed overhead power line, switching station, and associated access roads.

1.3 Assessment 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 preliminary identify water accumulation areas;
- The delineation of water resources in accordance with the DWAF (2005) guidelines, whereby the outer edges will be identified; and
- A functional and integrity assessment of the water resources.

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;
- It is assumed that the extent of the project area provided to the specialist is accurate;

- 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;
- Standard aquatic methodologies that require presence of water could not be conducted due to the ephemeral nature of the watercourses within the PAOI;
- The survey was limited to sites that were accessible;
- 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
- The GPS used for water resource delineations is accurate to five meters. Therefore, the delineation plotted digitally may be offset by a maximum of five meters 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	National Environmental Management Act (Act 107 of 1998) (NEMA)	Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), Appendix 6 requirements
	NEMA Assessment Protocol (March 2020)	The minimum criteria for reporting.
	NEMA Assessment Protocol (October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	National Water Act (Act 36 of 1998)	The regulation of water use.
	NWA - GN4167 of GG 49833 of 8th Dec 2023	General Authorisations in term of Section 39 of the National Water Act 36 of 1998 for Water Uses as defined in Section 21 (c) and (i)
Provincial	Limpopo Environmental Management Act (No. 7 of 2003)	An Act to consolidate and amend the environmental legislation of or assigned to the Province for matters incidental thereto, making provision with respect to the protection and conservation of the environment. To inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management.
	Limpopo Conservation Plan (2018)	To provide for the management and conservation of the province's biophysical environment and protected areas.

1.6 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources 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 water resources, which includes:

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

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 water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the 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	8.3
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae	8.4
A signed statement of independence by the specialist(s)	8.3
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.	3.1.12
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: (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	-
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: Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	4.3

Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: (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: (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.)	4.3
How will the proposed development impact on key ecosystems regulating and supporting services especially: (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?	4.3
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	8.1
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	3.3 and 3.4
Additional environmental impacts expected from the proposed development	-
Any direct, indirect and cumulative impacts of the proposed development on-site	4
The degree to which impacts and risks can be mitigated	4
The degree to which the impacts and risks can be reversed	4
The degree to which the impacts and risks can cause loss of irreplaceable resources	4
A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies	0
Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr)	4.5
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	6.2

Any conditions to which this statement is subjected	6.2

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 6th to 9th of January 2025 (summer) to identify the presence and condition of freshwater resources 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 within the 500 m PAOI were found during the site visit. Therefore, efforts were afforded to a riverine assessment rather than a wetland assessment for these systems.

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 is not located within any SWSAs for groundwater or surface water.	3.1.1
Conservation Plan	Yes	Whilst the PAOI does not overlap with any Critical Biodiversity Area, the entire PAOI overlaps with Other Natural Areas (ONAs).	3.1.2
National Biodiversity Assessment (NBA)	No	The PAOI does not traverse any NBA Wetlands or NBA Rivers.	3.1.3
Aquatic Ecosystem Threat Status	Yes	Whilst the PAOI does not overlap with any threatened watercourses, it is drained by a tributary of the Sand River, the latter being classified as 'Endangered'.	3.1.4
Aquatic Ecosystem Protection Level	No	The PAOI does not intersect or drain towards any protected watercourses.	3.1.5
National Freshwater Ecosystem Priority Areas (NFEPA)	No	The PAOI does not overlap any NFEPA wetlands, rivers or areas.	3.1.6
Protected Areas	Yes	The PAOI overlaps the Vhembe Biosphere Reserve Conservation Area.	3.1.7
RAMSAR Wetlands	No	The PAOI does not overlap with any RAMSAR Wetlands.	-
Renewable Energy Development Zones (REDZ)	No	The PAOI does not overlap with any REDZ.	3.1.8
Renewable Energy Database	No	The PAOI does not overlap with any approved Renewable Energy Projects.	3.1.9
Strategic Transmission Corridors (EGI)	Yes	The PAOI overlaps with the International 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 ≥ 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 project area is not located within any SWSAs for surface water or groundwater (Figure 3-1).

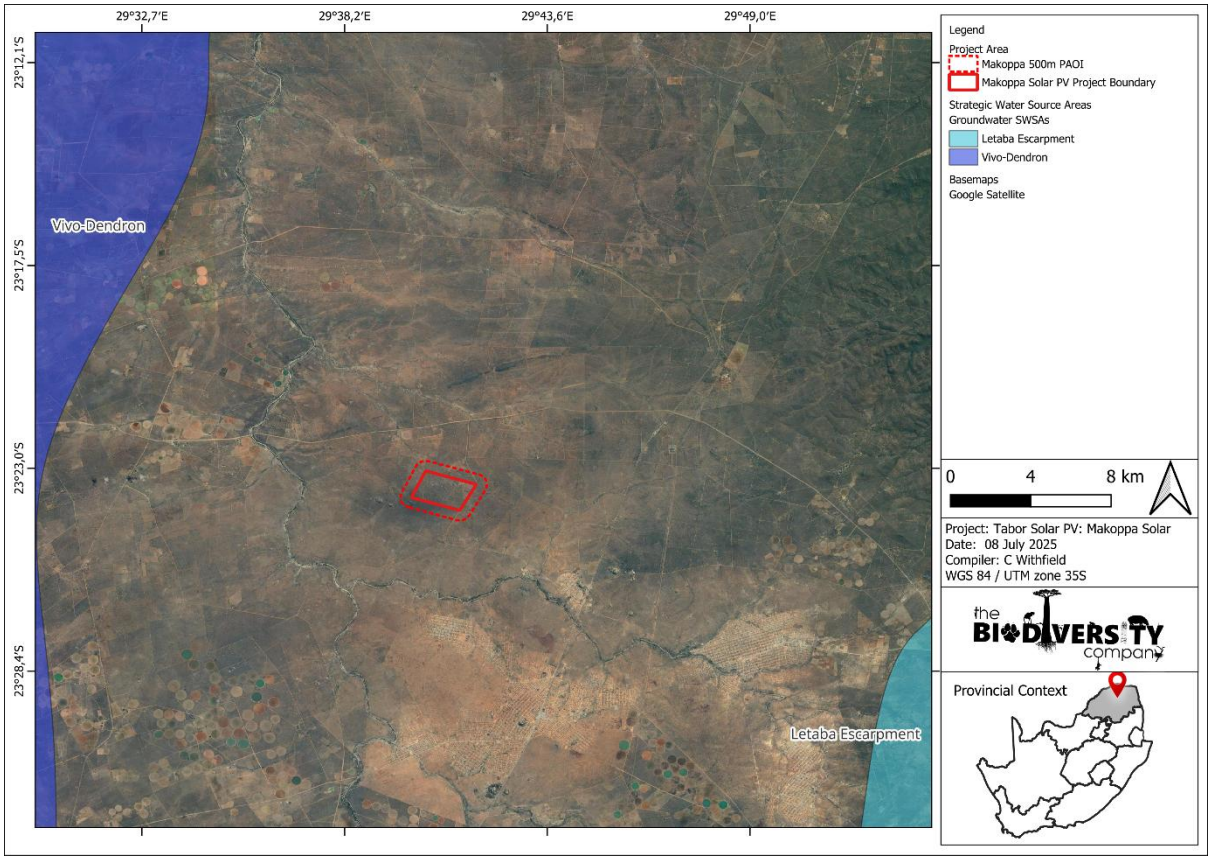

Figure 3-1 Map illustrating the SWSAs in relation to the PAOI

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).

Whilst the PAOI does not overlap with any Critical Biodiversity Area, the entire PAOI overlaps with Other Natural Areas (ONAs) (Figure 3-2).

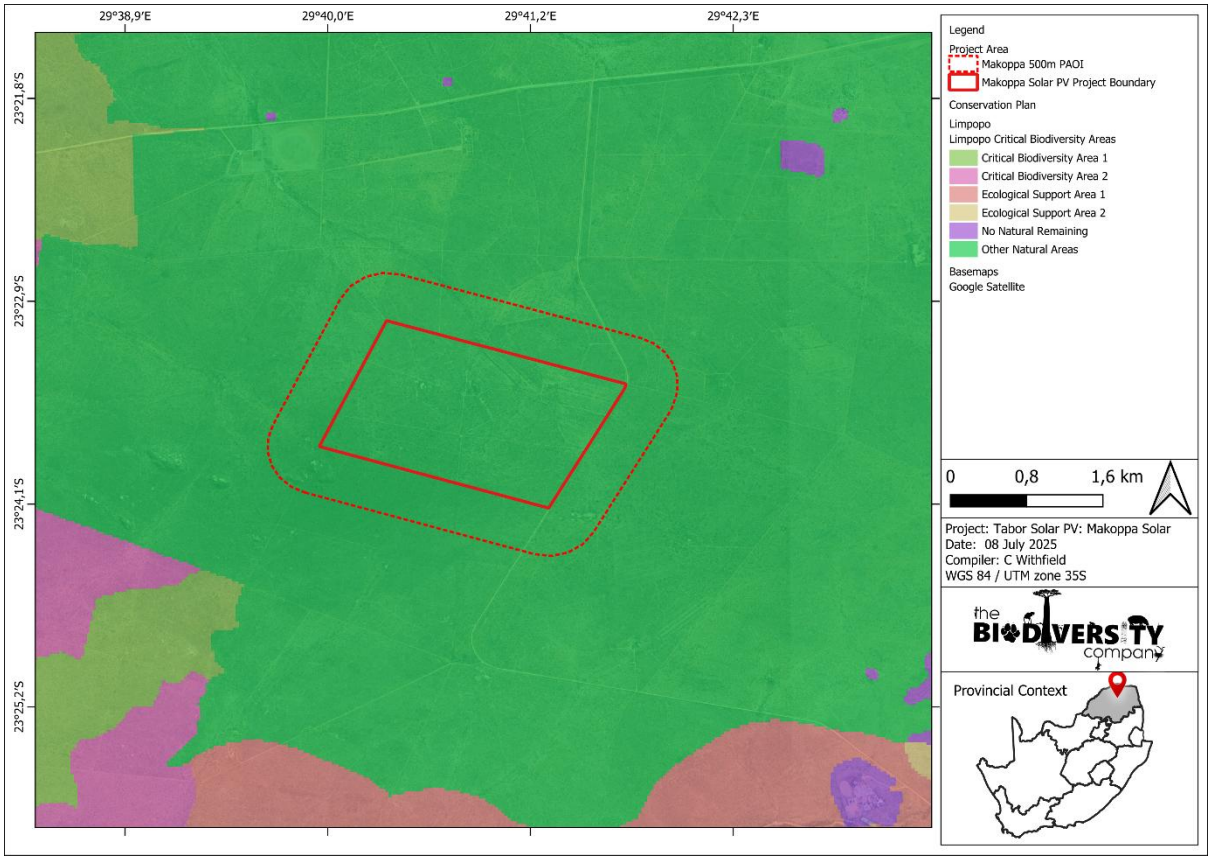

Figure 3-2 The PAOI superimposed on the Provincial Conservation Plan

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 (Figure 3-3) the PAOI does not traverse any NBA Wetlands or NBA Rivers.

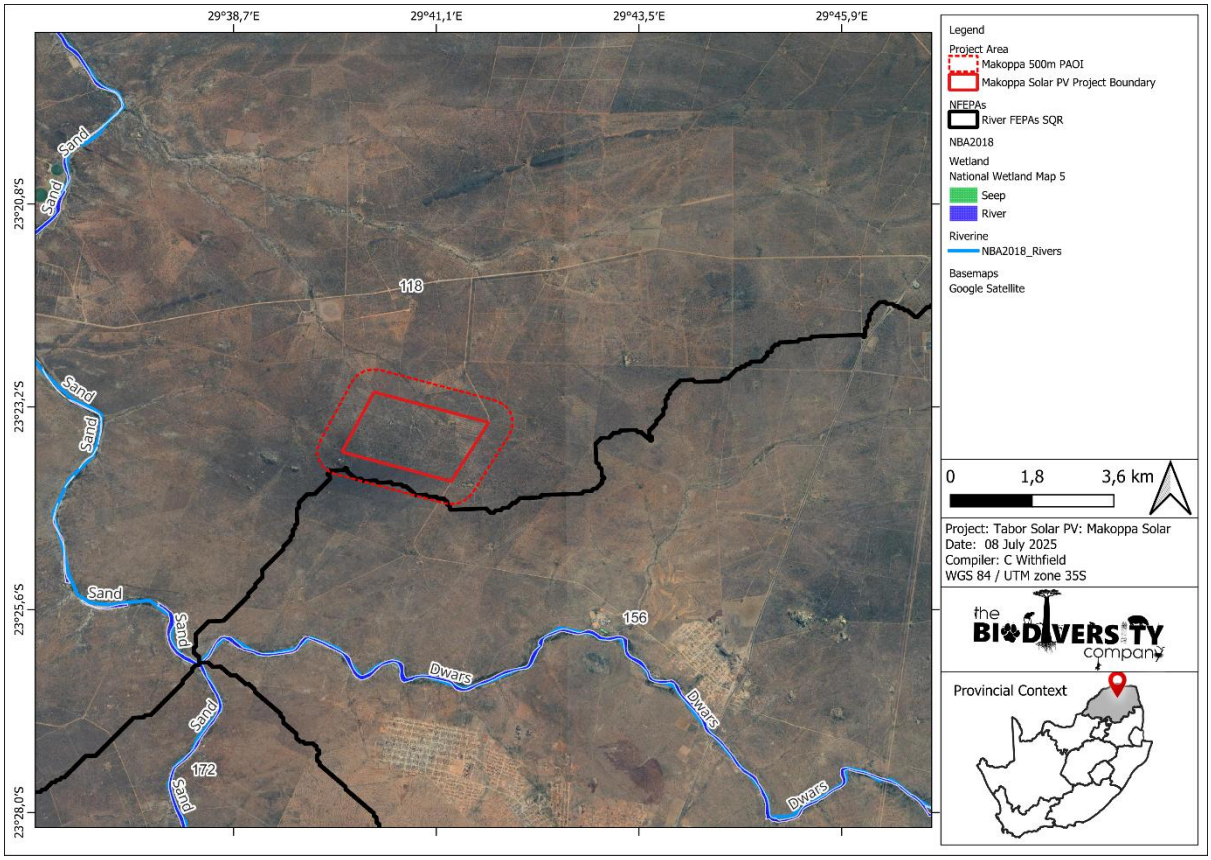

Figure 3-3 Illustration of NBA wetlands and/or rivers within the PAOI (NBA, 2018)

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 (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), 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 does not overlap with any threatened watercourses, however it is drained by a tributary of the Sand River, the latter being classified as 'Endangered' (Figure 3-4), indicating that impacts within the regulated area could potentially result in degradation of the downstream system.

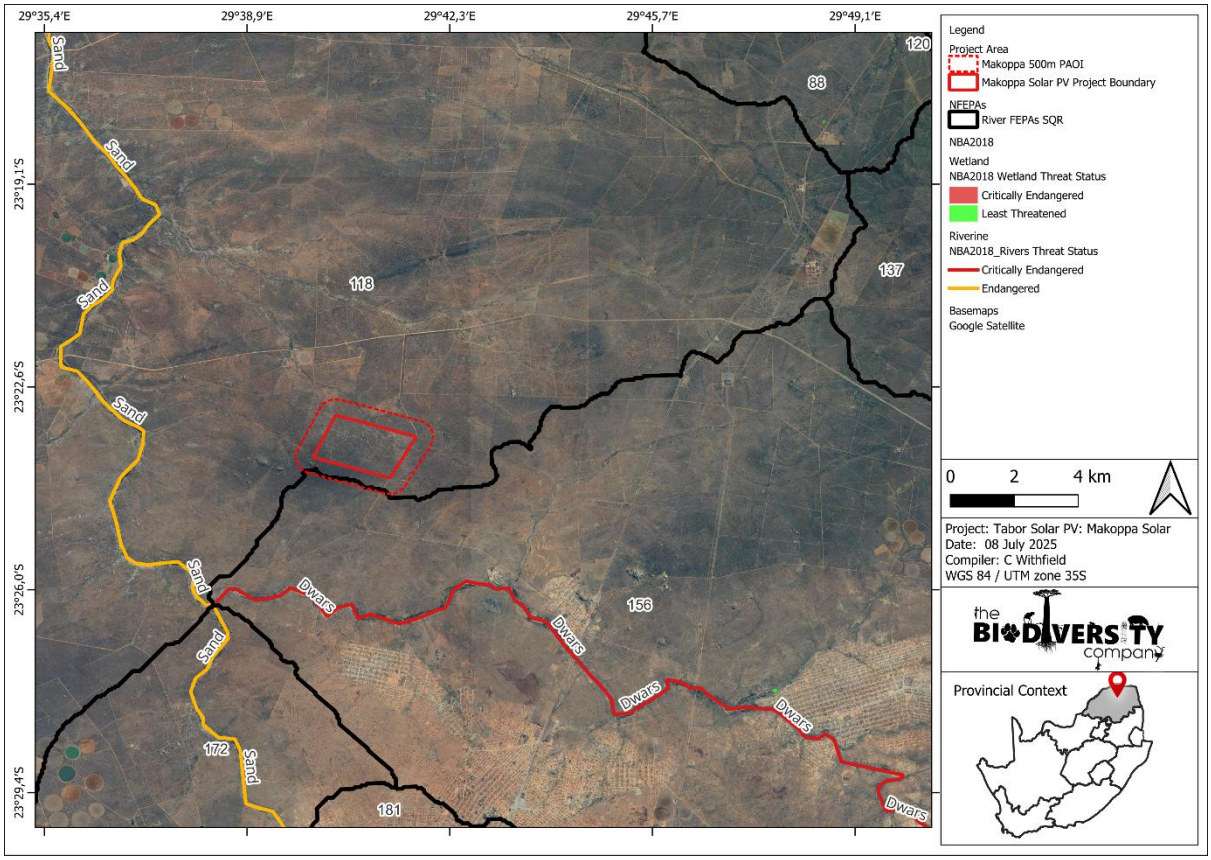

Figure 3-4 The project area showing the regional ecosystem threat status of the associated aquatic ecosystems (NBA, 2018)

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 (Figure 3-5). According to the SAIIAE dataset, the PAOI does not intersect or drain towards any protected watercourses.

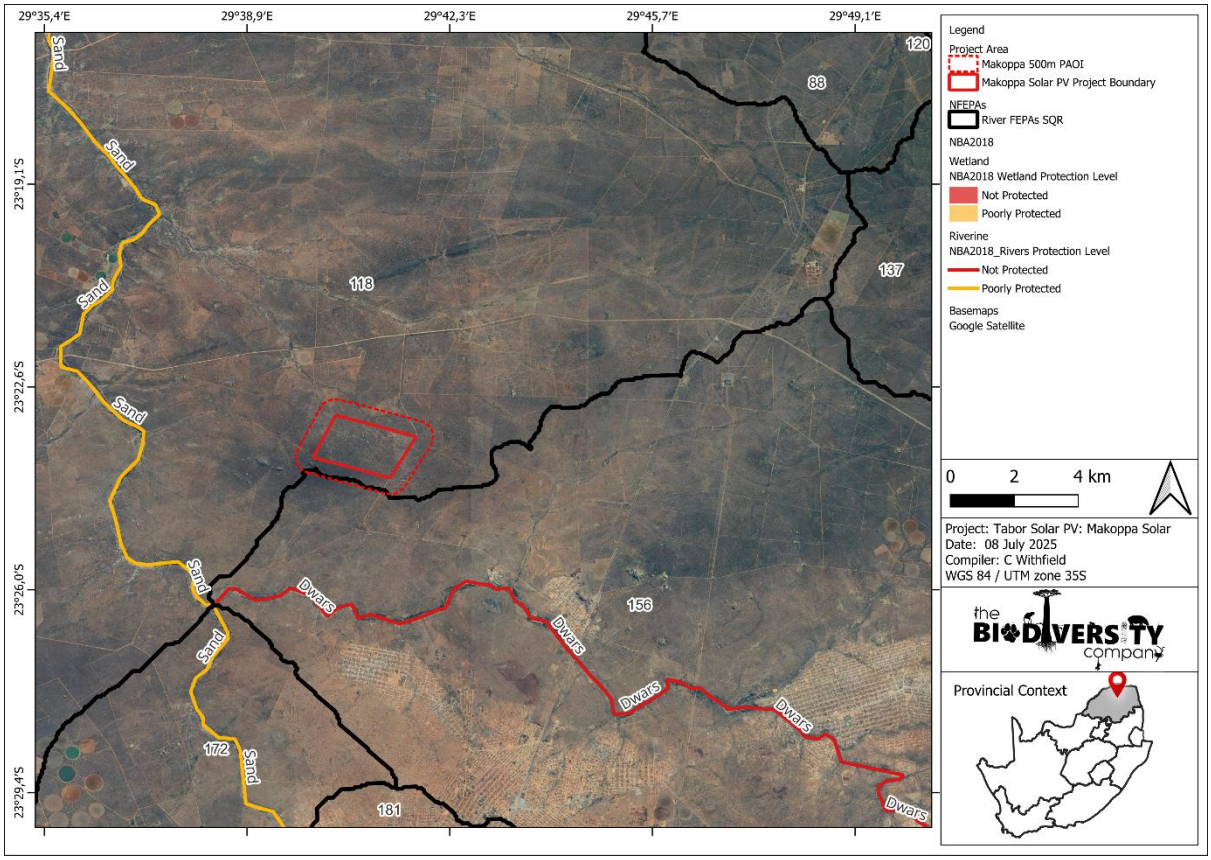

Figure 3-5 The project area showing the regional level of protection of aquatic ecosystems (NBA, 2018)

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 NFEPAs 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 (Figure 3-6), the PAOI does not overlap any NFEPA wetlands, rivers or areas. Conserving the water quality, watercourse 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 water resources in order to contribute to national biodiversity goals and support the sustainable use of water resources.

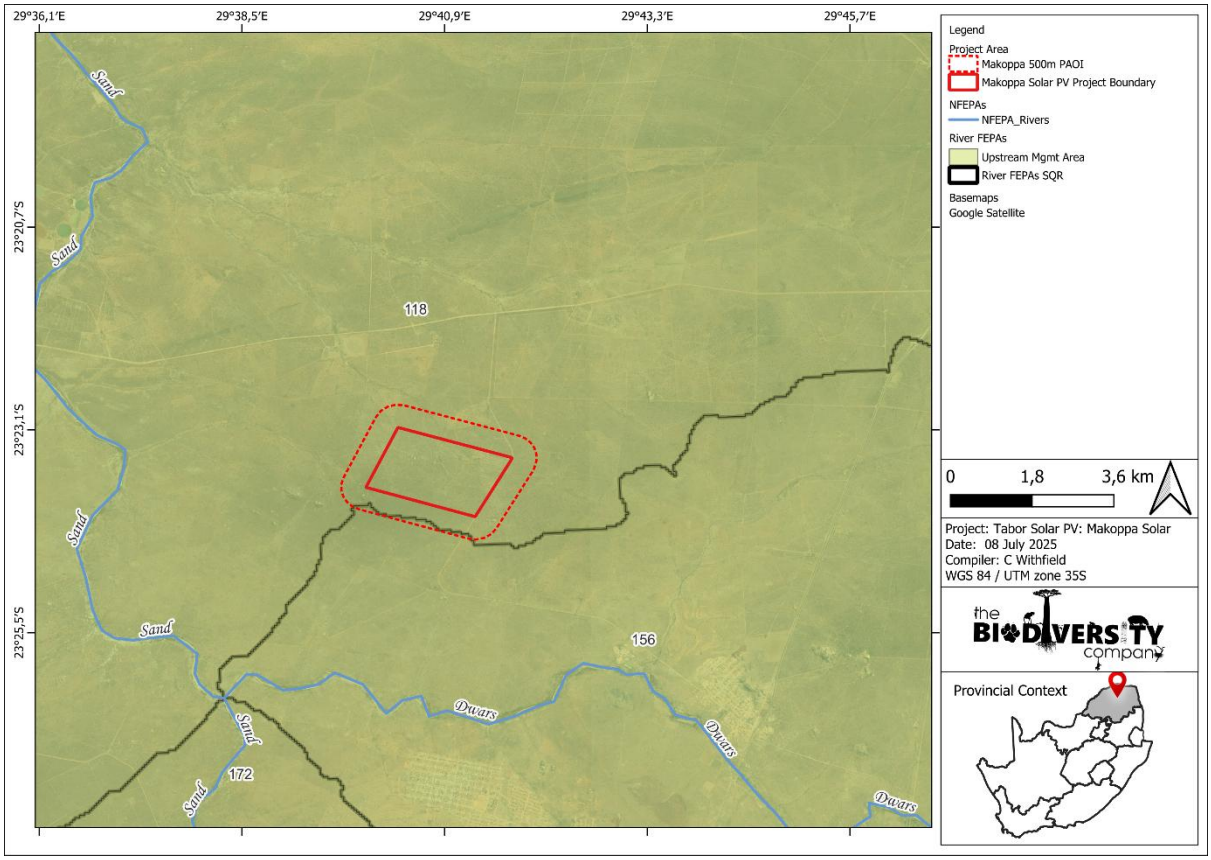

Figure 3-6 NFEPA map for the PAOI (Nel et al., 2011)

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 (2024) and SACAD (2024), the PAOI overlaps with the Vhembe Biosphere Reserve Conservation Area (Figure 3-7).

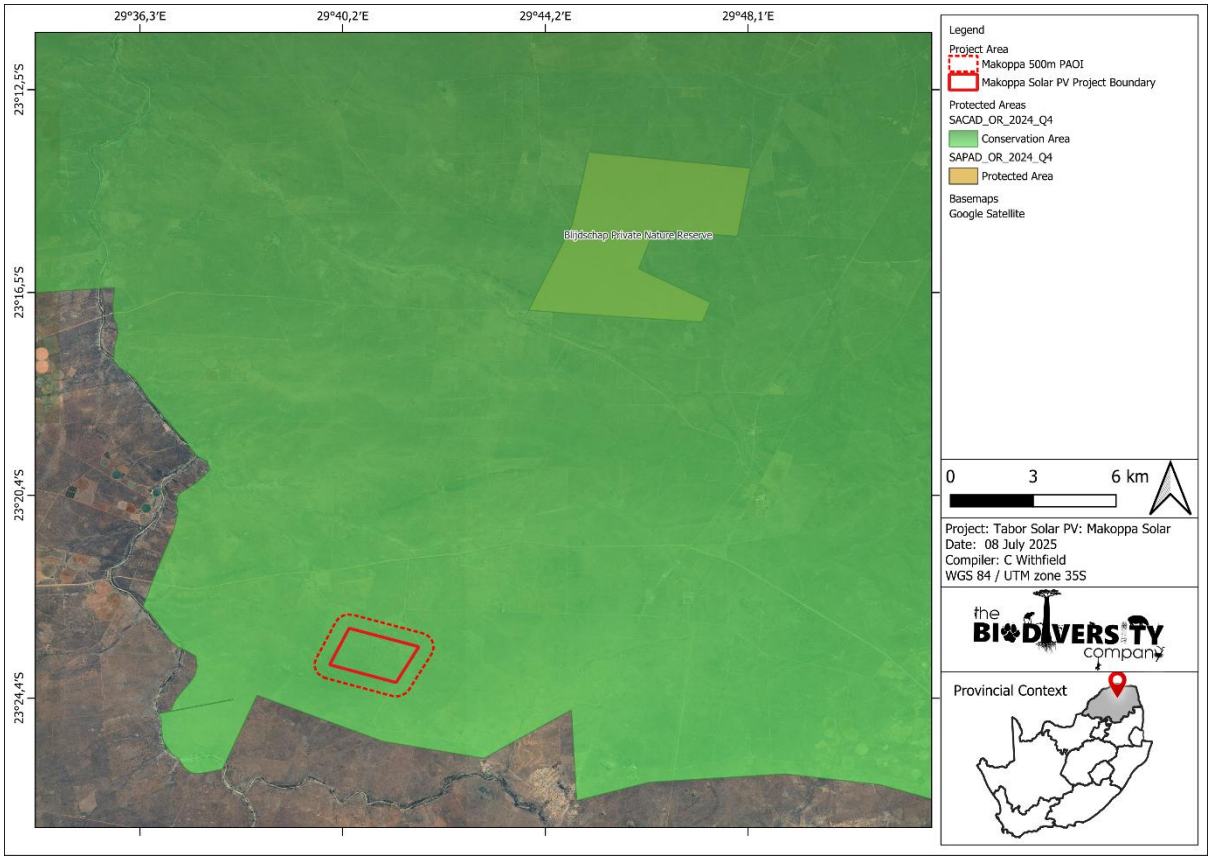

Figure 3-7 The project area in relation to the Protected Areas

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 project area does 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 of a similar nature in the near vicinity of the PAOI (Figure 3-8). This will increase the overall impact on the habitats in the area.

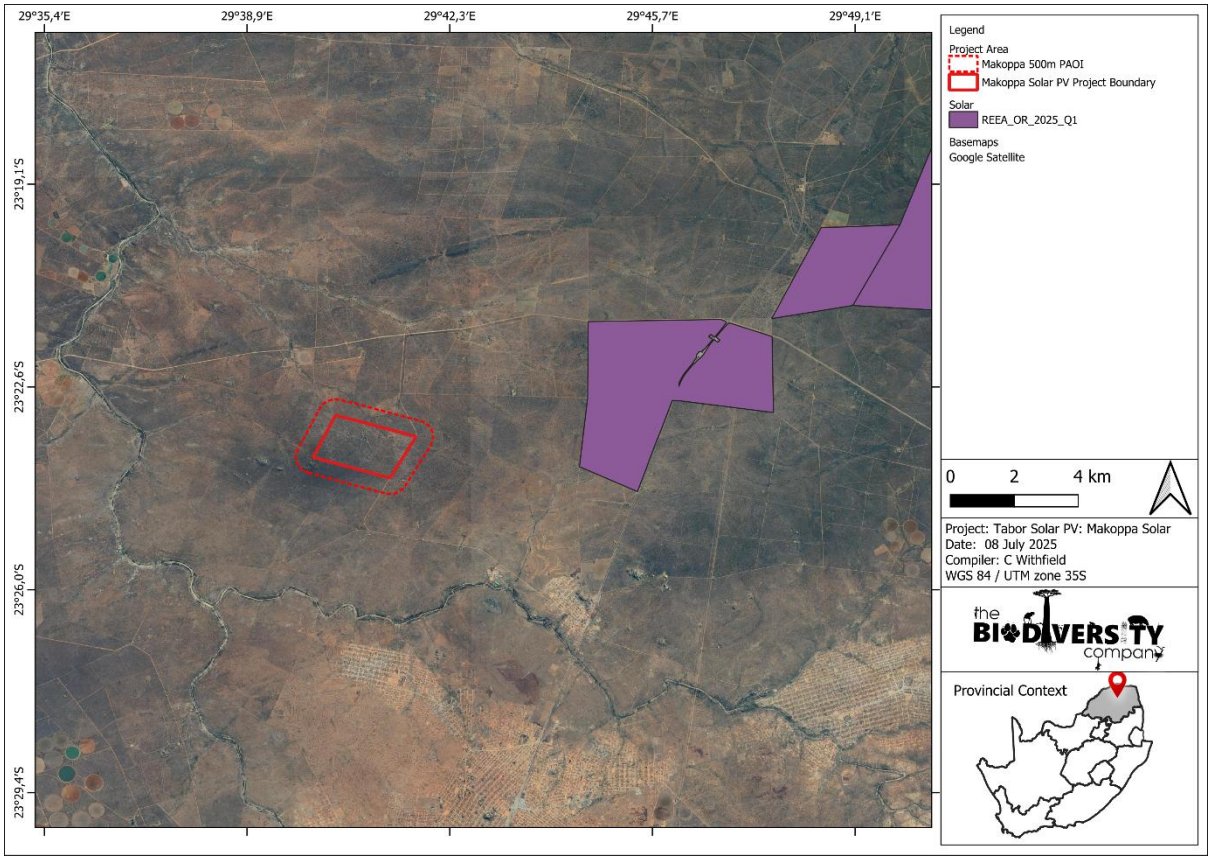

Figure 3-8 The project area in relation to the renewable energy database projects in the area.

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 project area falls within the International Strategic Transmission Corridor (EGI) (Figure 3-9).

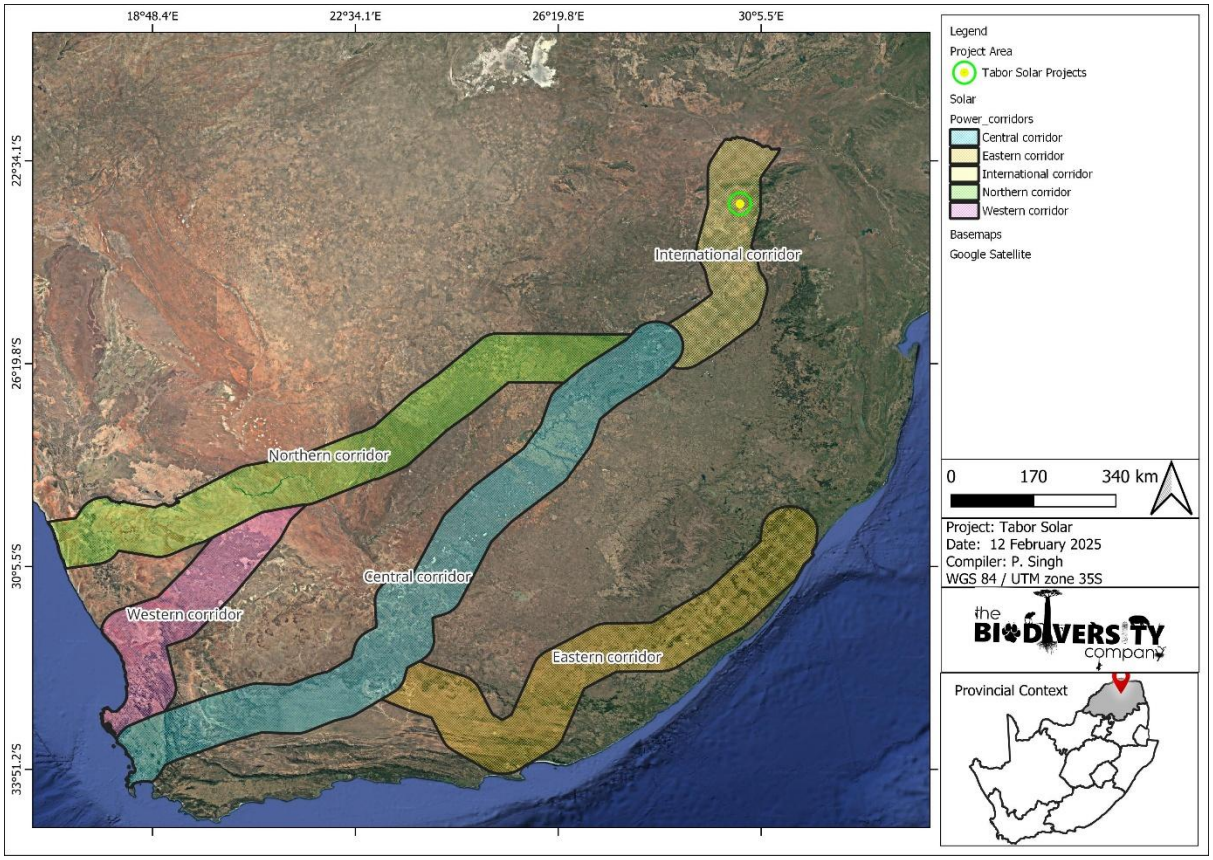

Figure 3-9 The PAOI in relation to the strategic transmission corridors

3.1.11 Freshwater Ecology

The project area falls within the Limpopo_Olifants Water Management Area (WMA) (DWS, 2023), the Limpopo Plain Ecoregion, and within the A71D quaternary catchment (Figure 3-10). Desktop information for the Sub-Quaternary Reaches (SQRs) associated with the PAOI was obtained from the DWS (2014). The PAOI falls within A71D-00118 SQR associate with the Sand River. The Present Ecological State (PES), Ecological Importance (EI), and Ecological Sensitivity (ES) for the SQRs are summarised in Table 3-2. The SQR impacts and activities include grazing (land-use), low water crossings, abstraction, bed and channel disturbance, small (farm) dams, overgrazing/trampling, sedimentation, vegetation removal, agricultural fields, algal growth, erosion, alien vegetation, inundation, irrigation (including runoff/effluent).

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

Component/SQR	A71D-0018 SQR (Sand River)
Present Ecological Status	Moderately Modified (category C)
Ecological Importance (EI)	Moderate
Ecological Sensitivity (ES)	Low

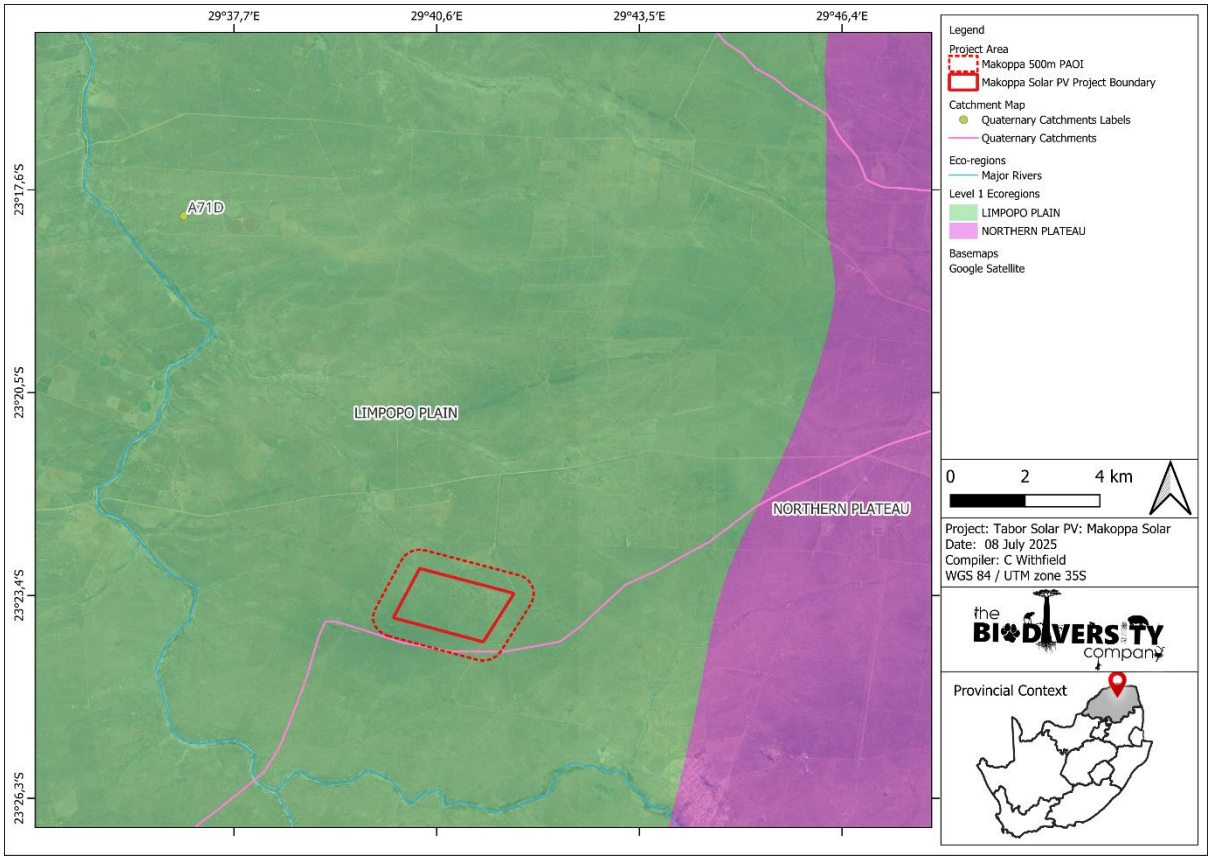

Figure 3-10 Hydrological aspects associated with the project area

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”. Currently there are no RQOs for the associated catchment.

3.2 Survey Results

During the field survey that was conducted between the 6th to 9th of January 2025 the following watercourses were identified within the PAOI:

- Rivers – None.
- Wetlands – None.
- Non-perennial/ephemeral watercourses:
    - Tributary of the Sand River.

The on-site assessment of the watercourses presented largely dry conditions in the tributary of the Sand River as well as the drainage areas, with surface water presence in isolated pools and instream impoundments. Cumulatively these non-perennial systems displayed ephemeral characteristics which is typical for watercourses in a semi-arid region. The watercourses drain the PAOI westward, eventuating in the Sand River. Portions of the watercourses intersect terrestrial habitat, highlighting their interdependence. Despite their current level of modification and ephemeral nature, the watercourses are sensitive to further modification as these systems do provide drinking opportunities (following rainfall) and habitat for foraging, nesting and refugia for terrestrial biota and avifauna (see respective specialist project). 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.

3.2.1 Investigation Sites

A single high flow survey was conducted on the 6th to 9th of January 2025. Sampling points (Figure 3-11) 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. Site investigations were conducted on systems presenting adequate surface water to conduct water quality, biological assessments. Photographs and Global Positioning System (GPS) coordinates pertaining to the sites are presented in Figure 3-11 and Table 3-3.

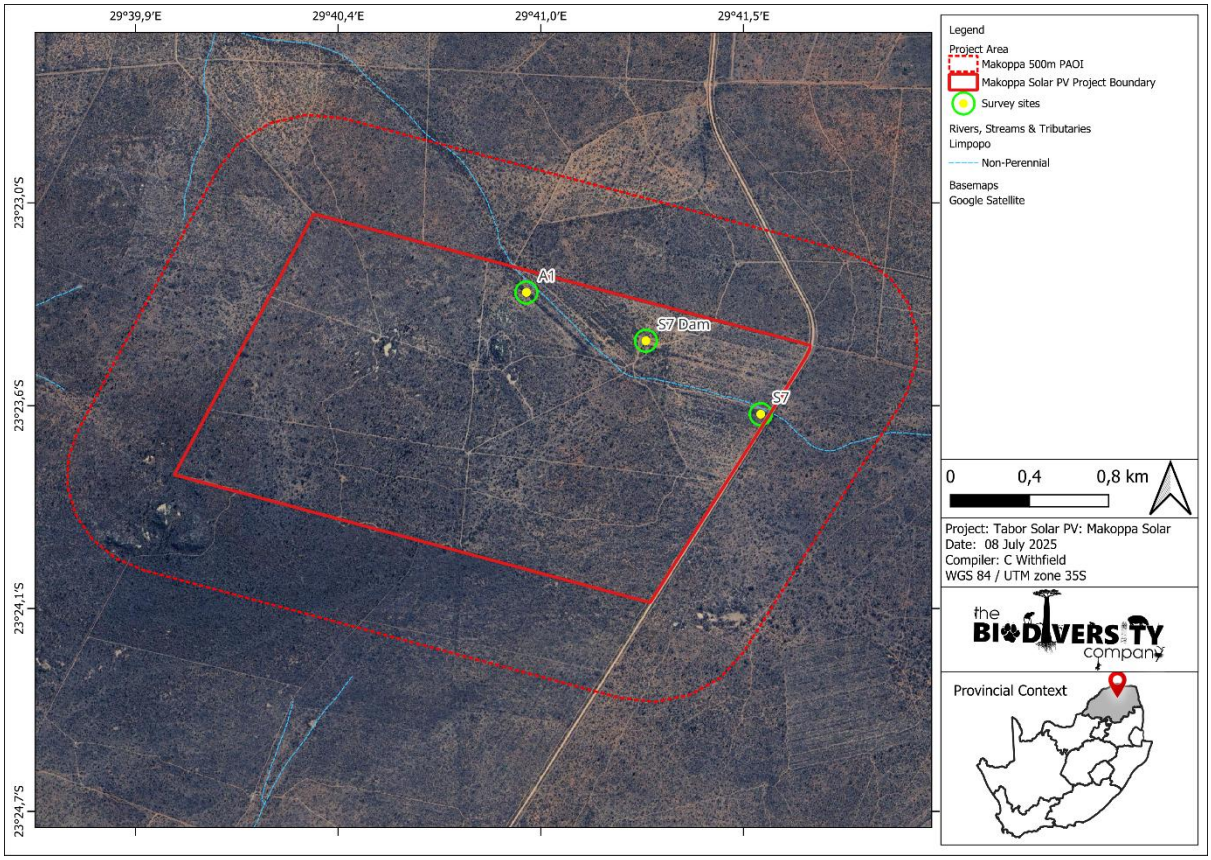

Figure 3-11 Locality map of the sampling sites within the PAOI

Table 3-3 Photos and coordinates for the sites sampled (January 2025)

Site	Upstream View	Downstream View
Sand River Tributary 3		
S7		
GPS	23°23'34.54"S 29°41'33.86"E	

Site	Upstream View	Downstream View
A1		
GPS	23°23'14.65"S 29°40'55.53"E	
Impoundments		
S7 Dam		
GPS	23°23'22.54"S 29°41'15.09"E	

3.2.2 Water Quality

The *in-situ* results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms. The *in-situ* results recorded during the January 2025 study are presented in Table 3-4. Results have been compared to the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996), DWAF (2011a) and Chapman and Kimstach (1996). Sites were listed in a downstream direction for better interpretation of the results.

Table 3-4 In-situ water quality results for the project area (January 2025)

Parameters	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
Limits	**6.5-8.4*** **	**500*** **	**>5.0** **	**5-30***
Sand River Tributary 3				
S7	Dry			
A1	Dry			
S8	Dry			
Impoundments				
S7 Dam	8.43	12.1	6.2	30.9
S8 Dam	8.21	108.7	5.4	25

Levels exceeding recommended guideline levels are indicated in red.
* TWQR – Target Water Quality Range (DWAF, 1996)
** Chapman and Kimstach (1996)
*** – Planning level water quality RSA (DWA, 2011a)

The sites within the PAOI were dry at the time of the survey. Therefore, instream impoundments (S7 Dam and S8 Dam) within the PAOI will be referred to for water quality. The *in-situ* water quality results indicated no water quality perturbations within Sand River Tributary 3 (as indicated by site S7 Dam and S8 Dam). pH levels, electrical conductivity (EC) and dissolved oxygen (Do) were within the acceptable limits, therefore indicative of limited to no pollution within the catchment. Water temperature at S7 Dam did not meet the acceptable limits. This was expected due to the site being an instream impoundment in a semi-arid location. Water quality may therefore limit the diversity and abundance of aquatic biota within the system, and may only be optimal for tolerant aquatic organisms. The water quality observed may be considered baseline/reference water quality for this reach of the tributary within the PAOI. It should be noted that *in-situ* water quality provides a simplistic overview of physical water quality parameters and aids in the interpretation of biological results.

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 completed for the assessed Sand River Tributary 3 within the project area.

The results for the instream and riparian Index of Habitat Integrity (IHI) assessment for the associated river reaches are presented in Table 3-5. IHI was conducted to determine the PES of the system. According to the IHI results, the instream and riparian habitat of. The instream and riparian habitat of Sand River Tributary 3 was rated as ‘Largely Natural’ (class B), indicating that a loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged. Anthropogenic activities within the local area and catchment that have contributed to the deteriorated state of the system include networks of roads and gravel roads as well as instream impoundments leading to inundation, flow modifications and channel modifications. This combination of impacts has resulted in habitat loss, flow modification, and therefore impacts to instream and riparian integrity.

Table 3-5 Results for the Instream Habitat Integrity assessment for the associated reaches (January 2025)

Instream Criteria	Sand River Tributary 3 (Site S7 and A1)
Water abstraction	5
Flow modification	8
Bed modification	8
Channel modification	8
Phys-chem modification	2
Inundation	2
Alien macrophytes	0
Introduced aquatic fauna	0
Rubbish dumping	0
Instream Habitat Integrity Score	**83**
Instream Habitat Integrity Category	**B**

Riparian Criteria	Sand River Tributary 3 (Site S7 and A1)
Vegetation removal	7
Exotic vegetation	1
Bank erosion	6
Channel modification	6
Water abstraction	4
Inundation	2
Flow modification	7
Phys-chem	2
Riparian Zone Integrity Score	**82**
Riparian Zone Integrity Category	**B**

3.2.4 Aquatic Macroinvertrebrates

3.2.4.1 Macroinvertebrates Habitat

Biological SASS5 assessments could not be completed as the watercourses did not qualify for assessment according to the method (Dickens and Graham, 2002).

3.2.5 Fish Community Structure

An expected fish species list was composed for the system based on habitat preferences and distribution(

Table 3-7). 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; 2024). Five (5) indigenous fish species were expected to occur in the Sub Quaternary Reach (SQR). It should be noted that these expected species lists are compiled on a SQR basis by DWS (2014) and not on a site-specific basis. It is therefore highly unlikely that all the expected species will be present at every site in the SQR with habitat type and availability being the main driver of species present. No 'Endangered' (EN) fish species were expected within the study area, however, one (1) South African 'Vulnerable' (VU) species is expected within the system (*Oreochromis mossambicus*) (IUCN, 2025). No fish were collected within the PAOI.

Fish species have different sensitivities to physiochemical and flow modification (Table 3-6) and therefore this was considered for the expected fish species assemblage. This indicated that the average expected assemblage is moderately tolerant to changes in flow and physiochemical modification. The average results for the observed community indicated that the community were tolerant to changes in flow and physiochemical modifications.

Table 3-6 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

Table 3-7 Summary of the expected fish species and sensitivity for the project area (January 2025)

Scientific name	Common name	IUCN Status (IUCN, 2025)	Sensitivity - Flow	Sensitivity - PhysChem	Collected
Clarias gariepinus	Sharptooth Catfish	LC	2.30	1.80	No
Enteromius paludinosus	Straightfin Barb	LC	2.70	1.80	No
Enteromius trimaculatus	Three Spotted Barb	LC	1.70	1.00	No
Pseudocrenilabrus philander	Southern Mouthbrooder	LC	0.90	1.30	No
Oreochromis mossambicus	Mozambique Tilapia	VU	1.00	1.40	No
Total Exotic Species Sampled					**0**
Total Indigenous Species Sampled					**0**

*IUCN: International Union for the Conservation of Nature
**Skelton (2024).
LC: Least Concern
VU: Vulnerable
Exotic species indicated in Red

Oreochromis mossambicus (Mozambique tilapia) is currently listed as Vulnerable (VU). The most serious threat facing *O. mossambicus* is hybridization with the rapidly spreading introduced species *Oreochromis niloticus* (Nile tilapia) (IUCN, 2021). Hybridization has already been documented throughout the northern part of the species' range, with most of the evidence coming from the Limpopo River catchment (IUCN, 2021). Given the rapid spread of *O. niloticus* it is anticipated that O. mossambicus will qualify as threatened under Criterion A due to rapid population decline through hybridization (IUCN, 2021). *Oreochromis mossambicus* occurs in all but fast flowing waters and is tolerant of high salinities. It feeds on algae and invertebrates. The clearest morphological indicator of hybridization between *O. mossambicus* and *O. niloticus* is barring on the caudal fin. No traces of hybridization were recorded amongst the O. *mossambicus* recorded in the project area although DNA analysis would be needed in order to confirm this (IUCN, 2025).

3.2.6 Present Ecological Status

Due to the ephemeral nature of the watercourses within the PAOI, standard aquatic methods could not be conducted. The Index of Habitat Integrity (IHI) model v2 as described in Kleynhans (1996) was therefore used to determine the Present Ecological State (PES) of these watercourses. The results are summarised in Table 3-8 below.

Table 3-8 Summary of the results (January 2025)

	Sand River Tributary 3 (Site S7, A1 and S8)
Instream Ecological Category (IHI)	B
Riparian Ecological Category (IHI)	B
Aquatic Invertebrate Ecological Category	Not Applicable
Fish Community	Not Applicable
PES	**B (Largely Natural)**
PES (DWS, 2014) – SQR A71D-00118	C (Moderately Modified)
Management Objective	Maintain PES

3.3 Riparian Delineations, Buffer Requirements and Regulated Areas

The riparian areas along the assessed watercourses were delineated according to DWAF (2005), 5 m contour data, the SAIIAE 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 3-13. 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.

The watercourses considered in this assessment represented ephemeral system characteristics that have naturally been subjected to instream erosion and sedimentation compounded by surface flow alterations (gravel road crossings and instream impoundments). Riparian areas comprised of a mix of herbaceous species and woody species present. Despite alteration, these areas were considered to be largely intact.

The ecological sensitivity of the watercourses draining the PAOI was determined to be 'Medium' and largely uniform across the project area. The watercourses presented evidence of reliance/ dependence on these systems by terrestrial biota (in times of surface water presence after rainfall), foraging, nesting and refugia, with animal tracks observed in the substrates in/proximal to majority of the watercourses. Despite the absence of water and consequently aquatic taxa at the time of the survey, all of the watercourses in the project area are regarded as sensitive environments in relation to changes in habitat integrity, flow and water quality (ecological drivers).

Given the varied geomorphological features of the watercourses, watercourse extents were mapped with associated sensitivity assigned by identifying vegetation features on aerial imagery and confirmation through ground truthing during the survey. A diagrammatic example of the typical watercourse extent as well as where appropriate buffer areas are located is provided in Figure 3-12. All infrastructure should avoid any 'Medium' sensitivity areas. The 'Medium' sensitivity areas are to be treated as no-go areas, allowing only minimum critical watercourse crossing in these areas.

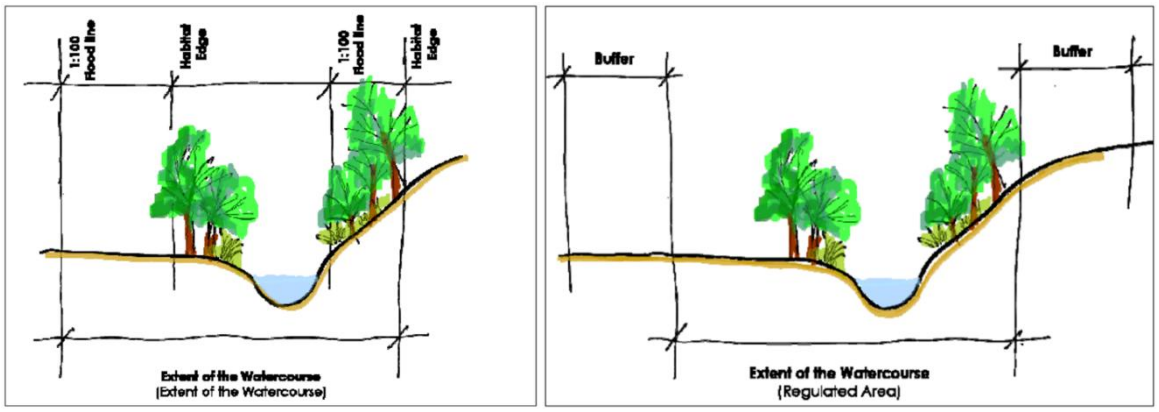

Figure 3-12 Illustration of the extent of a watercourse and the Regulated Area (DWA, 2012)

A minimum buffer zone strip of at least 32 meters wide is required for rivers as per NEMA (Act no. 107 of 1998). Using this sensitivity and the buffer tool (Macfarlane, *et al*., 2014), a conservative buffer zone of **20 m** was suggested for the watercourses within the PAOI (Figure 3-13). These buffer areas serve as **No-go** zones for unauthorised activities. The site development plan should therefore be created accordingly. Ensuring buffers are intact increases the resilience of a watercourse to future disturbances.

3.3.1 Regulation Zones

Table 3-9 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. The proposed activities would traverse or be located in proximity to regulated areas, and therefore the project will fall within the NEMA Act 107 and DWS GN 4167 regulated zones. The regulated areas have been applied to the delineations within the PAOI and presented in Figure 3-13).

Table 3-9 The legislated zones of regulation

Regulatory authorisation	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). **Department of Water and Sanitation (DWS)**	Government Notice 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: • 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.
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)**	**Activities of Listing Notice 1 (GN 983) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended):** **Activity 12:** The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres;or (j) infrastructure or structures with a physical footprint of 100 square metres or more. where such development occurs: a) within a watercourse; b) in front of a development setback; or c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse. Excluding – …(dd) where such development occurs within an urban area… **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 (i) a watercourse; (ii) the seashore; or (iii) 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— but excluding where such infilling, depositing, dredging, excavation, removal or moving— (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) 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,*

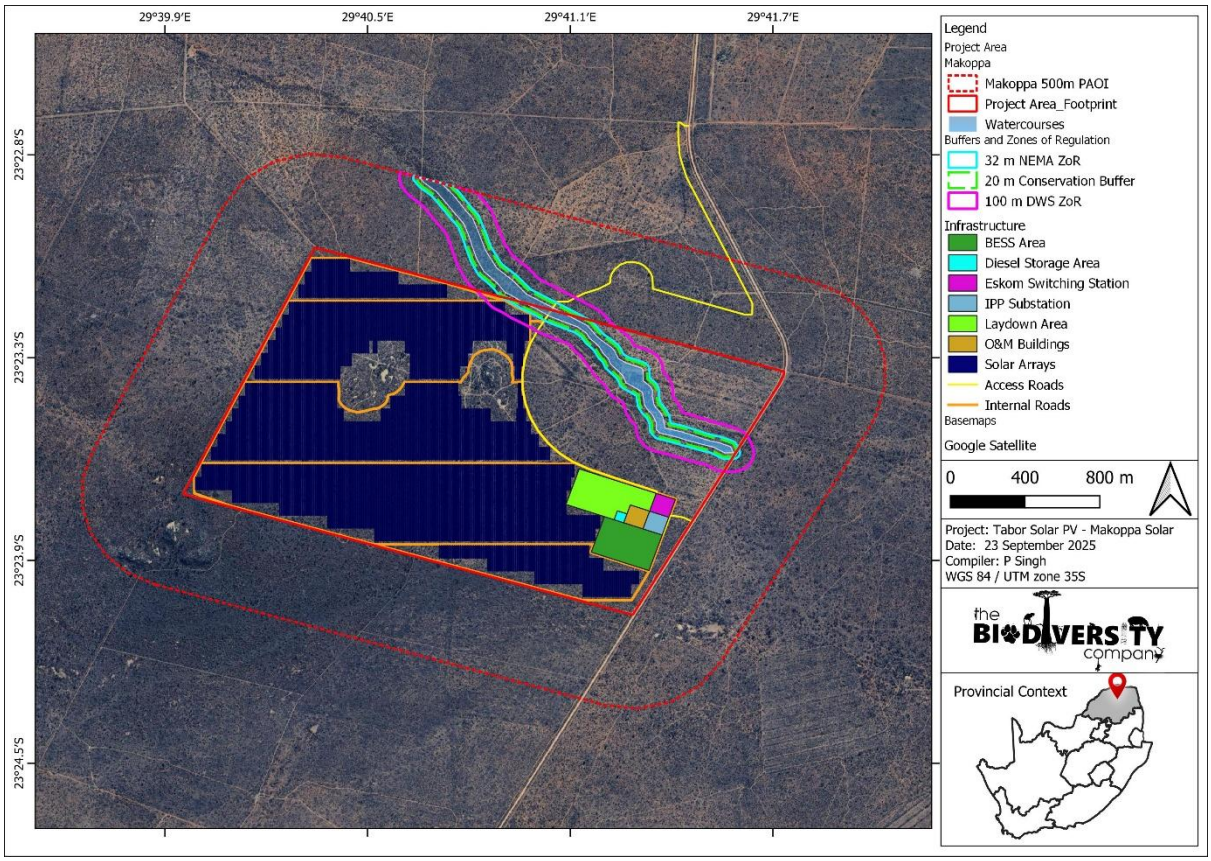

Figure 3-13 Riparian areas, regulated areas and sensitivity buffers for the proposed PAOI

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 “Low” (Figure 3-14).
- Table 3-10 provides a comparison between the Environmental Screening Tool and the specialist determined Site Habitat and System Characterisation. The specialist-assigned sensitivity ratings are based largely on the functionality assessment processes, and consideration is given to any observed or likely presence of Species of Conservation Concern (SCC). As the project area and proposed activities are located in the Vhembe Biosphere Reserve Conservation Area, and is in close proximity to watercourses, the sensitivity should therefore be regarded as “Medium” (Figure 3-15). The SQR includes the possible presence of one (1) South African fish species that is rated “Vulnerable” by the IUCN (2025).

Table 3-10 Sensitivity features associated with Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

Sensitivity	Features	Specialist Verification
Low	Low sensitivity	**Disputed. Medium and Low aquatic sensitivity areas present.** The Project Area and PAOI includes non-perennial/ephemeral watercourses

*Screening tool uses metadata from 2018 NBA

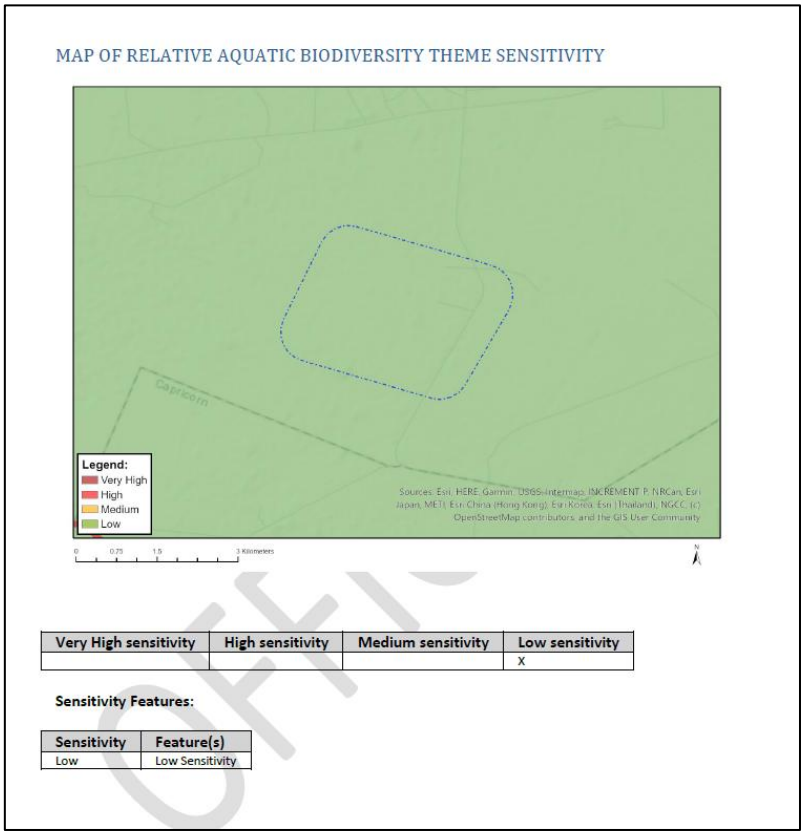

Figure 3-14 Aquatic Biodiversity Theme Sensitivity for the Project Area and PAOI

The freshwater ecology of the immediate project area and further downstream areas are considered sensitive to disturbance from a hydrological and biological perspective, however due to the ephemeral nature of the watercourses, this sensitivity applies more to the watercourses' physical characteristics that influence the hydrological and biological aspects in times of surface water presence/ inundation. This will include all watercourses within the project area which are considered sensitive due to their relatively small spatial scale when compared to adjacent terrestrial habitat with a large demand for the ecosystem services which they provide. Construction and operation activities must take cognisance of this and avoid any unnecessary disturbance of the watercourses and adjacent habitat Figure 3-15. All infrastructure should avoid any 'Medium' sensitivity areas. The 'Medium' sensitivity areas are to be treated as no-go areas, allowing only minimum critical watercourse crossing in these areas.

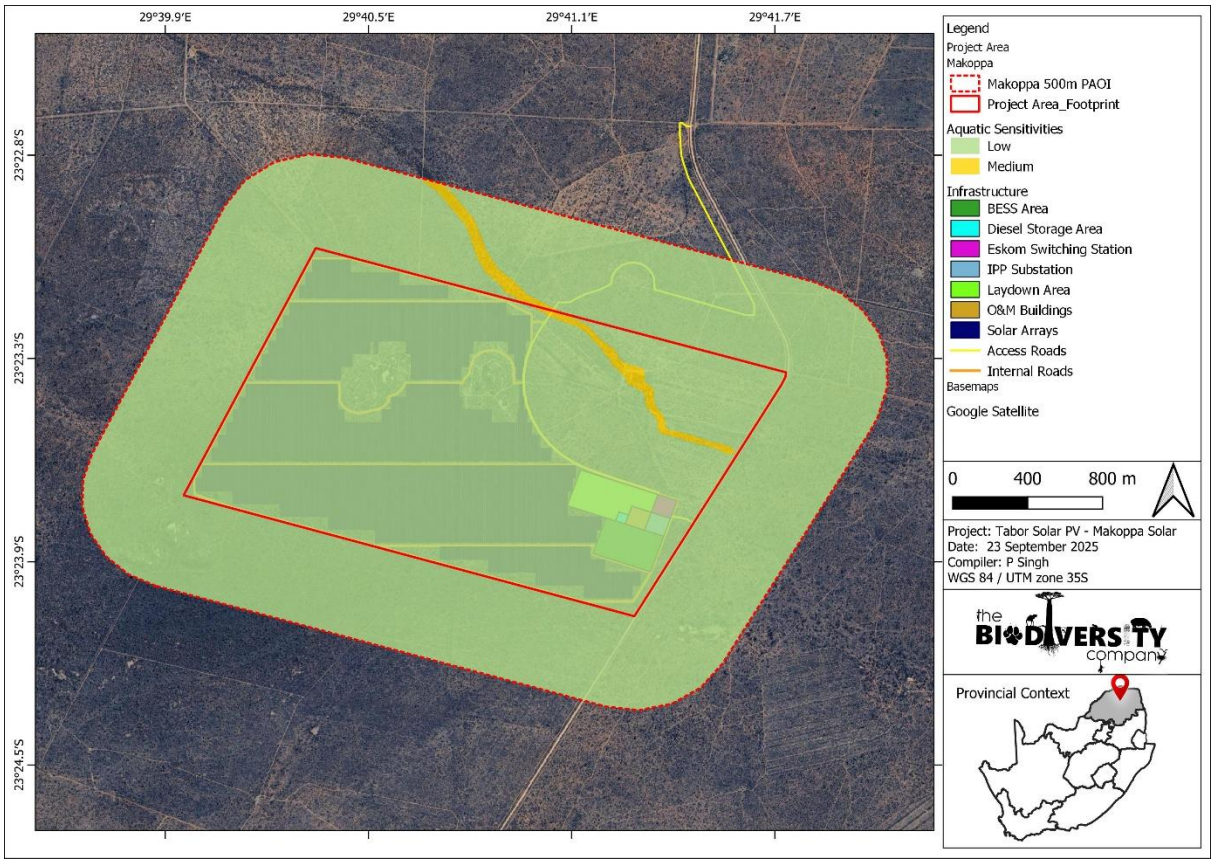

Figure 3-15 Aquatic delineated sensitivity for the PAOI

4 Risk and Impact Assessment

4.1 Current Impacts on Freshwater Biodiversity

The assessed watercourses exhibit impacts on both the catchment and local scale. These impacts, albeit of low/limited intensity, result from present and historical land use in proximity to water resources which have transformed their habitats and altered their natural hydrological regime as well as species composition. The list below refers to the present-day local impacts associated with the assessed freshwater areas:

- Historic land modification from reference conditions;
- Farm roads and main roads (and associated altered surface hydrology and wash of hydrocarbons into watercourses. Both formal and informal river crossing structures have altered instream flow characteristics);
- Game farms, fences and associated maintenance resulting in habitat fragmentation;
- Grazing and trampling of natural vegetation by livestock in watercourse areas;
- Erosion from variable slopes, embankments and roads (especially crossings and roads lacking anti-erosion measures);
- Instream impoundments;
- Instream sedimentation; and
- Existing Overhead powerlines (OHLs) and associated servitudes.

4.2 Alternatives Considered

Alternatives were not presented at the time of report compilation. As a result, any mitigation or management efforts were focused on the current proposed project within the proposed setup/footprint.

4.3 Loss of Irreplaceable Resources

The freshwater ecology of the project area is considered moderately sensitive to disturbance from a hydrological, biological and conservational perspective. This includes the 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.

4.4 Quantitative Risk and Impact 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 4-1). 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 water resources within and close to the project area. Mitigation measures should be implemented to negate potential impacts on the water resources associated with the project area.

A single risk assessment was compiled for the project, which relates to the Solar PV Energy Facility and associated activities post-mitigation. The DWS Risk Assessment Matrix (GN 4167) was used to assess both risks and impacts anticipated from the proposed activities as it is in the specialist's opinion

that is suitable and sufficient to assess risks to associated water resources and can be used to apply for the full EIA. This applies to all proposed activities of Section 21 (c), and (i) water uses.

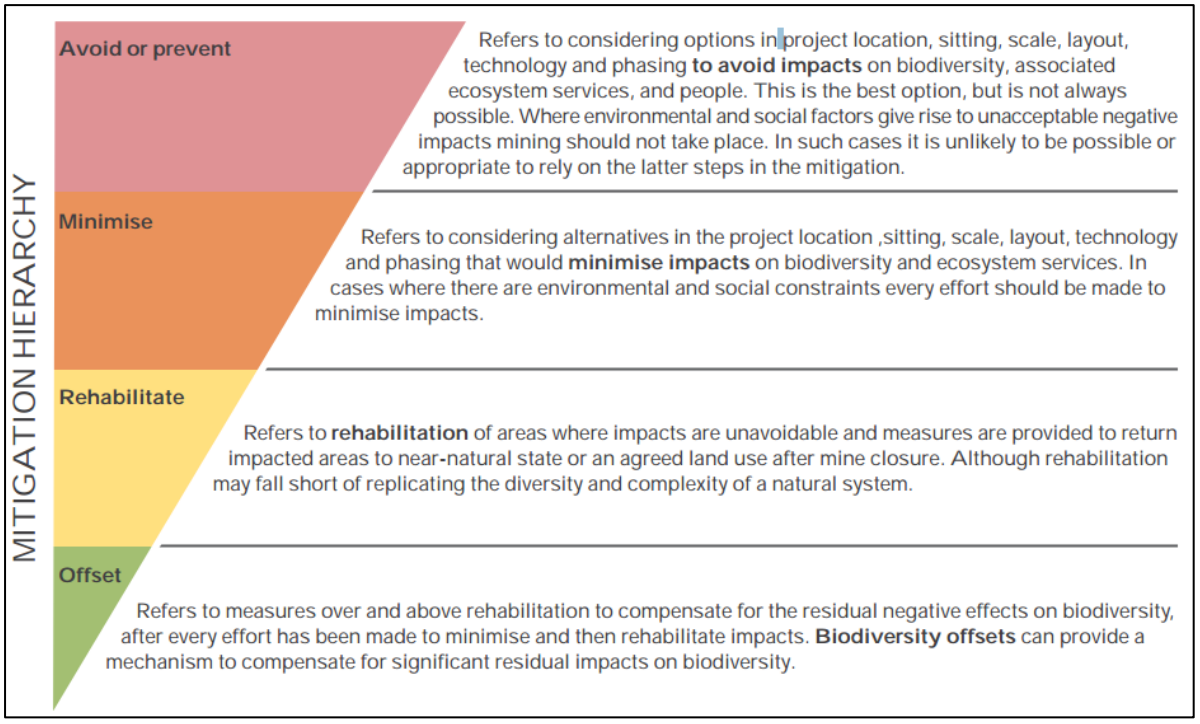

Figure 4-1 The mitigation hierarchy as described by the DEA (2013)

4.4.1 Potential Anticipated Impacts

Table 4-1 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, these results are presented in the subsequent tables.

Table 4-1 Summative results of the DWS Risk Assessment Matrix compiled by Prasheen Singh (Pr. Sci. Nat. 116822)

Phase	Activity	Impact	Significance (max = 100)	Risk Rating
CONSTRUCTION	Site clearing and preparation. Earthworks and Vehicle Movement. Road Construction. Civil Works. Transportation and Installation of towers. Wiring to Central Inverters. Storage and Use of Hazardous substances and Equipment.	Loss, disturbance and degradation of watercourse	12.6	L
		Increased bare surfaces, flood peaks and potential erosion	12	L
		Introduction and spread of alien and invasive vegetation	8.4	L
	Excavation and installation of PV Infrastructure	Decreased flow inputs to the watercourses	14.4	L
		Increased sediment loads to downstream reaches	19.2	L
OPERATIONAL	Routine operation and maintenance of PV farm	Proliferation of alien and invasive species	12	L
		Nutrient enrichment of watercourse	8.4	L
		Introduction and spread of alien and invasive vegetation	12	L
DECOMMISSIONING	Removal of infrastructure	Degradation of vegetation and proliferation of alien and invasive species	12.6	L
		Increased bare surfaces, runoff and potential for erosion	18	L

(L) Low Risk (+) Positive (+ +) Highly positive
(M) Moderate Risk
(H) High Risk

Anthropogenic activities drive habitat destruction, causing displacement of aquatic and terrestrial fauna and flora. Land clearing for development (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 stormwater discharge outlet layouts and facilities as well as consultation with various contractors involved with a diversity of proposed project related activities going forward.

The intended infrastructure was assessed as outlined in previous sections in this report. The potential impact and risk of the project on associated watercourses was based on avoidance mitigation. Alternatives were not provided for consideration for this assessment. Considering the size of these watercourse areas, their associated sensitivity and the volumes of water delivered by them (during the

height of the rainy season), the primary objective should be to avoid construction within them. Furthermore, these areas and associated buffer zones are suggested as no go areas and should be avoided if possible, and mitigated where avoidance is not feasible.

To further understand the impacts of a Solar PV infrastructure on aquatic habitat the footprint should be understood. The solar PV panels are generally monofacial or bifacial (fixed or tracking), and the ground beneath the PV array will be brushcut, rather than completely cleared, with no disturbance to the topsoil. However, if this activity occurs within a watercourse, the removal of vegetation, even if limited and comprising short, sparse, overgrazed cover that is largely devoid of obligate hydrophytes, may still pose several environmental challenges. This vegetation plays an important role in the maintenance of hydrological and sediment regimes of the watercourse. Removal of vegetation, particularly in the drainage areas has the potential to decrease infiltration and increase surface runoff. It also has the potential to result in erosion of the drainage area while at the same time increasing sediment loads and potentially toxicants delivered downstream. Permanent infrastructure will include buildings such as offices, control rooms, storage facilities, inverters, and transformers, which will be constructed at select locations within the PAOI. In addition, new internal access roads will be developed, as the existing dirt road network within the PAOI is insufficient. These new roads may contribute to habitat disturbance, which will need to be carefully managed through appropriate mitigation measures.

The Solar PV Energy Facility will occur within the Project Area and outside but proximal to the abovementioned sensitive areas/buffer areas. 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. 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 unauthorized heavy vehicles within delineated watercourses and buffer areas, and most importantly, avoidance of watercourses (as provided in the latest and approved site layout plan). 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 ecosystem degradation. A decommissioning phase for the proposed development was considered and would pose risks and impacts similar to the construction phase.

All activities and aspects associated with the **Makoppa PV Energy Facility** will have a ‘Low’ impact significance post-mitigation due to avoidance of watercourse and buffer areas as well as implementation of adequate and adaptive stormwater management.

Following the DEA mitigation hierarchy, the adverse effects to the receiving watercourses will need to be ameliorated through the implementation of watercourse rehabilitation. This could involve rehabilitation of disturbed drainage areas and banks to improve the phytoremediation capacity of the system. The proposed project therefore requires a DWS Water Use General Authorisation as the associated water use activities are within 100 m of the regulated area and trigger sections 21 (c) impeding or diverting the flow of water in a watercourse, and (i) altering the bed, banks, courses or characteristics of a watercourse with ‘Low’ post-mitigation risks.

4.5 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 4-2 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 4-2: Unplanned Events, Risks and their Management Measures

Flooding during construction	**Significant habitat degradation of downstream areas.**	**A flood emergency response plan should be drafted, with adequate stormwater management required.**
Spills into the surrounding environment and watercourses	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, an experienced aquatic ecologist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of downslope watercourses	Erosion control measures must be put in place. Measures must include monthly inspections across the project footprint and should be adaptive based 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.

4.6 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 and approved Solar PV projects) 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 PV cluster footprint combined with the low density anthropogenic activities currently present has the potential to degrade watercourse habitat across the catchment. The cumulative impact of the project was rated as 'Moderate' should the project go ahead and involve the implementation of mitigation. (Table 4-3).

Table 4-3: 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	Highly probable
Significance	Moderate	Moderate
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	Yes

4.7 Mitigation 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 of, and fragmentation, of the vegetation community (including the riparian area);
- Prevent the loss of the faunal community (including potentially occurring species of conservation concern) associated with these vegetation communities; and
- Limiting the construction area to the defined project areas and only impacting those areas where it is unavoidable to do so otherwise.

Considering the expected impacts from the project activities, the following mitigation measures have been proposed to lower the intensity of the impacts on the ecological integrity of the associated water resources. The focus of mitigation measures should be to reduce the significance of potential environmental impacts.

4.7.1 PV Facility Infrastructure and Road Network

The proposed Makoppa Solar PV Energy Facility construction is regarded as a low risk to the aquatic resources/sensitive areas should construction occur outside of the delineated sensitive drainage features. Any development with 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. Solar developments, particularly those located on degraded lands, are encouraged to take further steps to employ proactive conservation actions to enhance the habitat on-site and create benefits for biodiversity and people.

The following PV facility 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;
- 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 4-2). 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 4-3). 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;

Figure 4-2 Example of road margin erosion prevention.

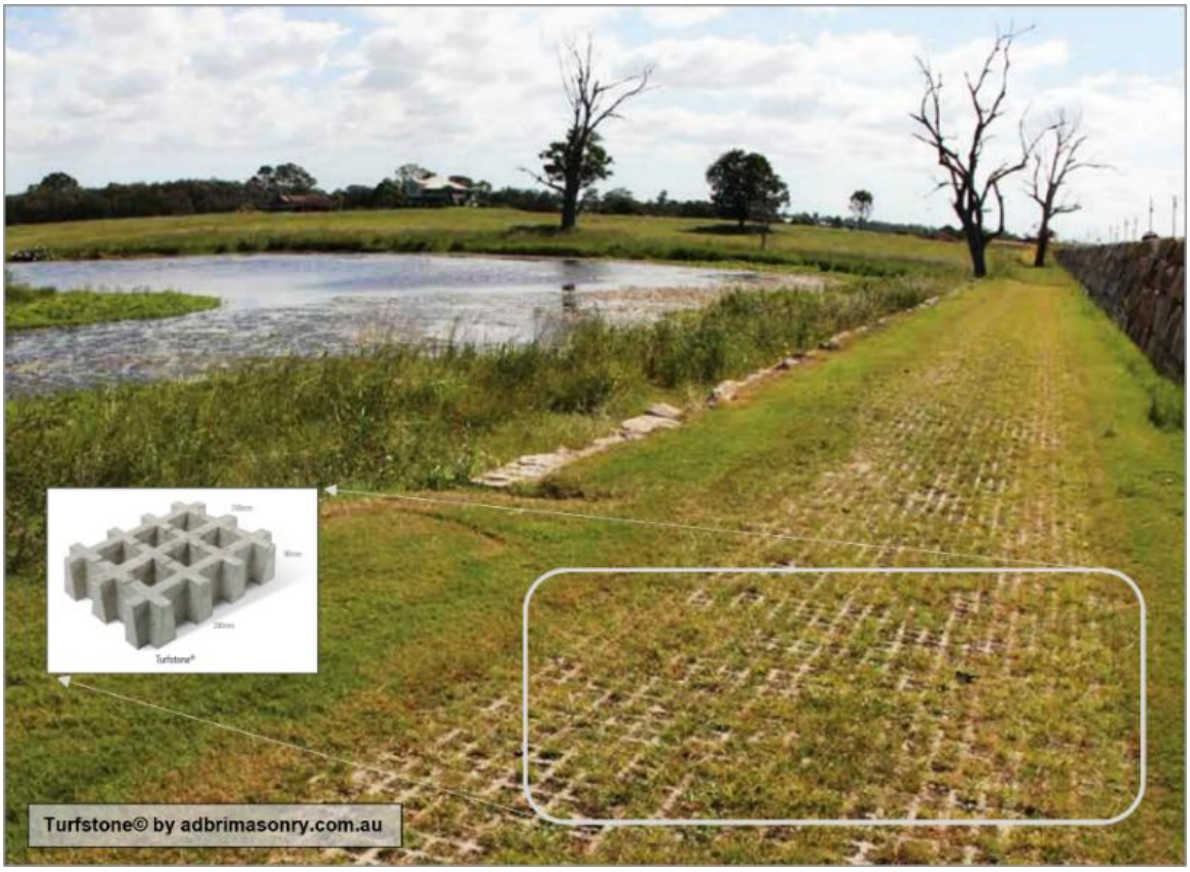

Figure 4-3 Example of permeable paving for roads and habitat maintenance.

- 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;
- Modify security fencing to minimise barrier effects for small- and medium-sized animals. Modifications to fencing can involve maintaining a gap between the base of the fence and the ground. This could occur across the full extent of, or at regular intervals, along the fence line. This can also involve creating passageways by modifying the fence weave to facilitate animal movement;
- Utilise non-reflective solar panels; and
- If reflective solar panels are used, then reduce reflection effects for aquatic insects. Non-polarising white tape can be used around and/or across panels to minimise reflection which can attract aquatic insects as it mimics reflective surfaces of waterbodies.

4.7.2 Erosion & Sedimentation

The following erosion specific mitigation measures are provided:

- All removed soil and material must not be stockpiled within any watercourses. 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 watercourses;

- 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, such as silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap, erosion mats, and mulching will be implemented where necessary, in accordance with the Stormwater Management Plan;
- Any exposed earth should be rehabilitated during the construction phase by establishing suitable vegetation (e.g., vigorous indigenous grasses) to protect the soil and minimise erosion; and
- Landscape and re-vegetate all cleared areas before the operational phase to limit erosion potential.

4.7.3 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.
- Keep disturbances to within footprints and outside of buffer zones;
- Control new stands of alien species as they arise;
- Land users are required by law, to remove and / or control Category 1 alien and invasive vegetation according to the National Environmental Management: Biodiversity Act (NEMBA: Act 10 of 2004) (September 2020 List – GN1003). Additionally, unless authorised, in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring in proximity to a watercourse;
- It is recommended that Category 1 species are prioritised for control, with control of herbaceous weedy species (which would need to include follow-up control);
- Foliar herbicide spray must not be used within any of the sensitive riparian areas, rather opt for mechanical removal or direct dribbled application to stumps (use a dye); and
- Wet season vegetation rehabilitation surveys need to be conducted of the vegetation within the project footprint to stay on top of the alien vegetation for the life of the project. This will improve the biotic integrity over the long term.

- Preventing the introduction, movement and spread of invasive species on and off the construction site.

4.7.4 Operation of Vehicles and Heavy Machinery

- Operating heavy machinery in watercourse 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;
- 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 use existing roads (including dirt roads) where available. Newly constructed internal access roads may also be used once completed and designated for construction access;
- The route for vehicles (including heavy machinery) must be planned to avoid sensitive habitats, watercourse vegetation, buffer areas and other water bodies as far as feasibly possible;
- Operators must be trained in operating machinery in sensitive environments and aware of the sensitivity of the area;
- Sensitive areas must be demarcated so as to guide operators, labourers and contractors;
- To minimise soil compaction and damage to wetland or riparian vegetation, a pioneer layer should be used when traversing wetland areas. The use of low ground pressure machinery (e.g., tracked vehicles or specialised tyres) may be alternatively considered where feasible and appropriate;
- Sediment and erosion control measures, including silt fences, erosion control blankets, and sediment trapsto prevent soil runoff into water bodies associated with vehicular movements and disturbed surfaces will be implemented as part of the Stormwater Management Plan;
- Spill prevention and response plans for potential leaks or spills of fuels, oils, or other hazardous substances will be implemented in accordance with Occupational Health and Safety (OH&S) protocols;
- 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).

4.7.5 General mitigation measures

The following general mitigation measures are provided:

- All work in and around watercourse areas, including those outside the specific project site, will be conducted in accordance with the Environmental Authorisation (EA) requirements to minimise impacts;
- Aspects of the site development plan (SDP) such as laydown area and site camp should be located outside of the buffer zone, which would significantly reduce potential impacts;
- Construction activities must take place during the low flow period (as much as possible). In addition to this, basic stormwater structures such as berms must be designed and implemented prior to and throughout the duration of the construction activities;
- Stormwater runoff from the development area should enter drainage systems through diffuse channels fitted with flow attenuation/energy dissipation structures in the form of green infrastructure;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Construction activities should, if possible, be scheduled during the dry season to reduce the erosion potential of exposed surfaces;
- Temporary stormwater channels and preferential flow paths will be managed using measures such as aggregate or logs to dissipate and slow flows, this will be detailed in the Stormwater Management Plan;
- Prevent uncontrolled access of vehicles through the river system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals, construction materials and toxicants to be used for the construction must be stored within bunded areas;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced in a designated area;
- 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. 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 contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place away from the watercourse and buffer area. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Any exposed earth should be rehabilitated during construction by planting suitable vegetation, such as vigorous indigenous grasses, to protect the 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;
- 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 watercourse buffer zones except where needed for the construction process;
- Erosion prevention and sediment control measures, including temporary and permanent methods such as silt fences, interceptor ditches, seeding and sodding, riprap, and mulching, will be implemented in accordance with the Stormwater Management Plan;
- Rehabilitation of the watercourse areas, bed and banks must be budgeted for and should 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 outside the defined construction footprint shall be designated as 'no-go' zones during the construction phase, with strict restrictions on access by construction personnel to prevent disturbance of sensitive habitats upstream and downstream of the site;
- Access to internal areas outside the active construction footprint that are essential for operational needs (such as firebreak maintenance and plant operation) should be controlled and managed in accordance with environmental best practices to minimise any impacts;
- Clear demarcation and signage must be installed to delineate construction zones and no-go areas, and all site staff should be trained on access restrictions and environmental protection measures;
- Areas exposed to erosion will be protected using appropriate measures such as sandbags, berms, and efficient construction practices, such as limiting the footprint and duration of exposed areas. This should be outlined in the Stormwater Management Plan;
- 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; and
- 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 (if present).

5 Recommendations

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

- A competent Environmental Control Officer (ECO) must oversee the construction and associated rehabilitation phase of the project, with watercourse areas as a priority to limit 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, and the full assessment report, to familiarise themselves with the mitigation and recommendations prior to construction;
- Several aquatic features or aquatic functional zones are present, which may provide some technical challenges due to seasonal flooding. Any footprint within these areas will likely require

careful planning in order to minimise changes to flows which could alter species composition and affect ecological processes to both aquatic and terrestrial areas. As a minimum any roads traversing these alluvial areas must accommodate lateral flows (interconnectivity) of water and sediment between watercourses and alluvial area where seasonal flooding occurs. This challenge can be overcome through the use of raised access roads fitted with appropriate aggregate base layers and culverts to allow lateral movement of water and to minimise localised flooding and/or drying out;

- The PV areas, infrastructure and road alignments must be designed to avoid watercourses and their 20 m buffer areas. Multiple crossings across the same watercourse section are not advised, and must be restricted to the minimum number feasible;
- A qualified Hydrologist with experience in semi-arid areas must develop a suitable and adaptive Stormwater management plan to ensure no erosion takes place and that clean water reports back to the local watercourses during rainfall events;
- An adaptive rehabilitation plan needs to be implemented from the onset of the project. The key focus should be placed on revegetation, stormwater and erosion prevention strategies for the development area. The plan should be adhered to for all stages of the project life; and
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase. This will include monitoring the crossings, all stormwater discharge points, energy dissipation structures, and stability and condition of watercourse habitat in the project footprint. This service plan should be adaptive based on on-site conditions.

6 Conclusion

The National Web-Based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area and the PAOI as “Low”. This is disputed due to the presence of ephemeral watercourses within the project area, overlap with a Conservation Area and possible presence of a ‘Vulnerable’ fish species in the SQR. At the desktop level, the ecological integrity (PES) of the associated SQR is classified as class C (Moderately Modified), with a ‘Moderate’ Ecological Importance (EI) and ‘Low’ Ecological Sensitivity (ES).

The survey sites were dry at the time of the survey. Therefore, water quality from instream impoundments were used for interpretation. Water quality as interpreted from instream impoundment(s) may limit the diversity and abundance of aquatic biota within the system and may only be optimal for tolerant aquatic organisms. The Index of Habitat Integrity (IHI) assessment indicated a ‘Largely Natural’ instream and riparian integrity for the section of the Sand River Tributary 3. The PES assessment indicated that the Sand River Tributary 3 is in a ‘Largely Natural’ (category B), therefore indicating a better PES than the DWS (2014) PES of ‘Moderately Modified’.

Buffer zones have been assigned to the water resources within the PAOI, these buffer zones are designated as No-go zones for any development, disturbance, equipment/machinery, waste dumping, and laydown yards unless authorized. A minimum buffer zone strip of **20 meters** for watercourses is recommended. The integrity of these buffers enhances the resilience of watercourses to future disturbances. Development plans activities should be crafted accordingly to ensure compliance with these buffer requirements.

6.1 Risk and Impact Statement

The Solar PV Energy Facility will occur within the Project Area and outside but proximal to the abovementioned sensitive areas/buffer areas. 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. 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 unauthorized heavy vehicles within delineated watercourses and buffer areas, and most importantly, avoidance of watercourses (as provided in the latest and approved site layout plan). 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 ecosystem degradation. A decommissioning phase for the proposed development was considered and would pose risks and impacts similar to the construction phase.

6.2 Specialist Opinion

Considering the assessment findings, it is the opinion of the specialist that the project may be considered for authorisation, on condition that all prescribed mitigation measures and recommendations are implemented. This includes the avoidance of sensitive freshwater habitats and their buffer zones (as far as is feasible), methods that prevent the introduction of contaminants into watercourses, as well as the minimisation of development/disturbances within these areas. The implementation of mitigation measures would result in an overall “Low” impact for the project. The project therefore warrants a General Authorisation application process and must adhere to the stipulations or directives that may arise consequently.

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8 Appendices

8.1 Appendix A: Freshwater Methodology

8.1.1 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).

8.1.1.1 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.

8.1.1.2 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.

8.1.1.3 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.

8.1.1.4 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).

8.1.2 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 (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

8.1.3 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 water resource 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.

8.1.3.1 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 8-1 and Table 8-2 respectively. The spatial framework for each IHI was 5 km upstream and downstream of the respective sampling points within the watercourse(s).

Table 8-1 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.
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 *et al*., 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 *et al*., 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 *et al*., 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 8-2 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 8-3). The relative weighting of criteria remains the same as for the assessment of habitat integrity (DWS, 1999).

Table 8-3 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 8-4.

Table 8-4 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

8.1.4 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.

8.1.4.1 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 8-5.

Table 8-5 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.

8.1.4.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) provides 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.

8.1.5 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 8-6. These tolerance levels are scored to show each fish species' sensitivity to flow and physicochemical modifications.

Table 8-6 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

8.1.5.1 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 8-1.

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 = Total Catch / Total Effort. The CPUE was presented per site.

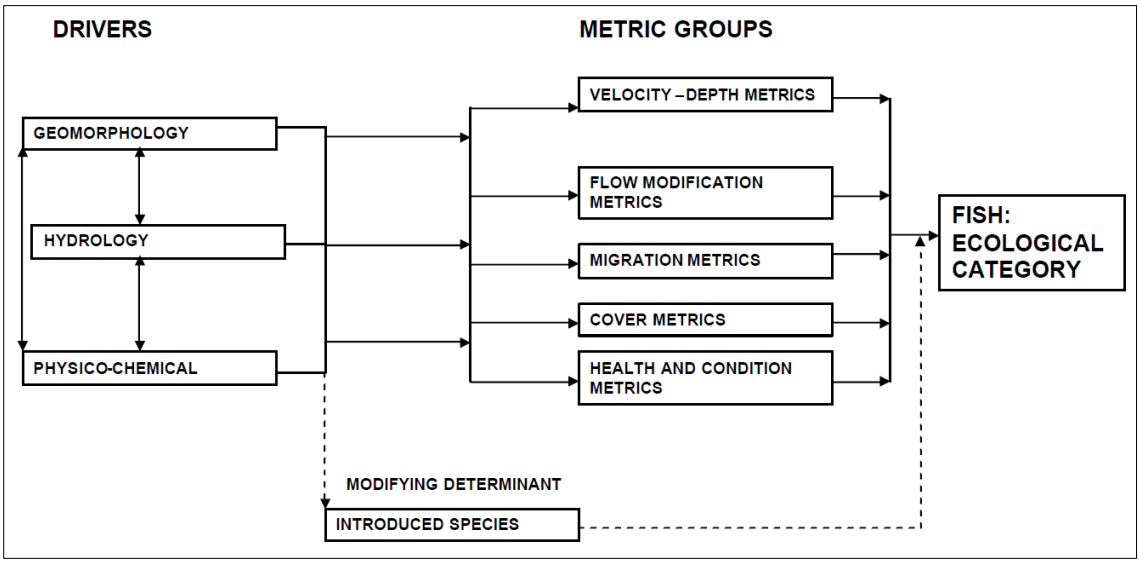


Figure 8-1 The relationship between drivers and fish metric groups (Kleynhans, 2007)

8.1.6 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 8-7) . 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 8-7 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.

8.1.7 Riparian Delineation

The riparian delineation was completed according to DWAF (2005). Typical riparian cross-sections and structures are provided in Figure 8-2. 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).

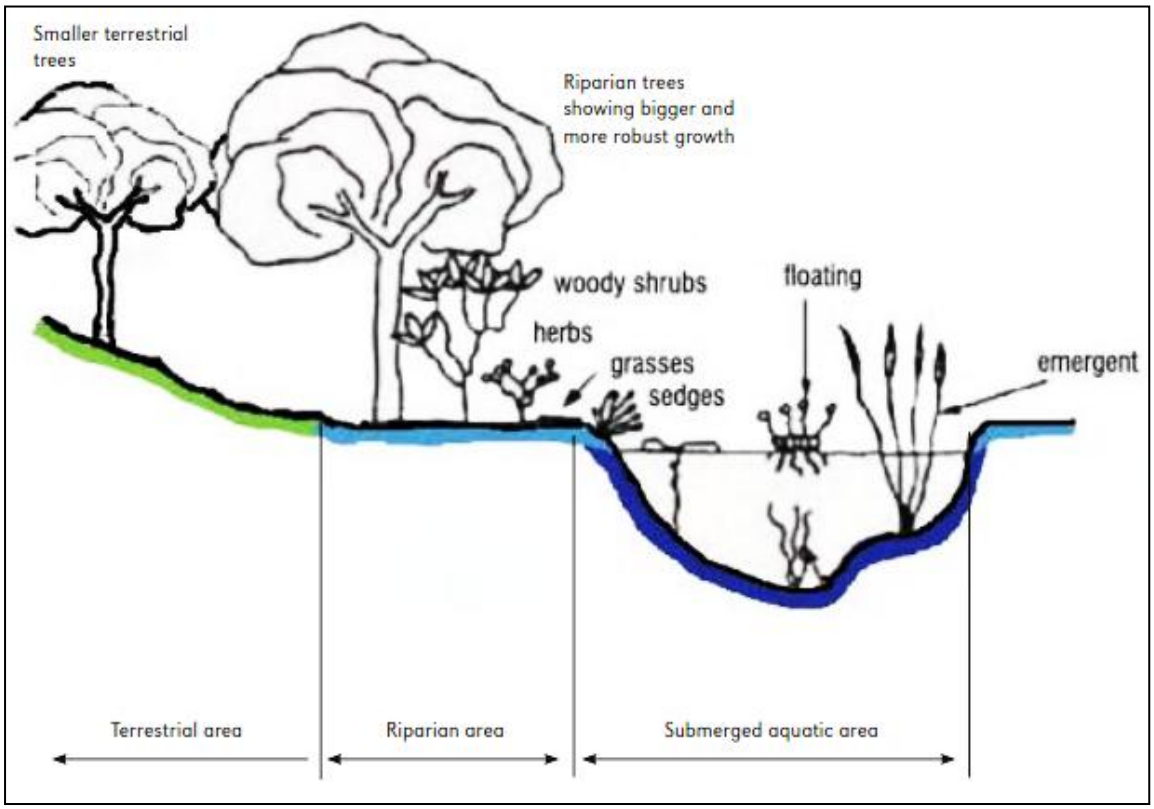


Figure 8-2 Riparian Habitat Delineations (DWAF, 2005)

8.1.8 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.

8.1.9 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.

8.2 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 8-8.

Table 8-8 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.

8.2.1 Cumulative Impact Assessment

The following aspects as presented in Table 8-9 were considered in the cumulative impact assessment which refers to quantifying the significance of impacts in relation to the proposed development.

Table 8-9 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

8.3 Appendix C – Specialist Declaration of Independence

DECLARATION

I, Charles de Beer, 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.

Charles de Beer

Aquatic Ecologist

The Biodiversity Company

02/10/2025

DECLARATION

I, Prasheen Singh, 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.

Prasheen Singh

Aquatic Ecologist

The Biodiversity Company

02/10/2025

DECLARATION

I, Bradley Matainz, 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.

Bradley Matainz

Aquatic Ecologist

The Biodiversity Company

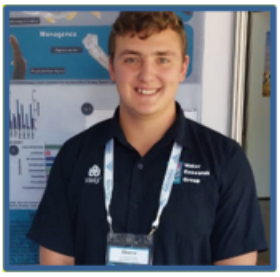
02/10/2025

8.4 Appendix D – Specialist CVs

Charles de Beer

BSc Honours in Environmental Sciences with Aquatic Ecosystem Health (Candidate Natural Scientist 168416)

Cell: +27 78 762 6542
Email: charles@thebiodiversitycompany.com
Identity Number: 0112205269080
Date of birth: 20 December 2001



Profile Summary

Aquatic Ecologist at The Biodiversity Company.

Specialist experience in various projects including Estuarine Health Assessments, Freshwater Ecological Assessments, Ecological Impact Assessments and Biomonitoring.

Specialist expertise includes Environmental Management, Aquatic Ecology and Water Quality.

Areas of Interest

Aquatic Ecology
Aquatic Ecosystem Health
Ecosystem Rehabilitation
Estuarine Health
Habitat and Biodiversity Conservation
Sustainable Development
Environmental Management
Water Quality

Key Experience

- Aquatic Impacts and Risk Assessments
- Water resource baseline monitoring and impact assessments
- The use of biological indicators such as fish, macroinvertebrates and diatoms
- Aquatic Ecological Assessments
- Biomonitoring Programmes
- Ecological Flow Requirements
- Ecological Impact Assessment
- Basic Assessments

International Experience

Botswana
Mozambique
Namibia
South Africa
Zimbabwe

Nationality

South African

Languages

Afrikaans – Proficient
English – Proficient

Qualifications

- National Senior Certificate (Oakdale Agricultural High School, 2019)
- BSc in Biological Science with Zoology and Botany (North-West University, 2022)
- BSc Honours in Environmental Science with Aquatic Ecosystem Health (North-West University, 2023)

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 Ecostatus 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

CURRICULUM VITAE: Prasheen Singh

Bradley Matainz

M.Sc. Aquatic Health (Cand Sci Nat)

Cell: +27 73 105 7000
Email: bradley@thebiodiversitycompany.com
Identity Number: 9802205071087
Date of birth: 20 February 1998

Profile Summary

Specialist expertise includes aquatic macroinvertebrate and fish community composition, aquatic ecology, habitat, water and sediment nutrient analysis.

Areas of Interest

Aquatic Ecology and Water Resource Management.

Sustainable Development

Habitat and Biodiversity Conservation

Risk Assessments

Key Experience

- Freshwater Ecology
- Baseline water resource studies
- Habitat Assessments and Delineation
- Macroinvertebrate and Fish sampling
- Water quality Testing
- Dust Monitoring

Provincial Experience

Gauteng

KwaZulu-Natal

Mpumalanga

Northern Cape

North West

Free-State

Limpopo

International Experience

Botswana

Zimbabwe

Mozambique

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- MSc (University of Johannesburg) – Aquatic Health (cum laude).
- BSc Honours (University of Johannesburg) – Zoology.
- BSc Zoology & Environmental Management (University of Johannesburg) Extended.
- SASS5 Accreditation - Department of Water and Sanitation for the River Health Programme
- SACNASP (166685) as Candidate Natural Scientist

- End of Report -

AQUATIC BIODIVERSITY SPECIALIST ASSESSMENT REPORT FOR THE PROPOSED GRIDLINE ASSOCIATED WITH THE MAKOPPA SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY

Makhado Local Municipality, Vhembe District Municipality, Limpopo Province, South Africa

20/08/2025

Prepared by:

The Biodiversity Company

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Report Name	**AQUATIC BIODIVERSITY SPECIALIST ASSESSMENT REPORT FOR THE PROPOSED GRIDLINE ASSOCIATED WITH THE MAKOPPA SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY**
Specialist Theme	Aquatic Biodiversity Theme
Project Reference	Makoppa Solar PV Energy Facility - Grid
Report Version/Date	20/08/2025
Environmental Assessment Practitioner/Client	Cape EAPrac
Fieldwork	Charles de Beer (SACNASP 168416)
Report Writer	Prasheen Singh (SACNASP 116822)
Declaration	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.

Abbreviations

Abbreviation	Definition
ASPT	Average Score per Recorded Taxon
CBA	Critical Biodiversity Area
DO	Dissolved Oxygen
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ECO	Environmental Control Officer
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EN	Endangered
ESA	Ecological Support Area
ETS	Ecosystem threat status
IHI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
LC	Least Concerned
MASL	Meters Above Sea Level
NEMA	The National Environmental Management Act
NFEPA (FEPA)	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
NWA	National Water Act
NWBEST	National Web-Based Environmental Screening Tool
PAOI	Project Area Of Influence
PES	Present Ecological State
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
SCC	Species of Conservation Concern
SQR	Sub Quaternary Reach
TBC	The Biodiversity Company
TWQR	Target Water Quality Range
VU	Vulnerable
WMA	Water Management Area

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Background

The Biodiversity Company was appointed to conduct an Aquatic Biodiversity Specialist Assessment for proposed Tabor Solar Photovoltaic (PV) Facilities. Four (4) facilities are proposed for the Tabor Solar cluster, with associated grid connection lines for each facility. This report assesses the **Gridline connecting the Makoppa Solar PV Energy Facility to the Tabor Main Transmission Substation (MTS)**. The other facilities and associated gridlines are assessed separately. The proposed Project Area is located approximately 40 km south of Makhado, and 8.5 km southwest of Bandelierkop, Limpopo Province, South Africa (Figure 1-1).

In order to achieve this a single aquatics survey was conducted on the 6th to 9th of January 2025, which constituted a wet season/high flow survey. A 500 m area has been demarcated for the project to facilitate the identification of water resources 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.

The purpose of the specialist assessment is to provide relevant input into the EA process and provide a report for the activities associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, 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.

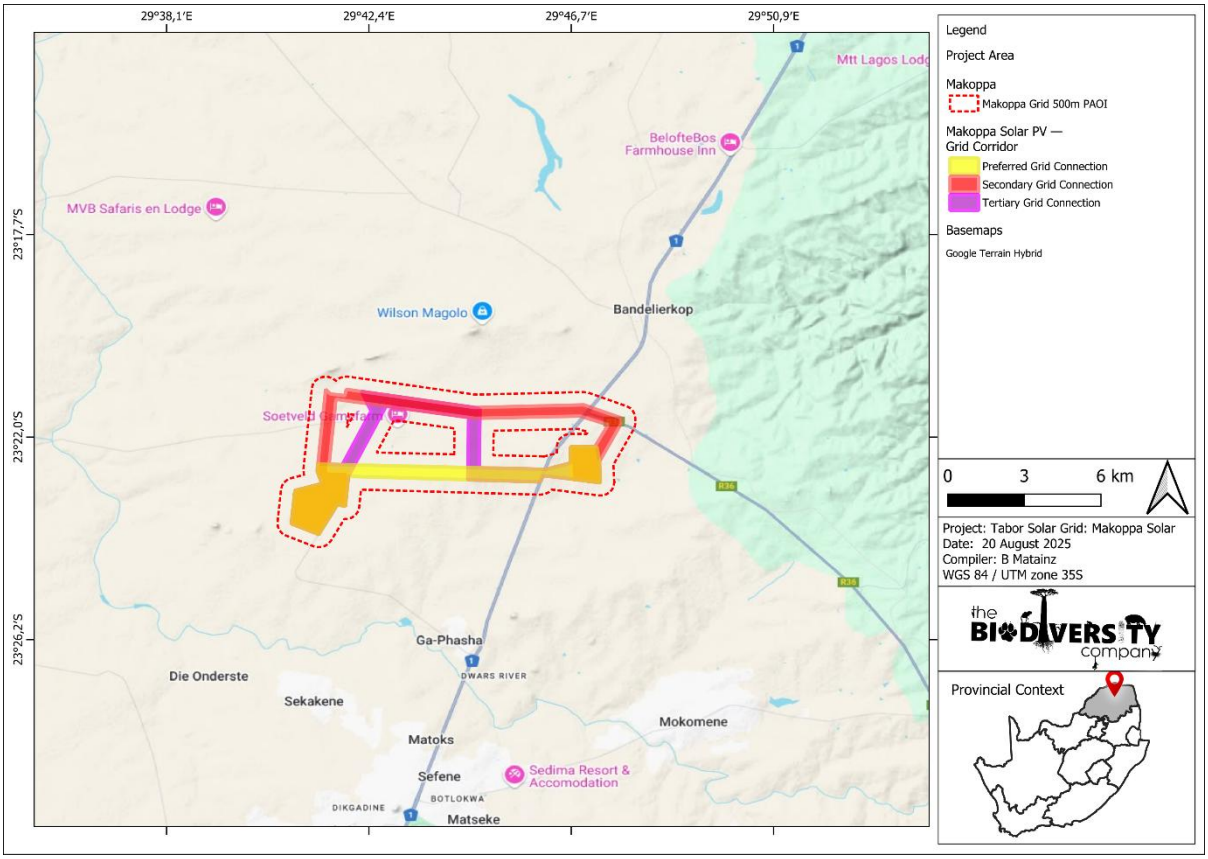


Figure 1-1 Location of the project area and PAOI

1.2 Project Description

The Applicant, Makoppa Solar PV (Pty) Ltd, are proposing the construction of a Solar Photovoltaic (PV) Energy Facility and associated infrastructure, known as Makoppa Solar PV Energy Facility, on Portion 1 of Farm 465 located South of Louis Trichardt in the Makhado Local Municipality, Vhembe District, Limpopo Province.

This environmental application process includes Electrical Grid Connection Infrastructure required to connect the Makoppa Solar PV Energy Facility to the National Grid via the existing Tabor Main Transmission Substation (MTS).

This Electrical Grid Infrastructure includes:

- Onsite Switching Station (SS) (up to 1 ha), adjacent to the IPP Substation.
- 132 kV Overhead Power Line (OHPL) – 30 m height from the switching station to the existing Eskom Tabor Substation;
- Access Road to Switching Station;
- Maintenance access road below or adjacent to the power line.

Three (3) Grid connection alternatives are under investigation as part of this environmental process. Different land portions are affected by the various grid connection alternatives.

1.3 Assessment 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 preliminary identify water accumulation areas;
- The delineation of water resources in accordance with the DWAF (2005) guidelines, whereby the outer edges will be identified; and
- A functional and integrity assessment of the water resources.

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;
- It is assumed that the extent of the project area provided to the specialist is accurate;
- 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;
- Standard aquatic methodologies that require presence of water could not be conducted due to the ephemeral nature of the watercourses within the PAOI;
- The survey was limited to sites that were accessible;
- 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
- The GPS used for water resource delineations is accurate to five meters. Therefore, the delineation plotted digitally may be offset by a maximum of five meters 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	National Environmental Management Act (Act 107 of 1998) (NEMA)	Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), Appendix 6 requirements
	NEMA Assessment Protocol (March 2020)	The minimum criteria for reporting.
	NEMA Assessment Protocol (October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	National Water Act (Act 36 of 1998)	The regulation of water use.
	NWA - GN4167 of GG 49833 of 8th Dec 2023	General Authorisations in term of Section 39 of the National Water Act 36 of 1998 for Water Uses as defined in Section 21 (c) and (i)
Provincial	Limpopo Environmental Management Act (No. 7 of 2003)	An Act to consolidate and amend the environmental legislation of or assigned to the Province for matters incidental thereto, making provision with respect to the protection and conservation of the environment. To inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management.
	Limpopo Conservation Plan (2018)	To provide for the management and conservation of the province's biophysical environment and protected areas.

1.6 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources 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 water resources, which includes:

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

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 water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the 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	8.3
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae	8.4
A signed statement of independence by the specialist(s)	8.3
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.	3.1.12
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: (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	-
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:	4.3

Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: (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: (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.)	4.3
How will the proposed development impact on key ecosystems regulating and supporting services especially: (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?	4.3
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	8.1
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	3.3 and 3.4
Additional environmental impacts expected from the proposed development	-
Any direct, indirect and cumulative impacts of the proposed development on-site	4
The degree to which impacts and risks can be mitigated	4
The degree to which the impacts and risks can be reversed	4
The degree to which the impacts and risks can cause loss of irreplaceable resources	4
A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies	8.1.7
Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr)	4.5

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	6.2
Any conditions to which this statement is subjected	6.2

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 6th to 9th of January 2025 (summer) to identify the presence and condition of freshwater resources 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 within the 500 m PAOI were found during the site visit. Therefore, efforts were afforded to a riverine assessment rather than a wetland assessment for these systems.

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 is not located within any SWSAs for groundwater or surface water.	3.1.1
Conservation Plan	Yes	Whilst the PAOI does not overlap with any Critical Biodiversity Area, the entire PAOI overlaps with Other Natural Areas (ONAs).	3.1.2
National Biodiversity Assessment (NBA)	No	The PAOI does not traverse any NBA Wetlands or NBA Rivers.	3.1.3
Aquatic Ecosystem Threat Status	Yes	Whilst the PAOI does not overlap with any threatened watercourses, it is drained by a tributary of the Sand River (Endangered) and a tributary of the Dwars River (Critically Endangered).	3.1.4
Aquatic Ecosystem Protection Level	No	The PAOI does not intersect or drain towards any protected watercourses.	3.1.5
National Freshwater Ecosystem Priority Areas (NFEPA)	No	The PAOI does not overlap any NFEPA wetlands, rivers or areas.	3.1.6
Protected Areas	Yes	The PAOI overlaps the Vhembe Biosphere Reserve Conservation Area.	3.1.7
RAMSAR Wetlands	No	The PAOI does not overlap with any RAMSAR Wetlands.	-
Renewable Energy Development Zones (REDZ)	No	The PAOI does not overlap with any REDZ.	3.1.8
Renewable Energy Database	No	The PAOI traverses the proposed Ingwe Solar Power Plant.	3.1.9
Strategic Transmission Corridors (EGI)	Yes	The PAOI overlaps with the International 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 ≥ 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 project area is not located within any SWSAs for surface water or groundwater (Figure 3-1).

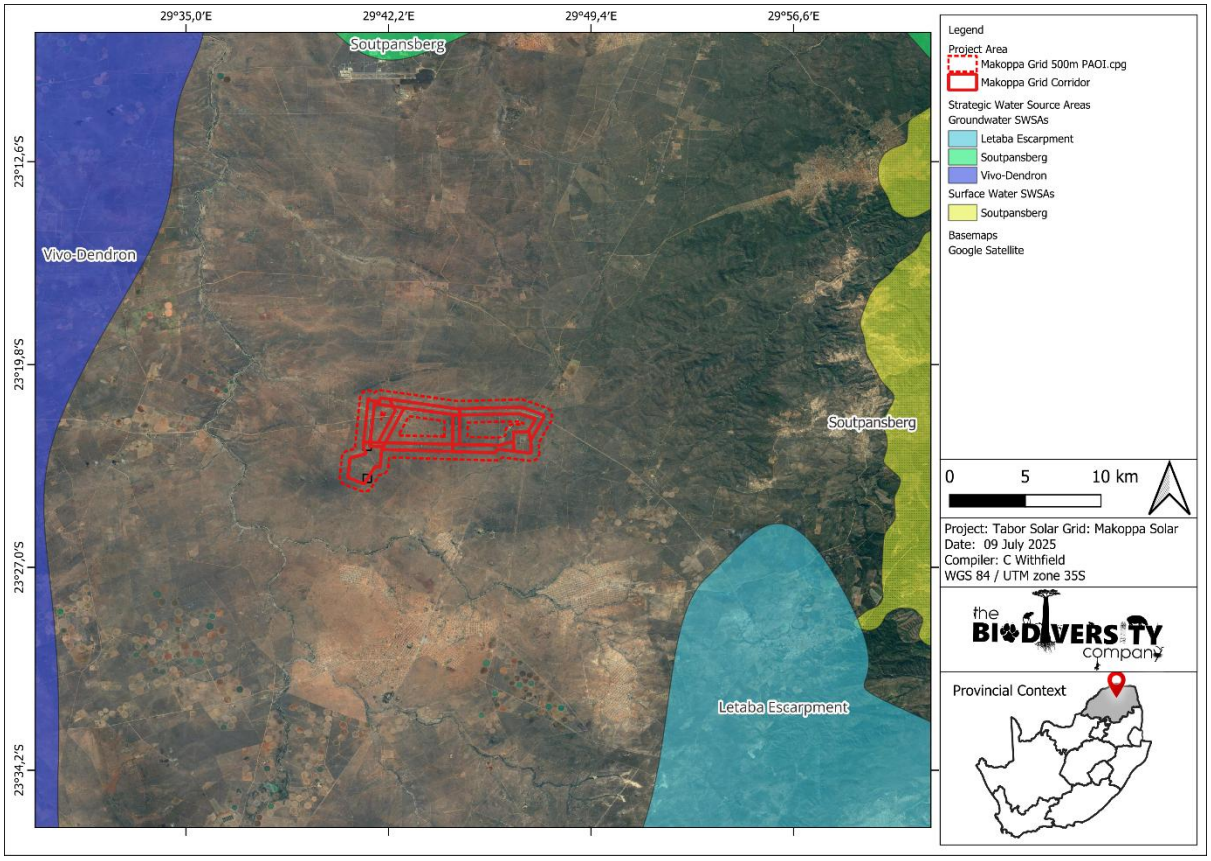


Figure 3-1 Map illustrating the SWSAs in relation to the PAOI

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).

Whilst the PAOI does not overlap with any Critical Biodiversity Area, the entire PAOI overlaps with Other Natural Areas (ONAs) (Figure 3-2).

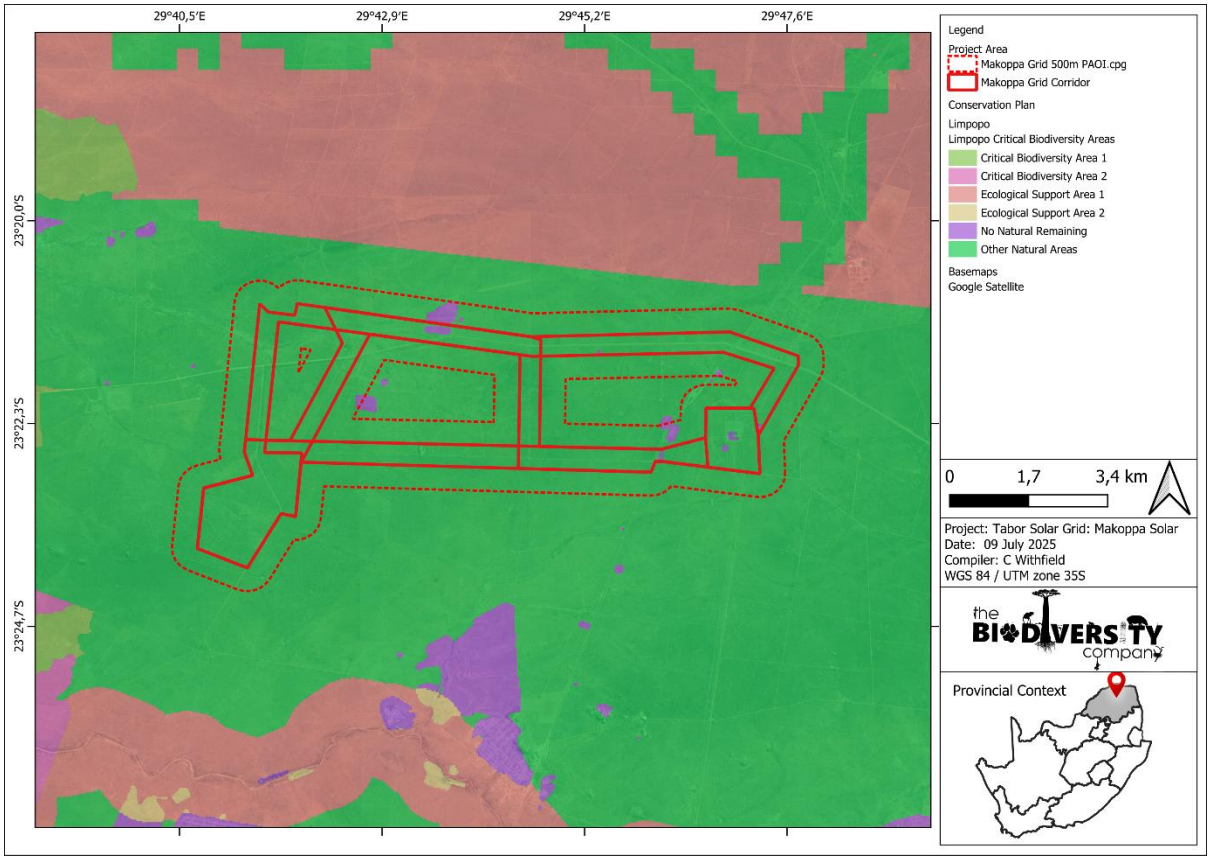


Figure 3-2 The PAOI superimposed on the Provincial Conservation Plan

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 (Figure 3-3) the PAOI does not traverse any NBA Wetlands or NBA Rivers. It is the specialist's opinion that the NBA2018 seep wetland within the PAOI may be an error due to the irregular spatial delineation (point location) within the dataset, as well as confirmed during the site verification.

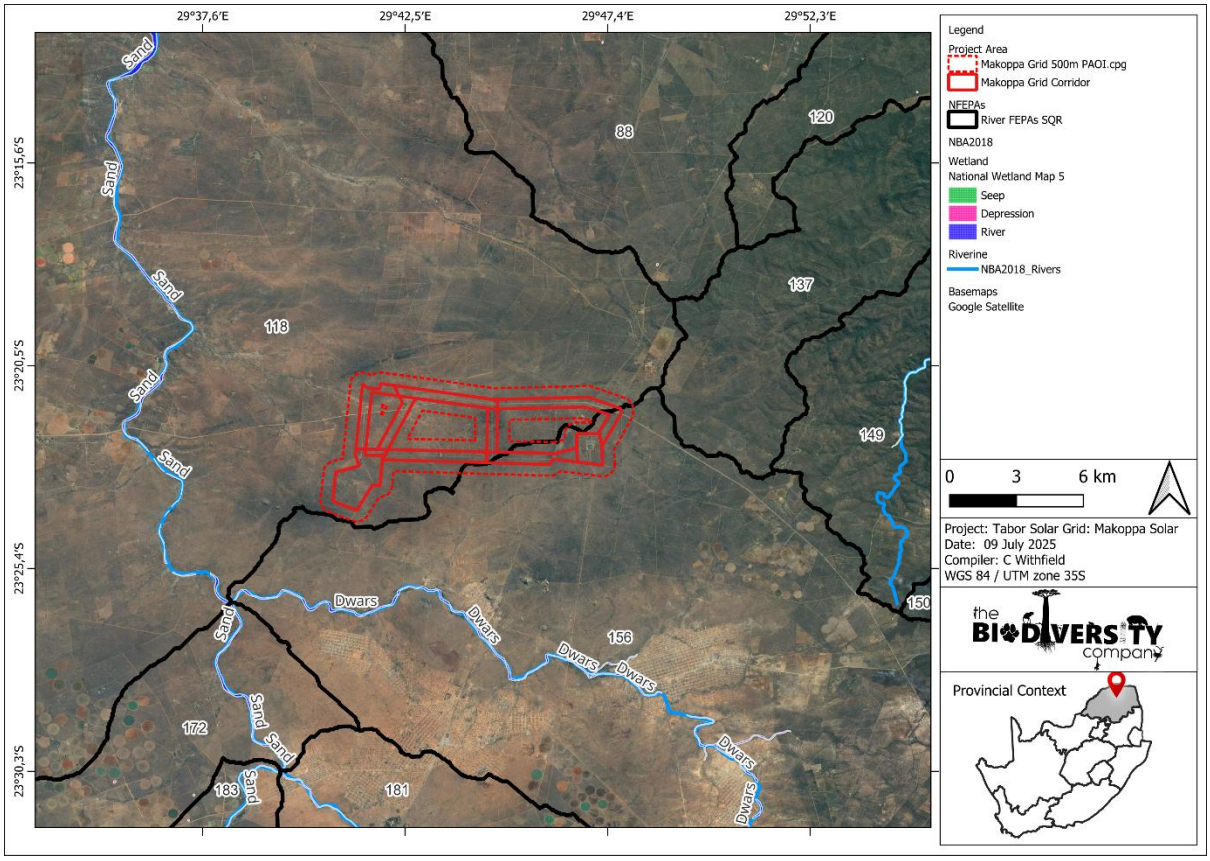


Figure 3-3 Illustration of NBA wetlands and/or rivers within the PAOI (NBA, 2018)

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 (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), 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 does not overlap with any threatened watercourses, however it is drained by a tributary of the Sand River (Endangered) and a tributary of the Dwars River (Critically Endangered) (Figure 3-4), indicating that impacts within the regulated area could potentially result in degradation of the downstream system.

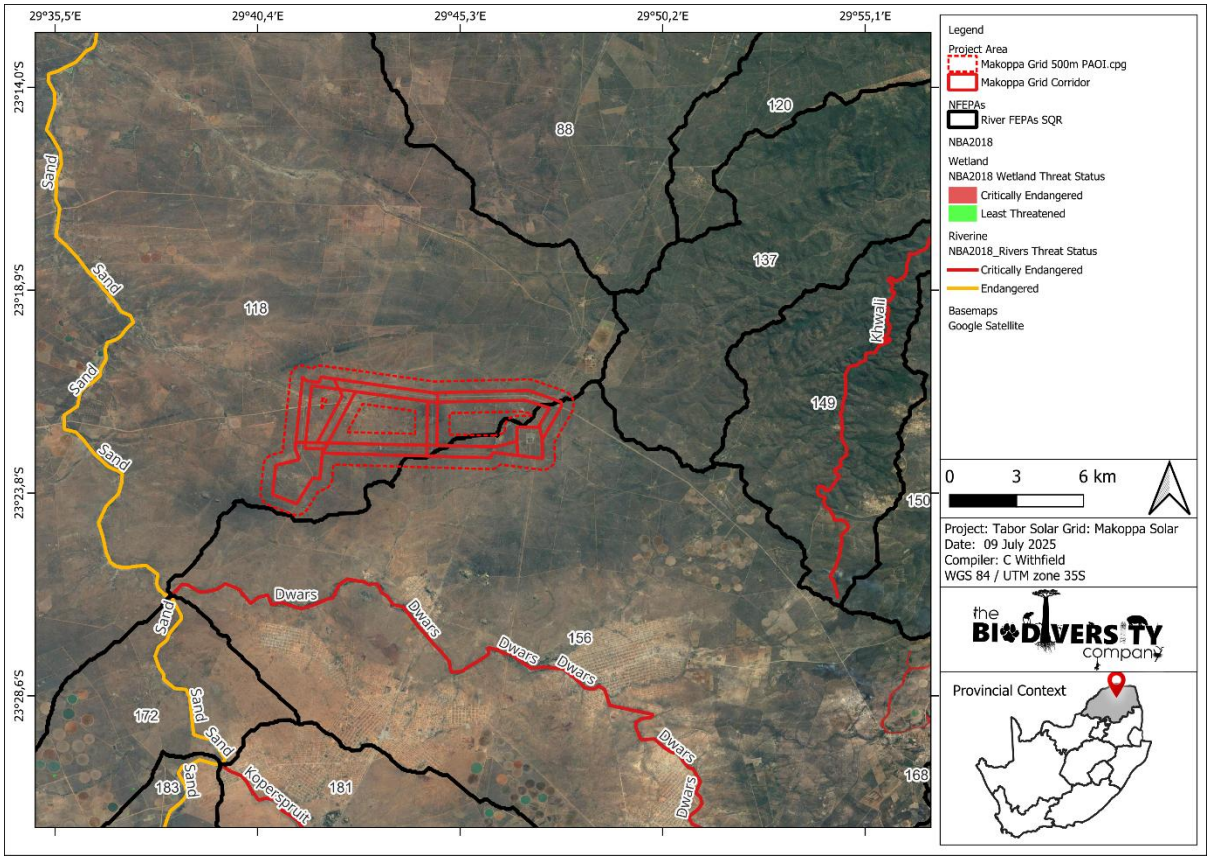


Figure 3-4 The project area showing the regional ecosystem threat status of the associated aquatic ecosystems (NBA, 2018)

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 (Figure 3-5). According to the SAIIAE dataset, the PAOI does not intersect or drain towards any protected watercourses.

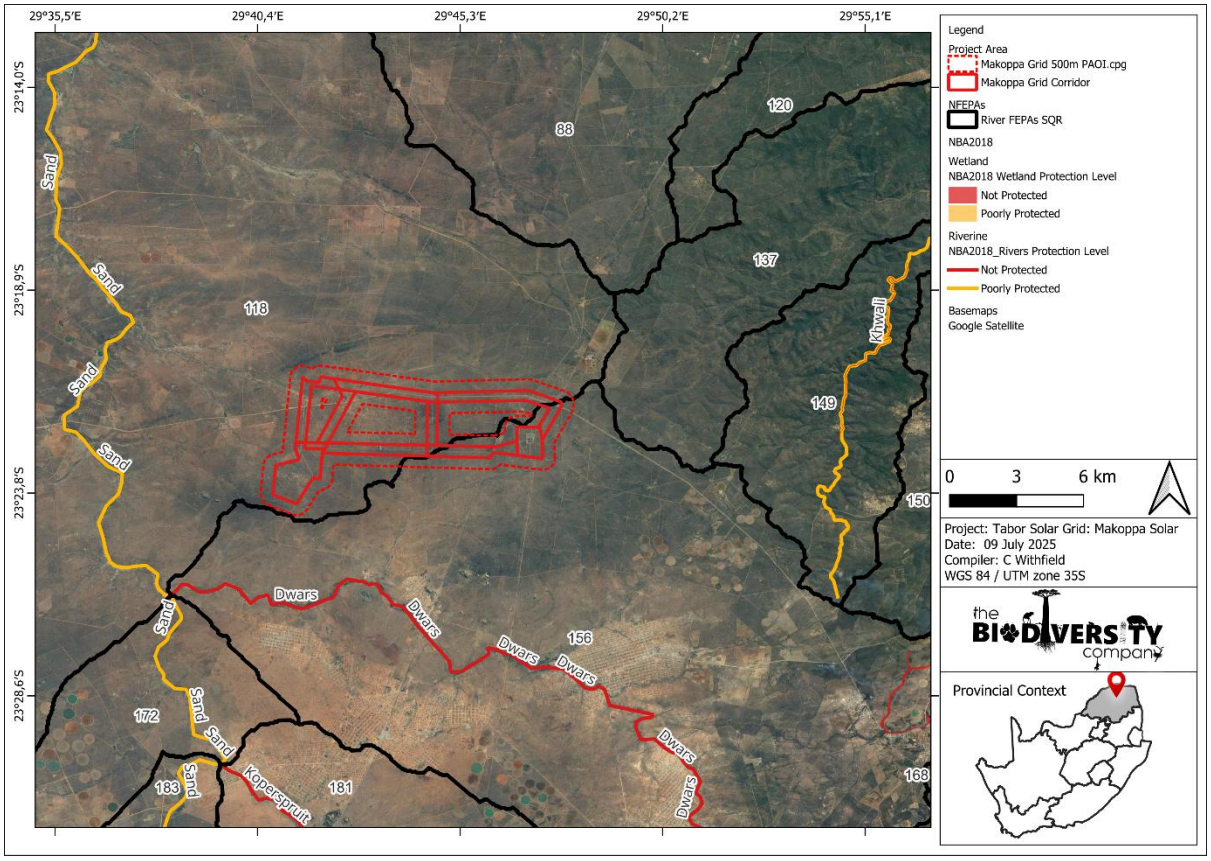


Figure 3-5 The project area showing the regional level of protection of aquatic ecosystems (NBA, 2018)

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 NFEPAs 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 (Figure 3-6), the PAOI does not overlap any NFEPA priority wetlands, rivers or areas. Conserving the water quality, watercourse 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 water resources in order to contribute to national biodiversity goals and support the sustainable use of water resources.

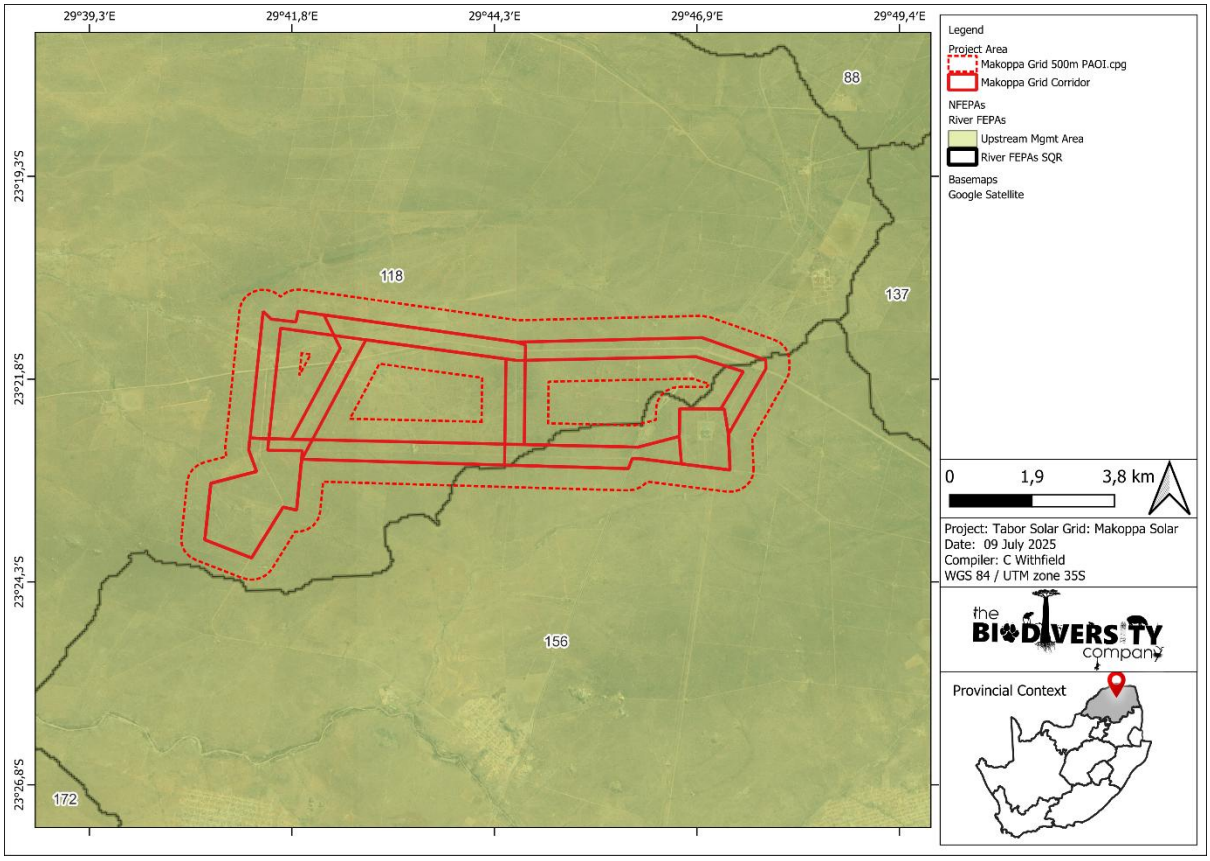


Figure 3-6 NFEPA map for the PAOI (Nel et al., 2011)

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 (2024) and SACAD (2024), the PAOI overlaps with the Vhembe Biosphere Reserve Conservation Area (Figure 3-7).

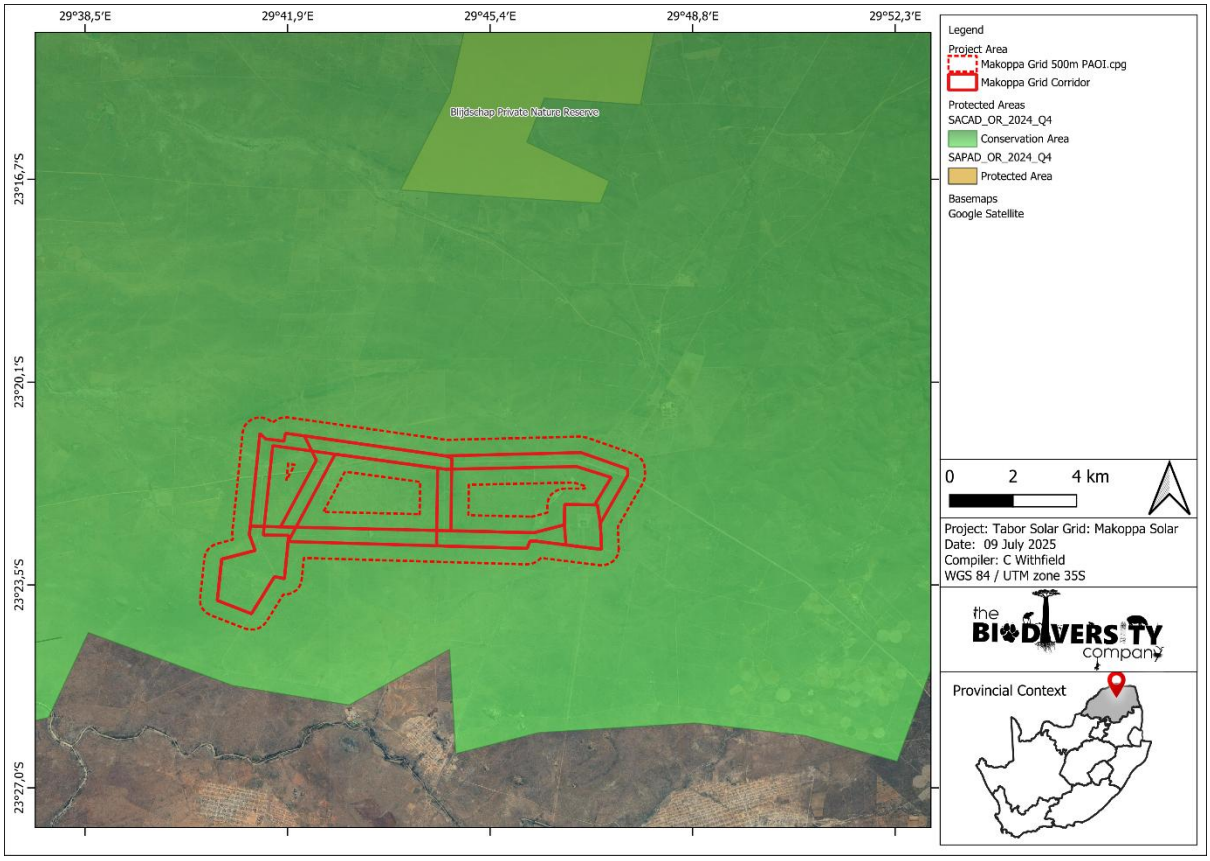


Figure 3-7 The project area in relation to the Protected Areas

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 project area does 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 of a similar nature in the near vicinity of the PAOI (Figure 3-8). This will increase the overall impact on the habitats in the area.

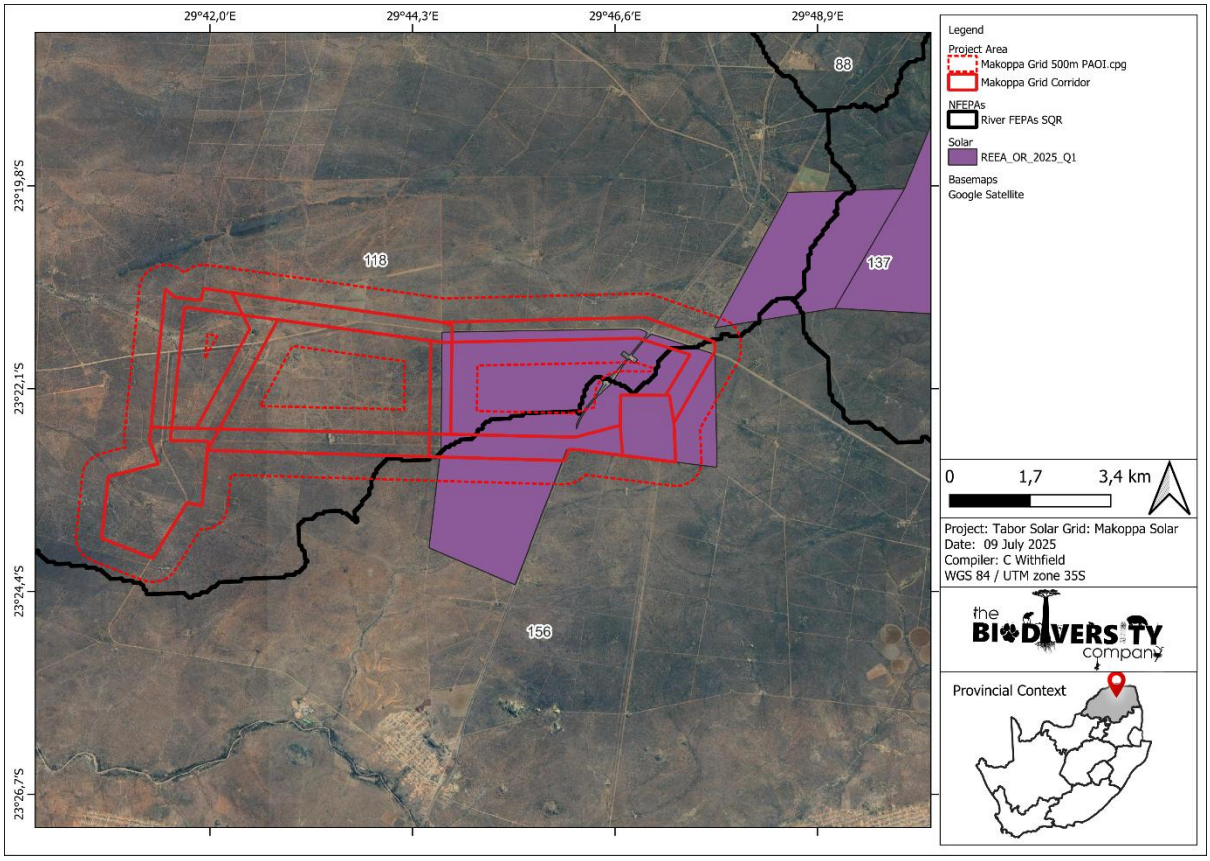


Figure 3-8 The project area in relation to the renewable energy database projects in the area.

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 project area falls within the International Strategic Transmission Corridor (EGI) (Figure 3-9).

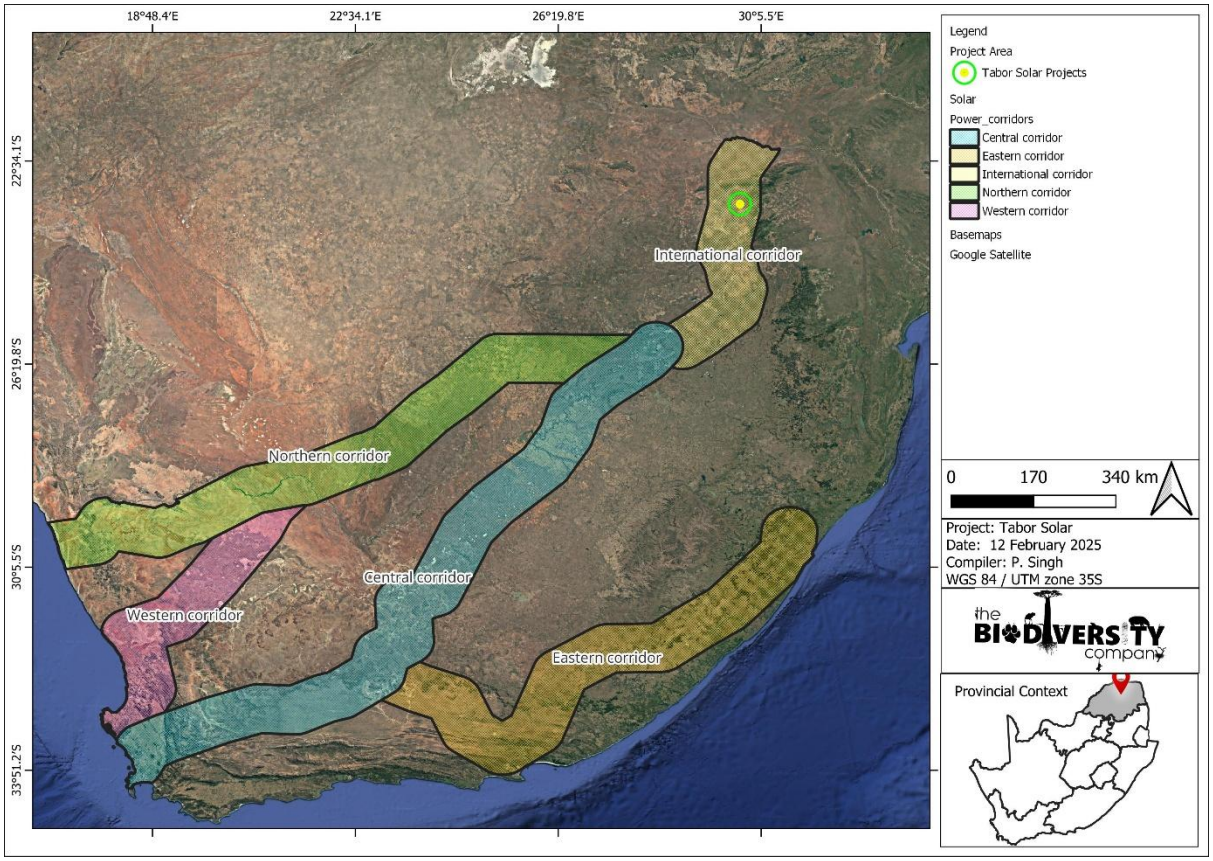


Figure 3-9 The PAOI in relation to the strategic transmission corridors

3.1.11 Freshwater Ecology

The project area falls within the Limpopo_Olifants Water Management Area (WMA) (DWS, 2023), the Limpopo Plain and Northern Plateau Ecoregions, and within the A71D quaternary catchment (Figure 3-10). Desktop information for the Sub-Quaternary Reaches (SQRs) associated with the PAOI was obtained from the DWS (2014). The PAOI falls within the A71D-00118 and A71C-00156 SQRs associated with the Sand River and Dwars River, respectively. The Present Ecological State (PES), Ecological Importance (EI), and Ecological Sensitivity (ES) for the SQRs are summarised in Table 3-2. The SQR impacts and activities include grazing (land-use), low water crossings, abstraction, bed and channel disturbance, small (farm) dams, overgrazing/trampling, sedimentation, vegetation removal, agricultural fields, algal growth, erosion, alien vegetation, inundation, irrigation (including runoff/effluent).

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

Component/SQR	A71D-0018 SQR (Sand River)	A71C-00156 SQR (Dwars River)
Present Ecological Status	Moderately Modified (category C)	Moderately Modified (category C)
Ecological Importance (EI)	Moderate	Moderate
Ecological Sensitivity (ES)	Low	Moderate

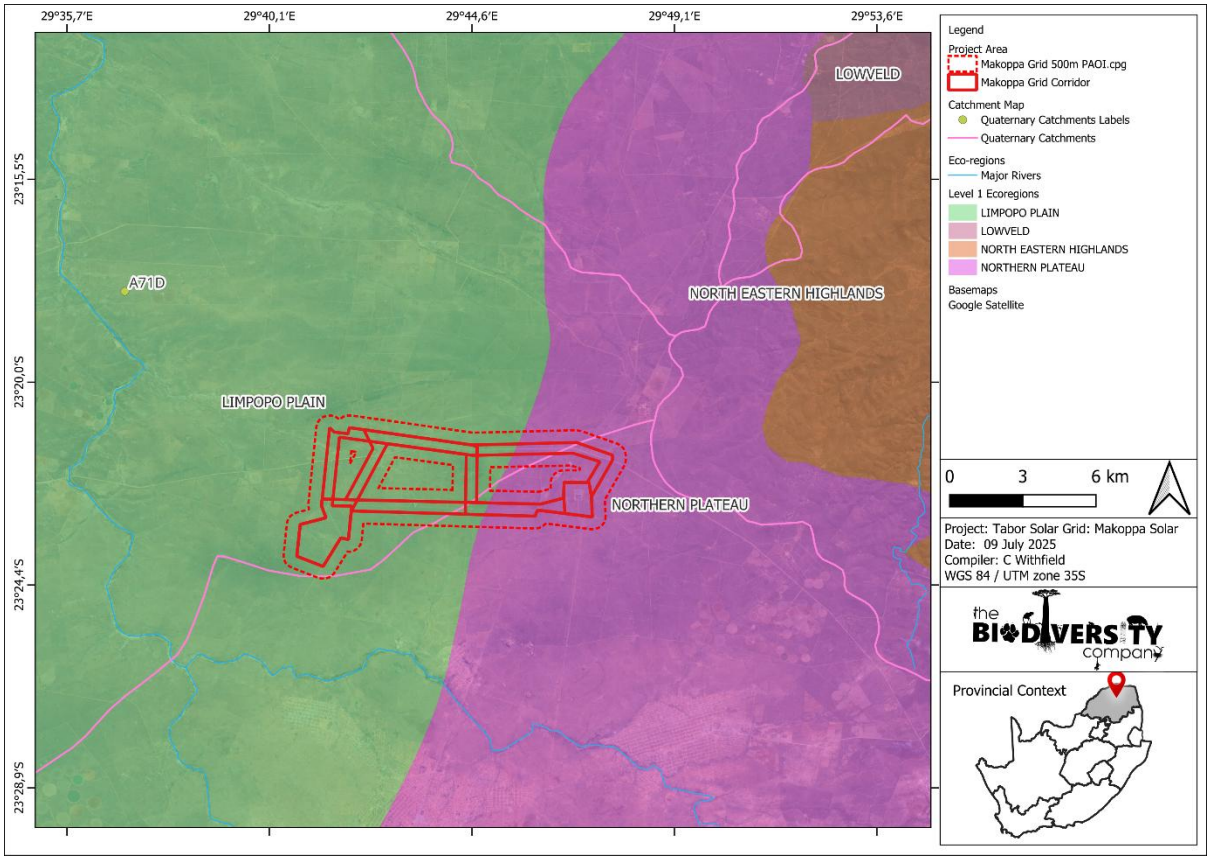


Figure 3-10 Hydrological aspects associated with the project area

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”. Currently there are no RQOs for the associated catchment.

3.2 Survey Results

During the field survey that was conducted between the 6th to 9th of January 2025 the following watercourses were identified within the PAOI:

- Rivers – None.
- Wetlands – None.
- Non-perennial/ephemeral watercourses:
    - Tributary of the Sand River;
    - Tributary of the Dwars River; and
    - Drainage areas.

The on-site assessment of the watercourses presented largely dry conditions in the tributary of the Sand River, tributary of the Dwars River, as well as the drainage areas, with surface water presence in isolated pools and instream impoundments. Cumulatively these non-perennial systems displayed ephemeral characteristics which is typical for watercourses in a semi-arid region. The watercourses drain the PAOI 1) westward, eventuating in the Sand River and 2) southward, eventuating in the Dwars River (which also confluences with the Sand River in the west). Portions of the watercourses intersect terrestrial habitat, highlighting their interdependence. Despite their current level of modification and ephemeral nature, the watercourses are sensitive to further modification as these systems do provide drinking opportunities (following rainfall) and habitat for foraging, nesting and refugia for terrestrial biota and avifauna (see respective specialist project). 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.

3.2.1 Investigation Sites

A single high flow survey was conducted on the 6th to 9th of January 2025. Sampling points (Figure 3-11) 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. Site investigations were conducted on systems presenting adequate surface water to conduct water quality, biological assessments. Photographs and Global Positioning System (GPS) coordinates pertaining to the sites are presented in Figure 3-11 and Table 3-3.

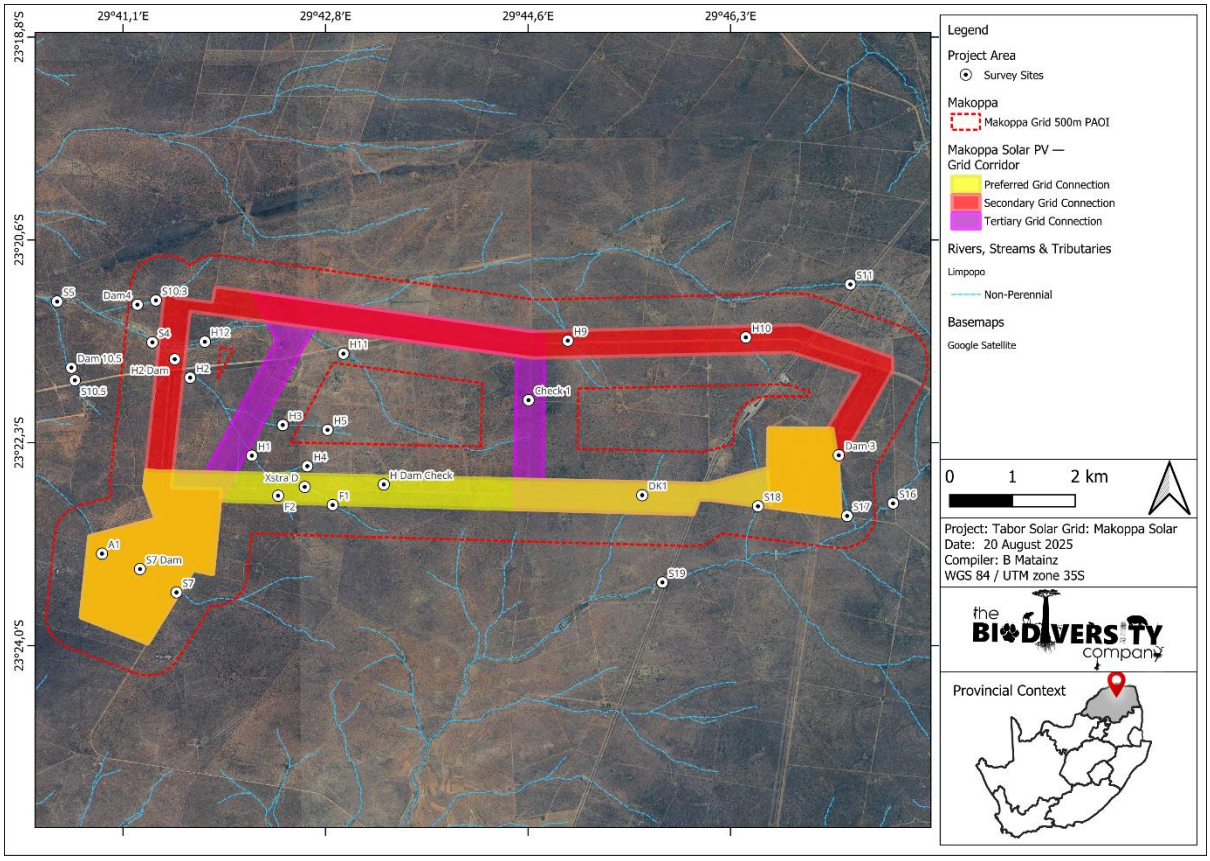
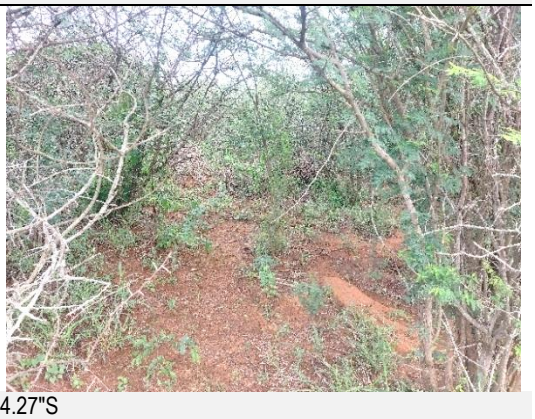


Figure 3-11 Locality map of the sampling sites within the PAOI

Table 3-3 Photos and coordinates for the sites sampled (January 2025)

Site	Upstream View	Downstream View
Sand River Tributary 2		
S4		
GPS	23°21'26.04"S 29°41'21.46"E	

Site	Upstream View	Downstream View
H12		
GPS	23°21'25.70"S 29°41'48.48"E	
Drainage Area 3		
S10.3		
GPS	23°21'4.47"S 29°41'23.27"E	
Dam 4		
GPS	23°21'6.67"S 29°41'13.76"E	
Drainage Area 5		
H11		

Site	Upstream View	Downstream View
GPS	23°21'31.86"S 29°42'59.77"E	
Drainage Area 4		
H2		
GPS	23°21'44.19"S 29°41'40.89"E	
H1		
GPS	23°22'24.27"S 29°42'12.65"	
H2 Dam		
GPS	23°21'34.70"S 29°41'32.98"E	
F1		

Site	Upstream View	Downstream View
GPS	23°22'49.62"S 29°42'54.27"E	
F2		
GPS	23°22'44.87"S 29°42'26.18"E	
Xstra D		
GPS	23°22'40.33"S 29°42'39.88"E	
Drainage Area 6		
H9		
GPS	23°21'25.14"S 29°44'55.27"E	
Drainage Area 7		

Site	Upstream View	Downstream View
H10		
GPS	23°21'23.48"S 29°46'26.94"E	
Dwars Tributary 1		
S16		
GPS	23°22'48.76"S 29°47'42.73"E	
Drainage Area 8		
S18		
GPS	23°22'50.28"S 29°46'33.20"E	
Drainage Area 9		

Site	Upstream View	Downstream View
S17		
GPS	23°22'55.25"S 29°47'19.07"E	
Dam 3		
GPS	23°22'24.04"S 29°47'14.80"E	

3.2.2 Water Quality

The *in-situ* results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms. The *in-situ* results recorded during the January 2025 study are presented in Table 3-4. Results have been compared to the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996), DWAF (2011a) and Chapman and Kimstach (1996). Sites were listed in a downstream direction for better interpretation of the results.

Table 3-4 In-situ water quality results for the project area (January 2025)

Parameters	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
Limits	**6.5-8.4*** **	**500*** **	**>5.0** **	**5-30***
Sand River Tributary 2				
S4	Dry			
H12	Dry			
Drainage Area 3				
S10.3				
Dam 4	8.47	889	5.5	27.6
Drainage Area 4				
H1	Dry			
H2	Dry			
H2 Dam	8.32	38.6	4.8	31.4

Parameters	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
Limits	**6.5-8.4*** **	**500*** **	**>5.0** **	**5-30***
F1	Dry			
F2	Dry			
Xstra D	Dry			
Drainage Area 5				
H11	Dry			
Drainage Area 6				
H9	7.65	41.8	6.0	23.8
Drainage Area 7				
H10	7.23	125.5	5.1	25.6
Dwars River Tributary 1				
S19	Dry			
S16	Dry			
Drainage Area 8				
S18	Dry			
Drainage Area 9				
S17	8.23	85.9	6.1	29.8
Dam 3	Dry			

Levels exceeding recommended guideline levels are indicated in red.
* TWQR – Target Water Quality Range (DWAF, 1996)
** Chapman and Kimstach (1996)
*** – Planning level water quality RSA (DWA, 2011a)

The *in-situ* water quality results indicated no water quality perturbations within watercourses in the PAOI (as indicated by sites H2 Dam, H9, H10 and S17). pH levels and electrical conductivity (EC) were within the acceptable limits, therefore indicative of limited to no pollution within the catchment. Furthermore, Drainage Area 3 (Dam 4) exhibited pH and EC levels above the stipulated values provided by the DWA (2011a). Dissolved oxygen (DO) and water temperature did not meet the acceptable limits in Drainage Area 4. This was expected due to the site being an instream impoundment in a semi-arid location. Water quality within Drainage Area 3 and 4 may therefore limit the diversity and abundance of aquatic biota within the system, and may only be optimal for tolerant aquatic organisms. Water quality within the other systems would not limit the diversity and abundance of aquatic biota as it fell within the acceptable limits. The water quality observed may be considered baseline/reference water quality for these reaches within the PAOI. It should be noted that *in-situ* water quality provides a simplistic overview of physical water quality parameters and aids in the interpretation of biological results.

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 completed for the assessed Sand River Tributary 2, Dwars River Tributary as well as Drainage Area 3 – Drainage Area 9 and their tributaries within the project area.

The results for the instream and riparian Index of Habitat Integrity (IHI) assessment for the associated river reaches are presented in Table 3-5. IHI was conducted to determine the PES of the system. According to the IHI results, the instream and riparian habitat of Sand River Tributaries were rated as 'Largely Natural' (class B), indicating a small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged. The instream and riparian habitat of the Dwars River Tributary as well as Drainage Area 3 – Drainage Area 9 were rated as 'Moderately Modified' (class C), indicating that a loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged. Anthropogenic activities within the local area and catchment that have contributed to the deteriorated state of the system include networks of roads and gravel roads as well as instream impoundments leading to inundation, flow modifications and channel modifications. This combination of impacts has resulted in habitat loss, flow modification, and therefore impacts to instream and riparian integrity.

Table 3-5 Results for the Instream Habitat Integrity assessment for the associated reaches (January 2025)

Instream Criteria	Sand River Tributary 2 (Site S4, H12) and Drainage Area 5 (H11)	Dwars Tributary 1 (Site S19, & S16), Drainage Area 8 (Site S18) and Drainage Area 9 (Site S17 and Dam 3)	Drainage Area 4 (Site H2, H1, H2 Dam, F2,F1, Xstra D)	Drainage Area 6 (Site H9) and Drainage Area 7 (Site H10)	Drainage Area 3 (S10.3, Dam 4)	Sand River Tributary 3 (Site S7 and A1)
Water abstraction	5	5	10	5	5	5
Flow modification	5	17	20	18	16	8
Bed modification	5	12	6	10	9	8
Channel modification	8	12	15	12	13	8
Phys-chem modification	2	2	2	5	2	2
Inundation	2	2	2	2	2	2
Alien macrophytes	0	0	0	0	0	0
Introduced aquatic fauna	0	0	0	0	0	0
Rubbish dumping	0	0	0	0	0	0
Instream Habitat Integrity Score	**86**	**61**	**62**	**63**	**66**	**83**
Instream Habitat Integrity Category	**B**	**C**	**C**	**C**	**C**	**B**
Riparian Criteria	**Sand River Tributary 2 (Site S4, H12) and Drainage Area 5 (H11)**	**Dwars Tributary 1 (Site S19, & S16), Drainage Area 8 (Site S18) and Drainage Area 9 (Site S17 and Dam 3)**	**Drainage Area 4 (Site H2, H1, H2 Dam, F2,F1, Xstra D)**	**Drainage Area 6 (Site H9) and Drainage Area 7 (Site H10)**	**Drainage Area 3 (S10.3, Dam 4)**	**Sand River Tributary 3 (Site S7 and A1)**
Vegetation removal	5	10	5	10	11	7
Exotic vegetation	2	2	2	2	2	1
Bank erosion	5	5	5	2	5	6

Channel modification	5	12	10	10	10	6
Water abstraction	5	5	8	5	4	4
Inundation	2	2	2	2	2	2
Flow modification	5	8	15	18	8	7
Phys-chem	2	2	2	2	2	2
Riparian Zone Integrity Score	**84**	**69**	**67**	**62**	**70**	**82**
Riparian Zone Integrity Category	**B**	**C**	**C**	**C**	**C**	**B**

3.2.4 Aquatic Macroinvertrebrates

3.2.4.1 Macroinvertebrates Habitat

Biological SASS5 assessments could not be completed as the watercourses did not qualify for assessment according to the method (Dickens and Graham, 2002).

3.2.5 Fish Community Structure

An expected fish species list was composed for the system based on habitat preferences and distribution(Table 3-7). 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; 2024). Five (5) indigenous fish species were expected to occur in the Sub Quaternary Reach (SQR). It should be noted that these expected species lists are compiled on a SQR basis by DWS (2014) and not on a site-specific basis. It is therefore highly unlikely that all the expected species will be present at every site in the SQR with habitat type and availability being the main driver of species present. No 'Endangered' (EN) fish species were expected within the study area, however, one (1) South African 'Vulnerable' (VU) species is expected within the system (*Oreochromis mossambicus*) (IUCN, 2025).

A single hybrid fish species between *Oreochromis mossambicus* (Mozambique Tilapia) and *Oreochromis niloticus* (Nile Tilapia), was collected at site Dam 4. Hybridization has already been documented in the Limpopo River Catchment (IUCN, 2025). Although the potential species list indicates *Oreochromis mossambicus* (Mozambique Tilapia) to be present within the SQR, it is possible that the hybrid fish species was introduced into the impoundment (Dam 4). Fish were collected using electrofishing, cast nets and visual observation techniques in all available biotopes. The fish species were then identified using a complete guide to the Freshwater Fishes of Southern Africa (Skelton, 2024). All fish were released at the point of capture. A photographic example of the fish species is presented in Figure 3-11 below.

Figure 3-12 Hybrid fish species Oreochromis mossambicus x niloticus collected during January 2025 survey

Fish species have different sensitivities to physiochemical and flow modification (Table 3-6) and therefore this was considered for the expected fish species assemblage. This indicated that the average expected assemblage is moderately tolerant to changes in flow and physiochemical modification. The average results for the observed community indicated that the community were tolerant to changes in flow and physiochemical modifications.

Table 3-6 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

Table 3-7 Summary of the expected and collected fish species and sensitivity for the project area (January 2025)

Scientific name	Common name	IUCN Status (IUCN, 2025)	Sensitivity - Flow	Sensitivity - PhysChem	Collected
Clarias gariepinus	Sharptooth Catfish	LC	2.30	1.80	No
Enteromius paludinosus	Straightfin Barb	LC	2.70	1.80	No
Enteromius trimaculatus	Three Spotted Barb	LC	1.70	1.00	No
Pseudocrenilabrus philander	Southern Mouthbrooder	LC	0.90	1.30	No
Oreochromis mossambicus	Mozambique Tilapia	VU	1.00	1.40	Yes***
Total Exotic Species Sampled					**0**
Total Indigenous Species Sampled					**1**

*IUCN: International Union for the Conservation of Nature
**Skelton (2024).
***Hybrid species
LC: Least Concern
VU: Vulnerable
Exotic species indicated in Red

Oreochromis mossambicus (Mozambique tilapia) is currently listed as Vulnerable (VU). The most serious threat facing *O. mossambicus* is hybridization with the rapidly spreading introduced species *Oreochromis niloticus* (Nile tilapia) (IUCN, 2021). Hybridization has already been documented throughout the northern part of the species' range, with most of the evidence coming from the Limpopo River catchment (IUCN, 2021). Given the rapid spread of *O. niloticus* it is anticipated that O. mossambicus will qualify as threatened under Criterion A due to rapid population decline through hybridization (IUCN, 2021). Oreochromis mossambicus occurs in all but fast flowing waters and is tolerant of high salinities. It feeds on algae and invertebrates. The clearest morphological indicator of hybridization between *O. mossambicus* and *O. niloticus* is barring on the caudal fin. No traces of hybridization were recorded amongst the O. *mossambicus* recorded in the project area although DNA analysis would be needed in order to confirm this (IUCN, 2025).

3.2.6 Present Ecological Status

Due to the ephemeral nature of the watercourses within the PAOI, standard aquatic methods could not be conducted. The Index of Habitat Integrity (IHI) model v2 as described in Kleynhans (1996) was therefore used to determine the Present Ecological State (PES) of these watercourses. The results are summarised in Table 3-8 below.

Table 3-8 Summary of the results (January 2025))

	Sand River Tributary 2 (Site S4, H12) and Drainage Area 5 (H11)	Dwars Tributary 1 (Site S19,& S16), Drainage Area 8 (Site S18) and Drainage Area 9 (Site S17 and Dam 3)	Drainage Area 4 (Site H2, H1, H2 Dam, F2, F1, Xstra D)	Drainage Area 6 (Site H9) and Drainage Area 7 (Site H10)	Drainage Area 3 (Site S10.3 and Dam 4)	Sand River Tributary 3 (Site S7, A1 and S8)
Instream Ecological Category (IHI)	B	C	C	C	C	B
Riparian Ecological Category (IHI)	B	C	C	C	C	B
Aquatic Invertebrate Ecological Category	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Fish Community	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
PES	**B (Largely Natural)**	**C (Moderately Modified)**	**C (Moderately Modified)**	**C (Moderately Modified)**	**C (Moderately Modified)**	**B (Largely Natural)**
PES (DWS, 2014) – SQR A71D-00118	C (Moderately Modified)	C (Moderately Modified)	C (Moderately Modified)	C (Moderately Modified)	C (Moderately Modified)	C (Moderately Modified)
Management Objective	Maintain PES	Maintain PES	Maintain PES	Maintain PES	Maintain PES	Maintain PES

3.3 Riparian Delineations, Buffer Requirements and Regulated Areas

The riparian areas along the assessed watercourses were delineated according to DWAF (2005), 5 m contour data, the SAIIAE 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 3-14 . 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.

The watercourses considered in this assessment represented ephemeral system characteristics that have naturally been subjected to instream erosion and sedimentation compounded by surface flow alterations (gravel road crossings and instream impoundments). Riparian areas comprised of a mix of herbaceous species and woody species present. Despite alteration, these areas were considered to be largely intact.

The ecological sensitivity of the watercourses draining the PAOI was determined to be 'Medium' and largely uniform across the project area. The watercourses presented evidence of reliance/ dependence on these systems by terrestrial biota (in times of surface water presence after rainfall), foraging, nesting and refugia, with animal tracks observed in the substrates in/proximal to majority of the watercourses. Despite the absence of water and consequently aquatic taxa at the time of the survey, all of the watercourses in the project area are regarded as sensitive environments in relation to changes in habitat integrity, flow and water quality (ecological drivers).

Given the varied geomorphological features of the watercourses, watercourse extents were mapped with associated sensitivity assigned by identifying vegetation features on aerial imagery and confirmation through ground truthing during the survey. A diagrammatic example of the typical watercourse extent as well as where appropriate buffer areas are located is provided in Figure 3-13. All infrastructure should avoid any 'Medium' sensitivity areas. The 'Medium' sensitivity areas are to be treated as no-go areas, allowing only minimum critical watercourse crossing in these areas.

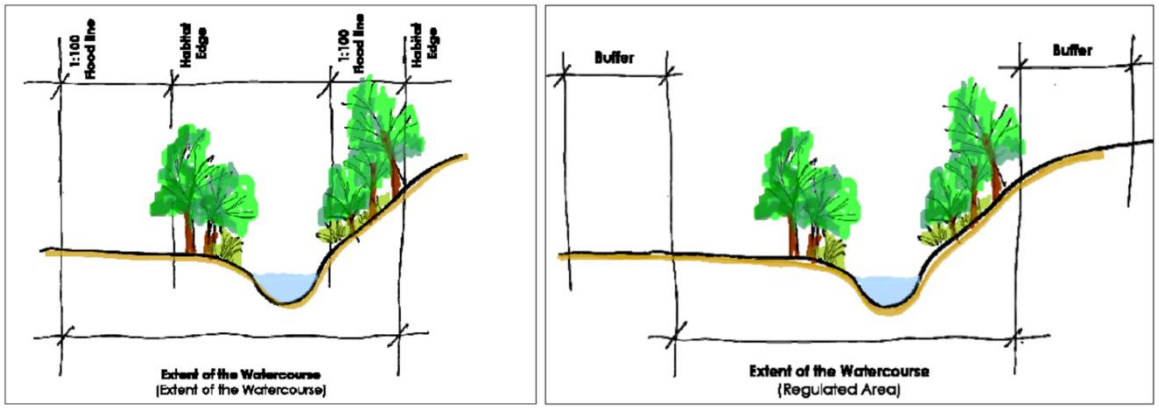


Figure 3-13 Illustration of the extent of a watercourse and the Regulated Area (DWA, 2012)

A minimum buffer zone strip of at least 32 meters wide is required for rivers as per NEMA (Act no. 107 of 1998). Using this sensitivity and the buffer tool (Macfarlane, *et al*., 2014), a conservative buffer zone of **20 m** was suggested for the watercourses within the PAOI (Figure 3-14). These buffer areas serve as **No-go** zones for unauthorised activities. The site development plan should therefore be created accordingly. Ensuring buffers are intact increases the resilience of a watercourse to future disturbances.

3.3.1 Regulation Zones

Table 3-9 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. As a limited SDP was provided, it is assumed that the proposed activities would traverse or be located in proximity to regulated areas, and therefore the project may fall within the NEMA Act 107 and DWS GN 4167 regulated zones. The regulated areas have been applied to the delineations within the PAOI and presented in Figure 3-14.

Table 3-9 The legislated zones of regulation

Regulatory authorisation	Zone of applicability
Water Use License Application in terms of the	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.

National Water Act, 1998 (Act No. 36 of 1998). **Department of Water and Sanitation (DWS)**	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: • 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.
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)**	**Activities of Listing Notice 1 (GN 983) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended):** **Activity 12:** The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres;or (j) infrastructure or structures with a physical footprint of 100 square metres or more. where such development occurs: a) within a watercourse; b) in front of a development setback; or c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse. Excluding – …(dd) where such development occurs within an urban area… **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 (i) a watercourse; (ii) the seashore; or (iii) 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— but excluding where such infilling, depositing, dredging, excavation, removal or moving— (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) 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. **<u>Activities of Listing Notice 3 (GN 985) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)</u>** **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,*

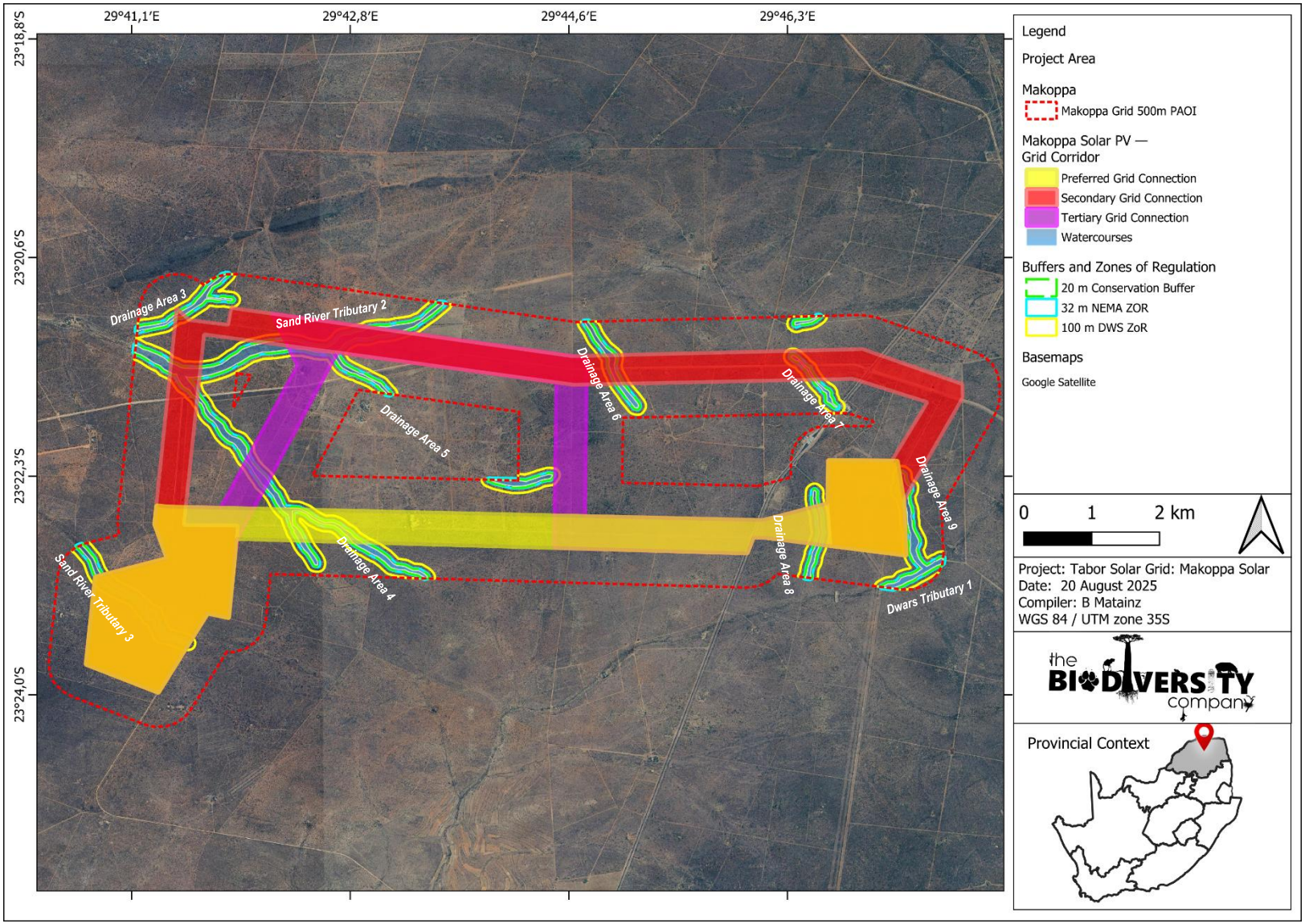


Figure 3-14 Riparian areas, regulated areas and sensitivity buffers for the proposed PAOI

3.4 Site Sensitivity Verification

3.4.1 Ecological Sensitivity

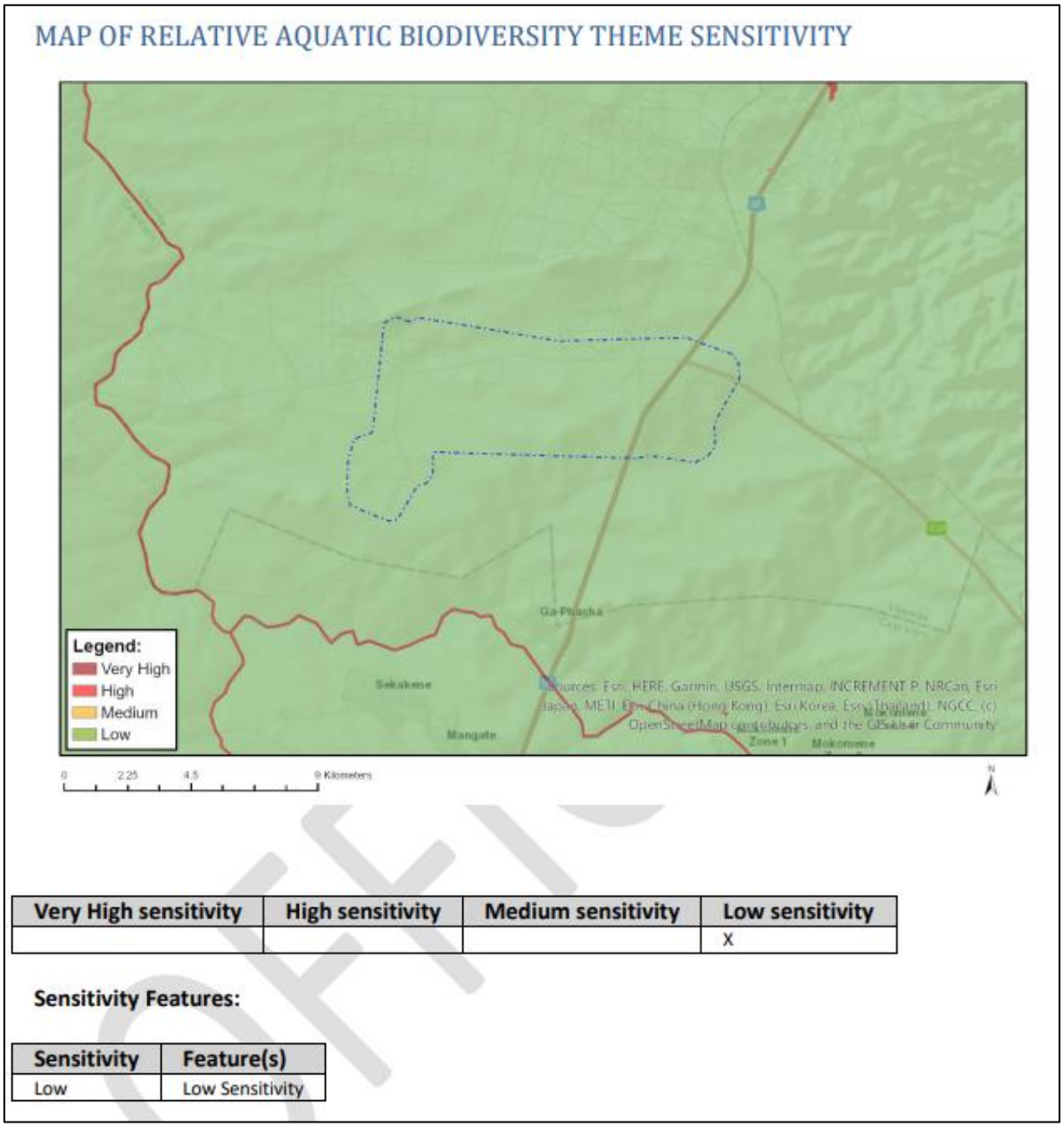
The following is deduced from the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended) and the current assessment:

- The National Web-Based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area and the PAOI as “Low” and “Very High” (Figure 3-15). Note: due to an error in the screening tool, the polygon had to be filled and is therefore not representative of the actual PAOI and project area.
- Table 3-10 provides a comparison between the Environmental Screening Tool and the specialist determined Site Habitat and System Characterisation. The specialist-assigned sensitivity ratings are based largely on the functionality assessment processes, and consideration is given to any observed or likely presence of Species of Conservation Concern (SCC). As the project area and proposed activities are located in the Vhembe Biosphere Reserve Conservation Area, and is in close proximity to watercourses, the sensitivity should therefore be regarded as “Medium” (Figure 3-16). The SQR includes the possible presence of one (1) South African fish species that is rated “Vulnerable” by the IUCN (2025).

Table 3-10 Sensitivity features associated with Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

Sensitivity	Features	Specialist Verification
Low	Low sensitivity	**Disputed. Medium and Low sensitivity areas present.** The Project Area and PAOI includes non-perennial/ephemeral watercourses

*Screening tool uses metadata from 2018 NBA



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

Figure 3-15 Aquatic Biodiversity Theme Sensitivity for the Project Area and PAOI

The freshwater ecology of the immediate project area and further downstream areas are considered sensitive to disturbance from a hydrological and biological perspective, however due to the ephemeral nature of the watercourses, this sensitivity applies more to the watercourses' physical characteristics that influence the hydrological and biological aspects in times of surface water presence/ inundation. This will include all watercourses within the project area which are considered sensitive due to their relatively small spatial scale when compared to adjacent terrestrial habitat with a large demand for the ecosystem services which they provide. Construction and operation activities must take cognisance of this and avoid any unnecessary disturbance of the watercourses and adjacent habitat Figure 3-16. All infrastructure should avoid any 'Medium' sensitivity areas. The 'Medium' sensitivity areas are to be treated as no-go areas, allowing only minimum critical watercourse crossing in these areas.

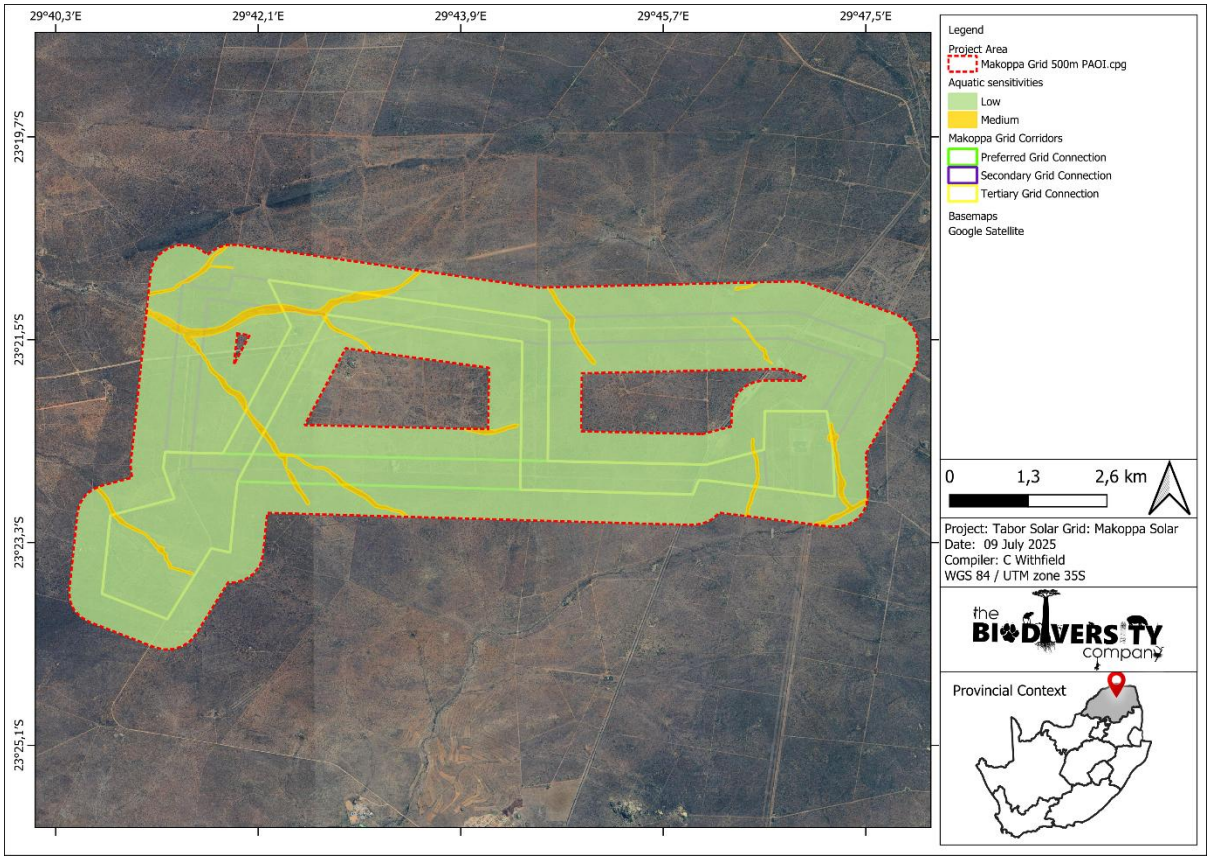


Figure 3-16 Aquatic delineated sensitivity for the PAOI

4 Risk and Impact Assessment

4.1 Current Impacts on Freshwater Biodiversity

The assessed watercourses exhibit impacts on both the catchment and local scale. These impacts, albeit of low/limited intensity, result from present and historical land use in proximity to water resources which have transformed their habitats and altered their natural hydrological regime as well as species composition. The list below refers to the present-day local impacts associated with the assessed freshwater areas:

- Historic land modification from reference conditions;
- Farm roads and main roads (and associated altered surface hydrology and wash of hydrocarbons into watercourses. Both formal and informal river crossing structures have altered instream flow characteristics);
- Game farms, fences and associated maintenance resulting in habitat fragmentation;
- Grazing and trampling of natural vegetation by livestock in watercourse areas;
- Erosion from variable slopes, embankments and roads (especially crossings and roads lacking anti-erosion measures);
- Instream impoundments;
- Instream sedimentation; and
- Existing Overhead powerlines (OHLs) and associated servitudes.

4.2 Alternatives Considered

Three (3) alternatives were presented at the time of report compilation. The impact of all the alternatives would be similar as each one crosses watercourses (Figure 3-14). The preferred alternative would be recommended as it crosses the least number of watercourses.

4.3 Loss of Irreplaceable Resources

The freshwater ecology of the project area is considered moderately sensitive to disturbance from a hydrological, biological and conservational perspective. This includes the 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.

4.4 Quantitative Risk and Impact 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 4-1). 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 water resources within and close to the project area. Mitigation measures should be implemented to negate potential impacts on the water resources associated with the project area.

A single risk assessment was compiled for the project, which relates to the Solar PV Facility Gridline and associated activities post-mitigation. The DWS Risk Assessment Matrix (GN 4167) was used to assess both risks and impacts anticipated from the proposed activities as it is in the specialist's opinion that is suitable and sufficient to assess risks to associated water resources and can be used to apply for the full EIA. This applies to all proposed activities of Section 21 (c), and (i) water uses.

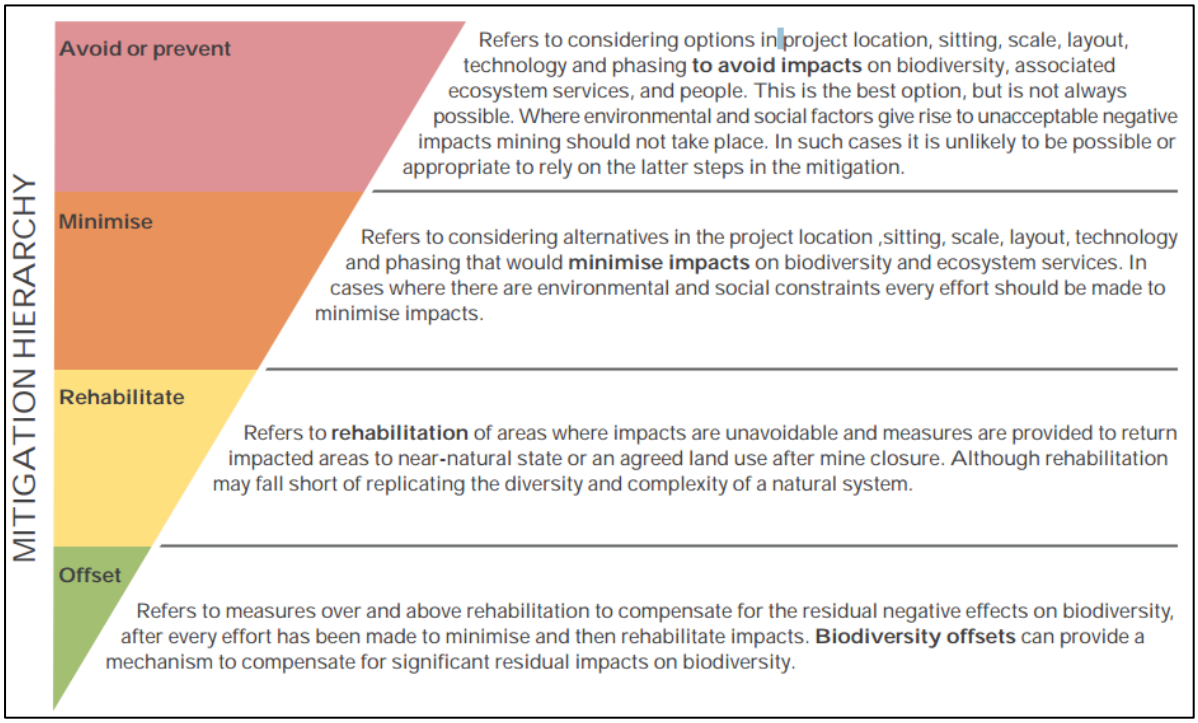


Figure 4-1 The mitigation hierarchy as described by the DEA (2013)

4.4.1 Potential Anticipated Impacts

Table 4-1 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, these results are presented in the subsequent tables.

Table 4-1 Summative results of the DWS Risk Assessment Matrix compiled by Prasheen Singh (Pr. Sci. Nat. 116822)

Phase	Activity	Impact	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 pylon towers. Construction of new OHLs. Wiring to Central Inverters. Storage and Use of Hazardous substances and Equipment.	Loss, disturbance and degradation of riparian systems	**28.8**	**L**
		Loss or degradation in ecosystem services	**12.8**	**L**
		Altered hydrological regimes	**17.6**	**L**
		Increase in erosion and sedimentation of receiving systems	**26.4**	**L**
		Introduction and spread of alien and invasive vegetation	**28.8**	**L**
		Impaired water quality	**26.4**	**L**
OPERATIONAL	Operation of the Grid Corridor. Established Grid Corridor Area. Vehicle Traffic (Security Monitoring and Maintenance).	Loss or degradation in ecosystem services	**17.6**	**L**
		Altered hydrological regimes	**12.8**	**L**

Phase	Activity	Impact	Significance (max = 100)	Risk Rating (with mitigation and avoidance)
	Operation of on-site Stormwater Management.	Increase in erosion and sedimentation of receiving systems	**14.4**	**L**
		Introduction and spread of alien and invasive vegetation	**21.6**	**L**
DECOMMISSIONING	Removal of infrastructure	Degradation of vegetation and proliferation of alien and invasive species	**16.8**	**L**
		Increased bare surfaces, runoff and potential for erosion	**19.2**	**L**

(L) Low Risk (+) Positive (+ +) Highly positive
(M) Moderate Risk
(H) High Risk

Anthropogenic activities drive habitat destruction, causing displacement of aquatic and terrestrial fauna and flora. Land clearing for development (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 stormwater discharge outlet layouts and facilities as well as consultation with various contractors involved with a diversity of proposed project related activities going forward.

The intended infrastructure was assessed as outlined in previous sections in this report. The potential impact and risk of the project on associated watercourses was based on avoidance mitigation. Three (3) alternatives were provided for consideration for this assessment. Considering the size of these watercourse areas, their associated sensitivity and the volumes of water delivered by them (during the height of the rainy season), the primary objective should be to avoid construction within them. Furthermore, these areas and associated buffer zones are suggested as no go areas and should be avoided if possible, and mitigated where avoidance is not feasible.

To further understand the impacts of a transmission infrastructure on aquatic habitat the footprint should be understood. Transmission tower electrical pylons which don't have standard distances between pylons normally range from 150 m to 500 m apart. The use of pylons indicate that the transmission is not buried, and watercourses are largely avoided. The vegetation plays an important role in the maintenance of hydrological and sediment regimes of the watercourse. Removal of vegetation, particularly in the tributaries and drainage areas have the potential to decrease infiltration and increase surface runoff. It also has the potential to result in erosion of the drainage area while at the same time

increasing sediment loads and potentially toxicants delivered downstream. Lastly, access will be provided via the existing dirt road network, along with a newly constructed gravel road to the substation. Without appropriate mitigation, these could contribute to further habitat degradation. The project alternatives traverse similar habitats and watercourse features hence will pose similar risk and impacts. All activities and aspects associated with the transmission line infrastructure will have 'Low' impact significance post-mitigation.

The grid will occur within the Project Area and across sensitive areas/buffer areas. 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. 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 unauthorized heavy vehicles within delineated watercourses and buffer areas, and most importantly, avoidance of watercourses and buffer areas for development activities (including placement of pylons). 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 ecosystem degradation. A decommissioning phase for the proposed development was considered and would pose risks and impacts similar to the construction phase.

All activities and aspects associated with the **Makoppa Solar PV Energy Facility - Grid Infrastructure** will have 'Low' impact significance post-mitigation due to the avoidance of watercourse and buffer areas as well as the implementation of adequate and adaptive stormwater management.

Following the DEA mitigation hierarchy, the adverse effects to the receiving watercourses will need to be ameliorated through the implementation of watercourse rehabilitation if disturbed. This could involve rehabilitation of disturbed drainage areas and banks to improve the phytoremediation capacity of the system. The proposed project therefore requires a DWS Water Use General Authorisation as the associated water use activities are within 100 m of the regulated area and trigger sections 21 (c) impeding or diverting the flow of water in a watercourse, and (i) altering the bed, banks, courses or characteristics of a watercourse with 'Low' post-mitigation risks.

4.5 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 4-2 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 4-2: Unplanned Events, Risks and their Management Measures

Flooding during construction	**Significant habitat degradation of downstream areas.**	**A flood emergency response plan should be drafted, with adequate stormwater management required.**
Spills into the surrounding environment and watercourses	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, an experienced aquatic ecologist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of downslope watercourses	Erosion control measures must be put in place. Measures must include monthly inspections across the project footprint and should be adaptive based 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.

4.6 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 4-3).

Table 4-3: 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	Highly probable
Significance	Low	Moderate
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

4.7 Mitigation 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 of, and fragmentation, of the vegetation community (including the riparian area);
- Prevent the loss of the faunal community (including potentially occurring species of conservation concern) associated with these vegetation communities; and

- Limiting the construction area to the defined project areas and only impacting those areas where it is unavoidable to do so otherwise.

Considering the expected impacts from the project activities, the following mitigation measures have been proposed to lower the intensity of the impacts on the ecological integrity of the associated water resources. The focus of mitigation measures should be to reduce the significance of potential environmental impacts.

4.7.1 Grid Infrastructure and Road Network

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 with 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 4-2). 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 4-3). 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;

Figure 4-2 Example of road margin erosion prevention.

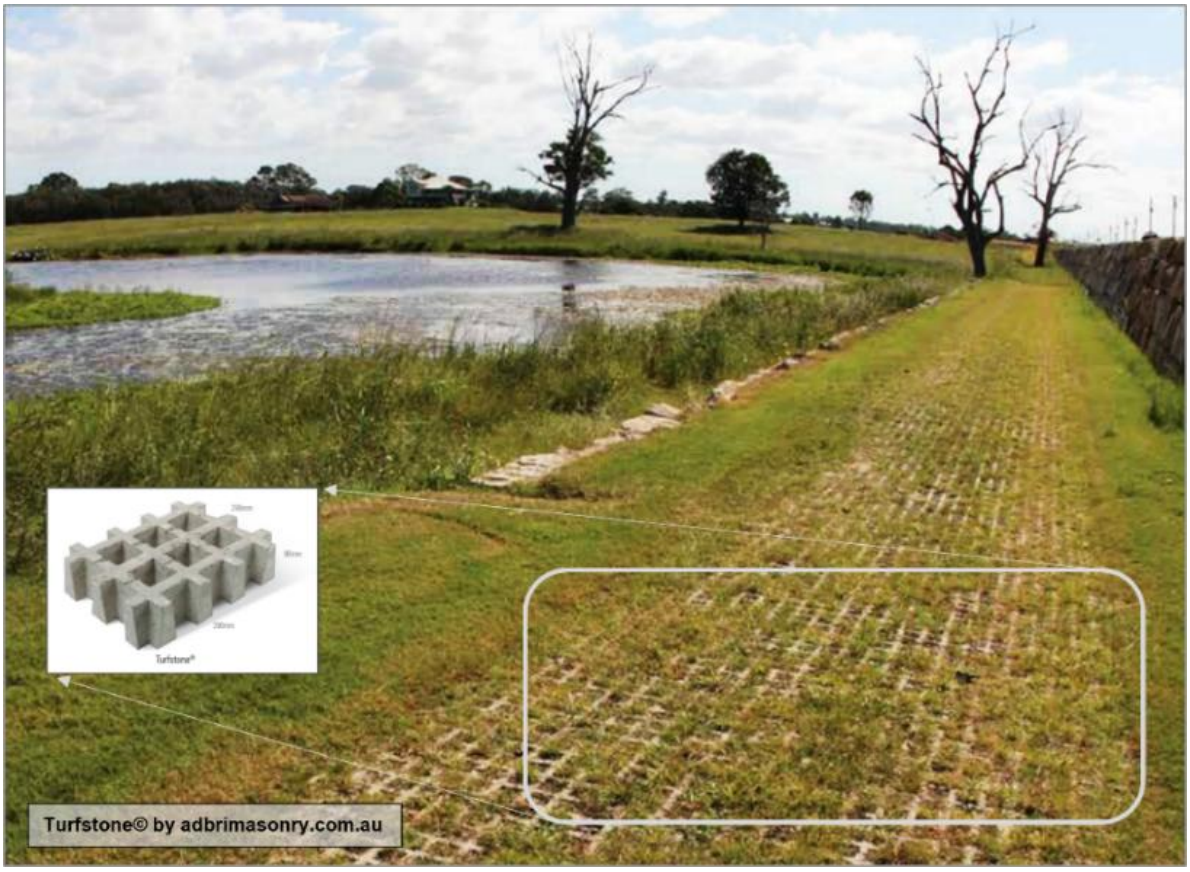


Figure 4-3 Example of permeable paving for roads and habitat maintenance.

- 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;

4.7.2 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 contactors 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.

4.7.3 Erosion & Sedimentation

The following erosion specific mitigation measures are provided:

- All removed soil and material must not be stockpiled within any watercourse. Stockpiling should take place outside of water resources. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds and/or any other appropriate erosion protection measures;
- 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 re-vegetate all cleared areas as soon as possible to limit erosion potential.

4.7.4 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.
- Keep disturbances to within footprints and outside of buffer zones;
- Control new stands of alien species as they arise;

- Land users are required by law, to remove and / or control Category 1 alien and invasive vegetation according to the National Environmental Management: Biodiversity Act (NEMBA: Act 10 of 2004) (September 2020 List – GN1003). Additionally, unless authorised, in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring in proximity to a watercourse;

- It is recommended that Category 1 species are prioritised for control, with control of herbaceous weedy species (which would need to include follow-up control);

- Foliar herbicide spray must not be used within any of the sensitive riparian areas, rather opt for mechanical removal or direct dribbled application to stumps (use a dye); and

- Wet season vegetation rehabilitation surveys need to be conducted of the vegetation within the project footprint to stay on top of the alien vegetation for the life of the project. This will improve the biotic integrity over the long term.

- Preventing the introduction, movement and spread of invasive species on and off the construction site, for example by washing down vehicles before they enter the site on designated areas;

4.7.5 Operation of Vehicles and Heavy Machinery

- Operating heavy machinery in watercourse 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 (if applicable);

- 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. An exception being emergency procedures, however this must be done with the approval and supervision of the ECO;

- Construction vehicles (including heavy machinery) must, as far as feasibly possible, use existing roads (including dirt roads). Where alternative routing is unavoidable, planned routes must avoid sensitive habitats, watercourse vegetation, buffer areas, and other water bodies;

- Operators must be trained in operating machinery in 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 water bodies 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).

4.7.6 General mitigation measures

The following general mitigation measures are provided:

- The watercourse areas outside of the specific project site area must be avoided where possible;
- Aspects of the site development plan (SDP) such as laydown area and site camps should be located outside of the buffer zone, which would significantly reduce potential impacts;
- Construction activities must take place during the low flow period (as much as possible). In addition to this, basic stormwater structures such as berms must be designed and implemented prior to and throughout the duration of the construction activities;
- Stormwater runoff from the development area should enter drainage systems through diffuse channels fitted with flow attenuation/energy dissipation structures in the form of green infrastructure such as vegetated swales, or grassed channels;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- Temporary storm water channels and preferential flow paths should be filled with aggregate and/or logs (branches included) to dissipate and slow flows limiting erosion;
- Prevent uncontrolled access of vehicles through the river system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals, construction materials and toxicants to be used for the construction must be stored within bunded areas;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced in a designated area;
- 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. 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 contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place away from the watercourse and buffer area. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds and/or any other appropriate erosion protection measures;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No indiscriminate dumping of construction material is permitted on-site. Any waste temporarily stored on-site must be placed in designated, contained areas in accordance with the approved waste management plan;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported; and
- 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 watercourse buffer zones 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 watercourse areas, bed and banks must be budgeted for and should 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.
- Mitigation 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.

5 Recommendations

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

- A competent Environmental Control Officer (ECO) must oversee the construction and associated rehabilitation phase of the project, with watercourse areas as a priority to limit 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, and the full assessment report, to familiarise themselves with the mitigation and recommendations prior to construction;
- Several aquatic features or aquatic functional zones are present, which may provide some technical challenges due to seasonal flooding. Any footprint within these areas will likely require careful planning in order to minimise changes to flows which could alter species composition and affect ecological processes to both aquatic and terrestrial areas. As a minimum any roads traversing these alluvial areas must accommodate lateral flows (interconnectivity) of water and sediment between watercourses and alluvial area where seasonal flooding occurs. This challenge can be overcome through the use of raised access roads fitted with appropriate aggregate base layers and culverts to allow lateral movement of water and to minimise localised flooding and/or drying out;
- The grid infrastructure and road alignments must be designed to avoid watercourses and their 20 m buffer areas. Multiple crossings across the same watercourse section are not advised, and must be restricted to the minimum number feasible;
- A qualified Hydrologist with experience in semi-arid areas must develop a suitable and adaptive Stormwater management plan to ensure no erosion takes place and that clean water reports back to the local watercourses during rainfall events;
- An adaptive rehabilitation plan needs to be implemented from the onset of the project. The key focus should be placed on revegetation, stormwater and erosion prevention strategies for the development area. The plan should be adhered to for all stages of the project life;
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase. This will include monitoring the crossings, all stormwater discharge points, energy dissipation structures, and stability and condition of watercourse habitat in the project footprint. This service plan should be adaptive based on on-site conditions;
- A walkdown must be conducted on the final layout to confirm the larger watercourses are adequately avoided, and that the smaller drainage features (regardless of how insignificant they may appear) will have adequate flow catering structures in place. This must be conducted prior to final design sign off and construction.

6 Conclusion

The National Web-Based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area and the PAOI as “Low” and “Very High”. This is disputed due to the presence of ephemeral watercourses within the project area, overlap with a Conservation Area, possible presence of a ‘Vulnerable’ fish species in the SQR, and the NFEPA non-priority seep wetland not occurring within the actual PAOI. The Project Area and PAOI are therefore a combination of “Low” and “Medium” sensitivity. At the desktop level, the ecological integrity (PES) of the associated SQR is classified as class C (Moderately Modified), with a ‘Moderate’ Ecological Importance (EI) and ‘Low’ Ecological Sensitivity (ES).

The *in-situ* water quality results indicated no water quality perturbation in the PAOI. Water quality (as interpreted from instream impoundment(s) and isolated pools) may limit the diversity and abundance of aquatic biota within the PAOI, and may only be optimal for tolerant aquatic organisms. The Index of Habitat Integrity (IHI) assessment indicated a ‘Largely Natural’ (category B) instream and riparian integrity for the Sand River Tributary 2 and 3, and ‘Moderately Modified’ instream and riparian integrity for Dwars River Tributary 1 and Drainage Area 3-Drainage Area 9. The PES assessment indicated that the Sand River Tributary 2 was in a ‘Largely Natural’ (category B) state and Drainage Area 3-Drainage Area 9 were in a ‘Moderately Modified’ (category C), therefore meeting the DWS (2014) PES of ‘Moderately Modified’.

Buffer zones have been assigned to the water resources within the PAOI, these buffer zones are designated as No-go zones for any development, disturbance, equipment/machinery, waste dumping, and laydown yards unless authorized. A minimum buffer zone strip of **20 meters** for watercourses is recommended. The integrity of these buffers enhances the resilience of watercourses to future disturbances. Development plans activities should be crafted accordingly to ensure compliance with these buffer requirements.

6.1 Risk and Impact Statement

The grid will occur within the Project Area and across sensitive areas/buffer areas. 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. 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 unauthorized heavy vehicles within delineated watercourses and buffer areas, and most importantly, avoidance of watercourses and buffer areas for development activities (including placement of pylons). 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 ecosystem degradation. A decommissioning phase for the proposed development was considered and would pose risks and impacts similar to the construction phase.

6.2 Specialist Opinion

Considering the assessment findings, it is the opinion of the specialist that the project may be considered for authorisation, on condition that all prescribed mitigation measures and recommendations are implemented. This includes the avoidance of sensitive freshwater habitats and their buffer zones (as far as is feasible), methods that prevent the introduction of contaminants into watercourses, as well as the minimisation of development/disturbances within these areas. The implementation of mitigation measures would result in an overall “Low” impact for the project. The project therefore warrants a General Authorisation application process and must adhere to the stipulations or directives that may arise consequently.

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8 Appendices

8.1 Appendix A: Freshwater Methodology

8.1.1 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).

8.1.1.1 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.

8.1.1.2 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.

8.1.1.3 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.

8.1.1.4 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).

8.1.2 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 (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

8.1.3 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 water resource 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.

8.1.3.1 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 8-1 and Table 8-2 respectively. The spatial framework for each IHI was 5 km upstream and downstream of the respective sampling points within the watercourse(s).

Table 8-1 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.
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 *et al*., 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 *et al*., 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 *et al*., 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 8-2 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 8-3). The relative weighting of criteria remains the same as for the assessment of habitat integrity (DWS, 1999).

Table 8-3 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 8-4.

Table 8-4 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

8.1.4 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.

8.1.4.1 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 8-5.

Table 8-5 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.

8.1.4.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) provides 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.

8.1.5 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 8-6. These tolerance levels are scored to show each fish species' sensitivity to flow and physicochemical modifications.

Table 8-6 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

8.1.5.1 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 8-1.

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 = Total Catch / Total Effort. The CPUE was presented per site.

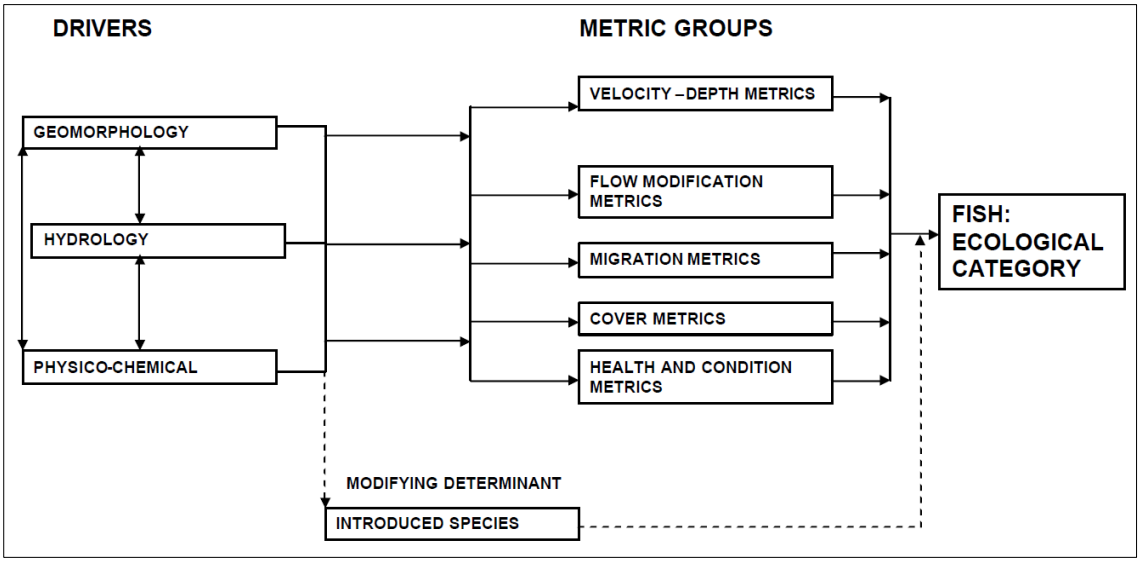

Figure 8-1 The relationship between drivers and fish metric groups (Kleynhans, 2007)

8.1.6 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 8-7) . 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 8-7 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.

8.1.7 Riparian Delineation

The riparian delineation was completed according to DWAF (2005). Typical riparian cross-sections and structures are provided in Figure 8-2. 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).

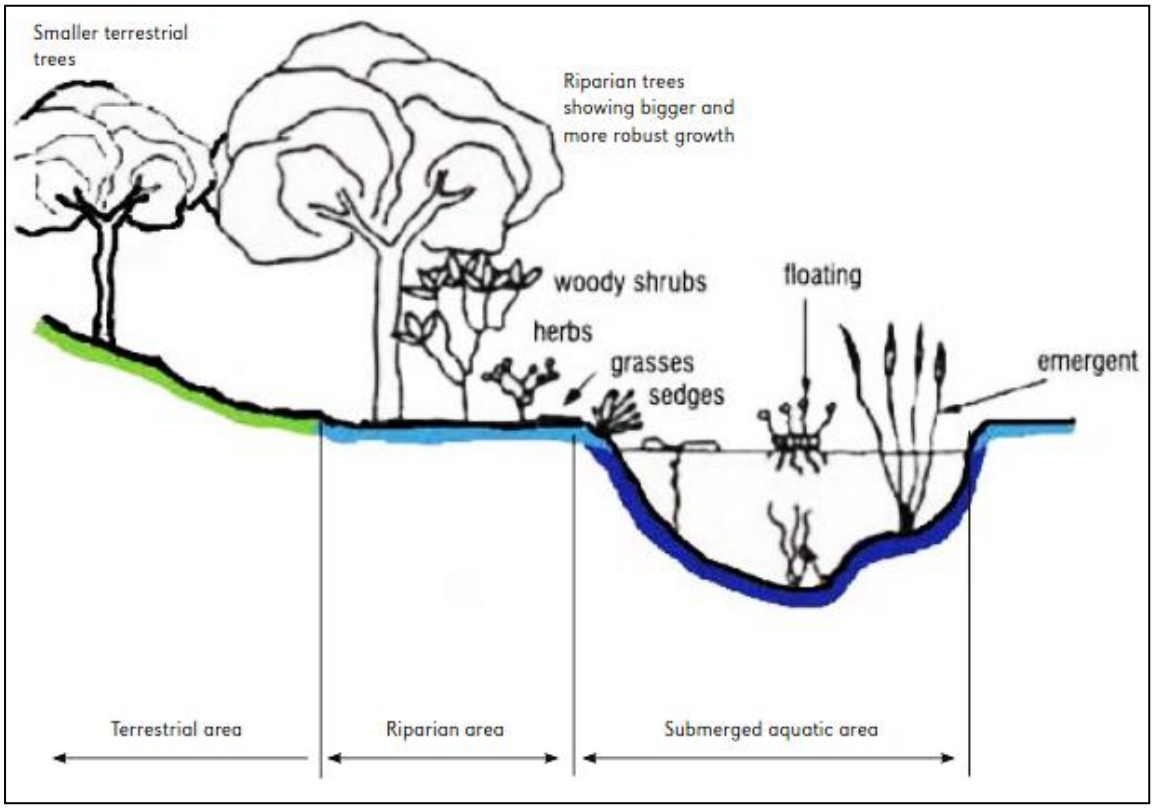

Figure 8-2 Riparian Habitat Delineations (DWAF, 2005)

8.1.8 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.

8.1.9 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.

8.2 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 8-8.

Table 8-8 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.

8.2.1 Cumulative Impact Assessment

The following aspects as presented in Table 8-9 were considered in the cumulative impact assessment which refers to quantifying the significance of impacts in relation to the proposed development.

Table 8-9 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

8.3 Appendix C – Specialist Declaration of Independence

DECLARATION

I, Prasheen Singh, 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.

Prasheen Singh

Aquatic Ecologist

The Biodiversity Company

20/08/2025

8.4 Appendix D – Specialist CVs

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 Ecostatus 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

CURRICULUM VITAE: Prasheen Singh

- End of Report -

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08 December 2025

Attention : Dale Holder
Cape Environmental Assessment Practitioners
17 Progress Street
George
6530

Via email: dale@cape-eaprac.co.za

RE: MITIGATED LAYOUTS FOR THE PROPOSED BETHEL SOLAR PV, DRAAILOOP SOLAR PV, KLIPPUT SOLAR PV, MAKOPPA SOLAR PV AND ASSOCIATED GRID CONNECTIONS SITUATED SOUTH-WEST OF LOUIS TRICHARDT IN THE MAKHADO MUNICIPALITY OF THE LIMPOPO PROVINCE.

As the Author of the Aquatic Biodiversity Impact Assessments for the proposed Bethel Solar PV, Draailoop Solar PV, Klipput Solar PV and Makoppa Solar PV facilities and associated grid connection infrastructure, this letter serves to confirm that I have reviewed the mitigated layout plans for these facilities as dated 01 December 2025.

Based on a review of these mitigated layout plans, I confirm the following:

1. The changes to the layouts do not change the nature of significance of impacts already assessed in my studies.
2. The changes to the layouts do not change the EMPr outcomes or mitigation measures outlined in my report.
3. The changes to the layouts do not change the significance of the mitigation measures outlined in my report.

All findings and recommendations in my report remain equally applicable to the revised layout plans dated 01 December 2025.

Sincerely,

Prasheen Singh (SACNASP 116822)
Aquatics Specialist
The Biodiversity Company