Upgrading of an Access Road and Main Transmission Line on Sun Central Cluster 1 Solar PV Facility Northern Cape Province.

Aquatic Biodiversity Impact Assessment, Section 21(c) & (i) Risk Assessment and Wetland Delineation Verification

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Upgrading and Development of an Access Road from the N10/'Burgerville' District Road (2448) Turn-Off into the Farm Riet Fountain No. 39C and to the Switching Station and Main Transmission Substation on Sun Central Cluster 1 (300 MW) Solar PV Facility between De Aar and Hanover, Emthanjeni Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province, South Africa.

Aquatic Biodiversity Impact Assessment - Basic Assessment & Water Use License Application

January 2023

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Executive Summary

The project is undertaking a Basic Assessment, Environmental Authorisation and Water Use License Application, regarding the upgrading and development of the access road from the N10 turn-off into the Farm Riet Fountain No. 39C and to the switching station and main transmission substation on Sun Central Cluster 1 (300 MW) Solar PV Facility between De Aar and Hanover, Northern Cape Province, South Africa.

This Specialist Study concerns the Aquatic Biodiversity Impact Assessment at the Sun Central Cluster 1 Solar PV Facility regarding the following services/specialist components:

1. The upgrades to the new access road across the Brak River floodplain will now require more extensive work than originally expected, due to the delivery requirements for the MTS transformers (large, long heavy trucks).
2. Additionally, there will be new sections of road constructed, not just the widening of existing roads, to the MTS.
3. Update the Phase 1 Aquatic Biodiversity Impact Assessment to include the new scope, also ensuring that it complies with the content requirements of the gazetted specialist protocols, and the ToR content supplied by Phase 3 of De Aar (must include Impact Assessment, PESEIS etc.).

Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration were identified by the screening tool and have been confirmed by undertaking a site sensitivity verification (Protocol 2). The outcome of the site sensitivity verification relating to the level and/or need for specialist assessments identified in the screening tool with regards to Aquatic Biodiversity: Environmental Sensitivity - Very High.

The Sun Central Cluster 1 Solar PV Facility drainage systems are predominantly classified as ephemeral, which means that the stream flows briefly in direct response to precipitation in the immediate vicinity, and the channel is at all times above the ground-water reservoir.

The main aquatic feature within the Sun Central Cluster Solar PV facility project area is the Brak River (Sub-quaternary D62D-05613), a seasonal tributary within the Orange River Catchment. The river drains the D62D quaternary catchment in the Nama Karoo Ecoregion of the Orange Water Management Area.

The Brak River and certain larger ephemeral tributaries are the only natural drainage structures in the study area with weak indicators of riparian vegetation in the riverbed and on the river banks. The water courses are characterised by azonal vegetation types, allied with Upper Gariep Alluvial Vegetation.

The Ecostatus of the SolarAfrica Energy PV Facility main drainage line, the Brak River, matches a Category C (Moderately modified). The table below provides the available parameters that were instrumental to establish the Ecostatus of the Brak River.

Parameter	Score %	Category	Description
VEGRAI	78.9	B/C	Moderately modified
SASS5	3.2	3-5	Fair
FRAI		D	Largely modified
Habitat	54.0	40-60	Poor
Ecostatus of the Brak River		C	Moderately modified

After establishing Ecological Importance and Sensitivity Category (EISC) of the different water resource groups, the outcome indicates that there is only one group that has an EISC as a "High", and that is the Large ephemeral drainage systems. All the other systems come out as "Low to Moderate", mainly due to their lack of surface water or the short-lived presence after a rainfall event. Due to their integral EIS class, these groups will be grouped as follow:

- "High" ecological and sensitivity classes: These areas, including their buffers, will be considered as no-go areas for all infrastructure apart linear systems.

- "Moderate**"** and "Low" ecological and sensitivity classes: These areas, are not considered as no-go areas, however, development within these areas shall be subjected to strict mitigation measures. This will include the management of surface water runoff, erosion monitoring, as well as constraints regarding the clearing of vegetation within these areas.

The distinct water resource types that have been recognised in the project- and surrounding area, grouped in their Ecological Importance and Sensitivity Categories, are listed as:

Large ephemeral drainage systems ("High" ecological and sensitivity classes):
- Brak River drainage system.
- Large ephemeral tributaries.

Smaller ephemeral drainage- and floodplain systems ("Moderate**"** and "Low" ecological and sensitivity classes):
- Smaller ephemeral tributaries.
- Alluvial floodplains.
    - Alluvial fans.
    - Braided channel: bar and swale topography.
    - Floodplain flats.
- Headwater drainage lines.

According to the initial buffer requirement, it becomes apparent that, to protect the SolarAfrica Energy major drainage systems in its current condition from any degradation, a buffer of 15 m wide on both sides of the Large ephemeral drainage systems delineation is required during the construction and operational phases.

According to the Specialist TOR, a GN509 Risk Assessment was completed for the study. Infrastructural components of the Sun Central Cluster 1 Solar PV Facility project were described and assessed. Special mitigation and management measures were determined, and the current existing best practice management described by the risk assessment report. The following main activities were identified and assessed:

Upgrade the access road
- Upgrade the access road (new sections of road constructed and widening of roads) from the N10 Burgerville District Road, across the Brak River floodplain and to the MTS and Switching Station development.

Extending the 2.5 km main transmission line
- Extending the 2.5 km main transmission line from the Main Transmission Station (MTS) to Line 1 of the 400 kV Eskom powerline.

Pipelines
- The underground pipeline between the boreholes (BH13/BH14) and the water tank, and between BH5 and the water storage at the MTS.

Placements and constructions of the substations and plants
- Placing and expansion of the MTS.
- Placing a 132 kV switching yard and constructing the Switching Station (Dx).
- Concrete batching

Boreholes

- Boreholes BH13/BH14 along the D62D-05610 drainage line, and BH5 near the solar pump on the ridge.

During the risk assessment, 11 potential impacts were identified, these are:

Construction

Activity 1: Preparing construction areas
Activity 2 Upgrading water course crossing
Aspect 2.1. Construction activities and the potential to disturb soil structure.
Aspect 2.2. Stormwater management.
Activity 2.3: Pollution potential.
Activity 3: Extending the 2.5 km main transmission line
Activity 4: Laying underground pipelines
Activity 5: Construction of other infrastructure.
Aspect 5.1. Disturbing topsoil by the placing and expansion of the MTS; constructing the Switching Station; Concrete batching.
Aspect 5.2. Potential pollution due to effluent from infrastructure.
Activity 5.3: Boreholes: On sensitive sites.
Activity 6: Alien invasive plants.

Operation

Activity 7: Upgrading water course crossing.

For these potential impacts identified during the risk assessment, all were assigned mitigation measures that reversed potential impacts to “Low” risk rating posed to the resource quality of the watercourse. No impact was identified to cause loss of irreplaceable resources.

By implementing all the mitigation measures and managing the system on a continuous basis as prescribed by the Risk Assessment, all the impacts will be addressed to a satisfactory level. Therefore, it is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document, where applicable, are included in the EMPr

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2.8.16 Any conditions to which this statement is subjected.

Summary: A reasoned opinion

References and Appendices

Abbreviations

°C	Degrees Celsius
AQV	Aquatic vegetation
ASPT	Average Score per Taxon
BA	Basic Assessment
BGIS	Biodiversity Geographic Information System
BH	Borehole
CAD	Computer-aided design
CBA	Critical Biodiversity Areas
Cell	Cell phone
CEL	Cost Estimate Letter
cm	Centimetre
DEA	Department of Environmental Affairs (National)
DFFE	Department of Forestry, Fisheries and the Environment
Dr	Doctor
DWA	Department of Water Affairs (post-2010)
DWAF	Department of Water Affairs and Forestry (pre-2010)
DWS	Department of Water and Sanitation (since May 2014))
E	East
EA	Environmental Authorisation
e.g.	For example
EC	Ecological Category
ECO	Environmental Control Officer
Ecoclassification	Ecological classification
EcoStatus	Ecological Status
EEC	Ecoleges Environmental Consultants
EFR	Environmental Flow Requirements
EI	Ecological Importance
EIA	Environmental Impact Assessment
EISC	Ecological Importance and Sensitivity Category
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
ESM&R	Equipment service management and rental
ESA	Ecological Support Area
ESKOM	Electricity Supply Commission
EWR	Environmental Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GIS	Geographic Information System
Gov	Government
GPS	Global Positioning System
GSM	Gravel, sand and mud
ha	Hectares
HCR	Habitat Cover Ratings
HGM	Hydro-Geomorphic
HQI	Habitat Quality Index
IHAS	Integrated Habitat Assessment System
IHI	Index of Habitat Integrity
IIHI	Instream Index of Habitat Integrity
km	Kilometre
KML	Keyhole Markup Language
KMZ	Keyhole Markup language Zipped
$KN/m^{2.}$	Kilonewton per meter square
KNP	Kruger National Park

kWh/m^2	Kilowatt-hour per square meter
kV	Kilovolt
LILO	Loop-In, Loop-Out
LUDS	Land-Use Decision Support Tool
mamsl	Metres above mean sea level
m	Meter
m^3	Cubic metre
MCDA	Multi Criteria Decision Analysis
mg/l	Milligrams per litre
MIRAI	Macro-invertebrate Response Assessment Index
mm	Millimetre
MPa	Megapascals
mS/m	milliSiemens per metre
MTS	Main Transmission Substation
MV	Marginal vegetation
MW	Megawatt
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NP	National Park
MVA	Mega-volt-amperes.
NWA	National Water Act
PES	Present Ecological State
PESEIS	Present Ecological State, Ecological Importance and Ecological Sensitivity
PhD	Doctor of Philosophy
PO Box	Post office box
Pr. Sci. Nat	Natural Scientific Professionals
Pty (Ltd)	Proprietary limited company
PV	Photovoltaic
REC	Recommended Ecological Category
Reg. no.	Registration number
REIPPP	Renewable Energy Independent Power Producers Procurement
RHP	River Health Programme
RIHI	Riparian Index of Habitat Integrity
RMF	Regional Maximum Flood
RMIPPP	Risk Mitigation IPP Procurement Programme
RQO	Resource Quality Objectives
S	South
SA	South Africa
SACNASP	South African Council for Natural Scientific Professions
SAE	SolarAfrica Energy
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SASS5	South African Scoring System version 5
S&EIA	Scoping and Environmental Impact Assessment
SHI	Site Fish Habitat Integrity Index
SIC	Stones in current
SIP	Strategic Infrastructure Project
SOOC	Stones out of current
SQR	Sub-quaternary reach
SSV	Site Sensitivity Verification
TOR	Terms of Reference
VEGRAI	Riparian Vegetation Response Assessment Index
WRC	Water Research Commission
WULA	Water Use License Applications

V-drain	Ventricular drain
yr	Year

1. Introduction

1.1 Background to the project

As part of the planned Upgrading & Development of an Access Road project, Ecoleges formulated a technical and financial proposal to undertake:

i. Application for Environmental Authorisation by way of Basic Assessment (BA),

ii. A Part 2 amendment to the current Environmental Authorisation (EA) and

iii. Integrated Water Use License Application (IWULA) for additional activities associated with the Sun Central Cluster 1 300 MW Solar PV project in the Northern Cape (Ecoleges, November 2022).

The additional activities include the development and widening of roads; extending the transmission line from the Main Transmission Substation (MTS) to Line 1 of the 400 kV Eskom powerline; and consolidation of water uses currently authorised under General Authorisation, including additional boreholes, into an Integrated Water Use License.

The Screening Assessments generated by the Department's National web-based Environmental Screening Tool, identified the need for an Aquatic Biodiversity Impact Assessment (Table 1).

Table 1: The Aquatic Biodiversity Impact Assessment identified in the Screening Report (Figure 2).

Theme	Sensitivity Rating	Reason for Sensitivity Rating		Type of Assessment	TOR
		Sensitivity	Features		
Aquatic Biodiversity	Very High	Very high	Rivers	Aquatic Biodiversity Specialist Assessment	Gazetted Protocol (GN No.320)
			Strategic water source area		
			Wetlands and Estuaries		
			FEPA quaternary catchments		

Background to the Scope of the project

In 2016 Ecoleges undertook a S&EIA for the development of a 225 MW Solar PV facility between Hanover and De Aar in the Northern Cape. Three alternative footprints (PV01, PV02, PV03) were investigated during the assessment process. The central footprint (PV02) was identified as the preferred option because of its lower environmental impact and proximity to an existing 400kV Eskom overhead powerline when compared with PV 01 and PV03. The National Department of Environmental Affairs granted an environmental authorisation (DEA Reference: 14/12/16/3/3/2/998) on 16th April 2018. This project was originally known as Phase 1.

An amendment to increase the capacity (not the footprint) of the facility to 300 MW due to technological advancements in solar photovoltaic efficiency and electrical output was granted on 24th November 2020.

A second amendment was granted in 2021 for the inclusion of containerised lithium-ion battery Storage and dual-fuel backup generators with associated fuel storage as part of the Risk Mitigation Independent Power Producers Procurement Program (RMIPPPP).

The competent authority was the National Department of Environmental Affairs because the application was part of the REIPPPP or RMIPPPP BID rounds, which formed part of a Strategic Infrastructure Project (SIP) as described in the National Development Plan, 2011.

Soventix SA (Pty) Ltd is also currently busy with an application for environmental authorisation to develop an additional 300MW on the PV03 footprint (Phase 2) that was considered during the initial S&EIA. It is proposed to connect this second phase to the substation that forms part of the authorised facility on PV02 (Phase 1).

Additionally, Soventix SA (Pty) Ltd is also busy with an application for environmental authorisation to develop Phase 3, which involves the development of a third 400 MW Solar Photovoltaic (PV) facility on the Remainder of Farm Goede Hoop 26C and Portion 3 of Farm Goede Hoop 26C.

The two additional Solar PV facilities (Phase 2 and 3) will feed into the authorised Main Transmission Substation (MTS) on the Phase 1 footprint.

Consequently, the expansion of the MTS, inclusion of a 132 kV Distribution (Dx) switching yard, additional access road and staging area, requires a third Part 2 amendment to the existing environmental authorisation (EA Reference: 14/12/16/3/3/2/998), which is currently sitting with the competent authority for decision. The additional activities and associated infrastructure require additional water use authorisations in the form of General authorisation for specifically Section 21 (a), (b), (c), (i) & (g).

Project Description

As the current project scope has grown beyond what was originally envisaged for Phase 1 (now known as Sun Central Cluster 1), additional authorisations will be required to upgrade the access road to the MTS (Figure 1), and to ensure compliance with Eskom minimum road requirements.

The upgrades to the new access road across the Brak River floodplain will now require more extensive work than originally expected, due to the delivery requirements for the MTS transformers (large, long heavy trucks). Additionally, there will be new sections of road constructed, not just the widening of existing roads, to the MTS.

Additionally, a Cost Estimate Letter (CEL) issued by Eskom during the baseline S&EIA in 2016, made provision for Loop-In, Loop-Out (LILO) into the 400 kV transmission overhead line closest to the MTS (known as Line 2). The client has decided, in spite of the decision by Eskom to allow LILO on the closest line, they still want the assessment and application to include the furthest line (Line 1), whenever additional renewable energy projects utilise the same MTS and can then LILO of the furthest line.

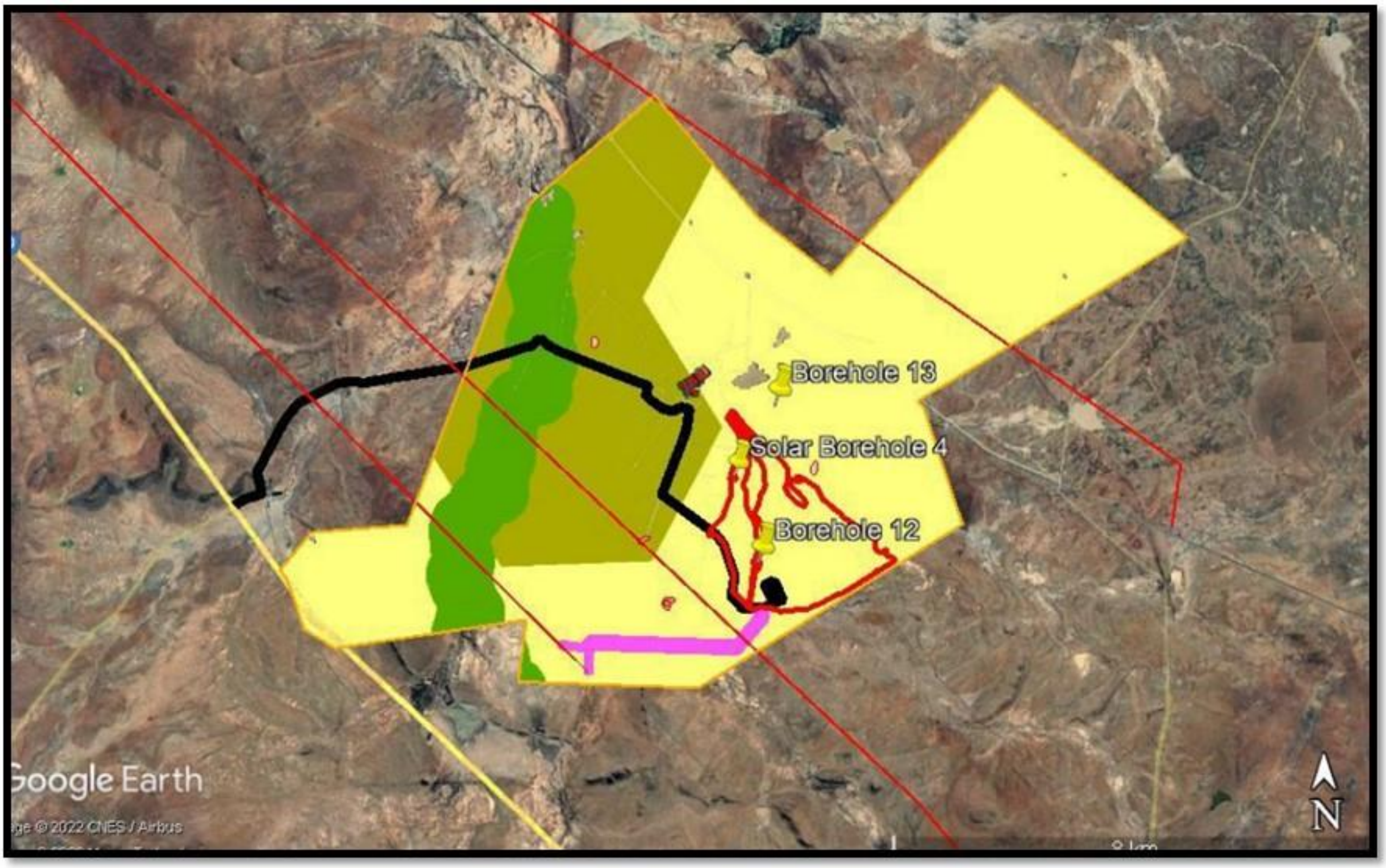

Figure 1. Access roads (black line), LILO transmission line (pink line) and boreholes forming dominant scope of authorisation processes.

Accordingly, a technical and financial proposal are being formulated to undertake the following additional activities and associated authorisations:

1. These above-listed changes will result in "triggering" additional Listed Activities not currently included in the EA, necessitating application for additional EA by way of Basic Assessment.
2. The scope of the road upgrades and additional length of transmission line will no longer constitute "low-risk" activities, resulting in an application for a Water Use License, which will also consolidate all the current water uses authorised under General Authorisation into an Integrated Water Use License. Furthermore, additional water, by way of groundwater, will be required for the project, to ensure adequate water provision for the road upgrades, on-site concrete batching activities, and transmission line pylons.
3. Finally, concrete batching was not included in the scope of the baseline S&EIA and will need to be included in the scope by way of another Part 2 amendment.

The client or applicant is SolarAfrica Energy (Pty) Ltd, a renewable energy company with its head office in Pretoria. The property owner is Mr. Willem Retief that has entered into a land use agreement with SolarAfrica Energy (SAE).

The main access to the site is off the N10 between De Aar & Hanover.

The current land use is sheep farming, which could continue within the solar PV plants (subject to economic and scientific feasibility) to ensure minimal reduction (if any) on agricultural potential of the land as well as a management tool to control vegetation growth.

The principal aims of the terrestrial, plant, and animal species (including avifauna) assessments will be to determine how this development (and its separate elements) will impact on the terrestrial ecological integrity of the area and demarcate appropriate ecological buffers around sensitive communities or receptors.

1.2 Specialist Terms of Reference

This Specialist Study concerns the Aquatic Biodiversity Impact Assessment at the Sun Central Cluster 1 Solar PV Facility regarding the following services/specialist components:

4. The upgrades to the new access road across the Brak River floodplain will now require more extensive work than originally expected, due to the delivery requirements for the MTS transformers (large, long heavy trucks).
5. Additionally, there will be new sections of road constructed, not just the widening of existing roads, to the MTS.
6. Update the Phase 1 Aquatic Biodiversity Impact Assessment to include the new scope, also ensuring that it complies with the content requirements of the gazetted specialist protocols, and the ToR content supplied by Phase 3 of De Aar (must include Impact Assessment, PESEIS etc.).

The principal aims of an aquatic assessment will be to determine how this development will impact on the aquatic ecological integrity of the area (particularly any important/sensitive aquatic invertebrate populations) demarcate appropriate ecological buffers along adjacent watercourses, and undertake a Risk Assessment of existing road crossings.

Site Sensitivity Verification and Minimum Report Content Requirements

Although Ecoleges has not yet undertaken a Site Sensitivity Verification (SSV) inspection, the intention is for specialists, where relevant, to update their previous phase 1 specialist reports, and in accordance with the minimum report content requirements in the relevant protocol.

It is the aquatic specialist's responsibility to ensure the assessment and reporting meets all the requirements of the relevant protocol.

Specialist Assessment and Minimum Report Content Requirements

Perform the Specialist Assessment according to the criteria provided by the "Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity" (Appendix D: Aquatic Biodiversity Protocol (GN No. 320 dated 20th March 2020)).

Write up the findings of the specialist assessment in an Aquatic Biodiversity Specialist Assessment Report or Aquatic Biodiversity Compliance Statement that contains the minimum report content requirements prescribed in the same protocol. Ensure the assessment and reporting meets all the requirements of the relevant protocol.

Water Use Authorisations for Section 21 (a), (b), (c), (i) and (g) water uses are also required, include the following technical information in your Aquatic Assessment as per the Water Use License & Appeals Regulations (2017):

- Perform a Present Ecological Study (PES) according to the "Supplementary Water Use Information Section 21(c) and (i) Water Uses (DW781suppl, DW775suppl, Edition 14 August 2009)").

- Undertake a Risk Assessment for S21(c) and (i) water uses associated with the potential transmission corridors and existing road crossings that may need to be widened.

- Generate a Wetland Delineation Report.

Objectives

- Determine how the widening of existing road crossings will impact on the aquatic ecological integrity of the area.
- Delineate the extent of adjacent watercourses, that is the edge of the riparian zone (or macro channel bank) or in the case of wetlands or pans, the outer edge of the temporary zone.
- Demarcate appropriate ecological buffers along adjacent watercourses.
- Undertake a Risk Assessment for S21(c) and (i) water uses associated with the potential transmission corridors.
- Undertake a Risk Assessment for S21(c) and (i) water uses associated with the existing road crossings that may need to be widened.
- Identify and quantify the perceived impacts and propose mitigations to be included in the EMPr. The potential impacts and recommended mitigations must be identified for the planning and design, pre-construction, construction, and post-construction (e.g., monitoring rehabilitation of the construction site) only.
- The impacts must be assessed and evaluated according to the EIA Regulations, 2014 as amended (https://cer.org.za/wp-content/uploads/1999/01/ EIA-Regulations.pdf) or the Impact Assessment Criteria and Matrix to be supplied upon appointment.
- Undertake a cumulative impact assessment of the Solar PV facility if there are other similar facilities within a 30km radius of the proposed development site. Information on the location of renewable energy developments.

4.3 Aquatic Biodiversity Specialist Assessment Report

The report must comply with the "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" for aquatic biodiversity assessment published in GN 320 on 20 March 2020.

4.4 Risk Assessment(s)

The assessment must conform to the General Authorisation requirements for Section 21(c) & (i) water uses published in GN 509 of 2016 as well as relevant specialist content prescribed in the WULA Regulations (2017).

4.5 Wetland Delineation Report

Wetland delineation must be undertaken in accordance with the Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas published by the Department of Water Affairs and Forestry, Sub-Directorate: Stream Flow Reduction Activities in September 2008.

4.6 Mapping

• Produce a map of the study area, delineating appropriate ecological buffers.
• All sensitivity maps indicating, for example a delineated edge, no-go area, or buffer zone, must be provided as KMZ, KML or geo-referenced CAD files.

1.3 Legal considerations

Environmental authorisation

The proposed development requires an environmental authorisation for the following listed (or specified) activities:

1.3 Triggers The proposed development requires an environmental authorisation for the following listed (or specified) activities:

LN 1, Listed Activity 12 The development of infrastructure or structures with a physical footprint of 100 square metres or more within a watercourse.

LN 1, Listed Activity 19 The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;

LN 1, Listed Activity 24 The development of a road where the road is wider than 8 metres.

LN 1, Listed Activity 48 The expansion of infrastructure or structures where the physical footprint is expanded by 100 square metres or more within a watercourse.

LN 1, Listed Activity 56 The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre.

LN 2, Listed Activity 9 The development of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more, outside an urban area (within a strategic transmission corridor).

LN 3, Listed Activity 4 The development of a road wider than 4 metres with a reserve less than 13,5 metres.

LN3, Listed Activity 14 The development of infrastructure or structures with a physical footprint of 10 square metres or more within a watercourse.

LN3, Listed Activity 18 The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.

LN3, Listed Activity 23 The expansion of infrastructure or structures where the physical footprint is expanded by 10 square metres or more within a watercourse.

Note that the scope of the application, assessment, and authorisation as per the wording of the listed (or specified) activity(ies) does not include operational aspects.

As such, operational aspects must not be assessed and mitigated. Nonetheless a person can still make recommendations to the design that will effectively mitigate any perceived operational impacts.

1.4 Aquatic Biodiversity Protocol

This section concerns the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (hereafter referred to as: Aquatic Biodiversity Protocol).

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on aquatic1 biodiversity for activities requiring environmental authorisation (Gov Gazette). In this Special Assessment Report, the corresponding numbering in the protocol will be added wherever it is relevant, for an example, this paragraph was obtained from Protocol 1 (1. Scope).

The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) (Protocol 1).

1.4.1 Screening Report for an Environmental Authorization as required by the 2014 EIA regulations – proposed site environmental sensitivity.

The National Web based Environmental Screening Tool allows for the generating of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation.

During the Application for Environmental Authorisation process for the access road to MTS and transmission line, Ecoleges Environmental Consultants (EEC) undertook a Screening Assessment of the project. By using the National web-based Environmental Screening Tool hosted by the Department (DFFE) on their website (www.environment.gov.za), the Screening Report (Ecoleges Environmental Consultants, 2022) identified certain specialist assessments based on the selected ‘application classification’.

A Screening Assessment was undertaken, and the Screening Report was generated on the 10 October 2022, using the application classification “Any activities within or close to a watercourse.”

Application classification “Any activities within or close to a watercourse.”

EIA Reference number: Application for Environmental Authorisation
Project name: Basic Assessment
Project title: Access road to MTS and transmission line
Applicant: SolarAfrica Energy
Compiler: Ecoleges Environmental Consultants

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 (Table 2).

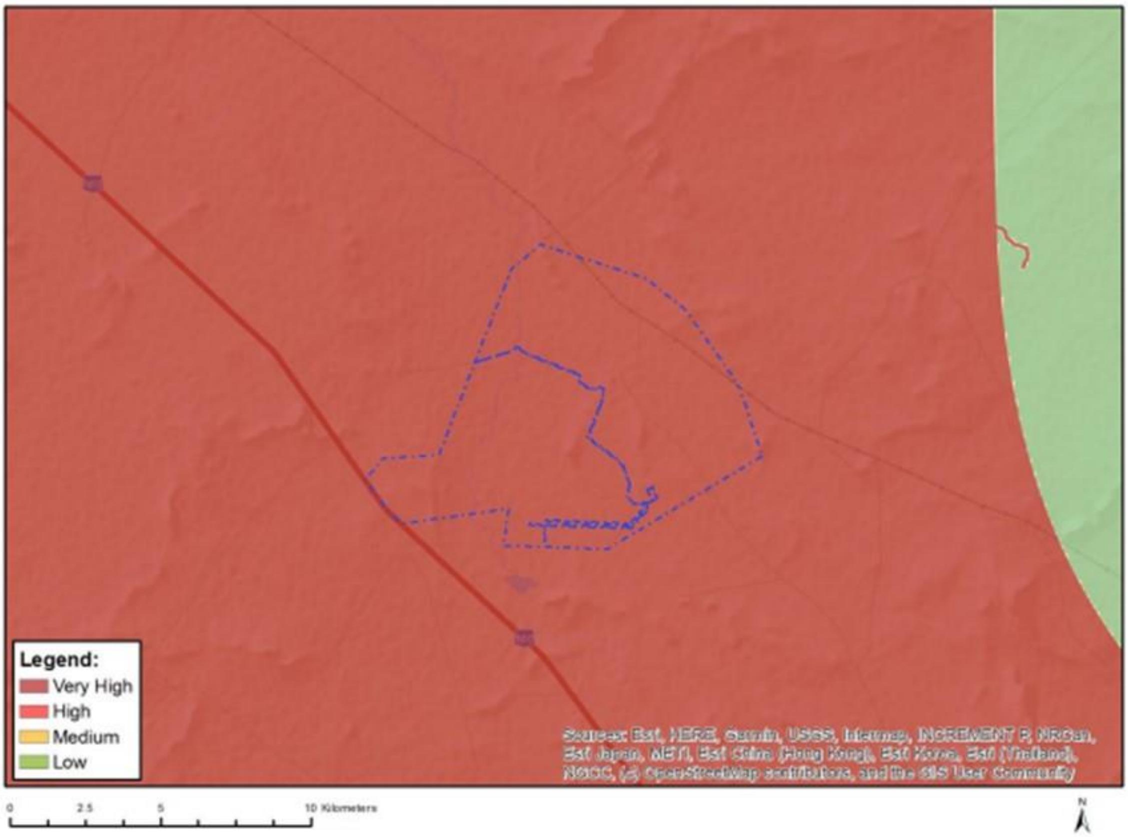

Figure 2: The proposed access road to the MTS area in the Brak River catchment and which is rated as "Very High" sensitivity (Environmental Screening Tool, 2022).

Table 2: The Aquatic Biodiversity Impact Assessment identified in the Screening Report (Figure 2).

Theme	Sensitivity Rating	Reason for Sensitivity Rating		Type of Assessment	TOR
		Sensitivity	Features		
Aquatic Biodiversity	Very High	Very high	Rivers	Aquatic Biodiversity Specialist Assessment	Gazetted Protocol (GN No.320)
			Strategic water source area		
			Wetlands and Estuaries		
			Freshwater ecosystem priority area quinary catchments		

EEC subsequently undertook a Site Sensitivity Verification (Ecoleges Environmental Consultants, 2022), which involved a desktop analysis and site inspection, to verify the land use and environmental sensitivity (rating) designated by the Screening Tool.

1.4.2 Site Sensitivity Verification and Minimum Report Content Requirements

Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration identified by the screening tool must be confirmed by undertaking a site sensitivity verification (Protocol 2)**.**

Although Ecoleges has not yet undertaken a Site Sensitivity Verification (SSV) inspection, the intention is for specialists, where relevant, to update their previous phase 1 specialist reports, and in accordance with the minimum report content requirements in the relevant protocol.

It is the aquatic specialist's responsibility to ensure the assessment and reporting meets all the requirements of the relevant protocol.

2. Specialist Assessment and minimum report content requirements

Assessment and reporting of impacts on aquatic biodiversity

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** (Screening Report).

The "Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity" (Appendix D: Aquatic Biodiversity Protocol (GN No. 320 dated 20th March 2020)) will be the proforma used throughout this report (see Table of Contents). Tables 3 and 31 summarises the main minimum report contents requirements.

Table 3:	Specialist assessment Checklist
	Requirements for Specialist Reports: Published in Government Notice No. 320; Government Gazette 43110**;** 20 March 2020
2.1	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.
2.2	The preferred site within the proposed development footprint.
2.3	The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:
2.3.1	A description of the aquatic biodiversity and ecosystems on the site, including; (a) aquatic ecosystem types; and
	(b) Presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns.
2.3.2	The threat status of the ecosystem and species as identified by the screening tool
2.3.3	An indication of the national and provincial priority status of the aquatic ecosystem.
2.3.4	A description of the ecological importance and sensitivity of the aquatic ecosystem including: (a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site.
	(b) the historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain habitat).
2.4	Identify alternative development footprints.

Table 3:	Specialist assessment Checklist
2.5	Assessment of the potential impacts of the proposed development:
2.5.1	Maintaining the priority aquatic ecosystem.
2.5.2	Maintaining the resource quality objectives.
2.5.3	Impact on fixed and dynamic ecological processes.
	a. Impacts on hydrological functioning.
	b. Sediment regime.
	c. Modification in relation to the overall aquatic ecosystem.
	d. Risks associated with water uses.
2.5.4	Impact on the functioning of the aquatic feature:
	a. Base flows.
	b. Quantity of water.
	c. Change in the hydrogeomorphic typing.
	d. Quality of water.
	e. Ecological connectivity.
	f. Loss or degradation of all or part of any unique or important features.
2.5.5	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;
	(h) carbon storage.
2.5.6	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?
2.6	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered?

2.1 Registered Specialist

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.

Dr Andrew Deacon is registered with the South African Council for Natural Scientific Professions (SACNASP). Registration number: 116951.

2.2 The preferred site within the proposed development footprint.

The area chosen for the access road will be from the N10 Burgerville District Road to the Switching Station on the De Bad farm (Figure 3). The 2.5 km main transmission line will run from the Main Transmission Station (MTS) to the 400kV Hydra-Poseidon Eskom overhead line (Figure 3).

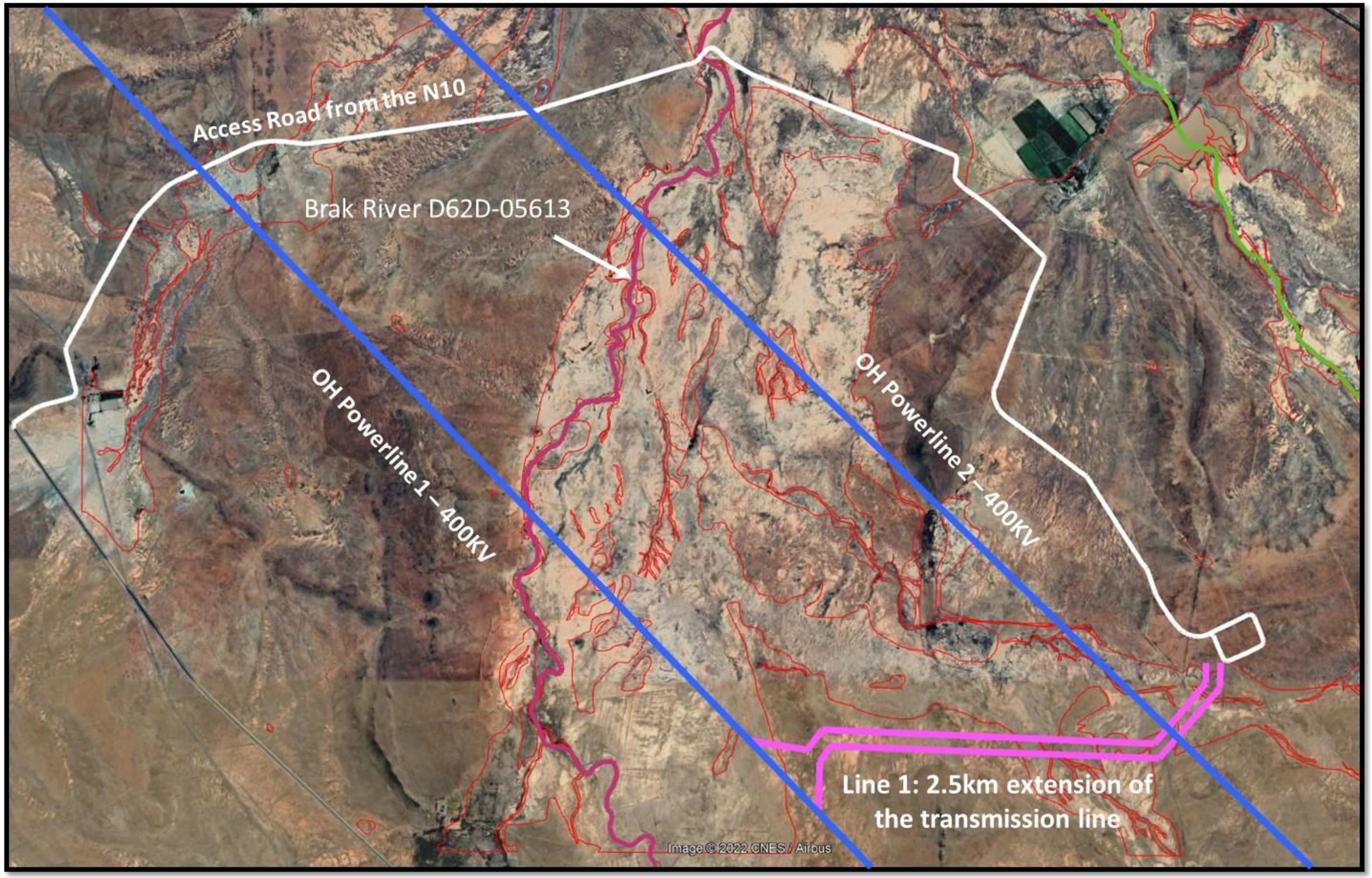

Figure 3: The planned locations of the access road from the N10 Burgerville District Road and the 2.5 km main transmission line in the project area.

2.3 Baseline description

According to the Aquatic Biodiversity Protocol, the assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:
A description of the aquatic biodiversity and ecosystems on the site, including:

(a) aquatic ecosystem types; and
(b) Presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns.

Landscape Features of the project area:

The study area lies near the eastern edge of the Nama Karoo biome, and is mapped according to the national vegetation types (Mucina and Rutherford, 2006) as being of the vegetation type Northern Upper Karoo (NKu 3) (Figure 4) which is considered to be least threatened. This Karoo unit is found on floristic and ecological gradients between the Nama-Karoo, arid Kalahari savanna and arid highveld grasslands.

The area is characterised by wide open plains with relatively flat topography typical of the Central Karoo. The vegetation cover is generally dominated by sparse dwarf karroid scrub and tufted grass with bare patches of sand in between. Portions of the area are in a disturbed condition, most likely as a result of livestock grazing.

The shrubland is dominated by dwarf karoo shrubs, grasses and low trees. The topography of the region is generally flat, characterised by wide plains and open spaces. It is evident that the Vegetation Map (Figure 4) provides an oversimplification of the vegetation of the site and there are at least three distinct vegetation types present on the site.

The open plains of the site correspond with the Northern Upper Karoo vegetation type, but the dolerite hills and koppies present have vegetation more closely allied with Upper Karoo Hardeveld, while the floodplain of the Brak River is clearly characterised by an azonal vegetation type, allied with Upper Gariep Alluvial Vegetation (Ecoleges Environmental Consultants, 2017). The floodplain has however been heavily modified by human activity with a lot of diversion walls and historical disturbance present.

Along the Brak River the common reed *Phragmites australis* dominates the instream habitat, while there is very little discernible riparian vegetation. The ephemeral streams have no visible aquatic vegetation. *Phragmites australis* reeds grow in the beds of several of the ephemeral rivers.

Geology & Soils

Shales form the underlying geology while Jurassic Karoo Dolerite silts and sheets support this vegetation complex in places. Wide stretches of land are covered by superficial deposits including calcretes of the Kalahari Group. Soils are variable from shallow to deep, red-yellow apedal, freely drained soils to very shallow Glenrosa and Mispah forms.

The Karoo landscape is heavily influenced by the occurrence of dolerite dykes, sills and rings for a description of these geological features which control surface and subsurface drainage patterns and the occurrence of watercourses and wetlands. The dolerite intrusions (dykes and sills) are more resistant to weathering than the sandstones and shales, thus causing the formation of the characteristic Karoo koppies.

Climate.

The climate of the study area can be regarded as warm to hot with a summer rainfall and dry, cold winters. Temperatures vary from an average monthly maximum and minimum of 32.6ºC and 15.4ºC for January to 16.8ºC and 0.3ºC for July, respectively. Temperature ranges are large with lows of -10°C in winter to mid 40°C in summer. The long-term average annual rainfall in this region of the Northern Cape is only 289mm, of which 201 mm (70%) falls from November to April. Frost occurs most years, 30 days on average, between late May and early September.

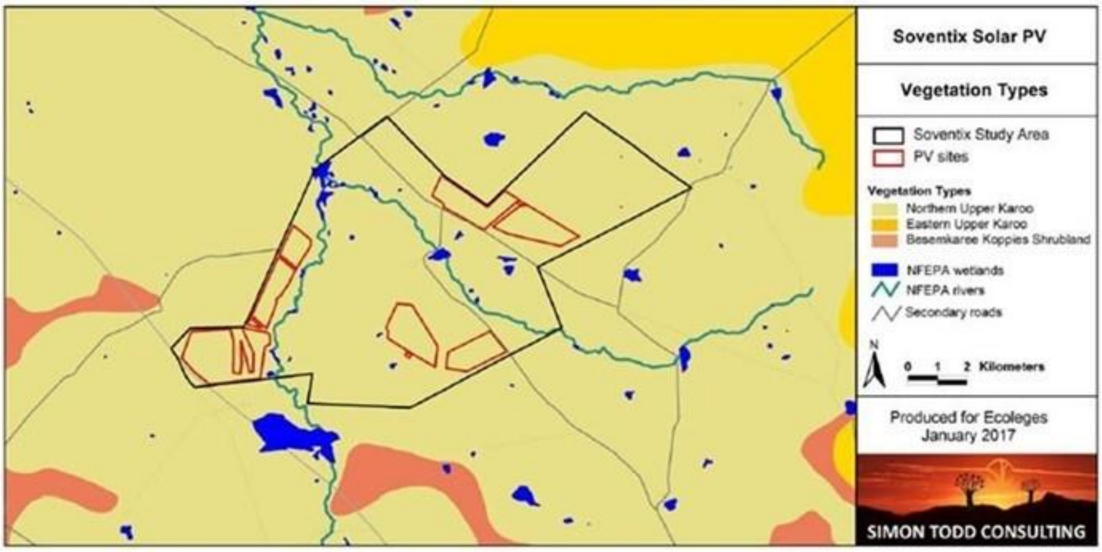

Figure 4. Broad-scale overview of the vegetation in and around the Sun Central Solar PV facility project site (Mucina & Rutherford, 2006) (Nel et al. 2011).

Conservation

This is a least threatened unit with a conservation target of 21%. None conserved in statutory conservation areas. About 4% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo) or irreversibly transformed by building of dams. Erosion is moderate (46.2%), very low (32%) and low (20%). *Prosopis glandulosa,* regarded as one of the twelve agriculturally most important invasive alien plants in South Africa, is widely distributed in this vegetation type.

2.3.1 Aquatic ecosystem types

Aquatic surveys and biomonitoring are essential components of ecological risk assessment and aim to measure present biological conditions and trends in the aquatic ecosystem. It attempts to relate the observed variation to changes in available habitat, as dictated by physical system drivers of the system such as water quality, geomorphology, and hydrology (Kleynhans & Louw, 2008).

2.3.1.1 Ecoregion and River Characteristics

The main water feature in the area is the Brak River, a seasonal tributary within the Orange River System. The Sun Central Solar PV facility project area has no permanent perennial water source although in favourable seasons the Brak River may flow. The seasonal Brak River flows in an arc from south-east to north-west, eventually feeding into the Orange River basin. The Nama Karoo is regarded as a semi-desert and precipitation, which occurs predominantly in the summer months, is unpredictable and sporadic.

The preferred Sun Central Solar PV facility project site and associated activities, are situated in the catchment of the Brak River, a seasonal river within the Orange River System in the Northern Cape Province.

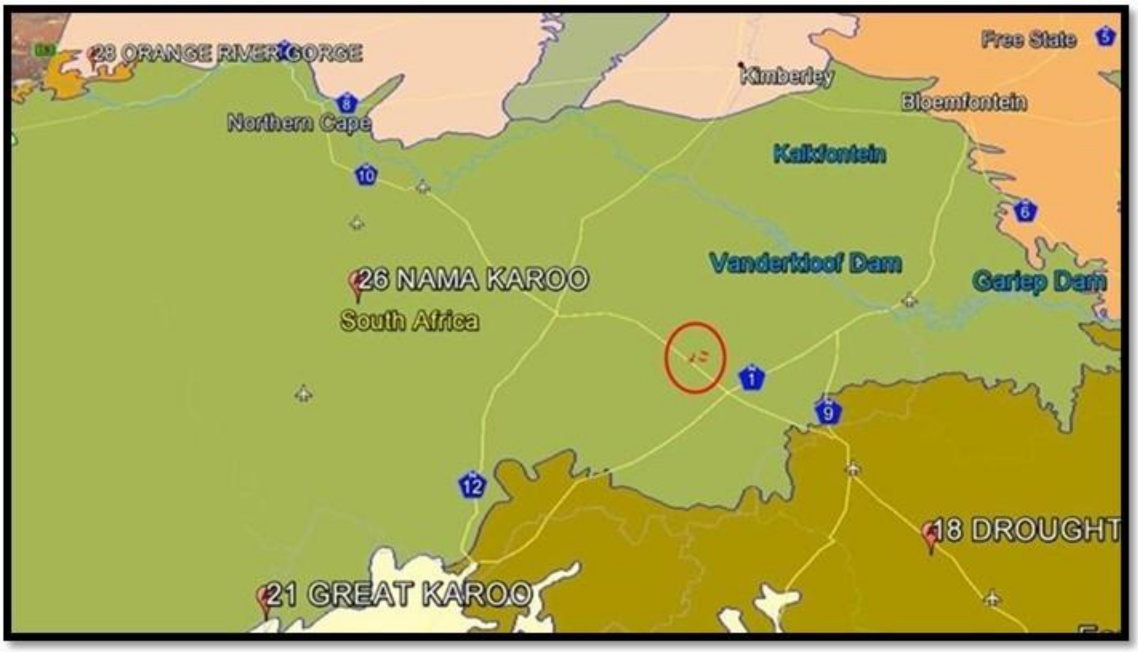

Figure 5: The position of the Project Area (red circle) in the Nama Karoo ecoregion according to the Water Resource Classification System (DWS, 2014).

The Brak River confluence with the Orange River is downstream of the Orange-Vaal confluence, and is a river which flows non-perennially from the south and is in turn fed by the Ongers River, rising in the vicinities of Hanover and Richmond respectively. The Brak River drains shrubland vegetation in an area with a very low rainfall. As a result, the water within the river system is saline and turbid and seasonally flowing.

The fauna of the more seasonal and ephemeral ecosystems is not well known, but they have been found to provide aquatic habitat to a diverse array of faunal species that depend on brief periods of inundation for hatching, mating, feeding and refuge. For instance, many frogs of the Karoo region breed in temporary pools associated with watercourses and wetlands, this includes the Karoo Toad *Vandijkophrynus gariepensis* and Karoo Dainty Frog *Cacosternum Karooicum*.

Habitat available can be diverse during flow but a very low diversity could be available during dry periods. The reduction in flow causes major habitat types (e.g., stones-in-current, marginal vegetation) to dry out and become unavailable to biota. The habitat type mostly available in temporary rivers is pools, in which invertebrates can survive the dry period and from where they can recolonise the stream as flow returns.

A great number of other organisms are not confined to these temporary systems, but derive crucial benefits from them, like migratory birds and many invertebrates that migrate from permanent to temporary habitats on a regular basis.

Non-perennial (seasonal, intermittent, ephemeral and episodic) tributaries to the Brak River are systems which place extreme stress on biota occupying them by exhibiting highly variable chemical and physical attributes. The most important of these are the unpredictable and highly variable flow patterns. These flow patterns determine the habitat available for biota such as aquatic invertebrates.

2.3.1.2 The ecology of the Brak River and associated drainage lines in the Sun Central Solar PV facility project area.

During the field surveys in the Sun Central Solar PV facility project area, the entire area was explored by vehicle or on foot in order to locate and identify all natural water resources which form part of the regional ecology and might be impacted by the upgrades to the new access road and extending the transmission line.

The Sun Central Solar PV facility water courses

According to the National Water Act (Act No. 36 of 1998), a water resource is defined as “a watercourse, surface water, estuary, or aquifer’. A watercourse in turn refers to:

a) a river or spring;
b) a natural channel in which water flows regularly or intermittently;
c) a wetland, lake or dam into which, or from which, water flows; and
d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse. Reference to a watercourse includes, where relevant, its bed and banks.”

River flow and sediment regimes.

The Brak River of the SQ reach D62D-05613 has a length of 41 km of which the last 10 km runs through the project area.

River classification

In order to assess the condition and ecological importance and sensitivity of the rivers in the study area, it is necessary to understand how the rivers might have appeared under un-impacted conditions. This is achieved through classifying rivers according to their ecological characteristics, in order that it can be compared to ecologically similar rivers. Table 4 provides the geomorphological features of the system assessed.

Table 4. Characteristics of the Nama Karoo Ecoregion (Dominant Types in Bold).

Main Attributes	Description
Terrain Morphology: Broad division	Plains; Low Relief; Plains Moderate Relief; Lowlands; **Hills and Mountains;** **Moderate and High Relief**; Open Hills, Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types	Eastern Mixed Nama Karoo; Upper Nama Karoo; **Bushmanland Nama Karoo**; Orange River Nama Karoo
Altitude (m.a.m.s.l)	300-1700
MAP (mm)	0 to 500
Rainfall seasonality	Late to very late summer to Winter
Mean annual temp. (°C)	12 to 20

Median annual simulated runoff (mm) for quaternary catchment	<5 to 60 mm

River/Site Characterisation

The Nama Karoo is regarded as a semi-desert and precipitation, which occurs predominantly in the summer months, is unpredictable and sporadic. The Sun Central project area has no permanent perennial water source although in favourable seasons the Brak River may flow. There is no water flow data available from DWS for this river reach (DWA Flow data, 2017). All the small tributaries in the area are ephemera or intermittent.

The Brak River drains an area with a very low rainfall. As a result, the water within the river system is saline and turbid and seasonally flowing. The peak flow for the area was calculated and evaluated for the node of interest (Jones & Wagener, 2017) and the 1:20, 1:50, 1:100 and Regional Maximum Flood (RMF) are presented in Table 5.

Table 5: Peak flows and catchment area for Node 1.

Node	**Peak Flow (m^3/s) for Recurrence Interval**						
	1:2 yr	**1:5 yr**	**1:10 yr**	**1:20 yr**	**1:50 yr**	**1:100 yr**	**RMF**
1	23	38	56	78	117	161	427

The daily simulated runoff volumes averaged to monthly runoff values based on Hydro Zone G, are indicated in Table 6 below.

Table 6: Estimated average seasonal runoff (WR2012) (m^3x10^6).

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stream flow	0.09	0.26	0.40	0.75	1.96	2.63	1.01	0.20	0.03	0.01	0.05	0.07

Most of the surface water ecosystems in the study area are thus intermittent or ephemeral, being inundated only for brief periods each year, with periods of drought that are predictable in frequency but unpredictable in duration. The low rainfall across the study area means that evaporation is the dominant component of the water balance and while rainfall drives the inundation periodicity of the aquatic ecosystems in the area.

The ephemeral rivers of the Karoo are highly dependent on groundwater discharge, which occurs at springs and when groundwater recharge (through precipitation at higher elevations) allows the water table to intersect with the river channel.

From the Site Characterisation assessments, the geomorphological and physical characteristics of the Brak River tributaries can be classified as shown in Table 7.

Table 7. Geomorphological and Physical features of the Brak River tributaries (Belcher, 2013).

River	Ephemeral tributaries of the Brak River
Geomorphological Zone	Foothill rivers in the Upper Karoo Geomorphic Province
Lateral mobility	Unconfined
Channel form	Complex
Channel pattern	Multiple thread: low sinuosity
Channel type	Silt/clayey with pebbles
Channel modification	Moderate modification (trampling and grazing within river channel, instream impoundments)
Hydrological type	Ephemeral
Ecoregion	Nama Karoo
DWA catchment	D62D
Vegetation type	Northern Upper Karoo shrubland
Rainfall region	Autumn

Water quality (including the physical, chemical and biological characteristics of the water) in relation to the flow regime.

DWS has no continuous water quality sampling sites in the Brak River (https://www.dwa.gov.za/iwqs/report.aspx). One sample was collected by DWS on 1987/07/24 in the Brak River and was obtained from the DWS website https://www.dwa.gov.za/iwqs/report.aspx. The results are summarised in Table 8.

Table 8: Median concentrations of water quality parameters at the De Bad sampling site (WMS D62_100917) for the one sample on 1987/07/24 in the Brak River (https://www.dwa.gov.za/iwqs/report.aspx).

Parameter	Brak River
Conductivity	101 mS/m
Ca_Diss_Water	104.3 mg/l
Cl_Diss_Water	80 mg/l
DMS_Tot_Water	749
EC_Phys_Water	101.2 mS/m
F_Diss_Water	1.12 mg/l
K_Diss_Water	3.04 mg/l
Mg_Diss_Water	39.7 mg/l
Na_Diss_Water	59.7 mg/l
NH4_N_Diss_Water	0.04 mg/l
NO3_NO2_N_Diss_Water	5.67 mgN/l
pH_Diss_Water	7.7
PO4_P_Diss_Water	0.014 mgP/l
Si_Diss_Water	13.51 mg/l
SO4_Diss_Water	98 mg/l
TAL_Diss_Water	277.3 mg/l

The Brak River drains an area with a very low rainfall. As a result, the water within the river system is saline and turbid and seasonally flowing. At the time of the field visit in October 2017 and April 2022, the river had no water in the system and therefore was not suited to an assessment of water quality or aquatic biota present.

Ephemeral rivers are particularly vulnerable to changes in hydrology, as they are specifically adapted to brief periods of inundation and flow. Consequently, pollutants and sediments entering these watercourses are not regularly diluted or flushed out of the catchment, leading to a lack of resilience to pollution, erosion and sedimentation.

2.3.1.3 Riparian and In-stream Habitat.

Morphology (physical structure) - Index of Habitat Integrity (IHI)

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 that are comparable to the characteristics of natural habitats of the region.

Habitat integrity assessment is approached from an in-stream and riparian zone perspective. Both of these are formulated according to metric groups, each with a number of metrics that enable the assessment of habitat integrity. The model functions in an integrated way, using the results from the assessment of metric groups, or metrics within a metric group, for the assessment of other metric groups where appropriate.

The Instream Index of Habitat Integrity (IIHI) and the Riparian Index of Habitat Integrity (RIHI) is based on the methods outlined in Kleynhans *et al*., 2008.

Table 9: The in-stream IHI: evaluated for the Brak River in the study area.

	MRU
INSTREAM IHI	
Base Flows	-0.5
Zero Flows	-1.0
Floods	-1.5
HYDROLOGY RATING	**1.0**
pH	0.5
Salts	0.5
Nutrients	0.5
Water Temperature	0.5
Water clarity	0.5
Oxygen	0.5
Toxics	0.5
PC RATING	**0.2**
Sediment	-1.5
Benthic Growth	0.0
BED RATING	**0.6**
Marginal	-2.0
Non-marginal	-1.5
BANK RATING	**1.8**
Longitudinal Connectivity	-2.5
Lateral Connectivity	-2.0
CONNECTIVITY RATING	**2.3**
INSTREAM IHI %	**78.8**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**3.4**

Table 10: The riparian IHI: evaluated for the Brak River in the study area.

	MRU
RIPARIAN IHI	
Base Flows	-2.0
Zero Flows	-2.0
Moderate Floods	-2.0
Large Floods	-1.5
HYDROLOGY RATING	**1.8**
Substrate Exposure (marginal)	1.0
Substrate Exposure (non-marginal)	0.0
Invasive Alien Vegetation (marginal)	0.0
Invasive Alien Vegetation (non-marginal)	0.0
Erosion (marginal)	0.0
Erosion (non-marginal)	1.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	1.0
Non-marginal	1.0
BANK STRUCTURE RATING	**1.0**
Longitudinal Connectivity	2.5
Lateral Connectivity	2.0
CONNECTIVITY RATING	**2.3**
RIPARIAN IHI %	**68.8**
RIPARIAN IHI EC	**C**
RIPARIAN CONFIDENCE	**3.2**

The outcome of the in-stream and riparian IHI evaluated for the Brak River in the study area, resulted in an in-stream IHI of 78.8 (B/C) (Table 9) which classifies as "Largely natural with few modifications" according to the Habitat Integrity Categories in Table 11, or "Good" (Small change) when using the finer detail EC rating table (Appendix 2). The riparian IHI of 68.8 (C) (Table 10) falls in a "Moderately modified" category (Table 11) or "Fair" (Moderate change) when using the finer detail EC rating table (Appendix 2).

Table 11: The ratings for the Habitat Integrity Categories prescribed to the IHI model (Kleynhans et al, 2008).

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

2.3.1.4 Watercourse classification

The main aquatic feature within the Sun Central Solar PV facility project area is the Brak River (Sub-quaternary D62D-05613), a seasonal tributary within the Orange River Catchment. The river drains the D62D quaternary catchment in the Nama Karoo Ecoregion of the Orange Water Management Area.

According to Ollis et al (2013), the Brak River is classified as “Rivers and streams with a Riparian zone” (Figure 6). A river is a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit.

According to the National Water Act (Act No. 36 of 1998), a water resource is defined as “a watercourse, surface water, estuary, or aquifer’. A watercourse in turn refers to:

a) a river or spring;
b) a natural channel in which water flows regularly or intermittently;
c) a wetland, lake or dam into which, or from which, water flows; and
d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse. Reference to a watercourse includes, where relevant, its bed and banks.”

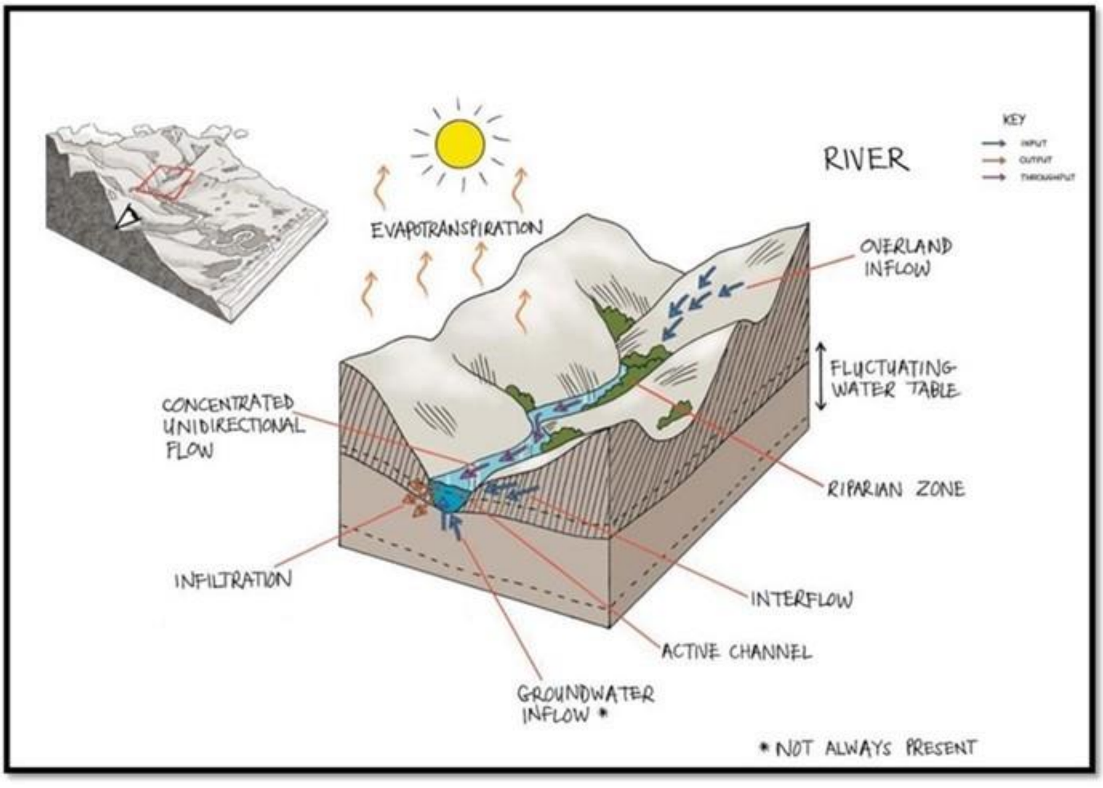

Figure 6: A diagram of a typical “Rivers and streams with Riparian zone” system (Ollis et al, 2013).

A generally accepted classification scheme distinguishes four main categories of streams (Boulton et al., 2000):

- Ephemeral streams – flow briefly (<1month) with irregular timing and usually only after unpredictable rain has fallen;
- Intermittent or temporary streams – flows for longer periods (>1 – 3 months), regularly have an annual dry period coinciding with prolonged dry weather;
- Semi-permanent streams – flow most of the year but cease flowing during dry weather (<3 months), drying to pools. During wetter years, flow may continue all year round;
- Permanent streams perennial flow. May cease to flow during rare extreme droughts.

According to the definitions in the National Water Act (Act No. 36 of 1998), "water resource" includes a **watercourse**, surface water, estuary, or aquifer. Where an application for a water use license is being applied for, all wetlands within 500 m of the proposed development should ideally be mapped. Seasonal or intermittent rivers are included in the National Wetland Classification System (SANBI, 2009) with the rivers and streams category:

Seasonal, intermittent and ephemeral rivers are included in the National Wetland Classification System (SANBI, 2009) with the Rivers and Streams category:

"Rivers and streams: This type of water resource is described as a channel (river, including the banks) in the National Wetland Classification System (SANBI, 2009). This is defined as *"an open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies. Dominant water sources include concentrated surface flow from upstream channels and tributaries, diffuse surface flow or interflow, and/or groundwater flow. Water moves through the system as concentrated flow and usually exits as such but can exit as diffuse surface flow because of a sudden change in gradient. Unidirectional channel-contained horizontal flow characterizes the hydrodynamic nature of these units."*

According to the classification system, channels generally refer to rivers or streams (including those that have been canalized) that are subject to concentrated flow on a continuous basis **or periodically during flooding**. This definition is consistent with the NWA (Act No. 36 of 1998) which makes reference to (i) a river or spring and (ii) a **natural channel** in which water **flows** regularly or **intermittently** within the definition of a water resource. As a result of the erosive forces associated with concentrated flow, channels characteristically have relatively obvious active channel banks which can be identified and delineated."

It is important to note that 'Riparian habitat' may be associated with either of these systems and is regarded by DWS as part of the water resource and 'regulated area'. **Riparian habitat** is defined in the NWA (Act No. 36 of 1998) as *"the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."*

Areas of riparian habitat which are saturated or flooded for prolonged periods would be considered 'wetlands' (in terms of the NWA) and should be mapped as such. Some riparian areas, however, are not 'wetlands' (e.g., where characteristic riparian trees have very deep roots drawing water from many metres below the surface). These areas do however provide a range of important services that maintain basic aquatic processes, services and values requiring protection in their own right. Where present, the boundary of the riparian habitat should therefore also be clearly delineated (Macfarlane et al 2010).

Associated Riparian zone

Rivers can be divided into the 'active channel' and 'riparian zone' components. Riparian habitat (or zone): includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods would be considered riparian wetlands, opposed to non-wetland riparian areas that that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many metres below the surface. Thus, it should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e., those associated with the drainage lines.

The morphology of the Sun Central Solar drainage system.

A dominant feature of the Karoo landscape is the alluvial floodplains, washes and fans. The drainage map compiled for the project area catchment (Figure 7) indicates the extent of these prominent alluvial fans and additional draining channels in the erodible and very dry landscape. The active channel and more prominent tributaries are only a fraction of the illustrated wetland area.

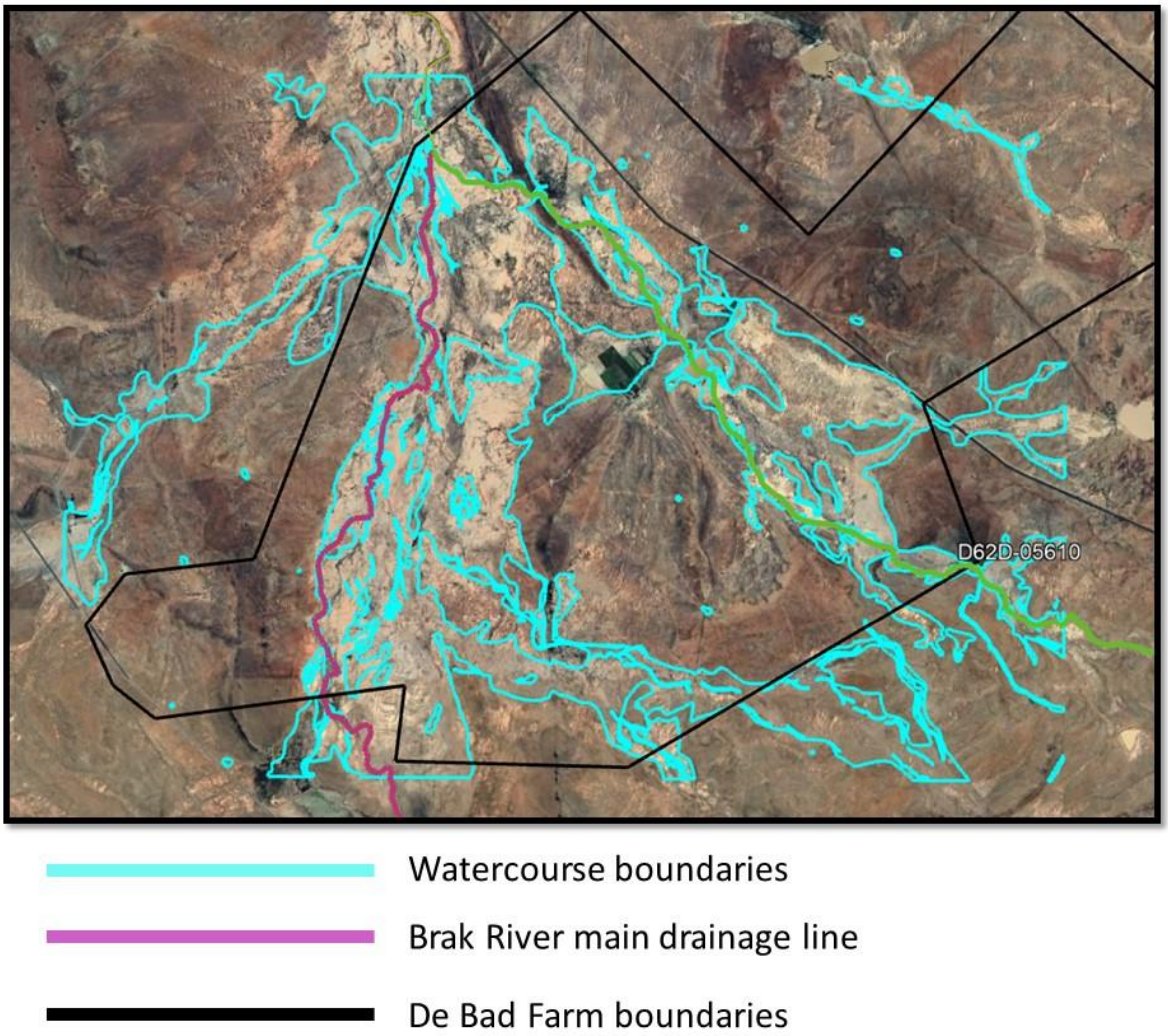

Figure 7: The active channel (Brak River – purple line) and more prominent tributaries are only a fraction of the illustrated drainage area (Blue outlines - watercourse delineation generated by the soil and drainage assessment (Iris, 2017)).

The Brak River

The Sun Central project area has no permanent perennial water source, although in favourable seasons the Brak River may flow. This river and its associated floodplains are relatively wide (ranging from about 30m to approximately 2000m) and consists of a main channel with incised banks and the wider floodplain with depression wetlands and secondary channels that are the remnants of old river channels, formed as the river has migrated within the alluvial floodplain.

The regional geomorphology is dominated by flat pediplain areas overlying Dwyka / Ecca shales. Soils are shallow sandy soils that drain well, allowing for the development of broad alluvial floodplains.

The Karoo landscape is heavily influenced by the occurrence of dolerite dykes, sills and rings and these geological features control surface and subsurface drainage patterns and the occurrence of watercourses and wetlands.

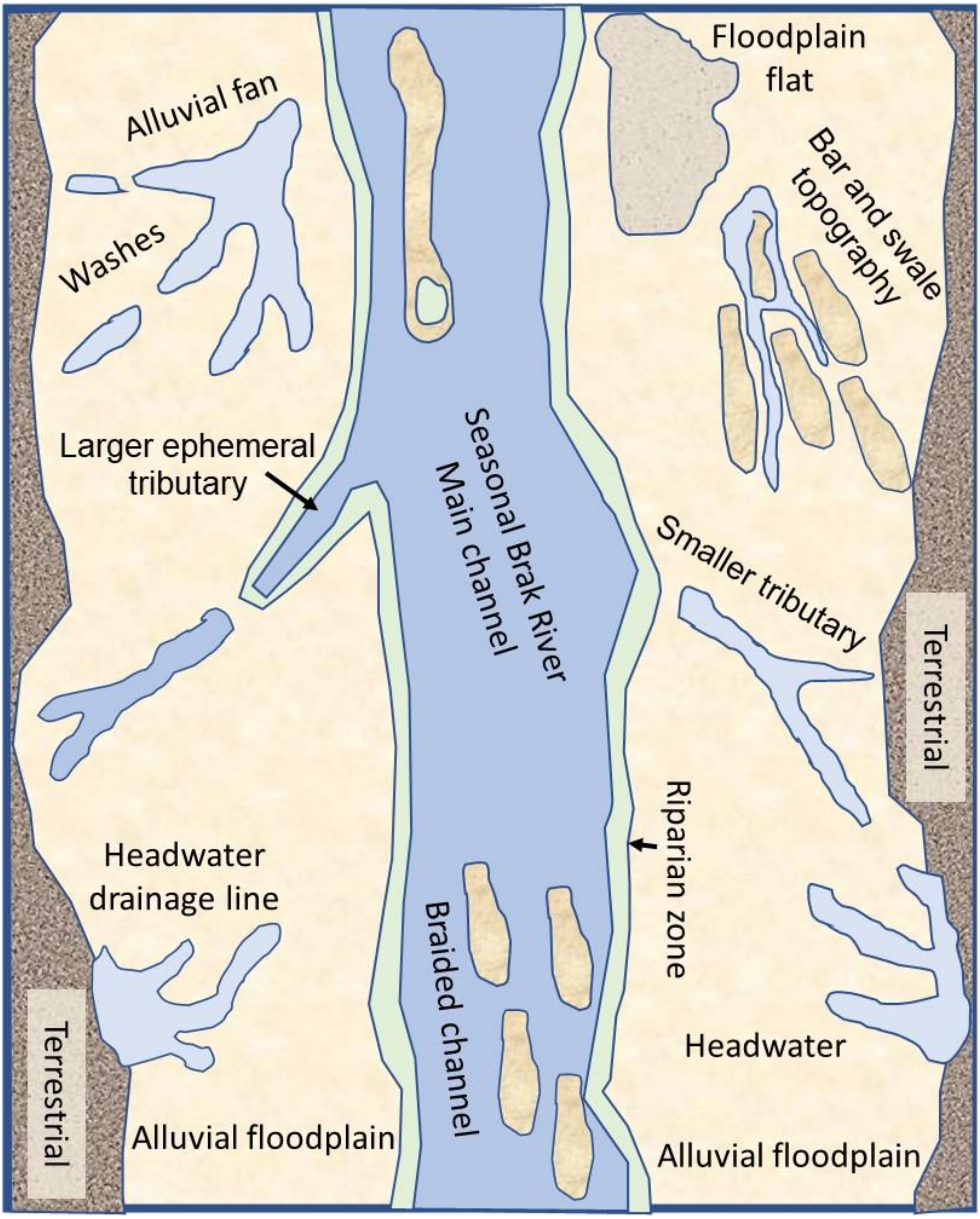

Figure 8: A diagram representing the different morphological aspects of the Sun Central drainage systems.

The river is in a moderately modified ecological condition with a moderate ecological importance and sensitivity. The floodplain has however been heavily modified by human activity with a lot of diversion walls and historical disturbance present.

Brak River riparian areas

The Brak River (Figure 9a) and certain larger ephemeral tributaries are the only natural drainage structures in the study area with weak indicators of riparian vegetation in the riverbed and on the river banks. The water courses are characterised by azonal vegetation types, allied with Upper Gariep Alluvial Vegetation (Ecoleges Environmental Consultants, 2017).

The Brak River system consists of a wide braided channel (Figure 9e) with alluvial bars that are dominated by tall hygrophilic grass (Figure 9c), sedges, rushes, and the common reed *Phragmites australis,* while the floodplain consists of low growing shrubs and grasses.

Reeds and tall hygrophilic grass (Figure 9c and d) can be found in certain areas in the riverbed which indicates areas of extended surface water accumulation, or a very shallow subsurface water source. On the riverbanks sedges (*Scirpoides*) and rushes (*Juncus*) can be found in a narrow band along the embankment (Figures 9b and d) and in some wet patches further away between drainage lines.

Larger ephemeral tributaries

Larger ephemeral washes are generally old, well-established, and stable floodplains. The smaller washes are typically found within smaller valley floor areas, indicating that these smaller valley floors do not have the same flood buffering capacities as the larger ephemeral washes.

According to Rossouw, et al (2005), the ephemeral drainage system dominating the project area, can be classified as “Intermittent A-seasonal”. These rivers exhibit intermittent, unpredictable, and highly variable flow within and between years in a five-year period. Usually occur in climatic transition zones, semiarid areas, and marginal areas, e.g., southern African drought corridor. Although major rainfall and discharge events may be broadly seasonal, flow follows no distinct pattern and drying may occur in any season. Duration of flow, no flow, and drying events are highly variable within and between years, depending on antecedent climatic conditions.

Apart from the basic channel that delineates the ephemeral drainage line, different geomorphological and vegetation features are present in the drainage line configuration. The riverbeds are only inundated with water during heavy rain downpours (Figure 10a). The “riparian zone” of the larger ephemeral tributaries is between 1 and 5 meters wide (Figure 10a), especially where depressions in the system allows for water to form temporary pools or ponds. Patches of sedges are scattered between dwarf karroid scrub and tufted grass on the stream banks (Figure 10a).

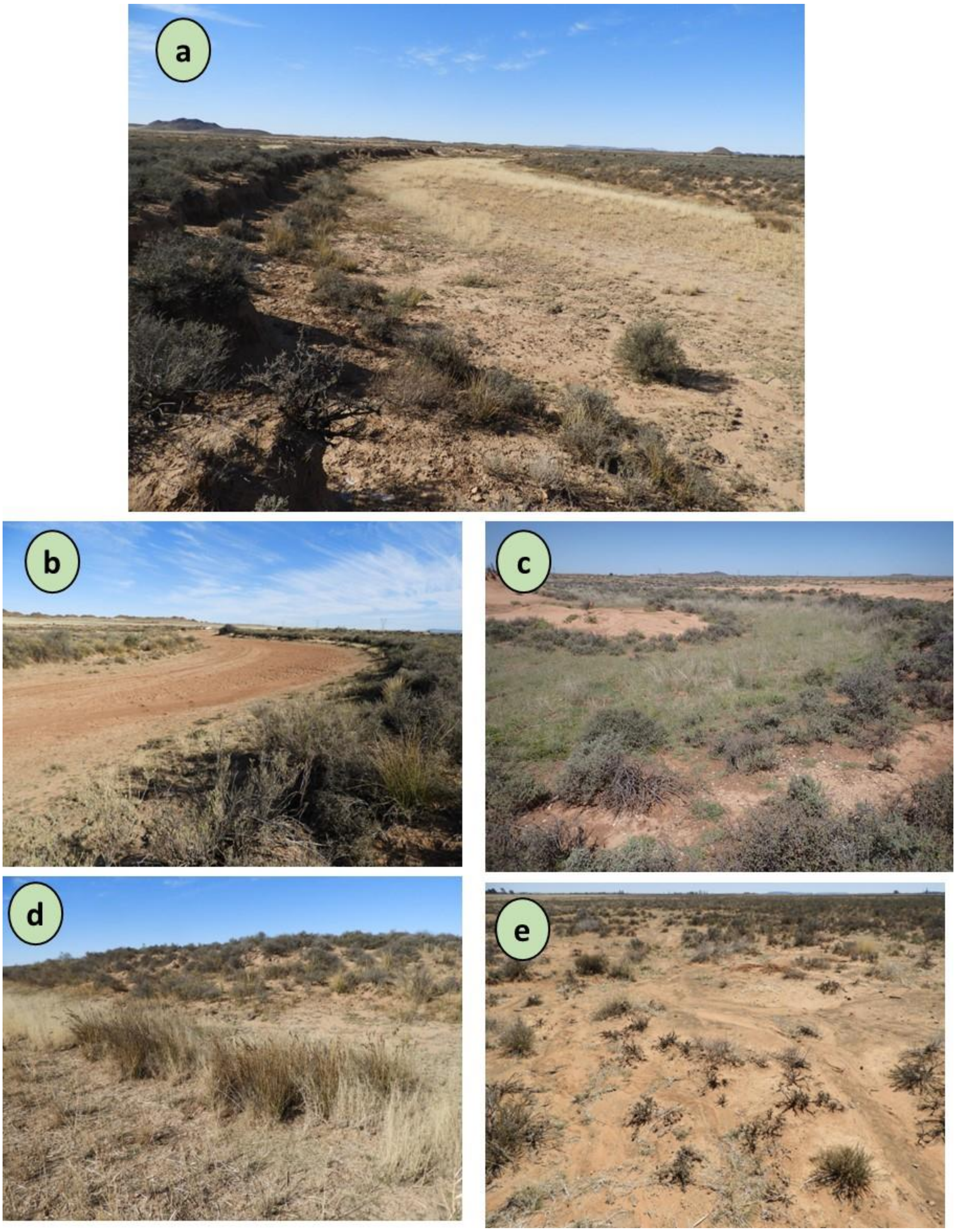

Figure 9: The Brak River

9a: The dry riverbed of the Brak River, filled with alluvial sediment and covered by hygrophilic grasses.
9b: Here the riparian vegetation consists of a relatively dense low shrub on the riverbank.
9c: Extended surface water accumulation in the drainage line resulted in tall hygrophytic grass cover and dense shrubbery on the marginal edges.
9d: A thin band of riparian vegetation lines the drainage line embankment.
9e: Occasional stretches with wide braided channel between alluvial bars are found in the drainage line.

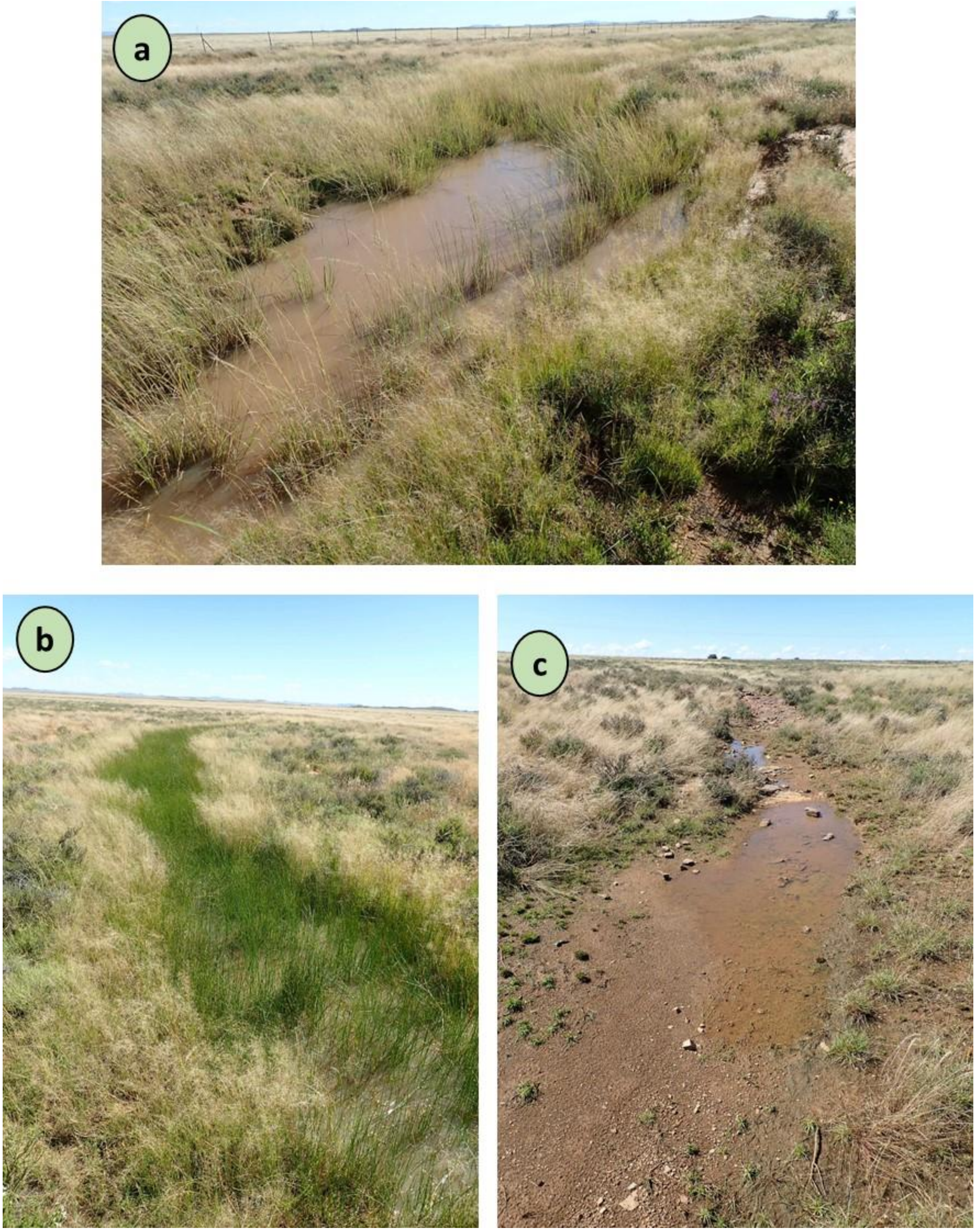

Figure 10: Larger ephemeral tributaries

10a: The riparian vegetation around this temporary pool in the drainage line is flanked by hygrophilous vegetation such as sedges and hydrophytic grass.

10b: Extended surface water accumulation in the drainage line depressions results in a dense growth of sedges.

10c: The drainage lines are only inundated with water for short periods during heavy rain downpours.

Figure 11: Smaller ephemeral tributaries

11a: All the smaller tributaries in the area are ephemeral and most are discernible only as slightly shallow depressions.
11b: In areas the drainage lines may erode into weak channels, mostly due to human intervention (roads and berms).
11c: Although the drainage lines usually have no clear associated vegetation, the vegetation in the drainage line differs from the terrestrial vegetation.

Smaller ephemeral tributaries

All the smaller tributaries in the area are ephemeral or intermittent and most are discernible only as slightly shallow depressions (Figure 11a) with no clear associated vegetation and slightly clayey soils. These unnamed ephemeral tributaries drain into these larger river corridors. It is clear that during rainy downpours that the rain water spreads evenly over the flat surface and flows in a sheet-like manner to the shallow depressions which represents the drainage line.

Most of the terrestrial areas around these drainage systems in the project area are covered with dwarf karroid scrub and tufted grass (Figure 11a) but devoid of trees or shrubs. Due to the fact that this river is an intermittent river, very little trees are present in the riparian zone. No hydromorphic (wetland soil) or hydrophyte (wetland plant) indicators are expected in these watercourses.

Small, shallow in-stream dams and multiple earthen berms have been constructed within many of these drainage channels.

Brak River catchment floodplains

The wide alluvial floodplain of the Brak River with depression wetlands and secondary channels that are the remnants of old river channels, formed as the river has migrated within the alluvial floodplain. They tend to be classified as watercourses rather than as wetlands as they show very few wetland characteristics in the strictest sense.

The alluvial fans and erosion dongas covers most of the demarcated “floodplain” and due to their function, slope and consistency, these areas will only be briefly inundated with surface water during rainy events (Figure 12) and the surface water will be rapidly transported to the low-lying active channel of the system. Precipitation in this semi-desert occurs predominantly in the summer months and is unpredictable and sporadic.

Alluvial fans

A dominant feature of the Karoo landscape is the alluvial floodplains or washes. Surface water may flow along a particular channel in one year, but owing to little topographic definition or gradient across the landscape, a parallel channel may be eroded the following year, leading to a network of channels.

Some ecologists call these features “dendritic drainage systems”, while others refer to them as washes or floodplains. They tend to be classified as watercourses rather than as wetlands as they show very few wetland characteristics in the strictest sense.

Alluvial fans are also tricky to classify as they do not sit neatly in any of the hydrogeomorphic units used by the National Classification System for Wetlands and other Inland Aquatic Ecosystems (Ollis et al., 2013). Alluvial fans are typically created when valleys widen suddenly or stream flows from a narrow, relatively steep valley onto a wider, gradually sloping valley floor or flatter plain.

Extensive alluvial fans are present in the drainage line, and it became evident that the rapid deposition of the sediment load carried by surface water, gave rise to these alluvial fans. Some alluvial fans (or portions of alluvial fans) have distinct channels, while others may lose this distinction as water and sediment disperse and settle relatively evenly across the fan.

These alluvial fans are usually bare soil flats or conduits (Figure 13a), however, in higher lying portions dwarf karroid scrub and tufted grass will colonise on ridges. The ecological functioning and importance of these alluvial features are not known.

The floodplain and alluvial fans have been heavily modified by human activity with a number of diversion walls and historical disturbance present.

Braided channel: bar and swale topography

Washes that lack distinct channel features (Figure 14a) do often display channel configuration referred to as bar and swale topography (Botha, 2021).

Arid ephemeral streams (washes) are typically discontinuous channels on a flat topography in dry environments (Figure 14b). Washes that lack distinct channel features do often display braided channel configuration referred to as bar and swale topography (Lichvar & Wakeley, 2004).

Discontinuous streams can also display a stream pattern characterized by alternating erosional and depositional reaches (Figure 14c).

Floodplain flat

Floodplain flat is described as a non-depressional, near-level wetland area forming part of a floodplain (Figure 15a). It is important to recognise that a floodplain flat is connected to a drainage network, as part of a broader wetland complex associated with a river channel (Figure 15b), while a wetland flat is not in any way connected to a drainage network. Floodplain flats are connected to and fed by a river, while the ‘wetland flats’ are fed only by precipitation and/or groundwater.

Sand washes are the seasonal watercourses that traverse the other types of washes. Here the soils have been washed clean of silt, with sand of medium to fine grain remaining. These watercourses tend to have mostly bare beds, with vegetation occurring in clumps along the bed and more densely along the banks (Figure 15b).

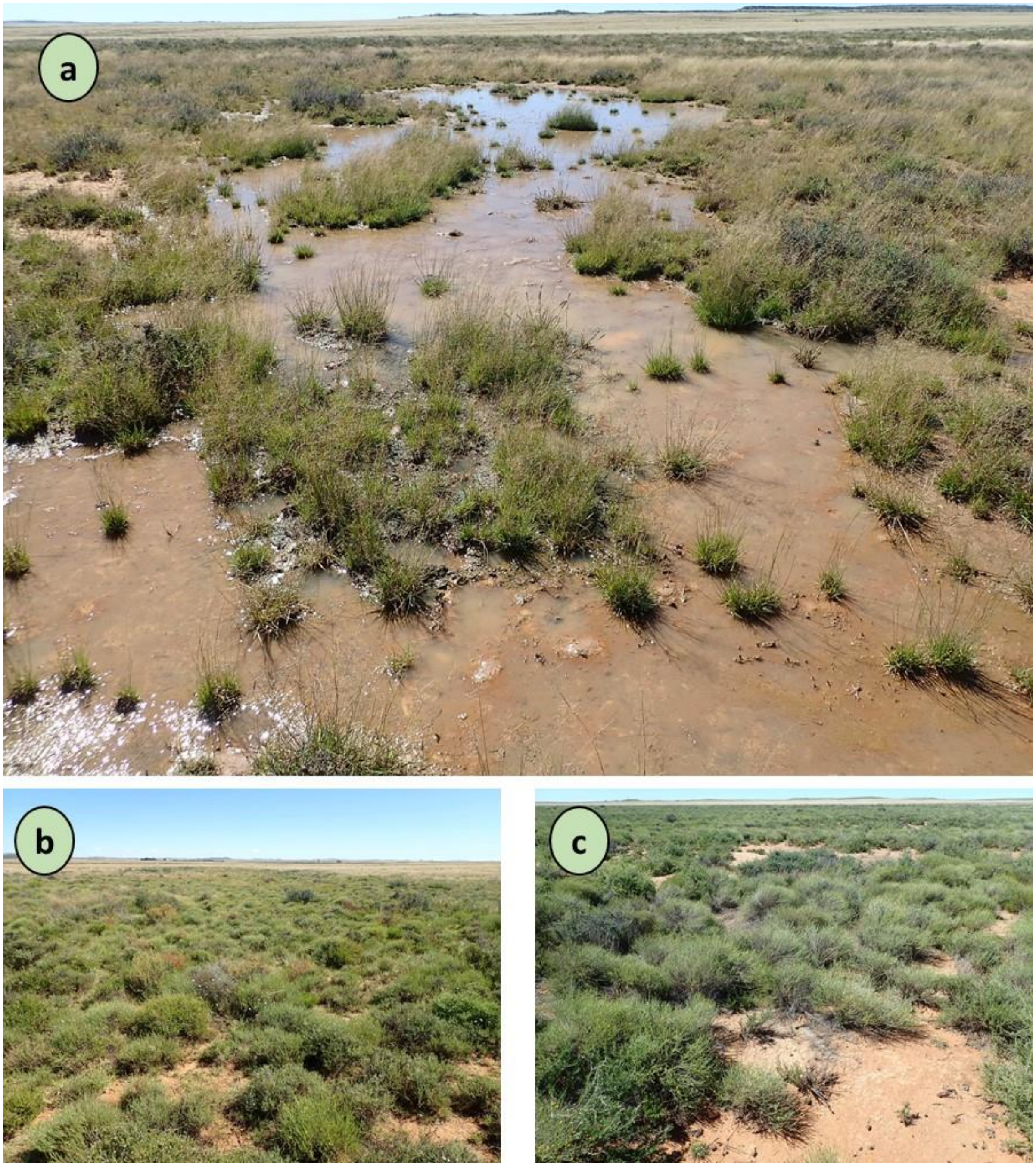

Figure 12: Brak River catchment floodplains

- **12a:** During rainy downpours the rainwater spreads evenly over the flat surface of the flood plains.
- **12b:** In areas the difference between the flood plain vegetation (karoo shrubs) shows clear differences to the vegetation cover of the adjacent terrestrial areas (white-coloured grasslands).
- **12c:** The flood plains consist of bare soil flats, mostly shrub-covered bars and conduits formed by depressions.

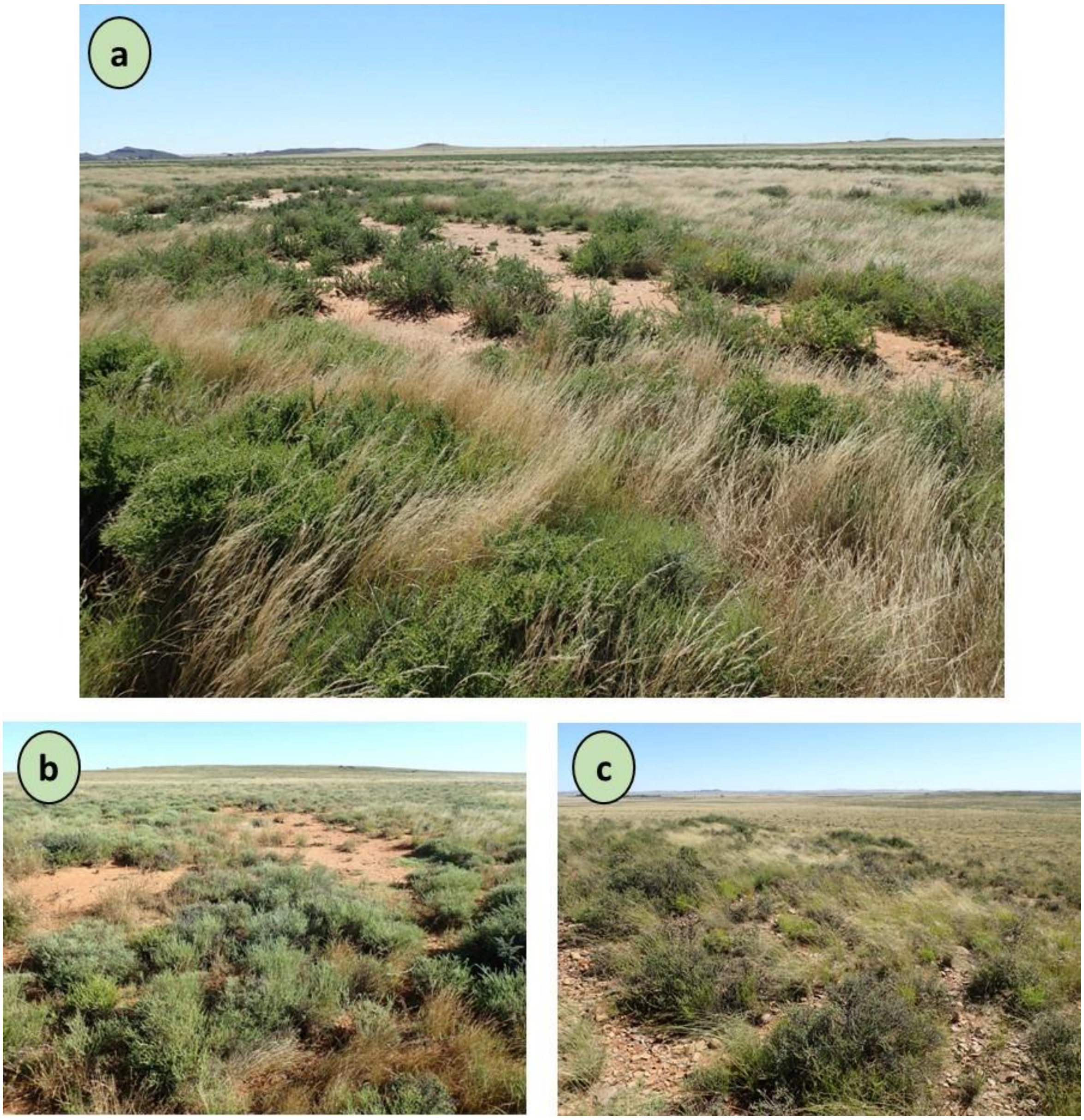

Figure 13: Alluvial fans

13a: Alluvial fans tend to be classified as watercourses rather than as wetlands as they show very few wetland characteristics in the strictest sense.

13b: Alluvial fans are typically created when valleys widen suddenly or stream flows from a narrow, relatively steep valley onto a wider, gradually sloping valley floor or flatter plain.

13c: Alluvial fans are usually bare soil flats or conduits, however, in higher lying portions dwarf karroid scrub and tufted grass will colonise on ridges.

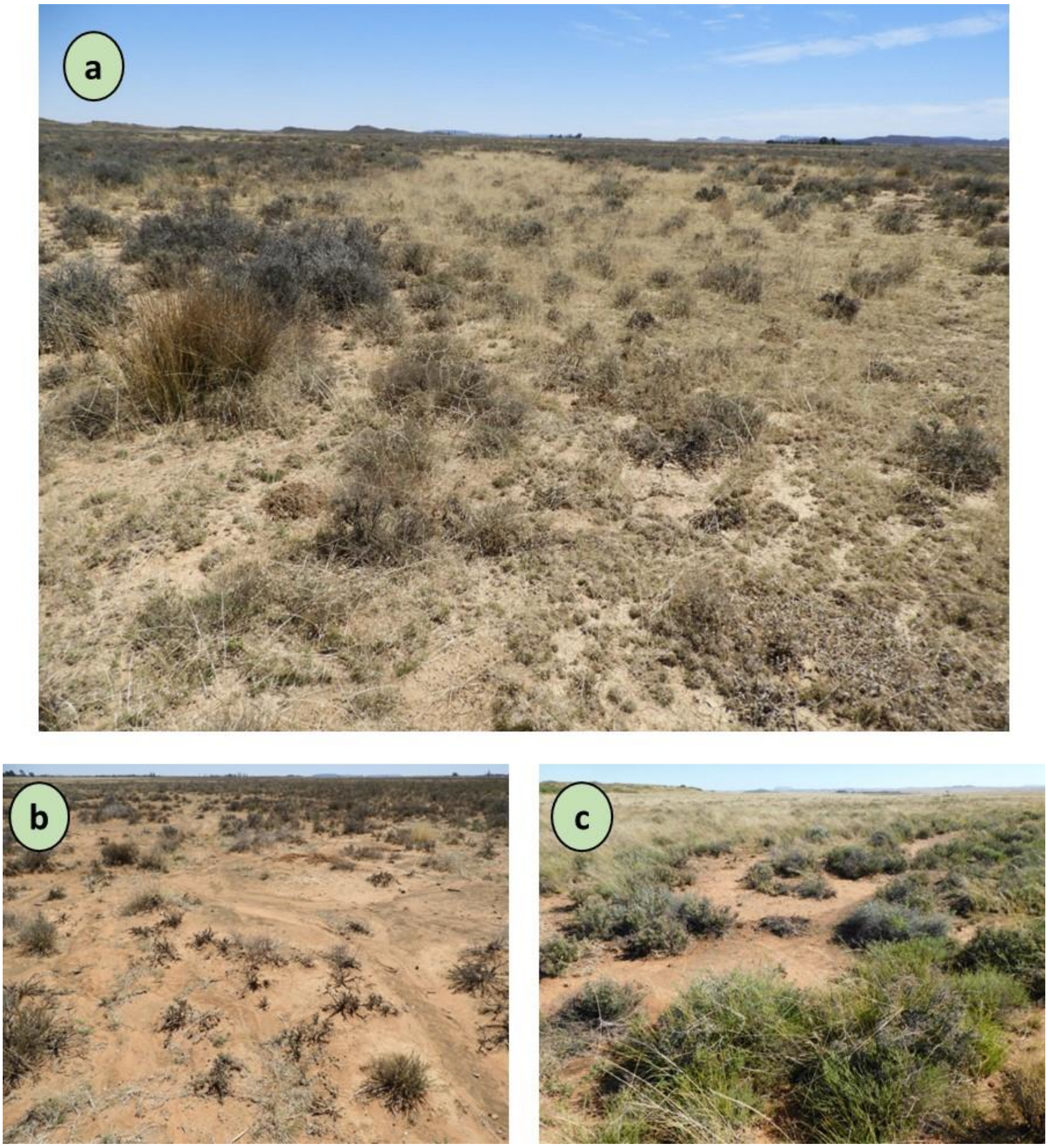

Figure 14: Bar and swale topography

14a: Washes that lack distinct channel features do often display channel configuration referred to as bar and swale topography.

14b: Arid ephemeral washes are typically discontinuous channels on a flat topography in dry environments.

14c: Discontinuous streams can also display a stream pattern characterized by alternating erosional and depositional reaches.

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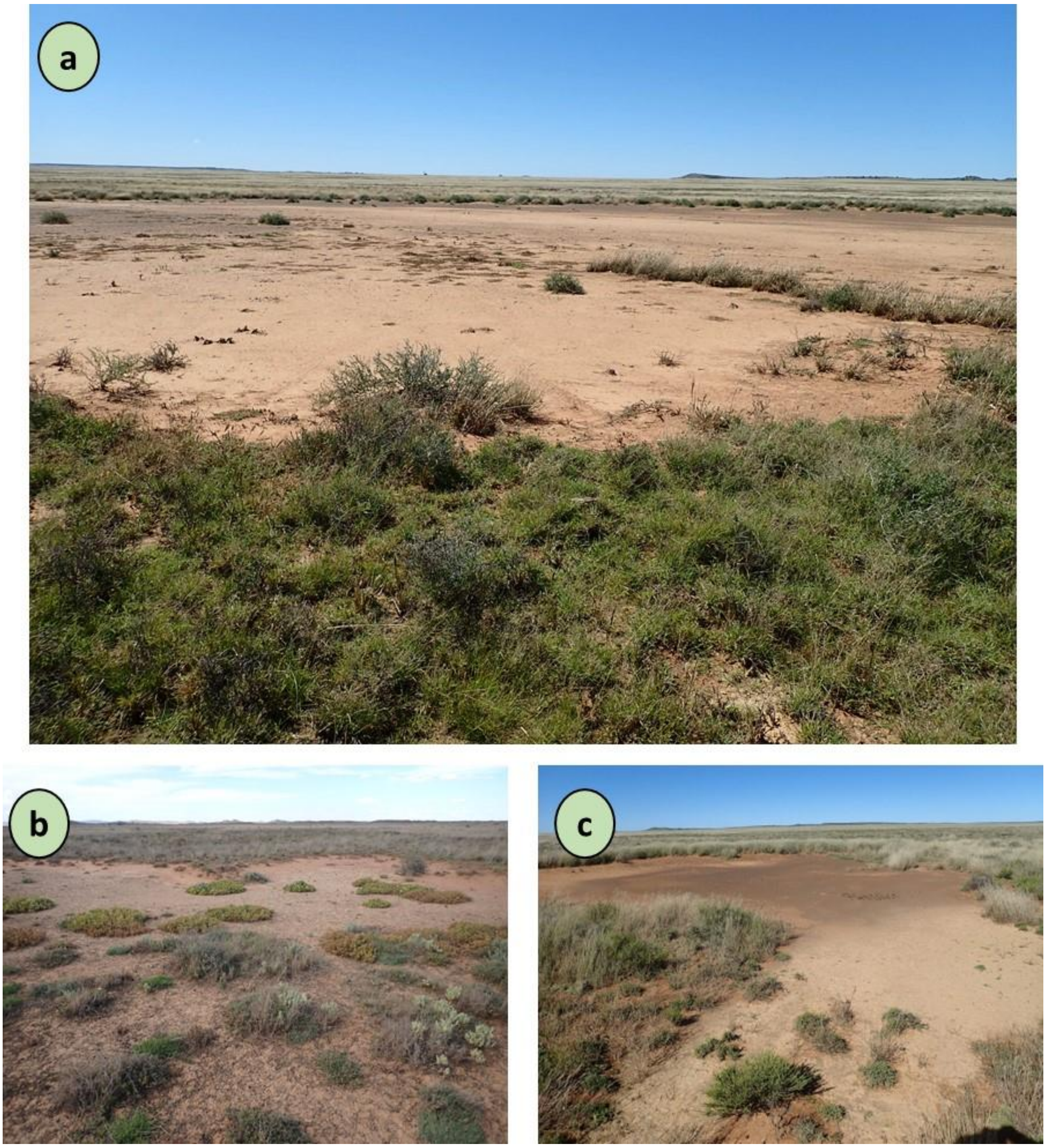


Figure 15: Floodplain flats

15a: Floodplain flat is described as a non-depressional, near-level wetland area forming part of a floodplain.
15b: A floodplain flat is connected to a drainage network as part of a broader wetland complex.
15c: Sand washes tend to have mostly bare beds, with vegetation occurring in clumps along the bed and more densely along the banks.

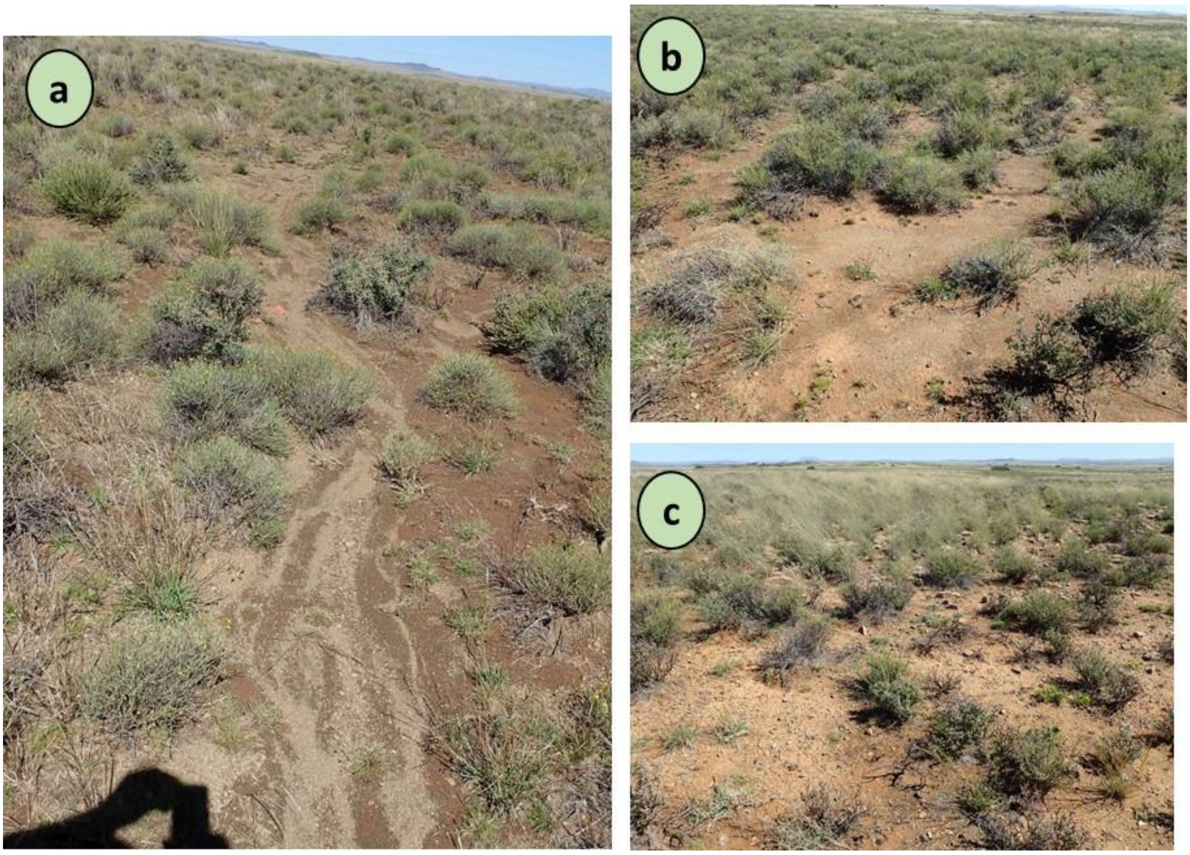


Figure 16: Headwater drainage lines

> **16a:** Headwater drainage lines that only carry storm flow are located at the source of drainage line networks.
> **16b:** Headwater drainage lines have discontinuous or swale-like channels.
> **16c:** These drainage lines have riparian vegetation that consists of a relatively sparse low shrub layer.

Headwater drainage lines

The arid drainage lines adjacent to the project area consist mostly of ephemeral channels and drainage lines. Ephemeral channels and drainage lines represent linear and narrow watercourses in the form of headwater drainage lines (second order drainage lines and channels). Headwater drainage lines that only carry storm flow are located at the source of drainage line networks (Figure 16a).

Headwater drainage lines, which include first and second order drainage lines and ephemeral channels, are also regarded as watercourses, even though they may have discontinuous or swale-like channels. They differ from downstream reaches due to a closer linkage with hillslope processes, higher temporal and spatial variation (Gomi et al. 2002).

Headwater systems form part of a continuum between hillslopes and stream channels (Gomi et al. 2002). Transitional channels (temporary or ephemeral channels) can have defined channel banks, as well as discontinuous channel segments along their length, and emerge out of zero-order basin. They form the headmost definable portion of the drainage line network (first-order channels) and can have either ephemeral or intermittent flow.

In certain situations, it might be challenging to know whether a particular wetland is a headwater drainage line or a seep, as some seeps are found in foot- or toe-slope locations with extremely shallow gradients. One of the key differences between these two wetland types, is that seeps are often fed primarily by the expression of groundwater at the ground surface whereas headwater drainage lines are typically fed by precipitation alone. It should also be noted that systems that are not permanently or periodically inundated are not considered true wetlands, i.e., those associated with the drainage lines.

Headwater drainage lines riparian vegetation consists of a relatively sparse low shrub layer. In between the sparse low shrub layer, a small sedge appears during very wet periods as part of the riparian zone, indicating the area of increased wetness.

Artificial wetlands – Dams and Earthen berms

Artificial wetlands associated with dammed drainage lines form part of the system, but due to the interference with natural flows, these structures are not considered as beneficial to the natural functioning of a stream system. The small farm dams which is present in the drainage line intercept flows and store it for agricultural uses. It thus prevents the flow in the early rainy season to reach downstream habitats, and it is only when the dams have filled that they overflow and release the disrupted flows to the downstream habitats.

Many earthen berms are present in the drainage lines and floodplain. These structures are there to distribute water more widely by releasing the water onto dry fields earmarked for grazing by livestock or game.

Figure 17: Dams and Earthen berms

17a: The small farm dams which is present in the drainage line intercept flows and store it for agricultural uses.

17b: Many earthen berms are present in the drainage lines and floodplain.

17c: These berms are there to distribute water more widely by canalising the flows along the berms and release the water through these breaches.

2.3.1.5 Ecological survey transects for the access road and the 2.5 km main transmission line in the project area.

The surveys planned for the Upgrading & Development of an Access Road project, assessed the sites for the presence of all drainage aspects which could potentially be influenced by the project activities (access road and transmission line). The coordinates of the transects are summarised in Table 12.

Table 12: Description of transects conducted for the drainage assessments in the Solar Africa Energy PV facility project area.

Survey transects in the Solar Africa Energy project area.	Coordinates		Length (km)
	Start	End	
Road transects			
Transect 1	30°52'32.58"S 24°13'26.37"E	30°51'16.39"S 24°15'54.58"E	5.28
Transect 2	30°51'16.39"S 24°15'54.58"E	30°51'52.85"S 24°18'7.23"E	4.18
Transect 3	30°51'52.85"S 24°18'7.23"E	30°53'22.23"S 24°19'2.20"E	3.67
Total			13.13
Transmission line transect			
Transect 5	30°53'28.56"S 24°18'57.86"E	30°54'2.47"S 24°17'6.81"E	3.68
Total			3.68

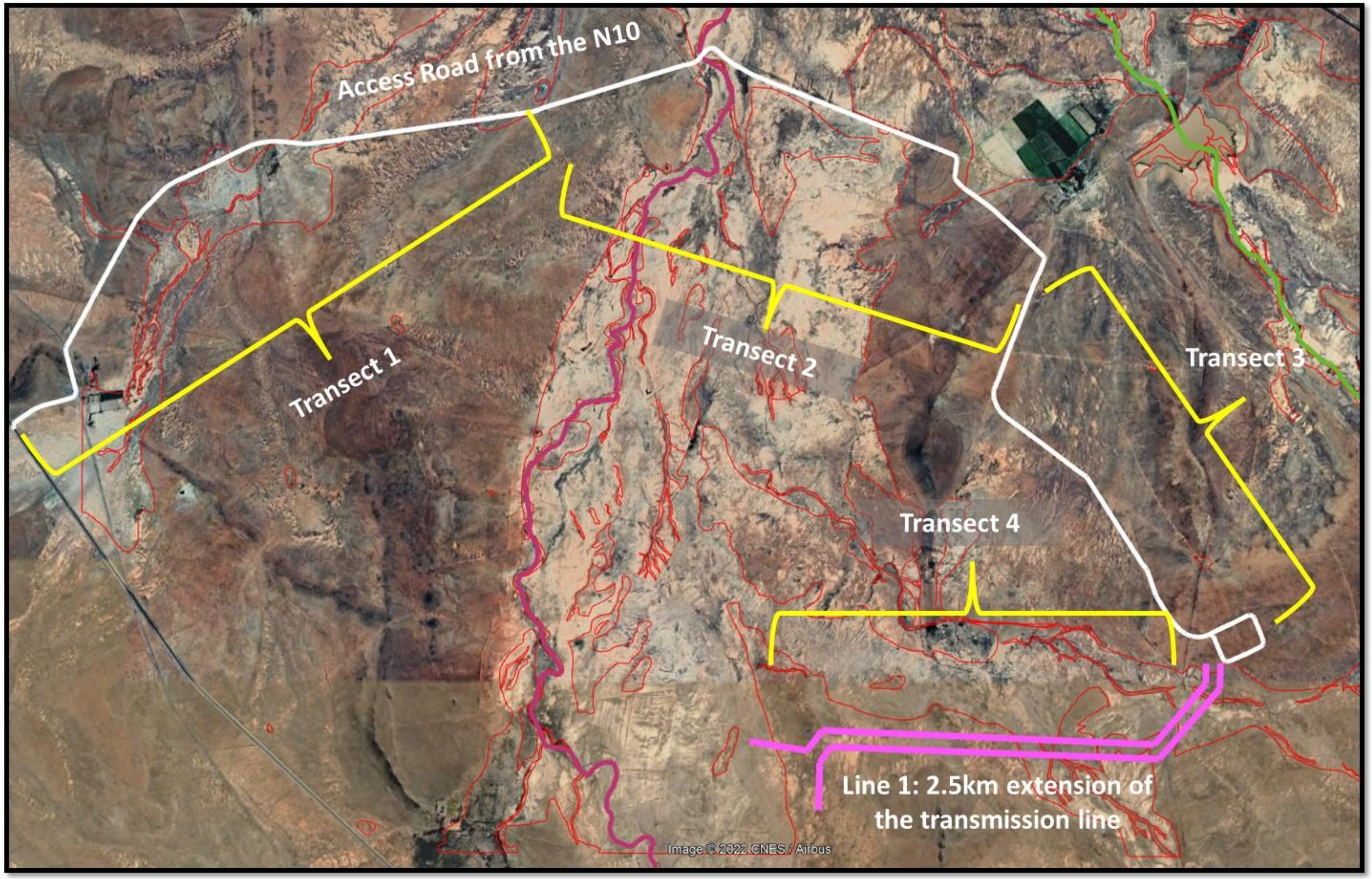


Figure 18: The transects conducted during the access road and transmission line assessments (Table 12).

2.3.1.6 Vegetation communities

In terms of the regional vegetation and aquatic habitat composition, there is very little discernible riparian vegetation in the SolarAfrica Energy project area. The riparian vegetation of the catchment floodplains consists of a relatively dense low shrub. These shrubby systems are often visible by the formation of smaller washes and dense encroachment by spiny shrubs.

Patches of sedges are scattered between dwarf karroid scrub and tufted grass on the stream banks of larger drainage lines. Reeds and tall hygrophilic grass can be found in certain areas in the riverbed which indicates areas of extended surface water accumulation, or a very shallow subsurface water source.

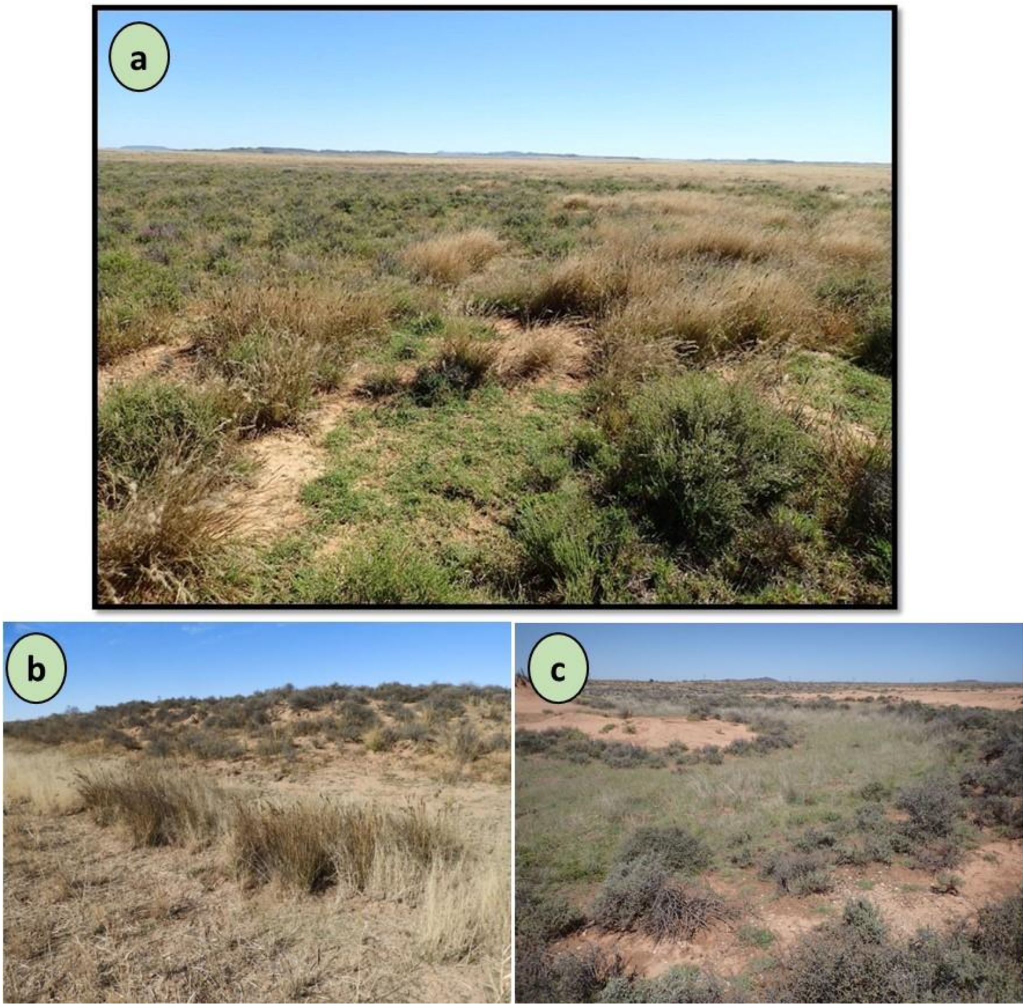


Figure 19: Vegetation communities

19a: The riparian vegetation of the catchment floodplains consists of dense spiny shrubs (darker vegetation in the middle of the figure).
19b: A thin band of riparian vegetation lines the drainage line embankment of the larger drainage lines.
19c: Dense shrubbery occurs on the marginal edges of the Brak River

VEGRAI model

The VEGRAI process has a spread sheet model component that is composed of a series of metrics and metric groups each of which is rated in the field with the guidance of data collection sheets (referred to as field forms).

The purpose is to evaluate and interpret the observed impacts at a site in terms of its relative influence on the riparian vegetation according to vegetation removal, alien vegetation invasion, water quantity and quality. The approach followed is that each of these four broad causes of modification relates to and is associated with particular human-related activities that would change the riparian vegetation characteristics directly or indirectly. Some of these changes may occur rapidly while others will occur gradually and only become evident through time.

Table 13: A comparative description related to reference and present state of the riparian zone in the project area.

Zones	Impacts	Response Metrics	Description of PRESENT STATE	Description of REFERENCE STATE
Marginal	Vegetation Removal Exotic Vegetation Water Quantity Water Quality	Cover Abundance Species Composition	The "riparian zone" of the Brak River is between 1 and 5 meters wide and the riverbed is between 5 and 30 meters wide. Along the active channel (1.0 -1.5 m deep) reeds and tall hygrophilic grass dominates the instream habitat, while there is very little discernible riparian vegetation in the marginal area. Some drainage line tributaries have sedges and rushes growing in the sandy riverbed which indicates areas of extended surface water accumulation, or a very shallow subsurface water source. On the riverbanks sedges (*Scirpoides*) and rushes (*Juncus*) can be observed in a narrow band along the embankment. The other ephemeral tributaries have no visible wetland vegetation present. Due to the fact that this river is an intermittent river, very little trees are present along the riverbanks. There are many impoundments on these drainage lines, and they are small- to medium-sized earthen farm dams.	The outline of the riverbed of the Brak River was more distinct and much less alluvial fans and additional draining channels in the erodible and very dry landscape than today. The "riparian zone" of the Brak River was between 1 and 5 meters wide and the riverbed between 5 and 30 meters wide. Along the active channel (1.0 -1.5 m deep) reeds and tall hygrophilic grass dominated the instream habitat, while very little discernible riparian vegetation was present in the marginal area. Some drainage line tributaries had sedges and rushes growing in the sandy riverbed which indicated areas of extended surface water accumulation (much more than today), or a very shallow subsurface water source. On the riverbanks sedges (*Scirpoides*) and rushes (*Juncus*) could be observed in a narrow band along the embankment. The other ephemeral tributaries have no visible wetland vegetation present. Due to the fact that this river is an intermittent river, very little trees was present along the riverbanks.

Non-marginal	Vegetation Removal Exotic Vegetation Water Quantity Water Quality	Cover Abundance Species Composition	The floodplain and alluvial fans have been heavily modified by human activity with a lot of diversion walls and historical disturbance present. All the smaller tributaries in the area are ephemeral or intermittent and most are discernible only as slightly shallow depressions with no clear associated vegetation. The higher lying areas or “islands” between the drainage lines are covered with dwarf karroid scrub and tufted grass but devoid of trees or shrubs. A small number of alien tamarisk trees are growing in the main drainage line. Sedges (*Scirpoides*) and rushes (*Juncus*) are found in some wet patches further away between drainage lines.	A dominant feature of the Karoo landscape was the alluvial floodplains, washes, and fans, however there were less of these features. All the smaller tributaries in the area were ephemeral or intermittent and most were discernible only as slightly shallow depressions with no clear associated vegetation. The higher lying areas between the drainage lines were covered with dwarf karroid scrub and tufted grass but devoid of trees or shrubs. Sedges (*Scirpoides*) and rushes (*Juncus*) were found in some wet patches further away between drainage lines.

Table 14: Evaluation of the marginal zone integrity (VEGRAI model) in the project area**.**

	MODIFICATION RATINGS						
CAUSES OF MODIFICATION	**INTENSITY**	**EXTENT**	**CONFIDENCE**	**NOTES: (give reasons for each assessment)**			
REMOVAL	0,5	1.5	2,0	Grazing by goats.			
EXOTIC INVASION	0,0		4,0	Only few *Tamarix* trees.			
WATER QUANTITY	0,5	1.0	3,0	Dams and berms. Weirs and dams impede subsurface flows.			
WATER QUALITY	0,0	0,0	3,0	None			
AVERAGE			3,0				
		RESPONSE METRIC RATINGS					
VEGETATION COMPONENTS	**RESPONSE METRIC**	**CONSIDER? (Y/N)**	**RATING**	**CONFIDENCE**	**NOTES: (give reasons for each assessment)**		
WOODY	COVER	Y	0,0	4,0	No change.		
	ABUNDANCE	Y	0,0	4,0	No change.		
	SPECIES COMPOSITION	Y	0,0	3,0	No change.		
			0,0	3,7			
NON-WOODY	COVER	Y	2.0	4,0	Grazing by goats, roads and berms		
	ABUNDANCE	Y	0,5	4,0	Grazing by goats.		
	SPECIES COMPOSITION	Y	0,0	3,0	Little change.		
			1.0	2,7			
VEGETATION COMPONENTS	**CONSIDER? (Y/N)**	**RANK**	**WEIGHT**	**RATING**	**WEIGHTED RATING**	**MEAN CONFIDENCE**	**NOTES: (give reasons for each assessment)**
WOODY	Y	2,0	10,0	0,0	0,00	3,7	None present
NON-WOODY	Y	1,0	100,0	0,3	0,33	2,7	Present
CHANGE (%) IN MARGINAL ZONE CONDITION				**18,2**	0,33	3,2	

Table 15: Evaluation of the non-marginal zone integrity (VEGRAI model) in the project area.

	MODIFICATION RATINGS						
CAUSES OF MODIFICATION	**INTENSITY**	**EXTENT**	**CONFIDENCE**	**NOTES: (give reasons for each assessment)**			
REMOVAL	0,5	1.5	2,0	Grazing by goats.			
EXOTIC INVASION	0,0		4,0	None			
WATER QUANTITY	2.0	1.5	3,0	Dams and berms. Weirs and dams impede subsurface flows.			
WATER QUALITY	0,0	0,0	3,0	None			
AVERAGE			3,0				
		RESPONSE METRIC RATINGS					
VEGETATION COMPONENTS	**RESPONSE METRIC**	**CONSIDER? (Y/N)**	**RATING**	**CONFIDENCE**	**NOTES: (give reasons for each assessment)**		
WOODY	COVER	Y	0,5	4,0	No change.		
	ABUNDANCE	Y	0,5	4,0	No change.		
	SPECIES COMPOSITION	Y	0,0	3,0	No change.		
			0,3	3,7			
NON-WOODY	COVER	Y	3.0	4,0	Grazing by goats, berms, dams and roads.		
	ABUNDANCE	Y	1.0	4,0	Grazing by goats.		
	SPECIES COMPOSITION	Y	0,0	3,0	Little change.		
			1,3	2,7			
VEGETATION COMPONENTS	**CONSIDER? (Y/N)**	**RANK**	**WEIGHT**	**RATING**	**WEIGHTED RATING**	**MEAN CONFIDENCE**	**NOTES: (give reasons for each assessment)**
WOODY	Y	2,0	10,0	0,3	0,03	3,7	None present
NON-WOODY	Y	1,0	100,0	1,3	1,33	2,7	Present
	CHANGE (%) IN MARGINAL ZONE CONDITION		**24.8**		1,37	3,2	

Table 16: The vegetation integrity evaluation of the riparian zone in the project area.

LEVEL 3 ASSESSMENT						
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT	NOTES: (give reasons for each assessment)
MARGINAL	81.8	45.5	3,2	1,0	100,0	Some cover
NON-MARGINAL	75.2	33.4	3,2	2,0	80,0	Very little present
	2.0				180.0	
LEVEL 3 VEGRAI (%)				78.9		
VEGRAI EC				B/C		
AVERAGE CONFIDENCE				3,2		

According to the VEGRAI assessment (Table 16) for the Solar Africa Energy PV facility drainage lines, the Ecological Class is a B/C (78,9%).

The final scores of the VEGRAI assessment regarding the riparian and marginal zone integrity of the Solar Africa Energy PV facility drainage lines are presented in Table 17.

Table 17: A summary of the VEGRAI scores of the Solar Africa Energy PV Facility in the project area.

Drainage lines	Non-marginal zone condition	Marginal zone condition	Level 3 VEGRAI	VEGRAI EC
Solar PV Facility	81.8%	75.2%	78.9%	B/C

The vegetation integrity score is 78.9% which represents an Ecological Class C (60-79). This score reflects an "Moderately modified." status (Table 18).

Table 18: Generic ecological categories for EcoStatus components (modified from Kleynhans 1999).

ECOLOGICAL 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.	80-89
C	**Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.**	**60-79**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically 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	0-19

2.3.1.7 Aquatic habitat assessment

Aquatic surveys and biomonitoring are components of ecological risk assessment and aims to measure present biological conditions and trends in the aquatic ecosystem. It attempts to relate the observed variation to changes in available habitat, as dictated by physical system drivers of the system such as water quality, geomorphology, and hydrology (Kleynhans et al, 2008).

During the survey in December 2022 the following parameters were measured - IHAS (Integrated Habitat Assessment System) and HQI (Habitat Quality Index) with the results summarized in Table 19. The only aquatic habitat present to sample, was a series of isolated pools in the system, filled with rainwater but not flowing (Figure 20). These pools are temporary and the habitats available were overhanging grass and a sandy pool bottom with loose pebbles and stones.

Figure 20: Isolated pools were present in the project area and aquatic surveys were done in these aquatic habitats.

Table 19: The combined habitat parameters as measured in the project pools.

SITE	IHAS%	CATEGORY	HQI%	CATEGORY
SITE 1	54	Poor	55	Poor

During the December 2022 survey, the IHAS and HQI scores were mostly “Poor” (Table 19) due to the shallow water level, brief presence of surface water and the lack of flow.

2.3.1.8 Presence of aquatic species

Aquatic invertebrate assessment

The aquatic macro-invertebrates were sampled according to the SASS5 method at the project pools, and Table 20 lists the macro-invertebrates sampled at the site and reflects the SASS5 scores for the survey.

The shallow water level, brief presence of surface water and the lack of flows, reflected in the macro-invertebrate scores (Table 20), resulting in “Fair” SASS scores and low number of families (Table 21). Most of the taxa recorded had low sensitivity scores, with the highest scores of 5, indicating the low sensitivity of the assemblage, mostly air-breathers.

Table 20: SASS5 scores of the different habitat types at the sampling pool site (a complete table of this summarized version can be viewed in Appendix 1).

TAXON	Stones	Vegetation	GSM	Total
Baetidae 1 spp 4	A	A	A	B
Corixidae 3			B	B
Notonectidae 3		A		A
Dytiscidae 5	1	A	1	A
Culicidae 1		A	A	A
SASS Score	9	13	13	16
No of families	2	4	4	5
ASPT	4.5	3.2	3.2	3.2

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Table 21: Categories used to classify Habitat, SASS and ASPT values:

HABITAT	SASS4	ASPT	CONDITION
>100	>140	>7	Excellent
80-100	100-140	5-7	Good
60-80	60-100	3-5	Fair
40-60	30-60	2-3	Poor
<40	<30	<2	Very poor

Fish Response Assessment Index (FRAI)

The purpose of the Fish Response Assessment Index (FRAI) is to provide a habitat-based cause-and-effect interpretation underpinning the deviation of the fish assemblage from the reference condition.

Unfortunately, at the time of the field visit the river had no water in the system and therefore was not suited to an assessment of water quality or aquatic biota present. Due to this lack of data, the PESEIS information of DWS (DWS, 2014) will be used to establish some background for the PES determination.

According to the DWS PESEIS database, the freshwater fish aspects of the Brak River (D62D-05613) read as follow:

Fish species per SQ: 2 species
Fish representivity per secondary: Moderate
Fish rarity per secondary class: Moderate
Fish species estimated:
Barbus anoplus
Labeo umbratus
Fish physical-chemical description: Moderate
Fish no-flow sensitivity description: Moderate

By using these parameters, the PESEIS assessors establish a PES of a Category D for the instream biota aspect, which equates to “Largely modified” (Table 21). However, by evaluating the changes in the system and the diversity of these ephemeral systems, it is rather a lack of diversity then a case of modification when the instream biota is evaluated (“Low diversity”).

Table 21: Ratings for the fish integrity classes

	FRAI ASSESSMENT CLASSES	
Class rating	Description of generally expected conditions for integrity classes	Relative FRAI score (% of expected)
A	Unmodified, or approximate natural conditions closely	90 to 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification.	80 to 89
C	Moderately modified. A lower than expected species richness and presence of most intolerant species. Some impairment of health may be evident at lower limits of this class.	60 to 79
D	**Largely modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderate intolerant species. Impairment of health may become more evident at the lower limit of this class.**	**40 to 59**
E	Seriously modified. A strikingly lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 to 39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species. Only tolerant species may be present with a loss of species at the lower limit of the class. Impairment of health generally very evident.	0 to 19

2.3.1.9 Ecological Category (EC)

EcoStatus Definition: "The totality of the features and characteristics of the river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services". This ability relates directly to the capacity of the system to provide a variety of goods and services.

The driver components are assessed separately (i.e., an EC for each driver) and not integrated at a driver level to provide a driver-based indication of the EcoStatus. However, the individual metrics of all the driver components are assessed in a combined fashion that allows some comparison between metrics of all drivers. This facilitates deriving the cause-and-effect relationship that is required in the interpretation and assessment of a particular biological responses.

The biological responses are assessed separately, but the resulting fish and macro-invertebrate ECs are integrated to provide an indication of the in-stream EC. Logically, the integration of the riparian vegetation EC and the in-stream EC would provide the EcoStatus. The influence of the riparian vegetation on the in-stream habitat is used to interpret the biological responses and endpoints. This means that in some cases, the integrated in-stream biological responses are deemed to provide a reasonable indication of the EcoStatus.

Table 22: The table below provides the available parameters that were instrumental to establish the Ecostatus of the Solar Africa Energy PV Facility drainage lines.

Parameter	Score %	Category	Description
VEGRAI	78.9	B/C	Moderately modified
SASS5	3.2	3-5	Fair
FRAI		D	Largely modified
Habitat	54.0	40-60	Poor
Ecostatus		C	Moderately modified

EcoClassification - the term used for the Ecological Classification process - refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers relative to the natural or close to the natural reference condition.

The overall Ecostatus of the Brak River on the Solar Africa Energy PV Facility matches a Category C (Moderately modified) (Table 23).

Table 23: Generic ecological categories for EcoStatus.

ECOLOGICAL 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.	80-89
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 have occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions are extensive.	20-39
F	Critical/Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

2.3.2 The threat status of the ecosystem and species as identified by the screening tool

Proposed Development Area Environmental Sensitivity

The following summary of the development footprint environmental sensitivities or threat status of the ecosystem and species is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

The following section with a map represents the results of the screening for environmental sensitivity for the aquatic ecosystem themes associated with the project classification.

Table 24: The Aquatic Biodiversity Impact Assessment identified in the Screening Report (Figure 21).

Theme	Sensitivity Rating	Reason for Sensitivity Rating		Type of Assessment	TOR
		Sensitivity	Features		
Aquatic Biodiversity	Very High	Very high	Rivers	Aquatic Biodiversity Specialist Assessment	Gazetted Protocol (GN No.320)
			Strategic water source area		
			Wetlands and Estuaries		
			Freshwater ecosystem priority area quinary catchments		

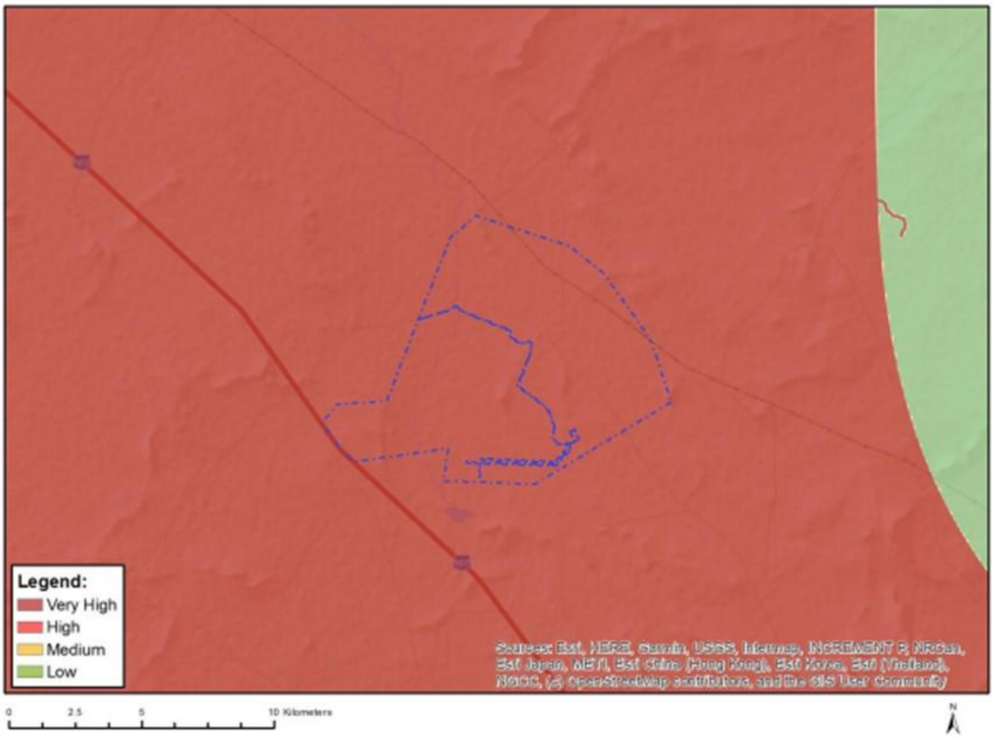


Figure 21: The map obtained from the Screening Tool, indicating the relative aquatic biodiversity theme sensitivity.

2.3.3 An indication of the national and provincial priority status of the aquatic ecosystem.

List and map sensitive environments in proximity of the project locality-sensitive environments include wetlands, nature reserves, protected areas, etc.

Northern Upper Karoo has not been significantly affected by transformation and is still approximately 96% intact. It is classified as Least Threatened (Mucina & Rutherford 2006). The SolarAfrica Energy Project Site falls within the planning domain of the Northern Cape Provincial Biodiversity Plan, developed by the Department of Environment and Nature Conservation, Northern Cape. The potential impact of the development on Critical Biodiversity Areas should be considered in detail as these areas have been identified through systematic conservation planning exercises and represent biodiversity priority areas which should be maintained in a natural to near natural state in order to safeguard biodiversity pattern and ecological processes. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives.

Ecological importance of the site

To establish how important the site is for meeting biodiversity targets, the Land-Use Decision Support Tool (LUDS) was used to compile the LUDS Report (BGIS, 2022). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level. Its primary objective is to serve as a guide for biodiversity planning but should not replace specialist ecological assessments.

Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Before the field study, the team will establish how important the site is for meeting biodiversity targets. To do this, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives (e.g., is it in a CBA or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the Department of Environment and Nature Conservation, Northern Cape's requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

The key results of the BGIS Maps are illustrated in Figure 22 and the LUDS Report are summarized in Table 25. The information is extracted for the area from national datasets available on the Biodiversity Geographic Information System (BGIS).

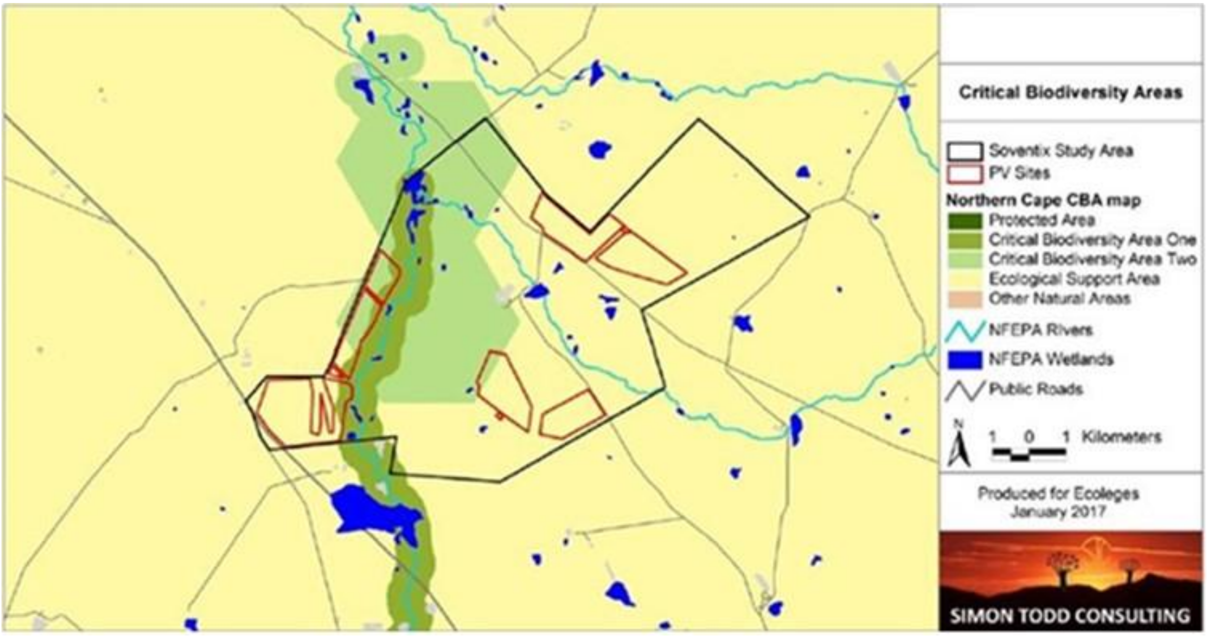


Figure 22: Critical Biodiversity Areas map of the proposed SolarAfrica Energy PV project and the surrounding area.

Critical Biodiversity Areas (CBAs)

Ecological Support Areas (ESAs): Those areas that play a significant role in supporting ecological functioning of Critical Biodiversity Areas (CBAs) and/or delivering ecosystem services, as determined in a systematic biodiversity plan. A Critical Biodiversity Area map is a map of Critical Biodiversity Areas and Ecological Support Areas based on a systematic biodiversity plan. Critical Biodiversity Areas and Ecological Support Areas are areas that require safeguarding to ensure the continued existence of biodiversity, ecological processes and ecosystem services. A Critical Biodiversity Area map, often developed at provincial level, provides the basis for a biodiversity sector plan.

Freshwater Ecosystem Priority Areas (FEPAs)

Freshwater Ecosystem Priority Areas (FEPAs) were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries FEPA maps show various different categories, each with different management implications. The categories include river FEPAs and associated sub-quaternary catchments, wetland FEPAs, wetland clusters, Fish Support Areas and associated sub-quaternary catchments, fish sanctuaries, phase 2 FEPAs and associated sub-quaternary catchments, and Upstream Management Areas. NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or FEPAs.

Table 25: The key results of the LUDS Report as extracted for the SolarAfrica Energy project area from national datasets available from BGIS.

National Data Set	Aspect	Presence
National terrestrial information: Northern Cape		
South African municipal boundaries	**Municipality name:** Local - Emthanjeni (NC073) District – Pixley ka Seme	NC073
Critical Biodiversity Areas		
Critical Biodiversity Area 1	Riverine system	Brak River
Critical Biodiversity Area 2	Drainage area	Brak River
Ecological support Area	Nama Karoo	Ephemeral - Lower foothill
National aquatic information: Lower Orange, Orange tributaries		
Brak River	Largely natural, not threatened	D62D-05613
NFEPA sub-quat. catchment river FEPAs (Wetland Cluster)	D62D	WetCluster FEPA

In the study area, the Brak River has been identified as having conservation importance. Figure 23 represents the Freshwater Ecosystem Protected Areas (FEPA) map for the area. For river FEPAs the whole sub-quaternary catchment is shown in dark green (Figure 23), although FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach.

Wetland clusters (Table 25) are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts.

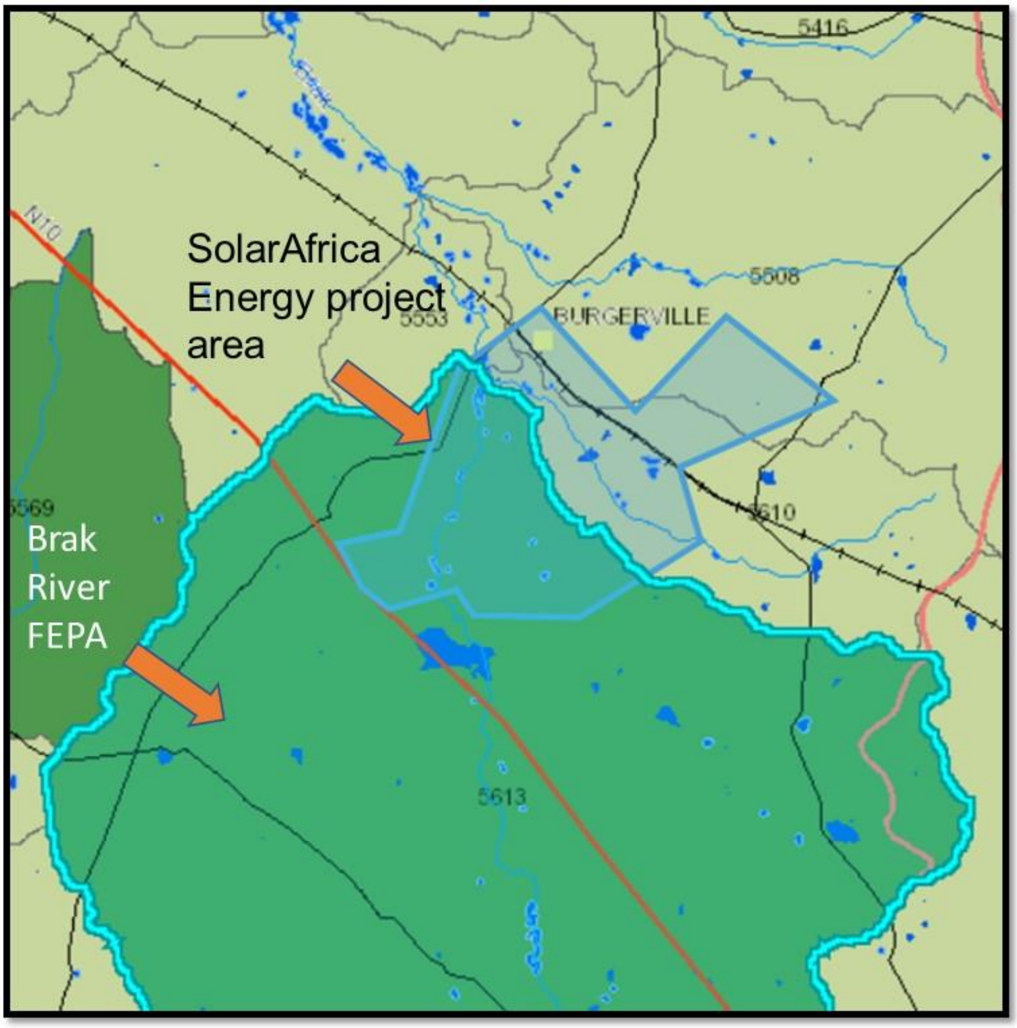


Figure 23: The position of the project site in relation to the Brak River FEPA.

The areas surrounding the drainage lines in the project area (green in Figure 23), is classified as an Ecological Support Area (ESA). The desired management objective for an ESA is to be maintained in a natural, functional state. Limited loss of ecosystems or functionality is acceptable, as long as the present ecological state is not lowered.

- All wetlands are protected under the National Water Act (Act 36 of 1998).
- In terms of the National Water Act, freshwater ecosystems (all wetlands included) should not be allowed to degrade to an unacceptably modified condition (E or F ecological category).
- Conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status.
- Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetland.

2.3.4 A description of the ecological importance and sensitivity of the aquatic ecosystem.

The Ecological Importance and Sensitivity (EIS) of a wetland is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans and Louw, 2007). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity.

2.3.4.1 Ecological importance and sensitivity of the local water resource types.

The distinct water resource types that have been recognised in the project- and surrounding area are listed as (see Section 2.3.1.4):

- Brak River drainage system (Figure 24a).
- Large ephemeral tributaries (Figure 24b).
- Smaller ephemeral tributaries (Figure 24c).
- Alluvial floodplains (Figure 24d).
    - Alluvial fans (Figure 24e).
    - Braided channel: bar and swale topography (Figure 24f).
    - Floodplain flats (Figure 24g).
- Headwater drainage lines (Figure 24h)

Following is a description of the ecological importance and sensitivity of ephemeral and intermittent streams:

When functioning properly, arid and semi-arid region systems provide many services that affect water quality and ecosystem health. These services include (Levick et al 200):

- landscape hydrologic connections;
- surface and subsurface water storage and exchange;
- ground-water recharge and discharge;
- sediment transport, storage, and deposition;
- flood plain development;
- nutrient cycling;
- wildlife habitat including movement and migration corridors;
- support for vegetation communities that help stabilise marginal biotopes and provide ecosystem services;
- water supply and water quality filtering or cleansing;
- and stream energy dissipation associated with high-water flows that reduces erosion and improves water quality

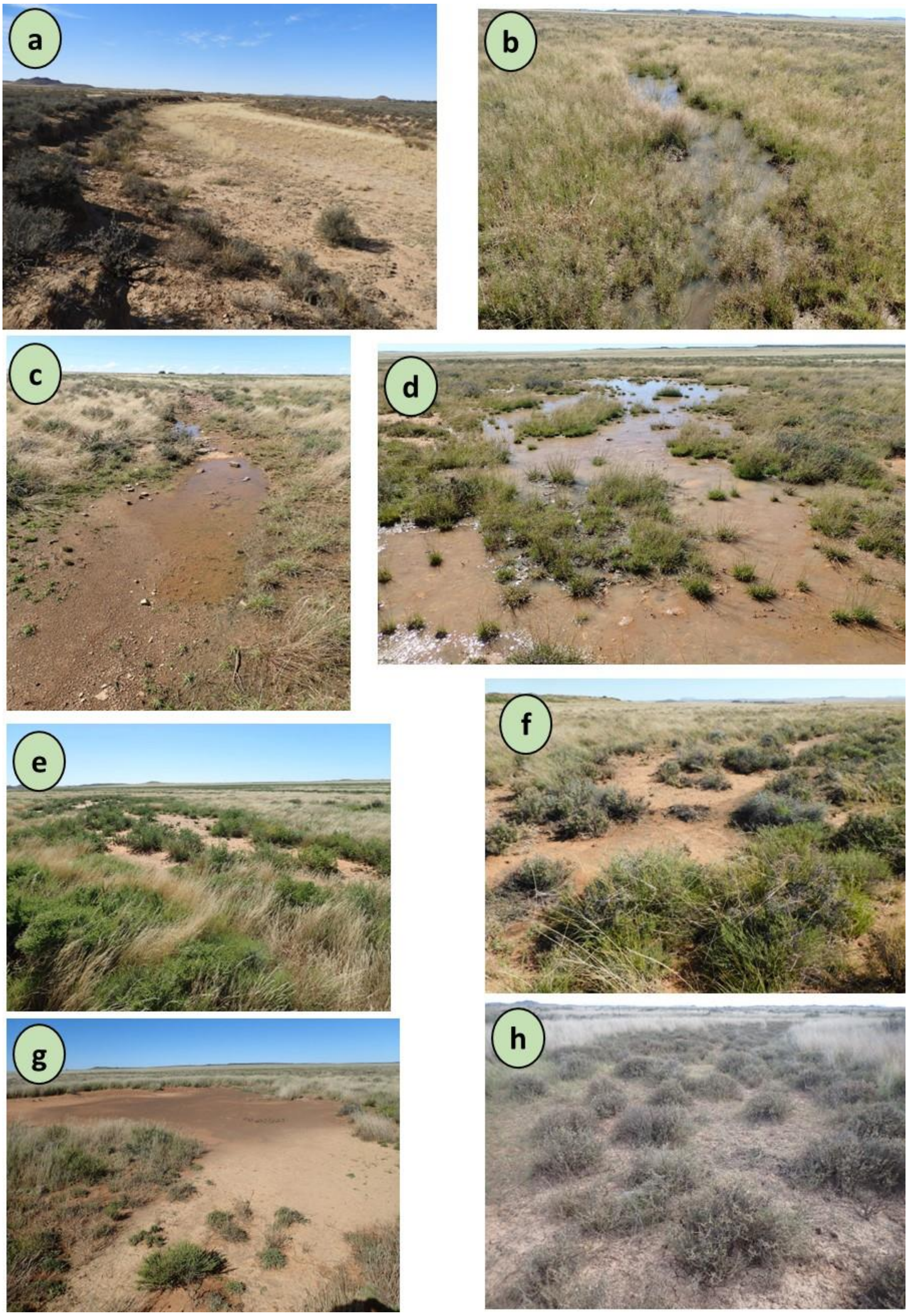


Figure 24: Water course types.

24a. Brak River drainage system	**24e.** Alluvial fans
24b. Large ephemeral tributaries	**24f.** Braided channel
24c. Smaller ephemeral tributaries	**24g.** Floodplain flats
24d. Alluvial floodplains	**24h.** Headwater drainage lines

Aspects shared with all the drainage systems

Due to the higher moisture content along ephemeral drainage systems, this situation produces more abundant vegetation than the surrounding areas.

Frogs have developed the ability to avoid the heat and dryness by burrowing underground in the alluvial soils for extended periods. Bullfrogs and rain frogs will bury into the soft alluvium of the drainage lines and floodplains to aestivate.

The greater plant densities and diversity in the ephemeral drainage systems and associated flood plain, attract antelope species to find the forage and cover they require.

The rich biodiversity of the invertebrate populations associated with ephemeral, intermittent, and headwater tributaries are important contributions to the biological integrity of river networks.

Although ephemeral streams only temporarily support fish, they indirectly support fish populations by helping to deliver required nutrients and other materials to the perennial segments.

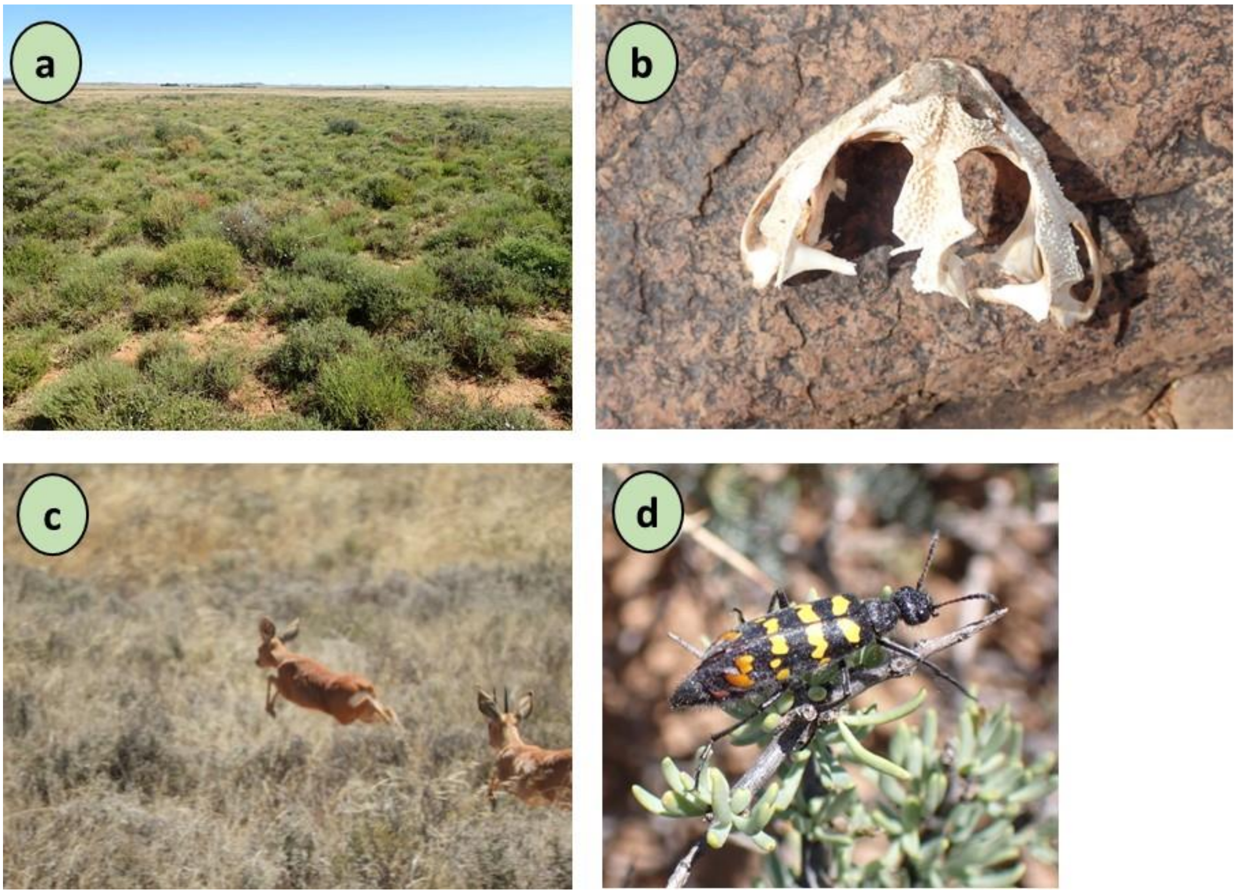


Figure 25: Ephemeral drainage systems

25a: Due to the higher moisture content along ephemeral drainage systems, the difference in structure and function adds to the diversity and patchiness of the project environment.

25b: A skull of an African bullfrog found on the floodplain indicates their presence and ability to bury into the soft alluvium of the drainage lines and floodplains to aestivate.

25c: The greater plant densities and diversity in the ephemeral drainage systems and associated flood plain, attract antelope species to find the forage and cover they require.

25c:The ephemeral drainage systems have a rich invertebrate biodiversity.

Aspects associated with the floodplain systems

Ephemeral and intermittent streams which lack a shallow ground-water system give rise to a distinctive vegetative habitat from the surrounding uplands, often referred to as xeroriparian habitat. These habitats add to the habitat diversity of the project area.

Drainage areas lacking shallow ground-water systems give rise to a riparian zone that differs from the well-defined riparian zones along the larger drainage lines. It however produces a ground cover that differs from surrounding uplands and is referred to as xeroriparian habitat.

Nutrient cycling of elements in the seemingly barren, ephemeral systems refers to:

- the uptake of nutrients by plants and algae from the soil and water,
- and detritus turnover from which nutrients are released back into the ecosystem by microbial activity.

Headwaters of a drainage system are important sources of sediment, water, nutrients, seeds, and organic matter for the downstream systems (Gomi et al., 2002).

Cracks and scour holes in the silts and clays on the floodplains can hold floodwaters long enough for tadpole development.

Certain crustaceans e.g., copepods, ostracods, and cladocerans (including tadpole and fairy shrimps) are able to survive in temporary waters in ephemeral biotopes. These species can complete their life cycle in days during summer. As cysts, these creatures are able to dry with the mud and rehydrate later when water returns, hatching hours after hydration.

Copepods, ostracods, and cladocerans are a food source for birds, especially for migrating species.

Floodplain systems are responsible for a large portion of basin ground-water recharge in arid and semi-arid regions through channel infiltration and transmission losses.

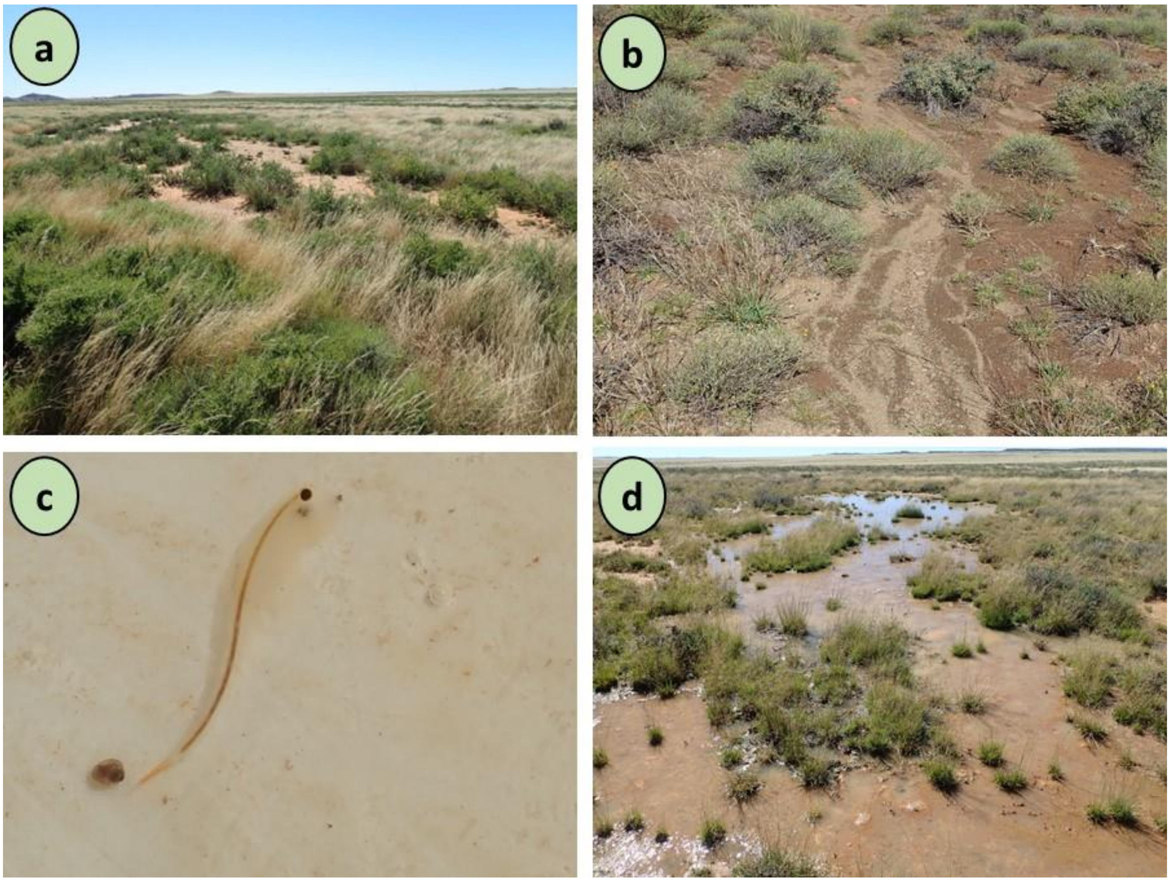


Figure 26: Floodplain systems

26a: Ephemeral and intermittent streams which lack a shallow ground-water system give rise to a distinctive vegetative habitat from the surrounding uplands, referred to as xeroriparian habitat.

26b: Headwaters of a drainage system are important sources of sediment, water, nutrients, seeds, and organic matter for the downstream systems.

26c: Certain crustaceans e.g., copepods, ostracods, and cladocerans are able to survive in temporary waters in ephemeral biotopes.

26c: Floodplain systems are responsible for a large portion of basin ground-water recharge in arid and semi-arid regions through channel infiltration and transmission losses.

Aspects associated with the larger drainage systems

The riparian zone along the larger drainage lines which has surface flow more often than the floodplain systems, is flanked by a denser riparian zone. The diversity of plants is also higher than the species diversity on the floodplains and adjacent terrestrial habitats.

These riparian areas generally support the greatest concentrations of wildlife, providing the primary habitat, predator protection, breeding and nesting sites, shade, movement corridors, migration stopover sites, and food sources.

When high-flows recedes in these systems, pools may persist for limited periods. These isolated waters can support fauna not found in an otherwise ephemeral system.

The larger drainage systems provide important wildlife movement corridors in arid and semi-arid regions because of the near continuous band of riparian or marginal vegetation that small and medium-sized animals can utilize for cover and food.

Migrating birds are highly dependent upon riparian and xeroriparian vegetation in arid and semi-arid lands. Here they utilise the denser vegetation structure in otherwise shrubby environment to perch and rest during migration.

Fluvial processes in the larger drainage systems creates habitat which include:

- Deposition of sediment and debris in the streambed.
- Exposing rocks and cobble or subsurface soil when the system is eroded.
- Steeper embankment created by stream flow erosion can provide shade of nesting sited for tunnelling bird species.

The steeper river embankment provides shelter for numerous species of wildlife in the arid environment, including reptiles, amphibians, birds, mammals and invertebrates. Dry wash embankments are full of small tunnels and crevices critical in the life of certain dry-land species: bee-eaters, swallows and swifts, water monitors, mongoose, etc.

Alluvium deposited in larger drainage lines is usually looser than the soils or colluvium of surrounding uplands, which enhances the potential for exploitation by specialized sand-burrowing species of wildlife, such as lizards, golden moles, meerkat, frogs, many insects, etc.

A drainage lines may also possess moist banks fed by capillary flow from ground water and which is moist enough for crabs, frogs and terrapins to inhabit.

A subsurface zone of flow with a distinct invertebrate fauna may underlie a dry streambed in the larger drainage systems.

Most local frogs spend at least part of their life cycle in water, but frequently only for breeding. Certain species that do not require permanent water (bullfrogs and rain frogs) may emerge from underground only after rainfall events to breed. Higher flows can fill in-channel or off-channel pools where amphibians breed during the summer months.

Since most of the mammals in the area needs to drink frequently. With temporary pools in the larger drainage lines, these mammals burrow underground in close proximity to the surface water, making them dependent upon riparian areas to some degree. During the hottest part of the day the rest underground to avoid the heat and increase water conservation.

Many macro-invertebrates require standing water for part of their life cycle. These include aquatic insects, water mites, crustaceans, etc. These species need to be in the aquatic environment long enough to complete the cycle, some as long as a year. Most of the species acquiring longer period of inundation will not breed in these temporary pools. However, a number of taxa will be able to complete the period required.

Aquatic macro-invertebrates and emerging adults of insect taxa will be a food source for birds, especially the migrating species.

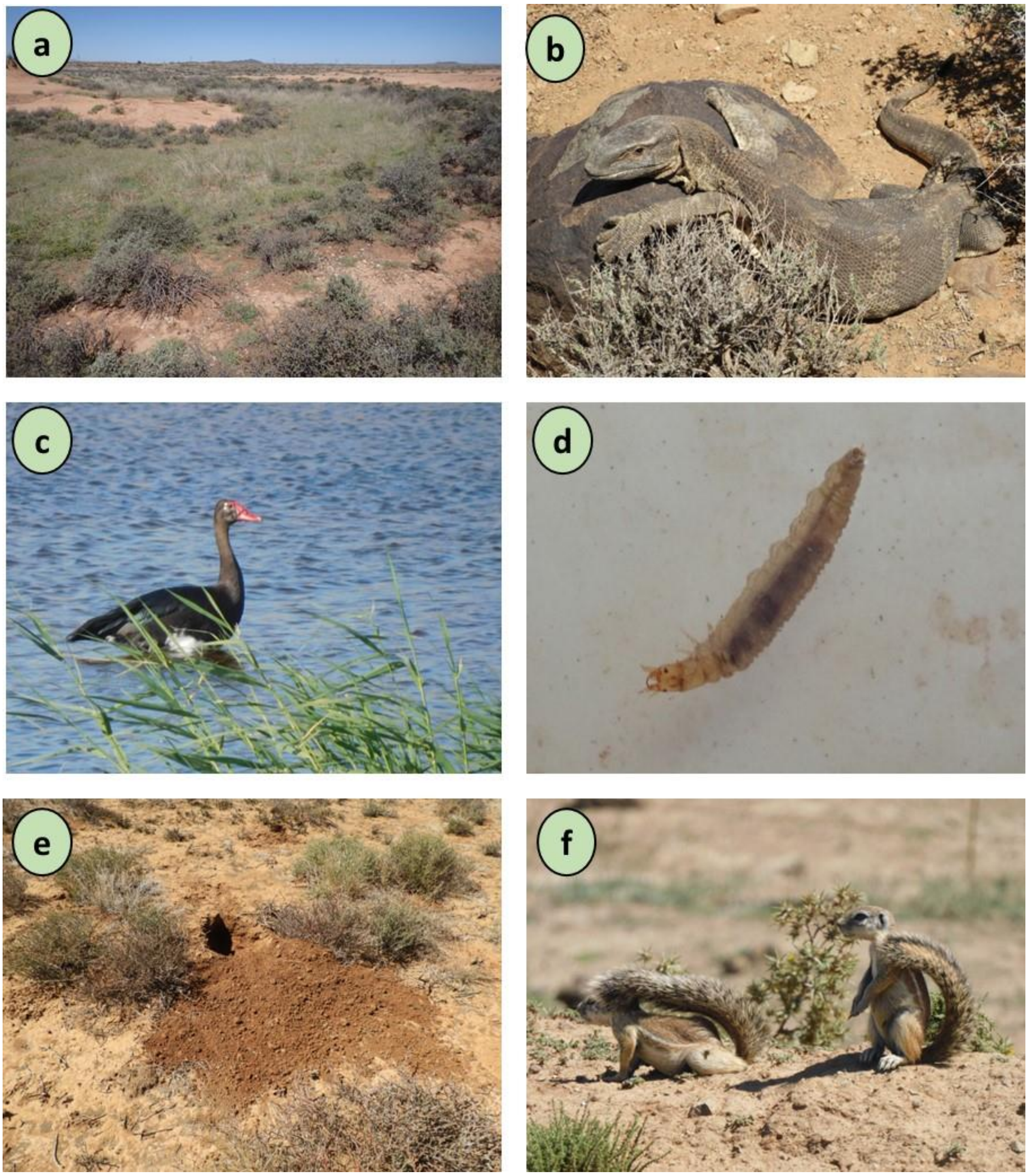


Figure 27: Larger drainage systems

27a: The riparian zone along the larger drainage lines which has surface flow more often than the floodplain systems, is flanked by a denser riparian zone.

27b: These riparian areas generally support the greatest concentrations of wildlife, providing the primary habitat, predator protection, breeding and nesting sites, shade, movement corridors, migration stopover sites, and food sources.

27c: When high-flows recedes in these systems, pools may persist for limited periods. Migrating birds are highly dependent upon these temporary habitats.

27d: Many macro-invertebrates require standing water for part of their life cycle; a number of taxa utilise the temporary aquatic habitat provided by temporary pools in the system.

27e and f: Alluvium deposited in larger drainage lines is usually looser than the soils or colluvium of surrounding uplands, which enhances the potential for exploitation by specialized sand-burrowing species of wildlife, such as.

Aspects associated with the smaller ephemeral tributaries

The riparian zone along the smaller drainage lines is not so pronounced as that of the larger systems and can be absent in some areas along the drainage.

Alluvium deposited in drainage lines is often looser than the soils or colluvium of surrounding uplands, which enhances the potential for exploitation by specialized sand-burrowing species of wildlife, such as lizards, frogs, golden moles, many insects, etc.

2.3.4.2 The ecological importance and sensitivity classes (EISC)

The EISC approach estimates and classifies the ecological importance and sensitivity of the streams in a catchment by considering a number of components surmised to be indicative of these characteristics.

The following ecological aspects should be considered as the basis for the estimation of ecological importance and sensitivity:

- The presence of rare and endangered species, unique species (i.e., endemic or isolated populations) and communities, intolerant species and species diversity should be taken into account for both the instream and riparian components of the system.
- Habitat diversity should also be considered. This can include specific habitat types such as reaches with a high diversity of habitat types, i.e., pools, riffles, runs, rapids, waterfalls, riparian forests, etc.
- With reference to the previous two points, biodiversity in its general form should be taken into account as far as the available information allows.
- The importance of the particular water source or stretch of river in providing connectivity between different sections of the system, i.e., whether it provides a migration route or corridor for species should be considered.
- The presence of conservation or relatively natural areas along the drainage section should also serve as an indication of ecological importance and sensitivity.
- The sensitivity (or fragility) of the system and its resilience (i.e., the ability to recover following disturbance) of the system to environmental changes should also be considered. Consideration of both the biotic and abiotic components is included here.

Table 27: The ecological importance and sensitivity classes (EISC) of the different water resource groups identified in the project area.

DETERMINANTS	Large ephemeral drainage systems	Smaller ephemeral tributaries	Alluvial floodplains	Headwater drainage lines
BIOTA (RIPARIAN & INSTREAM)	(0-4)	(0-4)	(0-4)	(0-4)
Rare & endangered (range: 4=very high - 0 = none)	2,00	2,00	2,00	1,00
Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	2,00	1,00	1,00	1,00
Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	2,00	0,00	0,00	1,00
Species/taxon richness (range: 4=very high - 1=low/marginal)	2,00	1,00	2,00	1,00
RIPARIAN & INSTREAM HABITATS	(0-4)	(0-4)	(0-4)	(0-4)
Diversity of types (4=Very high - 1=marginal/low)	4,00	2,00	2,00	2,00
Refugia (4=Very high - 1=marginal/low)	4,00	2,00	1,00	1,00
Sensitivity to flow changes (4=Very high - 1=marginal/low)	3,00	1,00	0,00	0,00
Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	2,00	0,00	0,00	0,00
Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	4,00	1,00	1,00	0,00
Importance of conservation & natural areas (range, 4=very high - 0=very low)	3,00	2,00	2,00	0,00
MEDIAN OF DETERMINANTS	**2,50**	**1,00**	**1,00**	**1,00**
ECOLOGICAL IMPORTANCE AND SENSITIVITY CLASS (EISC)	**HIGH**	**LOW**	**LOW**	**LOW**

Table 28: Environmental Importance and Sensitivity categories for biotic and habitat determinants (after DWAF, 1999)

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level.	>3 and <=4	**A**
High Wetlands that are considered to be ecologically important and sensitive.	>2 and <=3	**B**
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale.	>1 and <=2	**C**
Low/marginal Wetlands that are not ecologically important and sensitive at any scale.	>0 and <=1	**D**

After establishing EISC of the different water resource groups, the outcome indicates that there is only one group that has an EISC as a “High”, and that is the Large ephemeral drainage systems. All the other systems come out as “Low”, mainly due to their lack of surface water or the short-lived presence after a rainfall event. Due to their integral EIS class, these groups will be grouped as follow (Botha, 2021):

- “High” ecological and sensitivity classes: These areas, including their buffers, will be considered as no-go areas for all infrastructure apart from linear systems.

- “Moderate**”** and “Low” ecological and sensitivity classes: These areas, are not considered as no-go areas, however, development within these areas shall be subjected to strict mitigation measures. This will include the management of surface water runoff, erosion monitoring, as well as constraints regarding the clearing of vegetation within these areas.

Due to the gentle slope of the terrain where headwater drainage systems originate, downpours will dissipate downhill without forming any discernible wetland habitats. Thus, the very short-lived nature of the headwater drainage systems, the EISC of this biotope is classified as “Low”. These areas are not considered as no-go areas, however, development within these areas, such as placement of power line pylons and other linear infrastructure, shall be subjected to strict mitigation measures.

The ecological importance and sensitivity of the large ephemeral drainage systems are being classified as “High” (Table 27). Water resource types with a “High” EISC will be considered as no-go areas for all infrastructure apart access roads, pipelines and cables. The no-go areas will include the buffers of the drainage areas in the project footprint.

The finer detail of every different crossing will be re-assed due to the underlying differences and the final Ecological Management Class per water resource groups are listed in Section 2.5.2.1c.

2.3.4.3 Corridors for Connectivity

The guidelines for land-use practices or activities that impact on water quantity in freshwater CBAs includes the following: Generic buffers should be established around streams within these catchments. These buffers can be refined based on a site visit and applying the DWS's wetland delineation tool.

Certain guidelines for the current project will be incorporating the EISC of the water resource group, as well as the type of impact that will be assessed. Buffers planned for the "High" ecological and sensitivity class systems (Large ephemeral drainage systems) will need a DWS procedure for delineating and buffering the drainage lines. The buffer will create a no-go zone for all development other than linear systems (access roads, pipelines and cables).

The smaller drainage lines and floodplains with a "Low" EISC, will also be delineated, and the buffer will be established for the specific systems. These will differ from the "High" EISC systems (lack of riparian zones and narrower buffers) and although these areas will not be declared as no-go zones, any activities in the zones shall be subjected to strict mitigation measures.

Due to their positioning adjacent to water bodies, buffer zones associated with streams and rivers will typically incorporate riparian habitat. Riparian habitat, as defined by the NWA, includes the physical structure and associated vegetation of the areas associated with a watercourse (Macfarlane et al, 2015). However, the riparian zone is not the only habitat type that is present in the buffer as the zone may also incorporate stream banks and terrestrial habitat, depending on the width of the aquatic impact buffer zone applied. Therefore, the riparian zone must be delineated before the buffer zone is established.

2.3.4.3 a Riparian delineation

Riparian delineation and habitat evaluation was undertaken according to the DWAF Guidelines (2005) and DWAF updated manual (2008) (see Methods Section 2.8.4.3.2 Aquatic biota surveys). Figures 46 to 50 illustrate the project drainage lines with riparian zones delineated.

2.3.4.3.b Buffer zones

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. Buffer zones will serve as a mitigating measure for impacts created by the construction and operational phases of the SolarAfrica Energy PV facility project area, and the implemetation will be recapitulated in the mitigation section (2.5.2.1c).

Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity. These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Determining the required buffer width is largely an exercise of assessing the situation and linking it to an acceptable level of risk. Determining appropriate management measures for aquatic impact buffer zones is largely dependent on the threats associated with the proposed activity adjacent to the water resource. These threats include:

- Increases in sedimentation and turbidity;
- Increased nutrient inputs;
- Increased inputs of toxic organic and heavy metal contaminants; and
- Pathogen inputs.

Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality. The protected riparian zone will serve as a mitigating measure for impacts created by the construction and operational phases of the proposed project.

In determining the buffer zone requirements for river ecosystems, the process involves a number of steps in order to establish the buffer around the proposed riverine site. The following aspects were addressed specifically for the SolarAfrica Energy PV facility project (according to the steps suggested in Macfarlane, 2017):

Step 1: Define objectives and scope to determine the most appropriate level of the assessment.

The motivations for assessing potential impacts and establishing buffer zone requirements may be diverse. It is therefore important that the specific objective for the assessment is clearly understood before starting.

Determine the Most Appropriate Level of Assessment

Site-based assessment: This assessment is designed for detailed planning and includes a more rigorous assessment of risks as well as incorporating site-specific factors that can affect buffer requirements.

Step 2: Map and categorise water resources in the study area

After establishing the scope and appropriate level of the assessment (site-based delineation), the assessor must generate a map delineating the boundaries of the water resources potentially affected by proposed developments within the study area. The guidelines on delineating ephemeral and seasonal systems as suggested in Macfarlane (2017), were employed in the delineation exercise of the crossing drainage system.

Identify Water Resource Type: The Hydro-geomorphological (HGM) classification systems have been used to categorise the river system into the appropriate type (SANBI, 2009; Ollis et al., 2013), which is an ephemeral river type with headwaters and associated riparian zone.

Step 3: Refer to the DWS management objectives for mapped waterresources or develop surrogate objectives.

Understanding the rationale and objective for resource protection is a key step in informing management and protection requirements for water resources. Where impacts are likely to be low, it may be appropriate to simply set a management objective to “maintain” the status quo. This ensures that existing impacts are managed to a certain level without forcing applicants to undertake extensive surveys to establish whether improvement in water resource quality is required.

Determine the PES and Anticipated Trajectory of Water Resource Change

In Section 2.3.1.9 the PES for the SolarAfrica Energy PV facility drainage line in the study area was established as a "C" (Moderately modified) (Table 22) and the Ecological Importance and Sensitivity is rated as "High".

Step 4: Assess the risks from proposed developments and define mitigation measures necessary to protect mapped water resources in the study area

Do a Risk Assessment for Potential Impacts of Planned Activities on Water Resources:

Apart of the Risk Assessment that was done with the Risk Matrix, the desktop buffer zone tool has also a built-in risk assessment per site.

Site-based assessment: Desktop threat ratings are used as a starting point for buffer zone determination. While desktop threat ratings provide an indication of the level of threat posed by different land uses/activities, there is likely to be some level of variability between activities occurring within a sub-sector. It is therefore important that these threat ratings be reviewed based on specialist input and that a justification for any changes is documented in the Buffer Zone Tools.

Assess the Sensitivity of Water Resources to Threats Posed by Lateral Land Use Impacts.

The sensitivity of water resources to lateral impacts is another factor affecting the level of risk posed by a development. A more risk-averse approach is therefore required when proposed developments take place adjacent to water resources that are sensitive to lateral impacts, as opposed to the same development taking place adjacent to a water resource which is inherently less sensitive to the impacts under consideration.

The aspects utilised to establish the SolarAfrica Energy PV facility buffer zone, are listed in Table 29 and the buffers obtained from these features are displayed at the end of the table as: 15 m during the construction phase, and 15 m for the operational phase.

Table 29: Site-based tool: Determination of buffer zone requirements for drainage systems.

Site-based tool: Determination of buffer zone requirements for river systems.	
Name of Assessor	Dr AR Deacon
Project details	Sun Central Cluster 1: Upgrading & Development of an Access Road
Date of Assessment	2023/01/23
Level of Assessment	Site-based
Approach used to delineate the riparian zone & active channel?	Site-based delineation
River type	Lower foothills
Present Ecological State	C (Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged).
Ecological importance & sensitivity (Current status)	High: Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They

	typically play an important role in providing ecological services at the local scale.
Management Objective	Maintain
Sector	Transportation infrastructure: Land used to provide for developments and buildings associated with public and private transportation in all its forms.
Sub-sector	Unpaved roads: Land that has been provided for the full range of road infrastructures mainly within rural areas. Including dirt tracks and gravel roads that have not been formerly paved / asphalted.
MAP Class	0 - 400mm
Rainfall intensity	Zone 1
Stream order	2^{nd} order
Channel width	>20m
Perenniality	Seasonal systems (3-9 months)
Average slope of rivers catchment	3-5%
Inherent runoff potential of the soil in the river's catchment	Moderate (B/C)
Longitudinal river zonation	Lower foothill river
Inherent erosion potential (K factor) of catchment soils	0.25 - 0.50
Retention time	Generally slow moving
Inherent level of nutrients in the landscape	Moderate base status
Inherent buffering capacity	"Hard" water rich in bicarbonate and carbonate ions or naturally acid waters high in organic acids
Natural salinity levels	Slightly Saline (200-400 mS/m)
River depth to width ratio	> 0.25
Mean annual temperature	Zone 2 (15.5 - 16.9 Degrees C)
Level of domestic, livestock and contact recreational use	Low
Buffer attributes (Current status)	
Slope of the buffer	Gentle (2.1 - 10%)
Vegetation characteristics (Construction phase)	Poor: Vegetation either short (<5cm) or robust but widely spaced plants with poor interception (e.g., trees or shrubs with poorly vegetated understory).
Vegetation characteristics (Rehabilitation phase)	Poor: Vegetation either short (<5cm) or robust but widely spaced plants with poor interception (e.g., trees or shrubs with poorly vegetated understory).
Soil permeability	Moderately low: Deep moderately fine textured soils (e.g., loam & sandy clay loam) OR shallow (<30cm) moderately drained soils.

Micro-topography of the buffer zone	Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception.
Aquatic impact buffer requirement	
Construction Phase	**15m**
Operational Phase	**15m**

According to the initial buffer requirement, it becomes apparent that, to protect the SolarAfrica Energy Sun Central PV project larger drainage systems in its current condition from any degradation, a buffer of 15 m wide on both sides of the drainage line delineation is required during the construction and operational phases. This buffer width is obtained whenever the following mitigation measures are applied to the model:

- ensure least possible flow impediment due to the low water drift structure
- the management of surface water runoff,
- erosion monitoring, as well as constraints regarding the clearing of vegetation within these areas.

Step 5: Assess risks posed by proposed development on biodiversity and identify management zones for biodiversity protection.

Step 6: Delineate and demarcate final buffer zone requirements.

Once protection requirements for water resources and associated biodiversity have been established, the buffer zone requirements have to be finalised and delineated on a layout plan and in-field.

Figures 46 to 50 outlines the proposed buffer of 15m (yellow line) in order to protect the drainage line environment.

Step 7: Document management measures necessary to maintain the effectiveness of the final buffer zone areas.

Once a final buffer zone area has been determined, appropriate management measures need to be documented to ensure that the water quality enhancement and other buffer zone functions, including biodiversity protection, are maintained or enhanced. These measures should ideally be integrated in the environmental management programme (EMPr) for the proposed development, as it includes a requirement to assign clear responsibilities for buffer zone management at both the construction and operation phases. Although management measures will be specific to each site, some guidance is provided to ensure that management measures cater adequately for key buffer zone functions.

2.3.4.4 Present Ecological State of the study area

The land use is currently agriculture, and will retain in part its agricultural use for livestock grazing (subject to feasibility), but will convert significant sections for commercial Solar PV for a fixed-term.

Erosion and sedimentation are important ecological processes in the Karoo. Loss and fragmentation of habitat disrupt these processes. Erosion is a particularly high risk on steep slopes, and in drainage lines that lack channel features and are naturally adapted to lower energy runoff with dispersed surface flows (such as unchannelled valley-bottom wetlands), and naturally less turbid freshwater systems.

Once permanent roads are built and regularly maintained and graded, there will be erosion that results from the formation of rills. This will change hydrological flows and have a detrimental effect on vegetation surrounding the roads.

2.3.4.5 Resource quality objectives.

No RQO was set by DWS for this part of the ephemeral system.

2.3.4a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site.

This aspect will be discussed in detail in the introductory sections of the Risk Assessment (2.5.2.1c).

2.4 Identify alternative development footprints.

A number of alternative sites were evaluated and the preferred route site is partially a combination of alternative routes.

There have been some very minor tweaks to the route of the access road that was described in the Terms of Reference:

- The Terms of Reference describes the “Consolidated Access Road to the MTS (Rev01)”
- The preferred route includes an almost hairpin bend that needs to be smoothed out, hence a potential realignment “De Aar Access Road_4(New)”.
- There will be a short entrance to the Switching Station (Dx) on the SolarAfrica facility “DX Access Road”.
- The southern portion comprises a new road development (as there are no existing farm tracks) and will therefore, irrespective of the revision always go through virgin veld to reach the MTS.
- Similarly, the dolerite ridge cannot be avoided and will therefore, irrespective of the revision, always be crossed by an Access Road from the N10 to the MTS.
- This ‘established canal’ is the reason for the first revision. The earth berm structure, whilst man-made, is ecologically highly sensitive as activity (burrows to diggings) and evidence of increased animal activity. By shifting this southern portion off the berm structure and further to the north, a buffer between the road and the significant ephemeral drainage line located along this section of the berm, will be created.

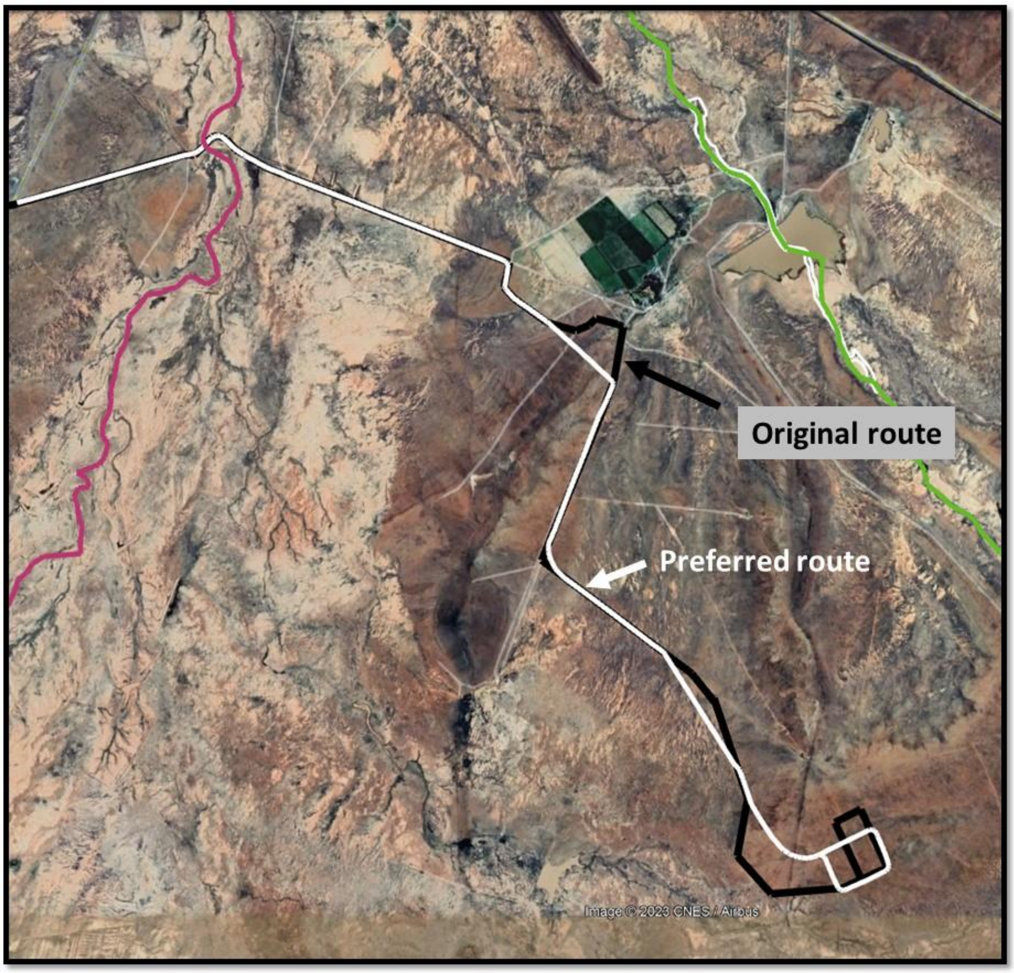


Figure 28: A Google Earth photo of the preferred route to be upgraded on the project area.

2.5 Assessment of the potential impacts of the proposed development.

NEMA defines "evaluation" as "the process of ascertaining the relative importance or significance of information, in the light of people's values, preferences and judgements, to make a decision." NEMA and the EIA Regulations call for a hierarchical approach to impact management.

According to the Specialist TOR (Section 1.2), in addition to the Impact Assessment required for the Aquatic Biodiversity Specialist Assessment, a GN509 Risk Assessment should also be completed for the study.

2.5.1 Infrastructural components to be evaluated for the impact assessment

The additional activities include the development and widening of roads; extending the transmission line from the Main Transmission Station (MTS) to Line 1 of the 400 kV Eskom powerline; and consolidation of water uses currently authorised under General Authorisation, including additional boreholes, into an Integrated Water Use License.

Infrastructural components

Assessing the impacts of activities and infrastructure relating to the following:

Part 2 Amendment of the Environmental Authorisation for Sun Central, including *inter alia* an additional LILO into the existing 400kV Eskom transmission line, concrete batching plant (on Cluster 1 development footprint) and additional abstraction from boreholes BH13 & 14 (outside the Cluster 1 development footprint).

A pipeline will be installed from Borehole 13 and 14 to an overhead water storage tank on the Cluster 1 footprint (to provide water for the construction of the access road, e.g., stabilisation, etc.). The pipeline crosses the unnamed FEPA drainage line D62D – 05610 SQ (a tributary of the Brak River). Boreholes 13 and 14 are alongside one another and probably feed off the same aquifer. The plan is to authorise both boreholes in case something happens to one of them e.g., borehole collapses, pump fails etc.

Floodlights and a telecommunications tower will be added to the Dx (Switching Station) footprint and the MTS footprint.

Linear structures

During the project development, the following linear structures will be constructed in close proximity of the drainage lines and will be crossing these watercourses in certain areas.

- Basic Assessment to get an Environmental Authorisation for the access road from the N10 to the Sun Central Cluster 1.
- The upgrades to the new access road across the Brak River floodplain will now require more extensive work than originally expected, due to the delivery requirements for the MTS transformers (large, long heavy trucks).
- Additionally, there will be new sections of road constructed, not just the widening of existing roads, to the MTS.
- The client has decided, in spite of the decision by Eskom to allow LILO on the closest line, they still want the assessment and application to include the furthest line, whenever additional renewable energy projects utilise the same MTS and can then LILO of the furthest line.

The access road from the N10 to the Sun Central Cluster 1 is in a fairly good condition, but would require subgrade and subbase reconstruction in a number of areas, particularly in areas where stormwater runoff needs to be improved. These are all low-lying areas where water ponding occurs and has softened the layer works to the point where deep rutting occurs due to wheel tracks from traffic on the roads (SolarAfrica, 2022). The balance of the road may only require top layer reconstruction.

Typical structural road design for an ESKOM and SANRAL acceptable delivery and access road is suggested as follows (SolarAfrica, 2022):

- 6m wide road with 0.5m shoulder including drainage (V-drain),
- 2 layers of imported G5 subbase fill (2x150mm).
- A California Bearing Pressure (CBA) of 200MPa (kN/m^2) should be achieved.
- Parameters of the required road geometry must include for longitudinal slope, lateral slope, turning circle radii, concave and convex longitudinal radii and road clearance for the trailer delivering the MTS 500mVA transformer.

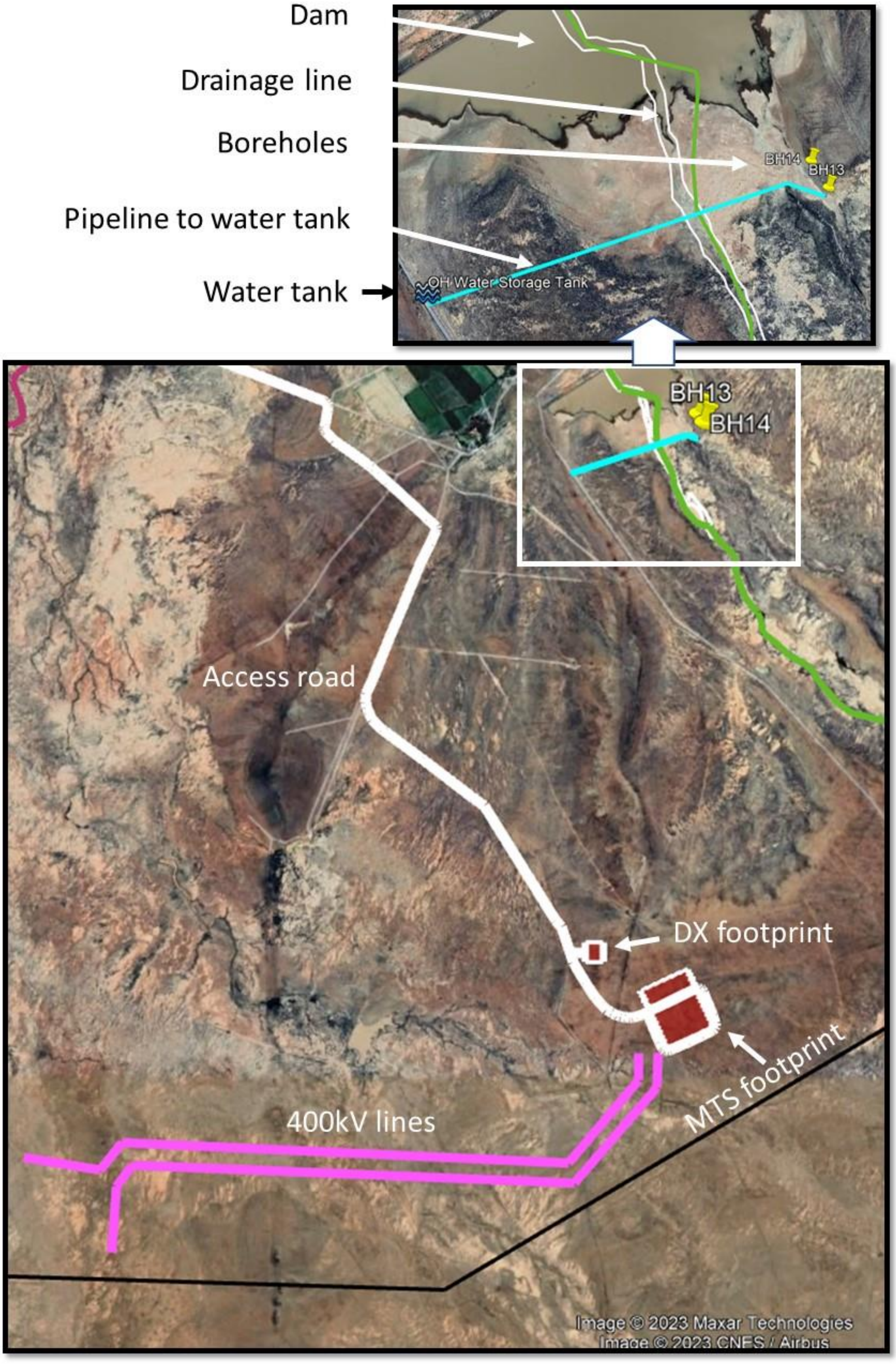


Figure 29: Infrastructural components to be evaluated for the impact assessment.

2.5.2 Assessment of impacts – Risk Matrix (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

The risks associated with the water use/s and related activities.

The Risk Assessment was done in accordance with the Risk Matrix (Based on DWS 2015 publication: Section 21 (c) and (I) water use Risk Assessment Protocol and as contained in Appendix A in GN509 of 26 August 2016) and was carried out considering the risk rating of the project. Following is an abstract from the completed Risk Matrix to indicate the significance of the project activities in the Sun Central Solar PV facility project area:

NEMA and the EIA Regulations call for a hierarchical approach to impact management. The Impact Mitigation Hierarchy:

- Firstly, alternatives must be investigated to avoid negative impacts altogether.
- Secondly, after it has been found that the negative impacts cannot be avoided, alternatives must be investigated to reduce (mitigate and manage) unavoidable negative impacts to acceptable limits.
- Thirdly, alternatives must be investigated to remediate (rehabilitate and restore).
- Fourthly, unavoidable impact that remain after mitigation and remediation must be compensated for through investigating options to offset the negative impacts.
- While throughout, alternatives must be investigated to optimise positive impact.

Undertaking a Risk Assessment of certain activities associated with the development (to determine if S21(c) and (i) water uses can be authorised under a General Authorisation), specifically:

2.5.2.1a Upgrade the access road

- Upgrade the access road (new sections of road constructed and widening of roads) from the N10 Burgerville District Road, across the Brak River floodplain and to the MTS and Switching Station development.

2.5.2.1b Extending the 2.5 km main transmission line

- Extending the 2.5 km main transmission line from the Main Transmission Station (MTS) to Line 1 of the 400 kV Eskom powerline.

2.5.2.1c Pipelines

- The underground pipeline between the boreholes (BH13/BH14) and the water tank, and between BH5 and the water storage at the MTS.

2.5.2.1d Placements and constructions of stations and plants

- Placing and expansion of the MTS.
- Placing a 132 kV switching yard and constructing the Switching Station (Dx).
- Concrete batching

2.5.2.1e Boreholes

- Boreholes BH13/BH14 along the D62D-05610 drainage line, and BH5 near the solar pump on the ridge.

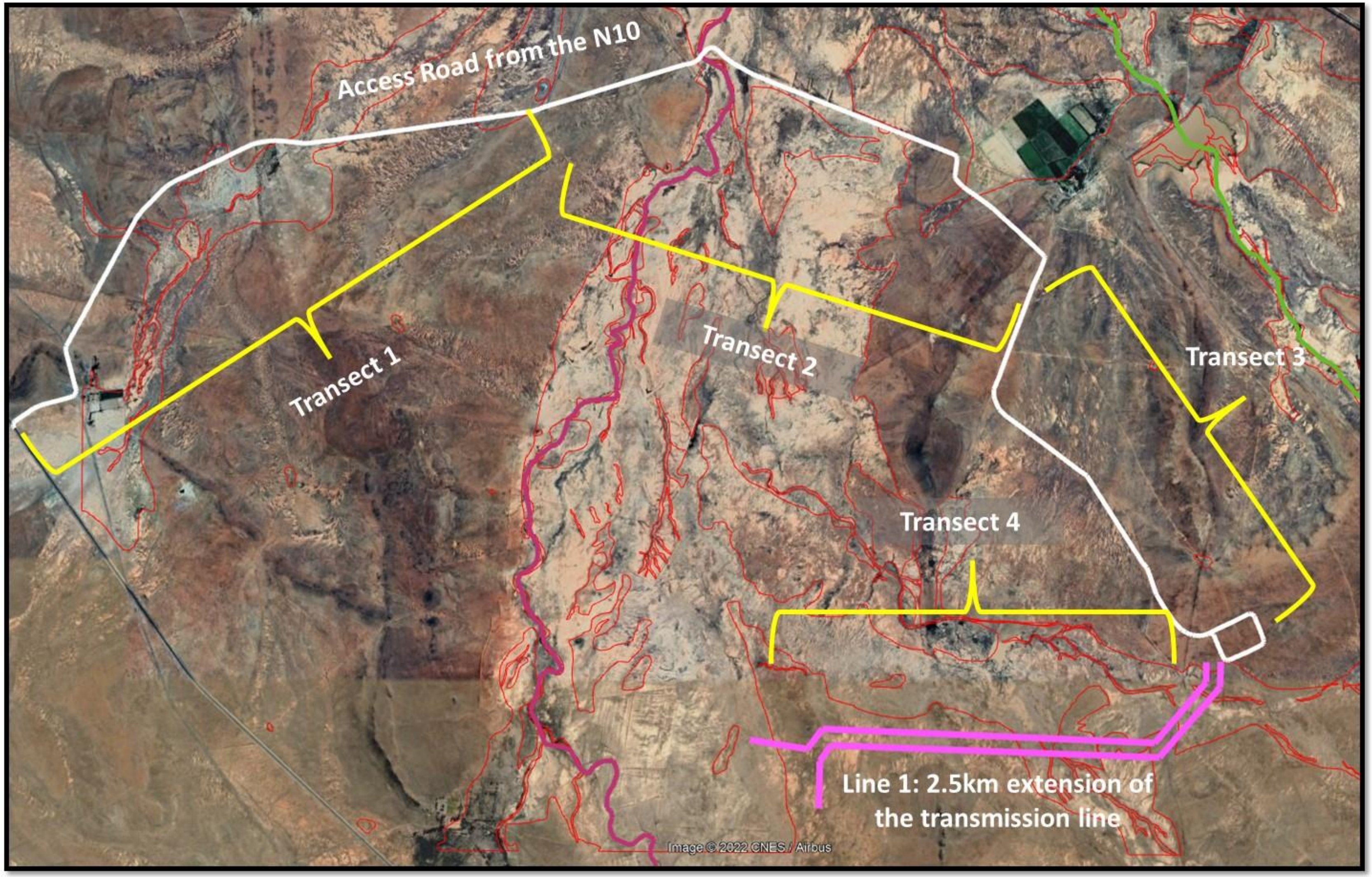


Figure 30: For this section of the report, the main access road and transmission line will be divided into four transects to simplify the descriptions of the different aspects. Red lines = watercourse delineation generated by the soil and drainage assessment (Iris, 2017).

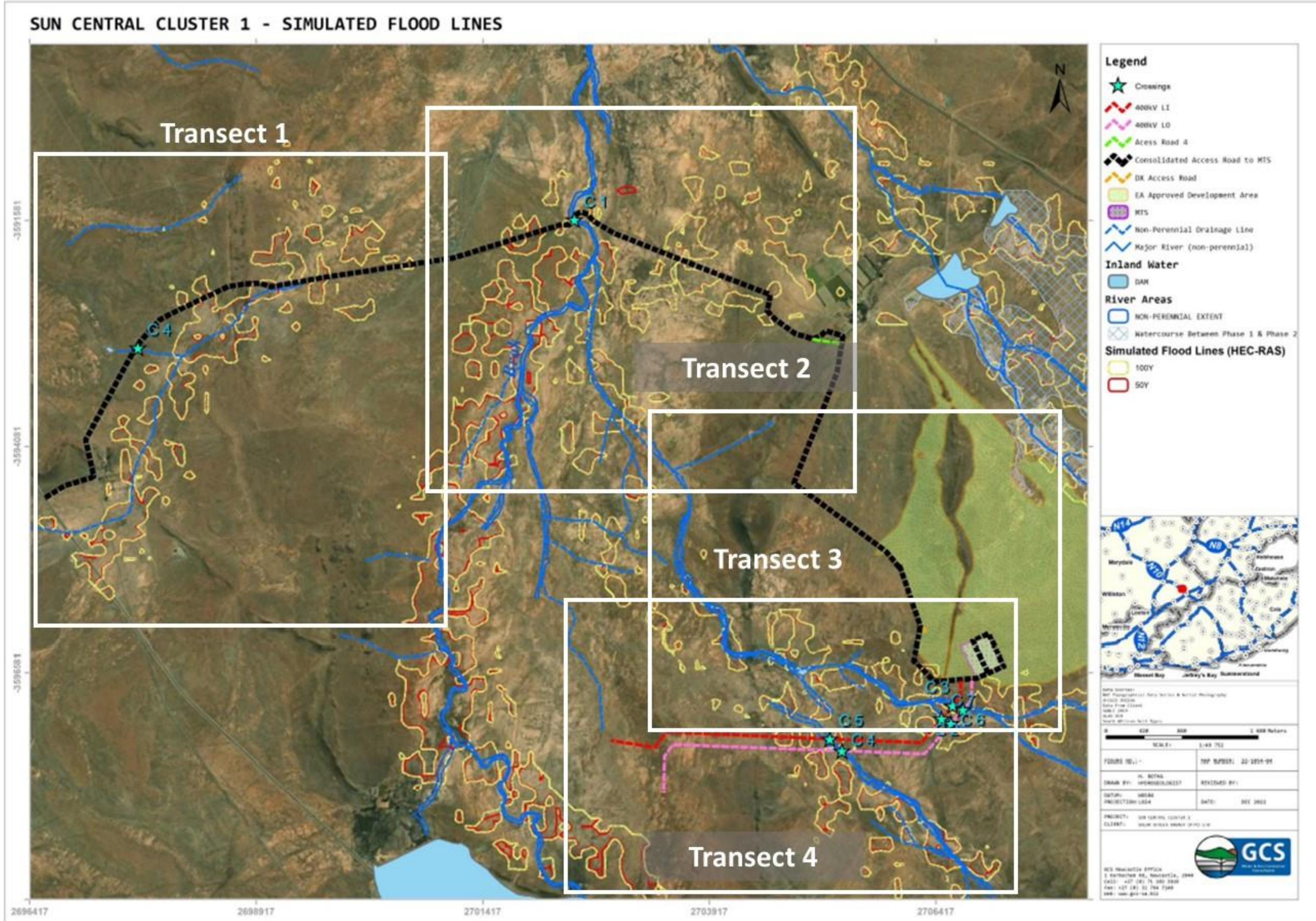


Figure 31: The simulated flood lines (50 and 100-year) generated by the GCS (Botha, 2022) and the watercourse delineation generated by the soil and drainage assessment (Iris, 2017) acted as guidelines to delineate drainage lines and floodplain boundaries.

2.5.2.1 The description (originally part of 2.3.4a) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site.

Due to the diversity of water resource types covering the project area, and the multiple development aspect planned in and adjacent these systems, the setting of each development will be evaluated in relation to the specific drainage type. Figures 30 and 31 supply background to the process of impact evaluation relating to the development (drainage crossings) and the affected water resource types.

2.5.2.1a Upgrade the access road

Aspect 1: Upgrade the access road (new sections of road constructed and widening of roads) from the N10 Burgerville District Road, across the Brak River floodplain and to the MTS and Dx development.

For this section of the report, the main access road and transmission line will be divided into four transects to simplify the descriptions of the different aspects (Figure 30). Transect 1 consists of the road turning off the N10 road to the gate of the De Bad farm on the northern boundary of the farm.

Road Transect 1

Section 1.1: 30 52 32.0 S; 24 13 26.9 (Alt. 1322 m)

This is the turn-off from the N10, going eastwards on the northern perimeter of a wide floodplain area. The water resource type nearest to the road consists of headwater drainage on the edge of the extensive floodplain. It is evident that the road does not interfere with any of the drainage line functions.

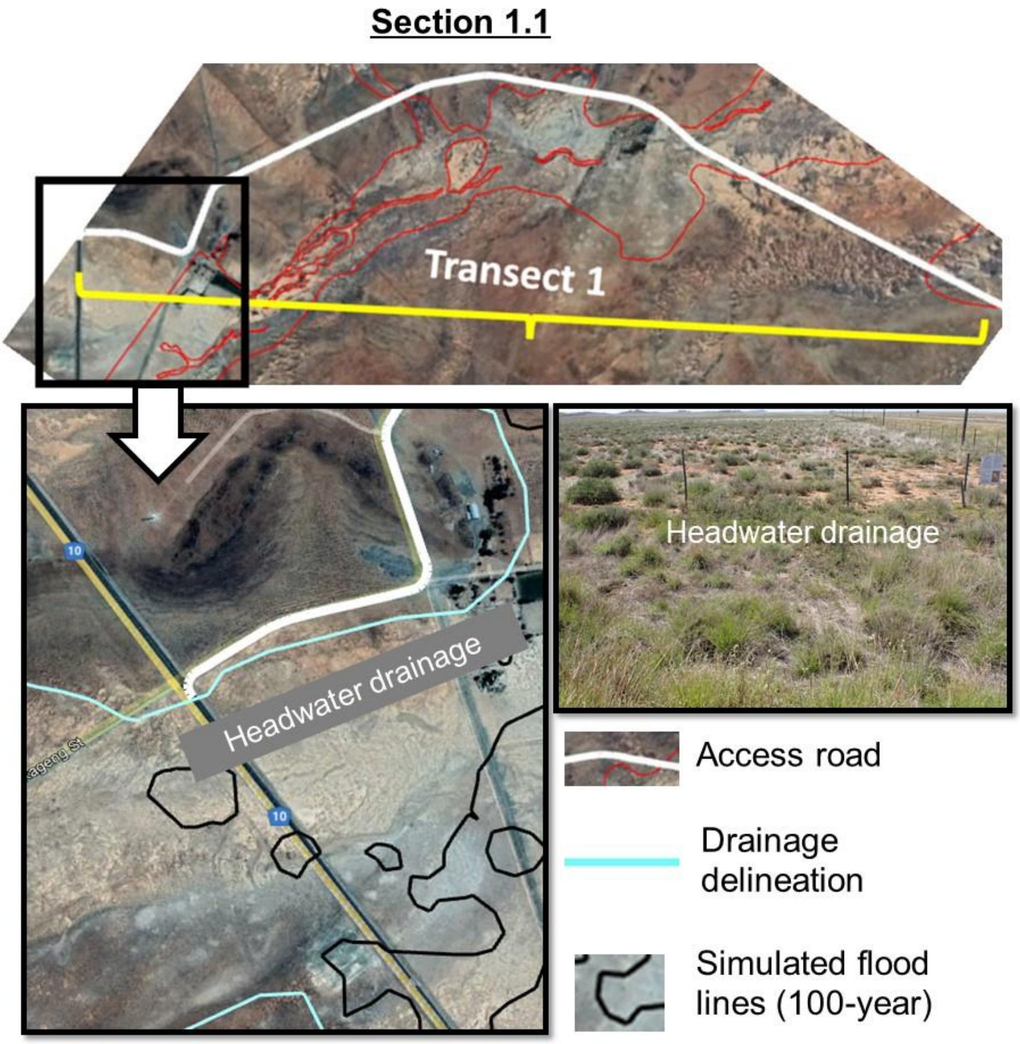


Figure 32: Road Section 1.1 of Transect 1, indicating the section of the road adjacent to the delineated headwater drainage on the edge of the floodplain.

Section 1.2: 30 51 59.1 S; 24 13 49.7 (Alt. 1311 m)

A smaller ephemeral drainage line reaches the road, flows along the left shoulder of the road up to the coordinates above, where it crosses the road (Figure 33).

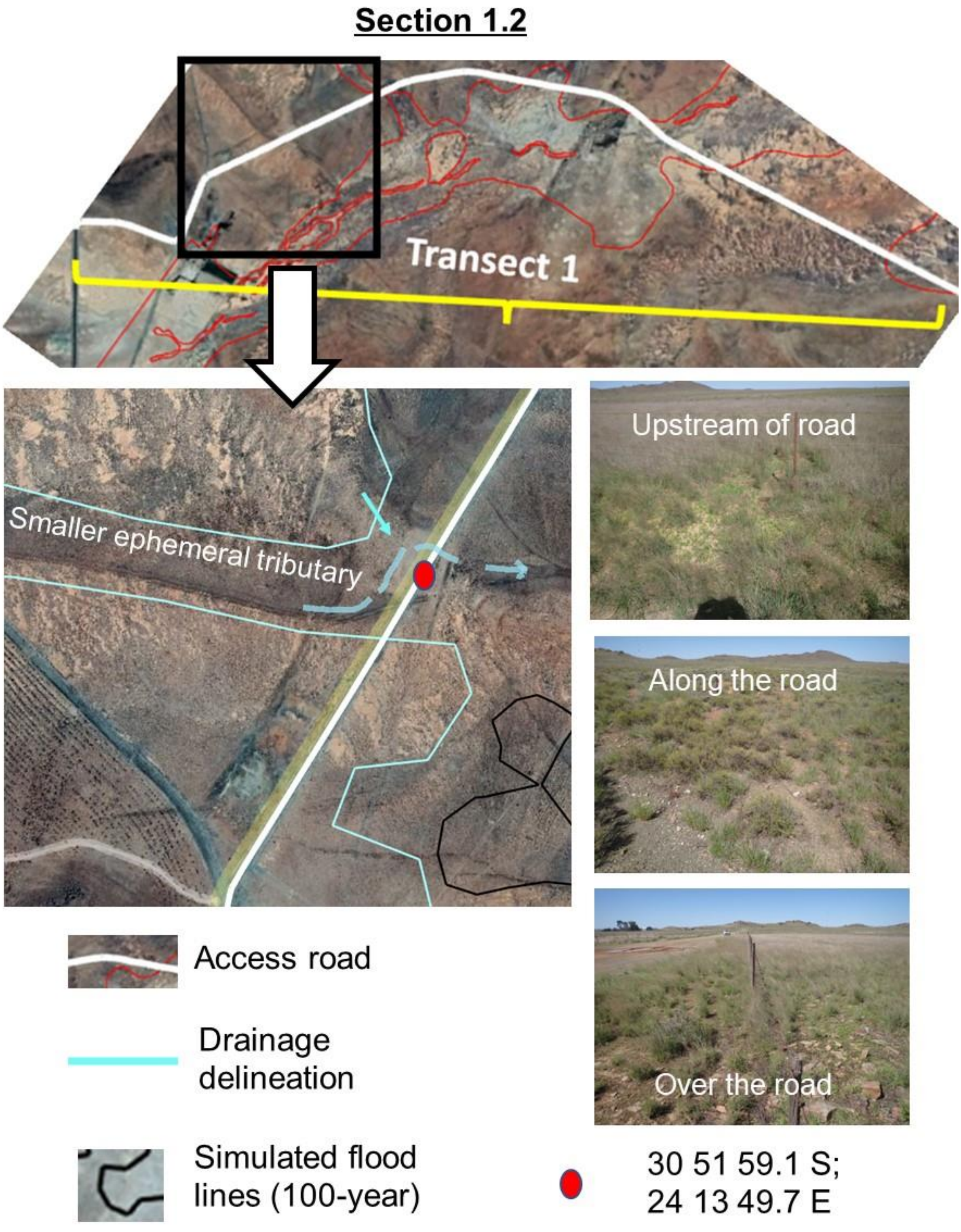


Figure 33: Road Section 1.2 of Transect 1, indicating the section of the road where a smaller ephemeral drainage line crosses the road.

Section 1.3: 30 51 42.6 S; 24 14 00.5 E (Alt. 1315 m)

Where the large ephemeral tributary reaches the road, it is dammed by the presence of the road and start draining down the left shoulder of the road. The area along the road is scoured due to periodic flows, and where the flows cross the road to the downstream catchment, flow damage to the road is evident.

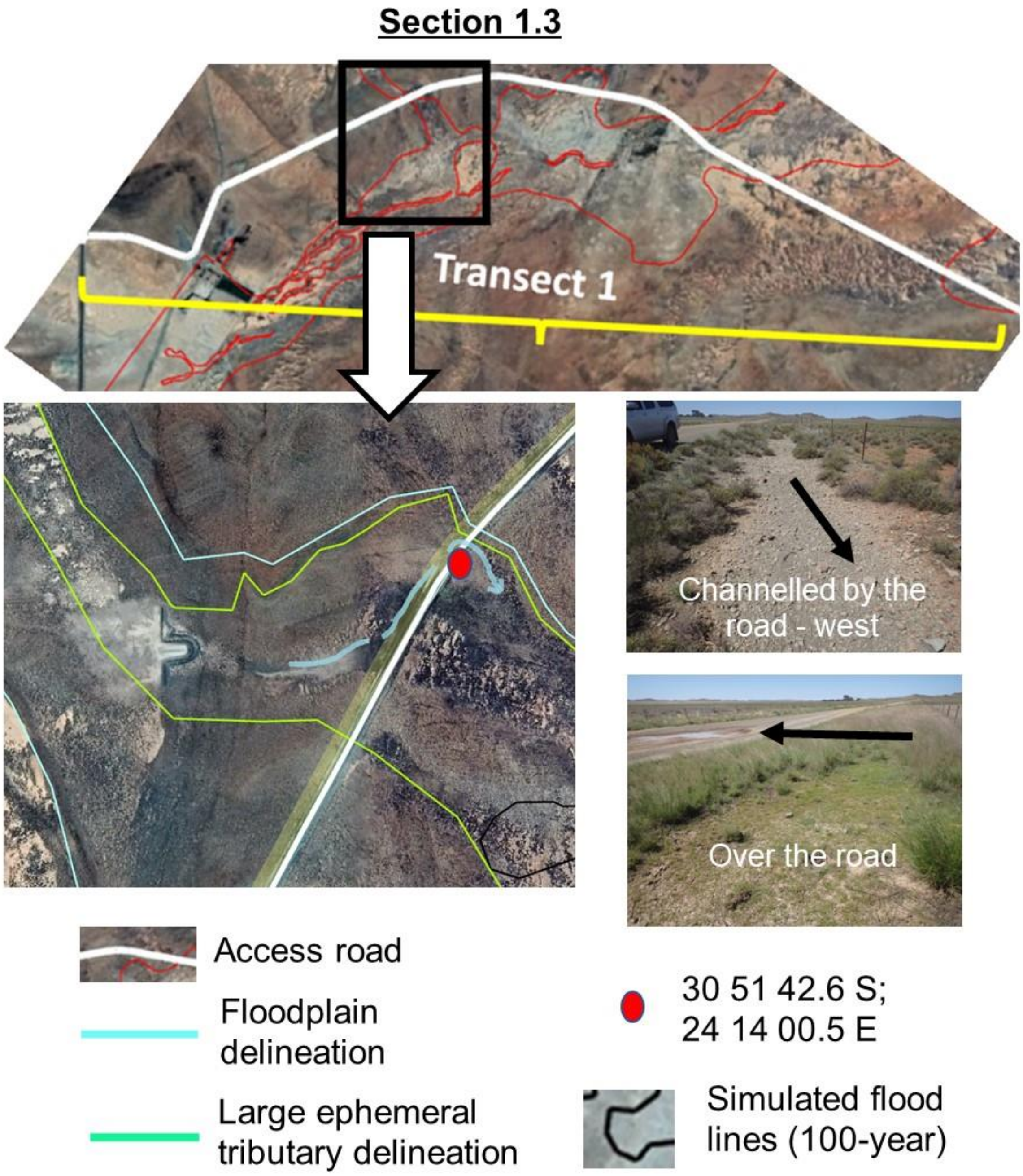


Figure 34: Road Section 1.3 of Transect 1, indicating the section of the road where the drainage is diverted to an area downstream of the original drainage crossing. The floodwater then crosses the road to enter the downstream drainage and later joins the original drainage line.

Section 1.4: 30 51 29.3 S; 24 14 23.7 E (Alt. 1314 m)

Road Section 1.4 of Transect 1, indicating the section of the road where the road cross over a headwater drainage area. The road obstructs seepage from the small headwater drainage catchment and sedges appear in the wetter clay soil next to the road. It seems that drainage water does not flow over the road (no damage or pooling on the road). Downstream of the road the drainage area is covered with shrub growth.

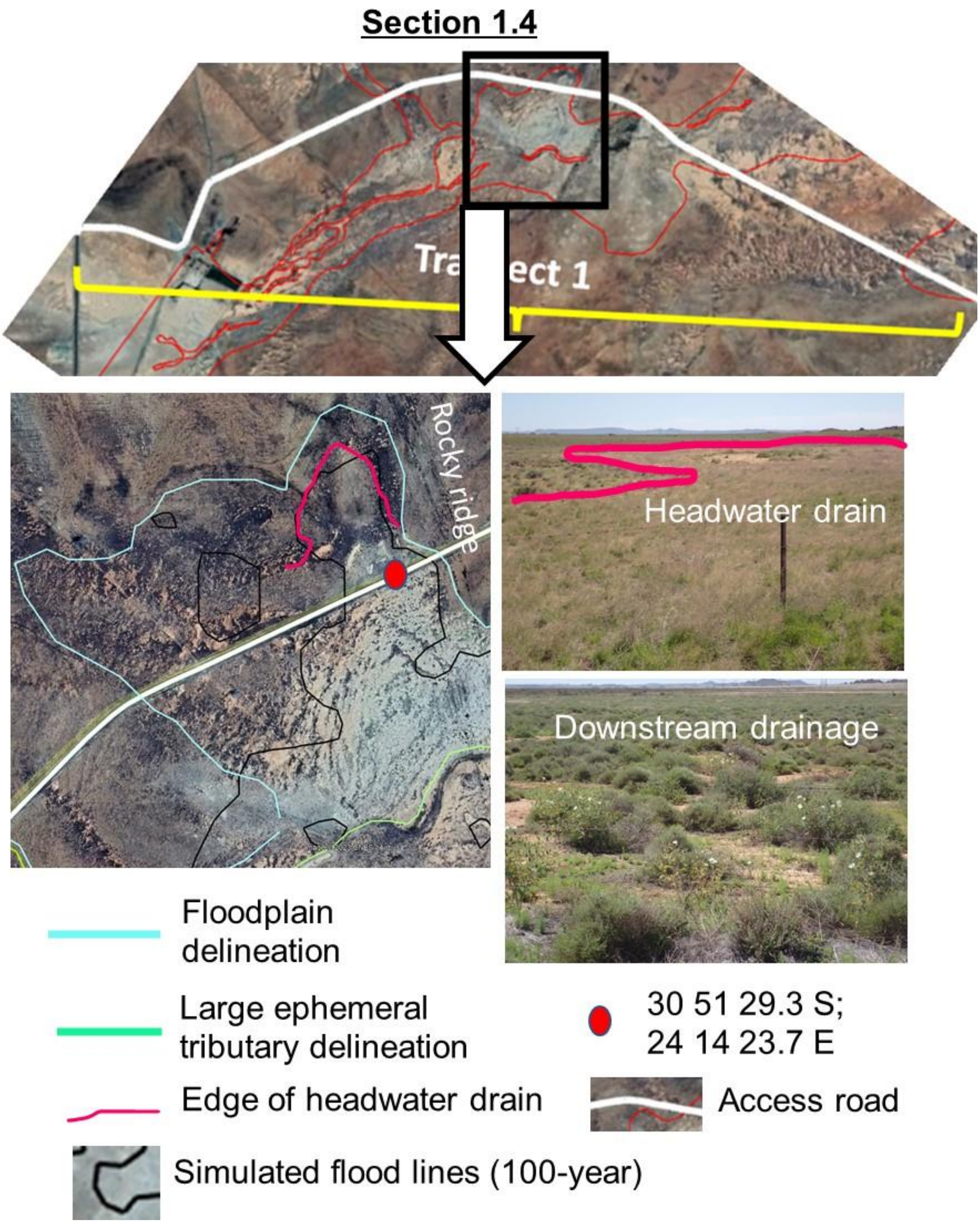


Figure 35: Road Section 1.4 of Transect 1, indicating the section of the road where the road cross over a headwater drainage area.

Section 1.5: 30 51 25.7 S; 24 14 12.3 E and 30 51 25.8 S; 24 14 47.1 E (Altitude 1309 m)

Road Section 1.5 of Transect 1, indicating the section of the road where the road cross over two drainage lines: a) the start of a short tributary of the main local drainage line and b) a large ephemeral drainage line crosses the road through a culvert bridge.

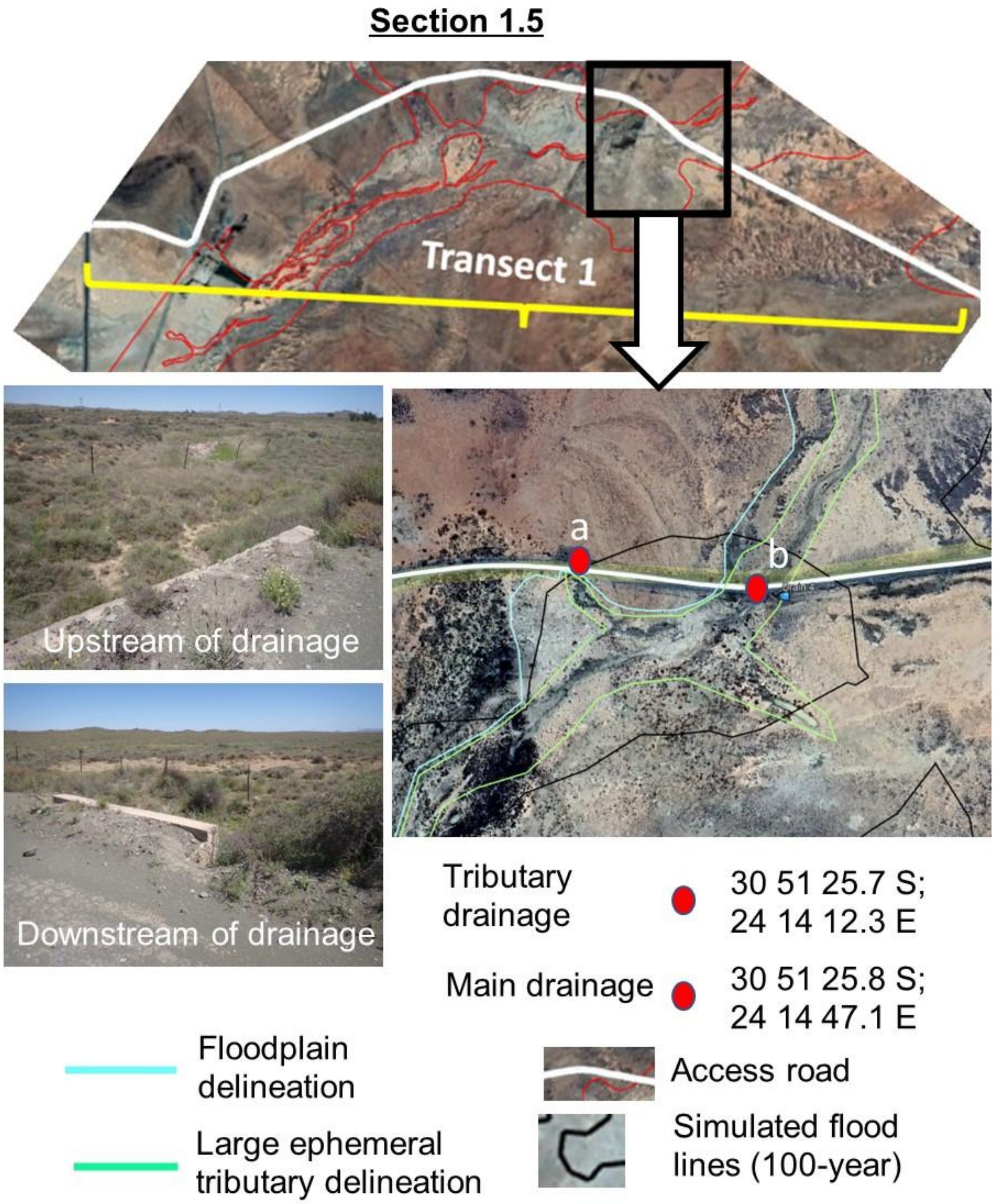


Figure 36: Road Section 1.5 of Transect 1, indicating: a) the start of a short tributary of the main local drainage line and b) a large ephemeral drainage line crossing (with culvert).

Section 1.6: 30 51 24.3 S; 24 14 59.3 E (Altitude 1302 m)

Road Section 1.6 of Transect 1, indicating the section of the road where the wet drainage line floodplain is indicated by the white grass and patches of mud during the late wet season. The floodplain can be delineated by using the simulated 100-year flood line, which indicates that the increased wetness influences the road; pools of water remain on the road where the flood line meets the road.

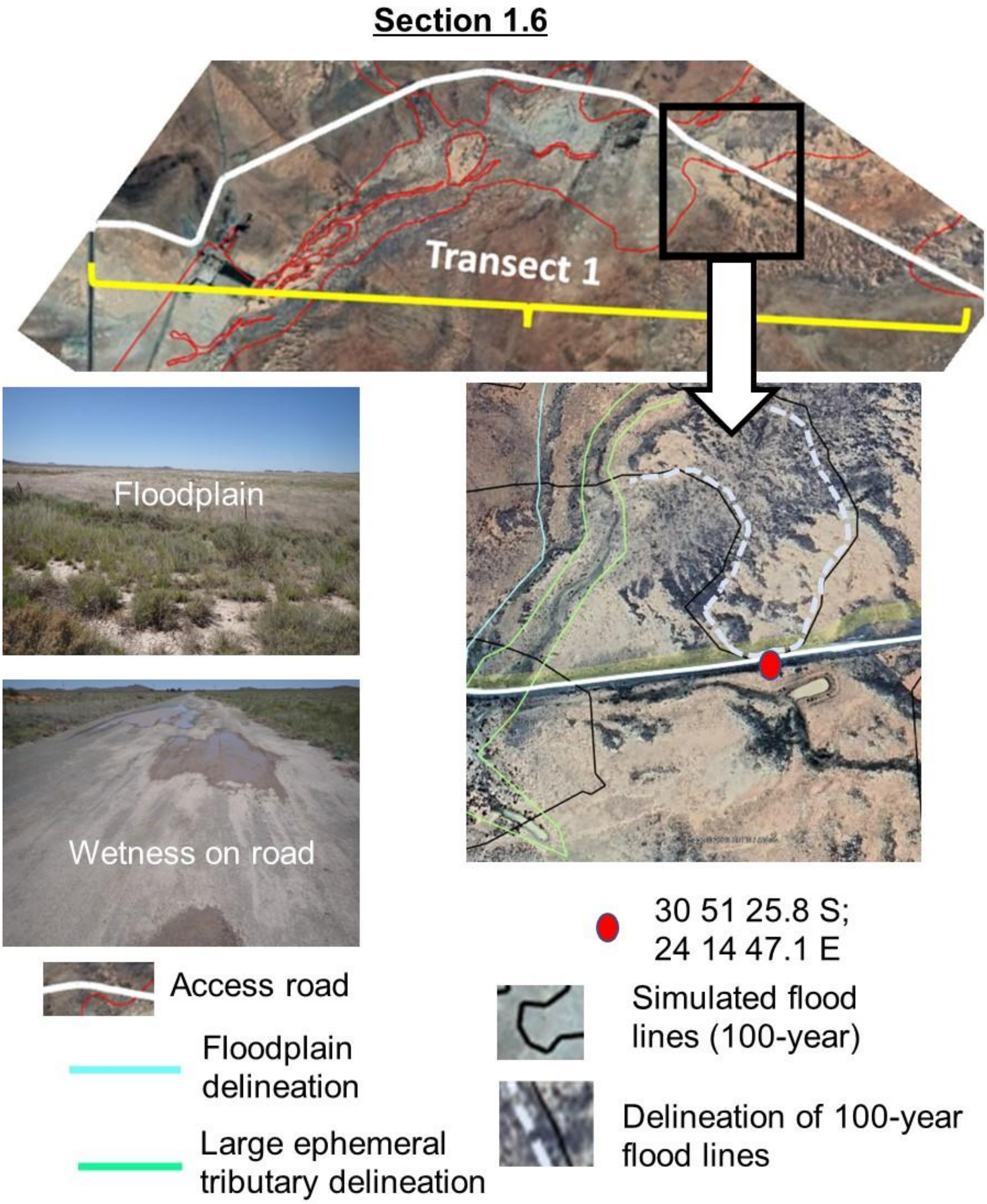


Figure 37: Road Section 1.6 of Transect 1, indicating the influence of the edge of the delineated drainage line floodplain influencing the road.

Section 1.7: 30°51'23.25"S; 24°15'7.15"E

Road Section 1.7 of Transect 1, indicating the section of the road where a floodplain flat borders the road on the edge of the simulated 100-year flood line. Increased wetness of the soil is probably the reason for ponding on the road where the flood line meets the road and where deep rutting occurs due to wheel tracks from traffic on the roads. An earthen berm on the southern side of the road (Figure 38) might be an indication of some surface flows during the rainy season.

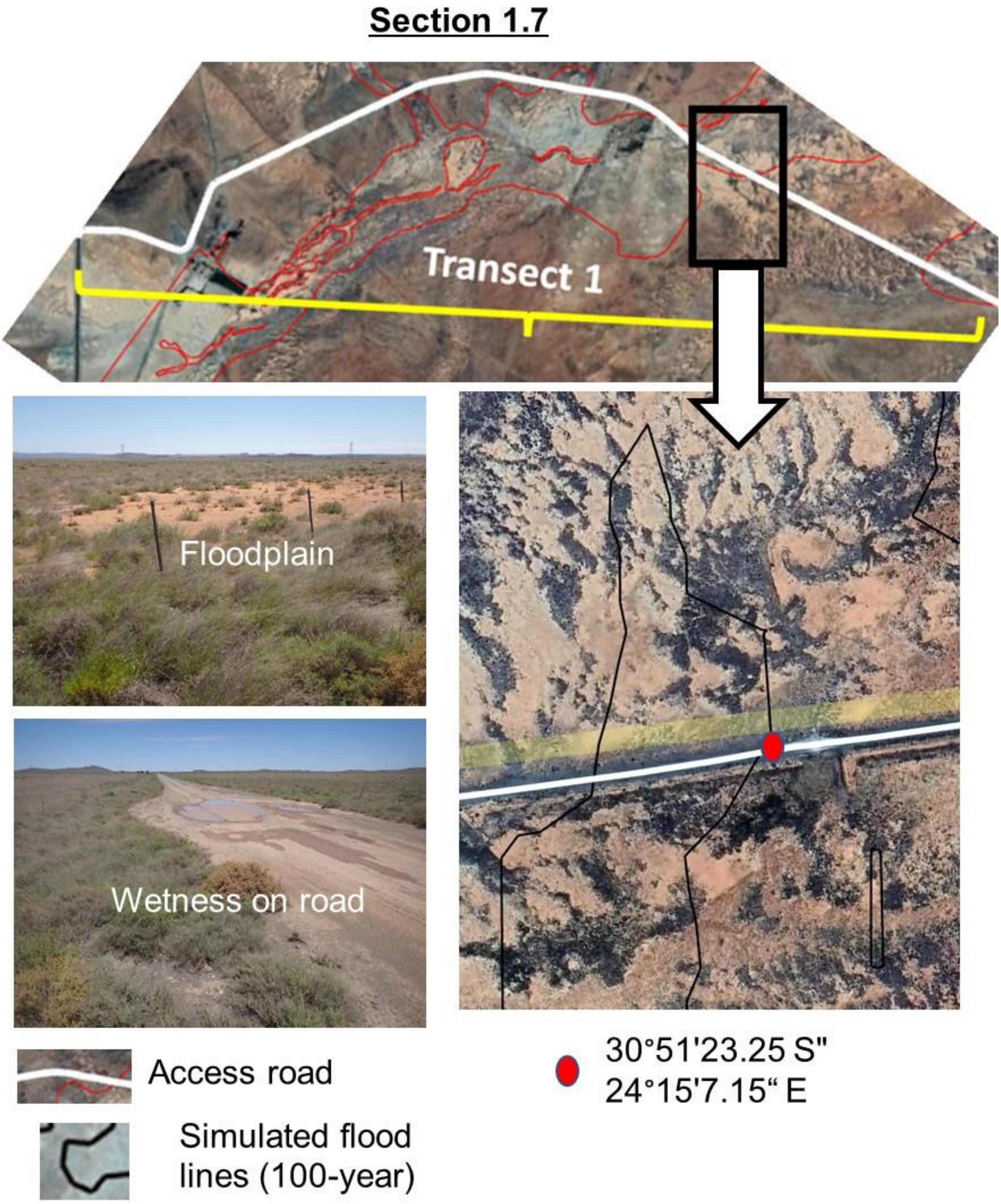


Figure 38: Road Section 1.7 of Transect 1, indicating the influence of the edge of the floodplain flat influencing the road.

Section 1.8: 30°51'20.34"S; 24°15'34.11"E (Altitude 1297 m)

Road Section 1.8 of Transect 1, indicating the section of the road where a floodplain flat borders the road inside a simulated 100-year flood patch. The floodplain resumes on the southern side of the road as a shrub-covered floodplain.

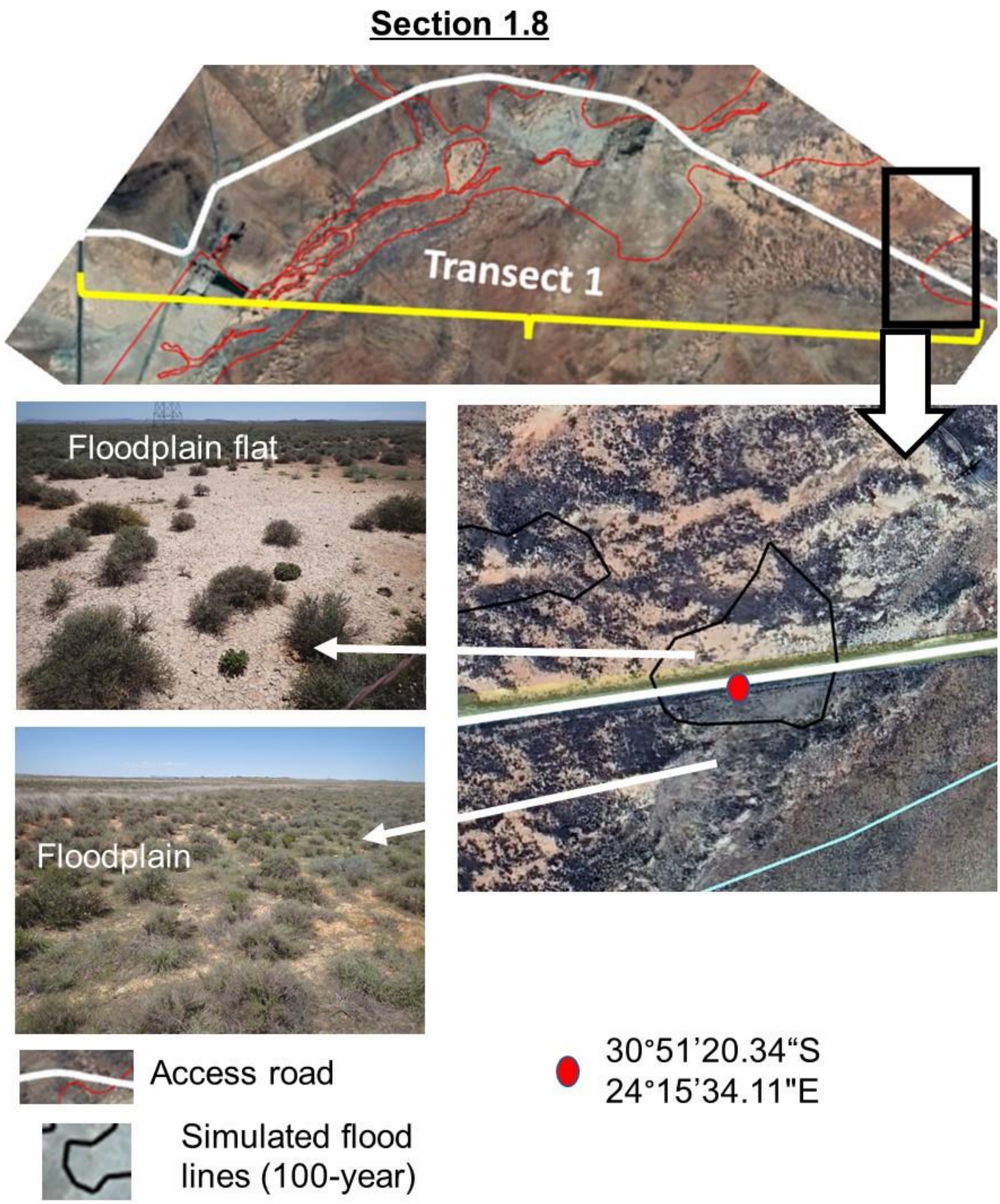


Figure 39: Road Section 1.8 of Transect 1, runs through a 100-year flood line patch between a shrubby floodplain and floodplain flat.

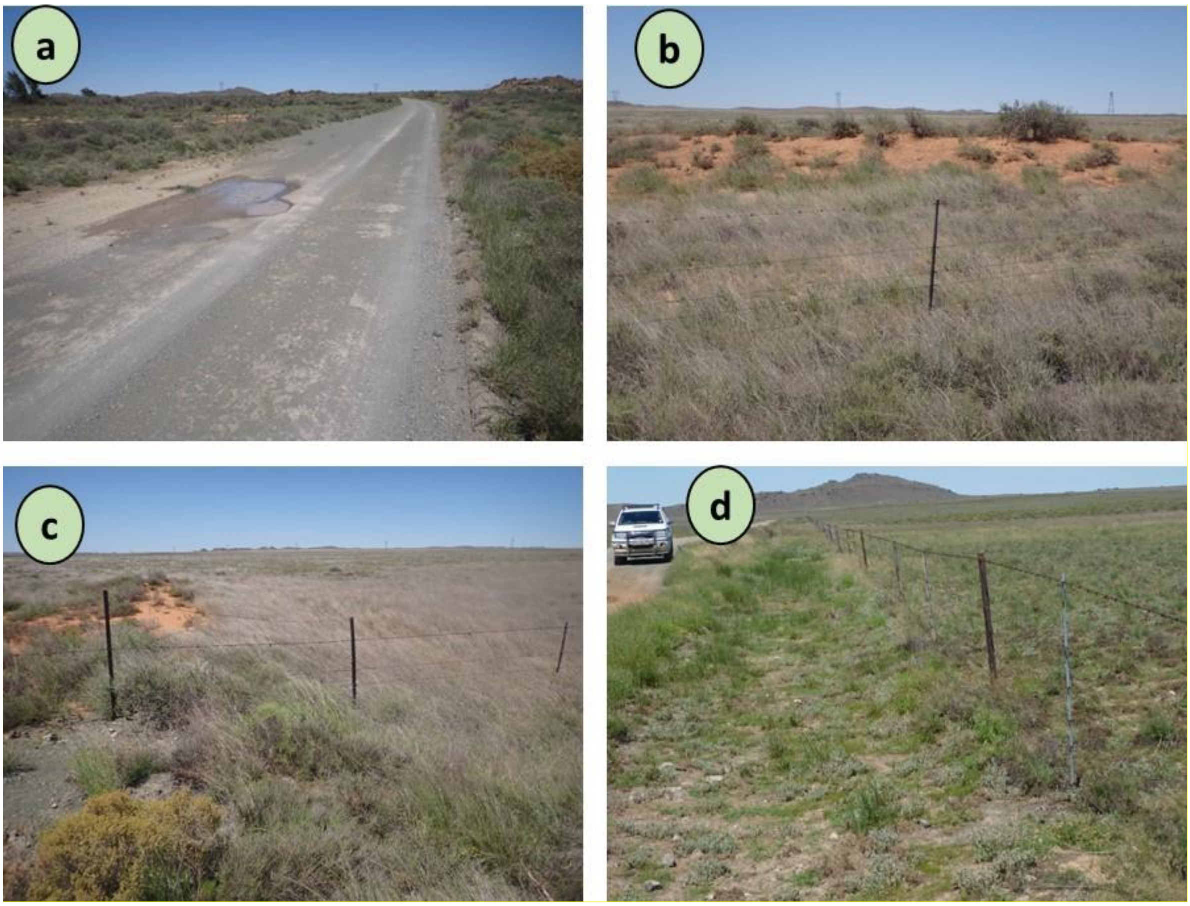


Figure 40: The road in Transect 1

40a: In many areas where diffuse drainage or concentrated ephemeral flows are expected, ponding on the road where the flood line meets the road and where deep rutting occurs due to wheel tracks from traffic on the roads. (Example Section 1.5a and 1.6).

40b: The earthen dam adjacent to the road at Section 1.6.

40c: An earthen berm at road Section 1.7 might be an indication of some surface flows during the rainy season.

40d. Where the road crosses floodplains, the damming effect of the road can create damp soil (hydromorphic) at the edge of the road that creates habitat for wetland plants (sedges and hydrophytic grass) to settle in these areas.

Section 2.1: 30°51'13.13"S 24°16' 8.41"E and 30°51'7.53"S 24°16'30.31"E (Altitude 1303 m at both points)

Road Section 2.1 of Transect 2, crosses an alluvial, shrub-covered floodplain and the many earthen berms through the road indicate some kind of water diversion takes place in the floodplain. The smaller berms on the road are probably just to protect the road from erosion.

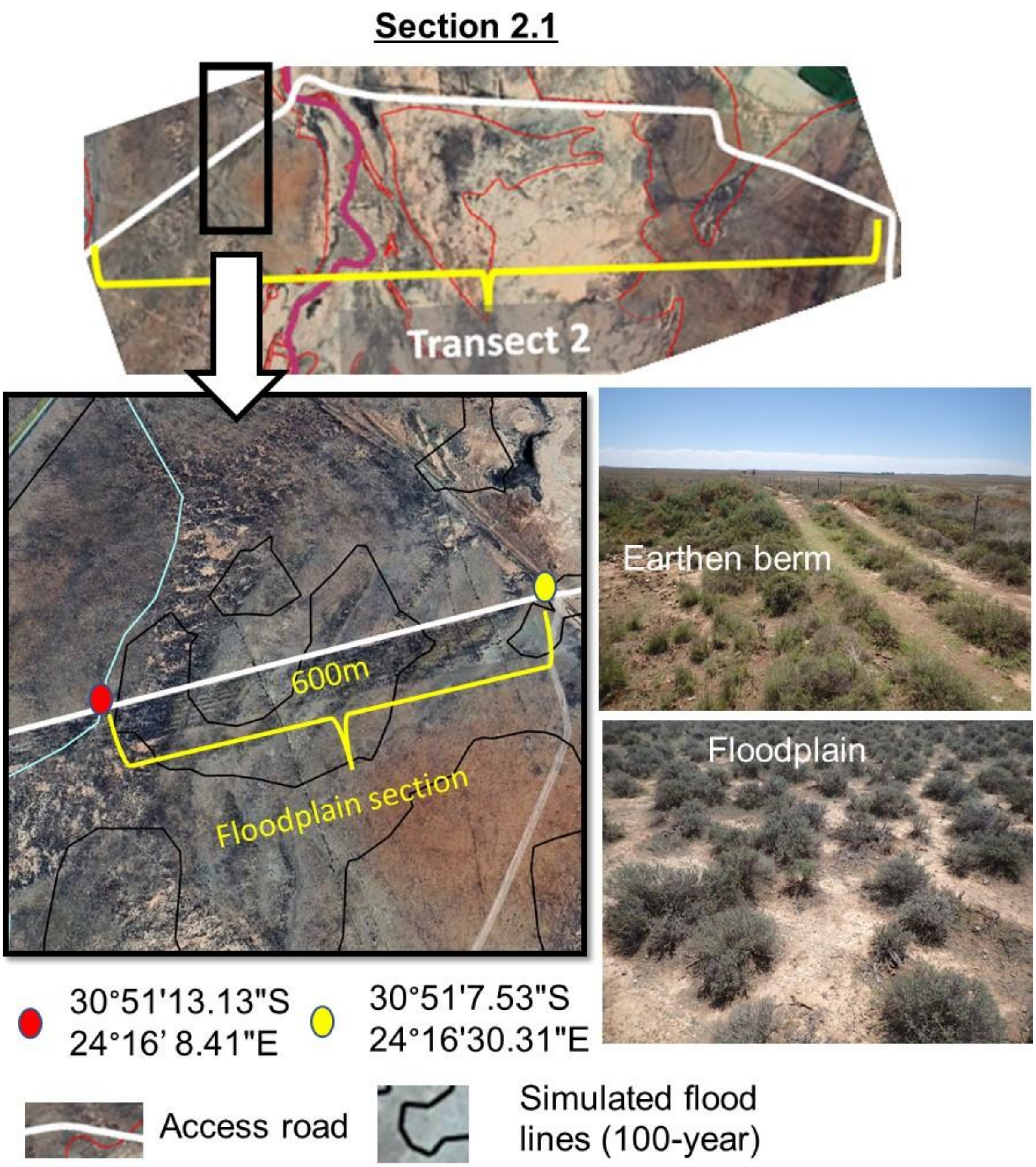


Figure 41: Road Section 2.1 of Transect 2, stretches over 600m of shrubby floodplain.

Section 2.2: 30°51'6.74"S 24°16'32.57"E and 30°51'9.48"S 24°16'48.11"E (Altitude: from 1303 m to 1294 m)

Road Section 2.2 of Transect 2, crosses the seasonal Brak River on the farm De Bad.

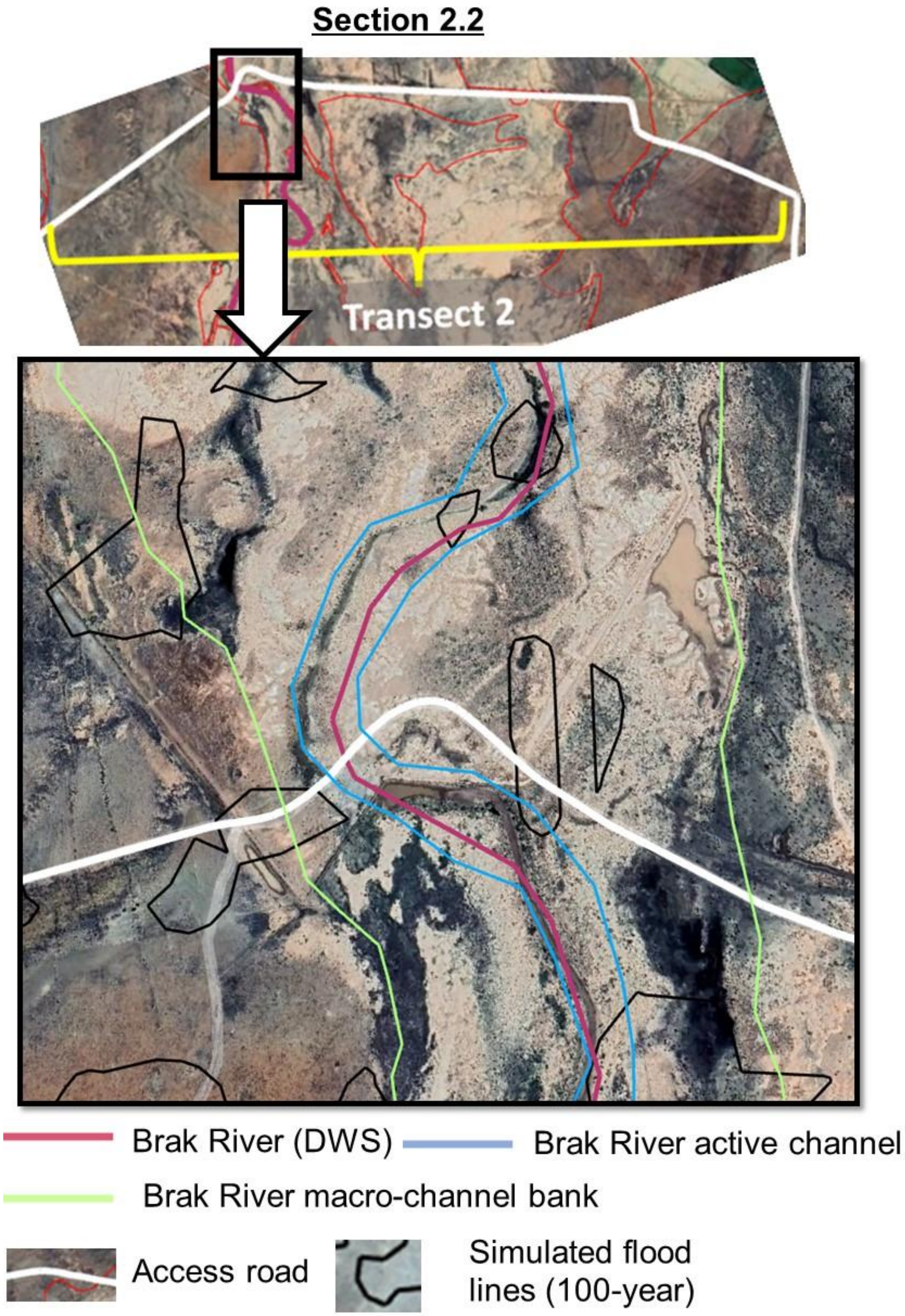


Figure 42: Road Section 2.2 of Transect 2, crosses through the seasonal Brak River.

The Brak River macro channel is the first channel in the wide river floodplain to flow during good rains. However, the channel is not set in its position and can change course during every major flood. Old channels are visible in the alluvial floodplain, and some disappear under sediment deposited during high flows.

This part of the river has no prominent riparian zone, thus the process of delineating the water course, makes use of the discernible macro-channel banks.

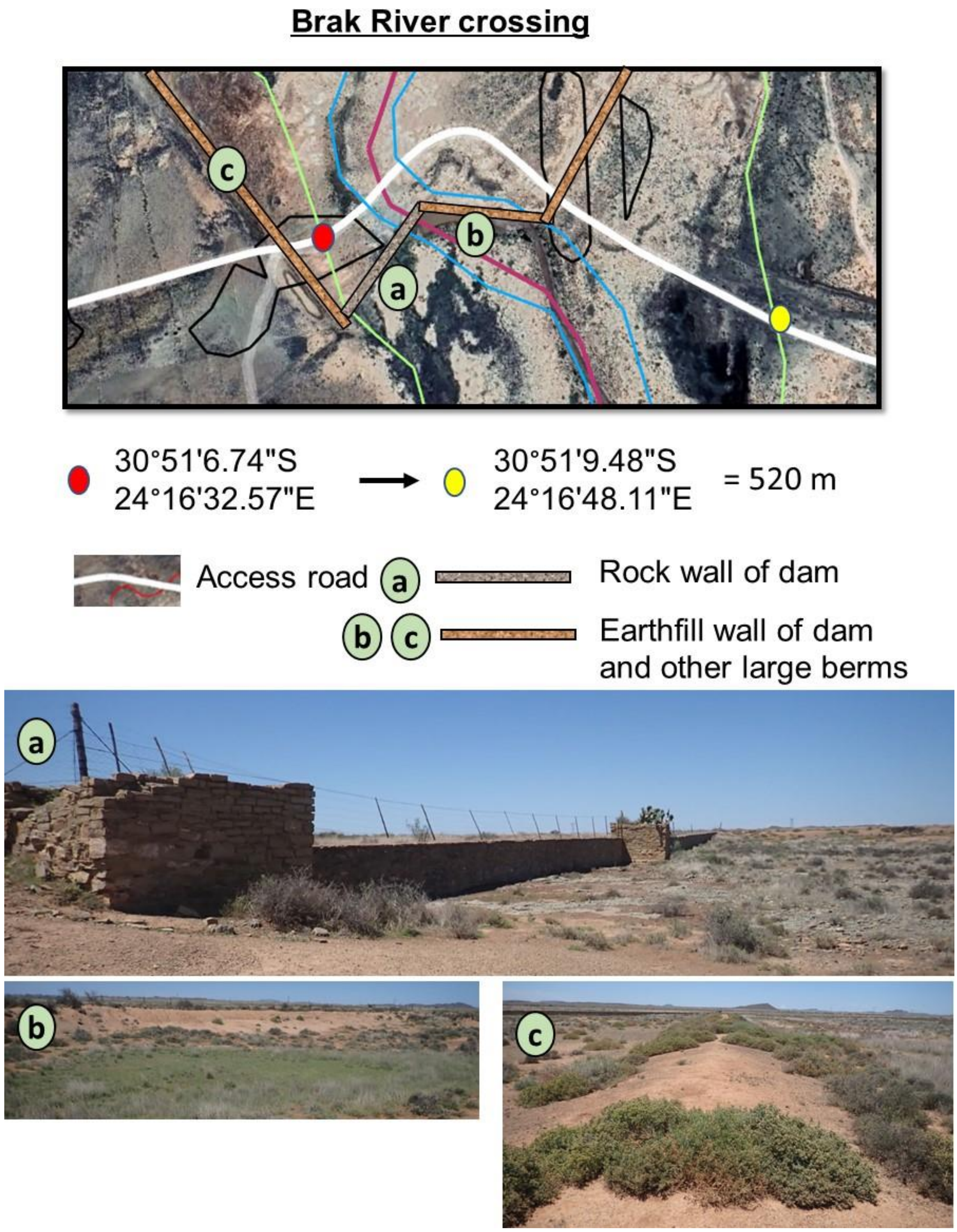


Figure 43: A visual compilation of the Brak River crossing and upstream dam. a) Rock wall dam b and c) earth fill dam wall and berm.

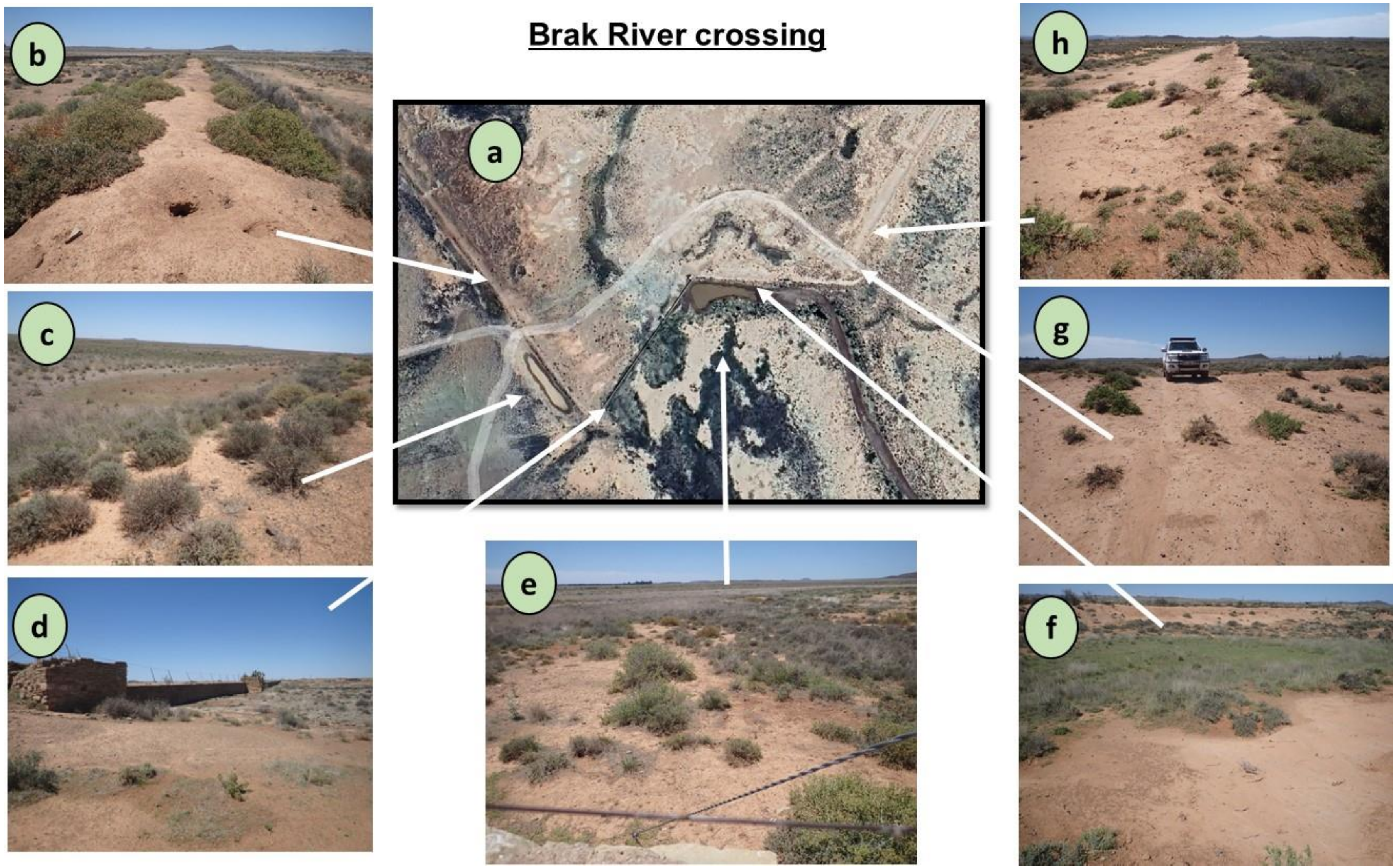


Figure 44: A visual compilation of the man-made elements that transformed the form and function of the river section.

The drainage ecosystem in the vicinity of the current road crossing (Figure 42 and Figure 43) has been transformed considerably by the farming activities on the farm. Flow patterns and fluvial geomorphology has been altered due to the presence of the instream dam (Figure 43a) and multiple large earthen berms (Figures 43 b and c) in the area surrounding the dam.

A large earthen berm (Figure 44b), approximately 3m high, is stretching from the dam for 566m to the north-west along the Brak River floodplain. The berm forms a barrier to flows from the west and the pool near the road and the dam (Figure 44c) are caused by this obstruction. The instream dam (Figure 44d) does not have much storing capacity as it has been silted up by alluvial sediment (Figure 44e). The earthen portion of the dam wall (Figure 44f) is 136m long and where it meets the road (Figure 44g), it meets up with another large soil berm that extends about 366m to the northeast (Figure 44h). This berm also acts as a barrier to flows from the east and a large pool form seasonally between the berm and the right hand macro-channel bank (Figure 44a).

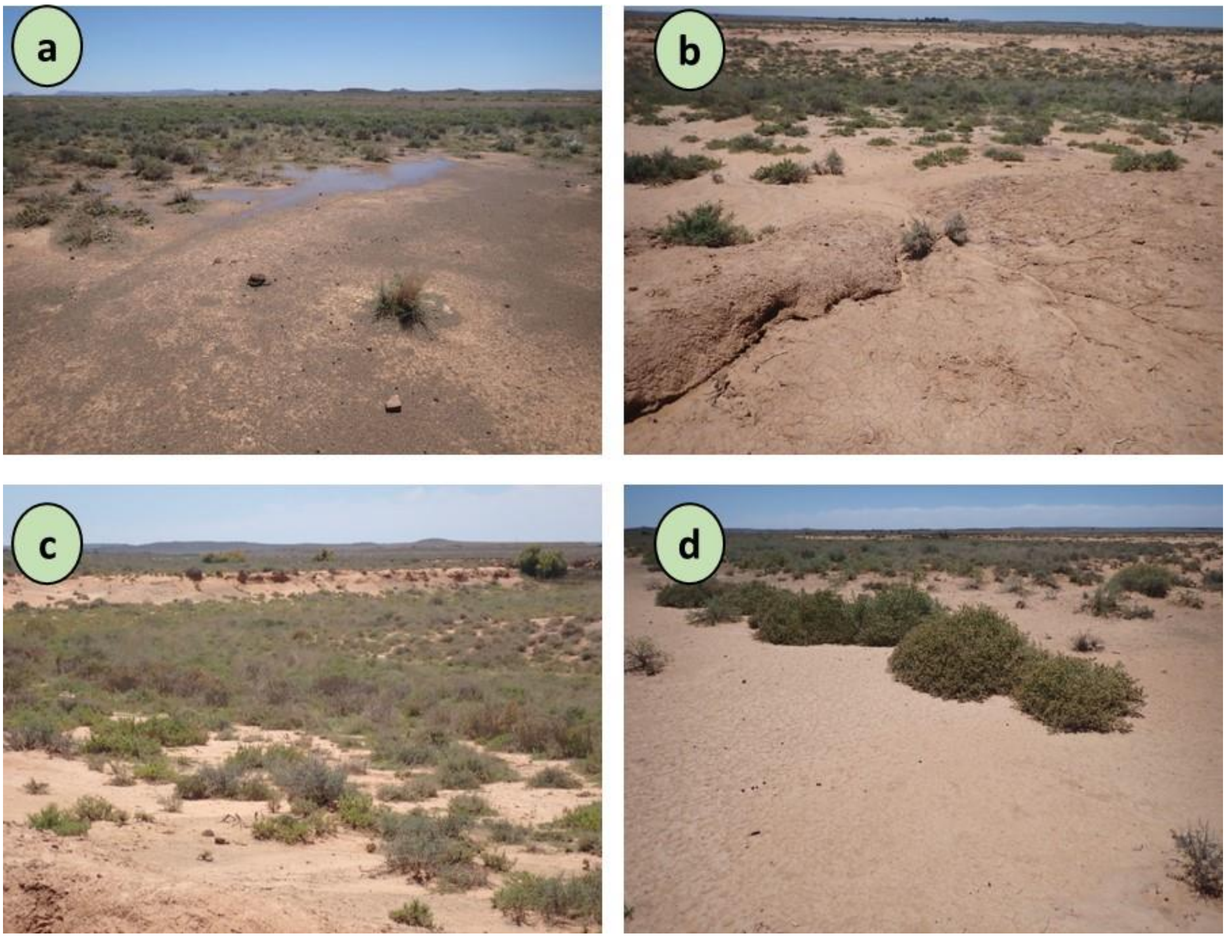


Figure 45: The Brak River drainage line

- **45a:** The active channel of the Brak River in the alluvial floodplain.
- **45b:** Signs of natural erosion of the macro channel banks as rainwater flows down to the main channel.
- **45c:** Embankment slopes and riverbed of the Brak River riverine environment, covered by xerophytic shrubbery.
- **45d.** A floodplain flat that forms part of the mosaic of habitats on the alluvial floodplain.

Brak River crossing

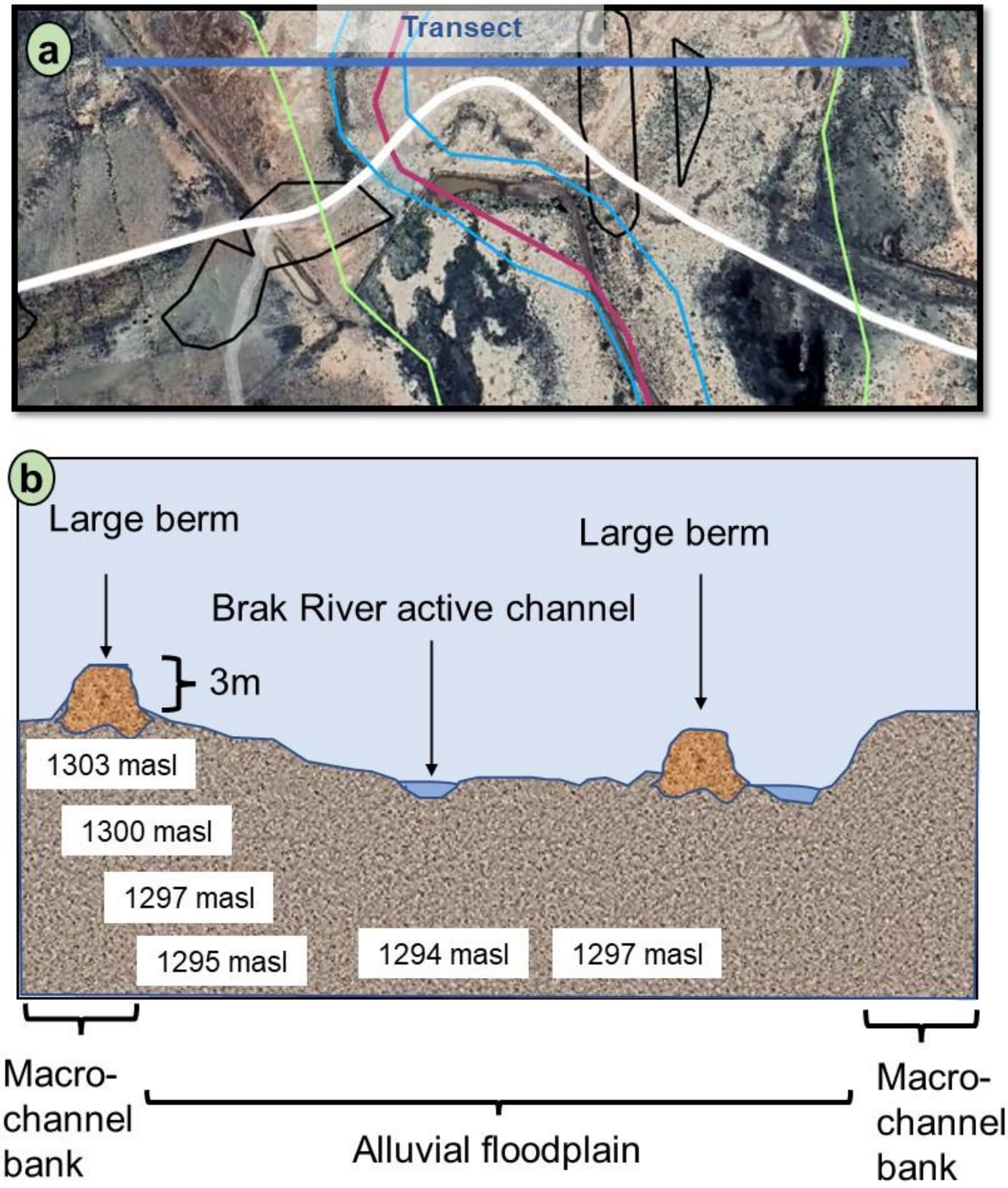


Figure 46: A transect through the Brak River drainage system illustrates the profile and contours of the river bed.

Section 2.3: 30°51'15.66"S 24°17'4.51"E.

Road Section 2.3 of Transect 2, crosses a small ephemeral drainage line that originates on the Brak River floodplain. There is a small dam in the upstream drainage and after it crosses the road, a series of short berms which manipulate the flows, probably to protect the road and distribute the water into the floodplain.

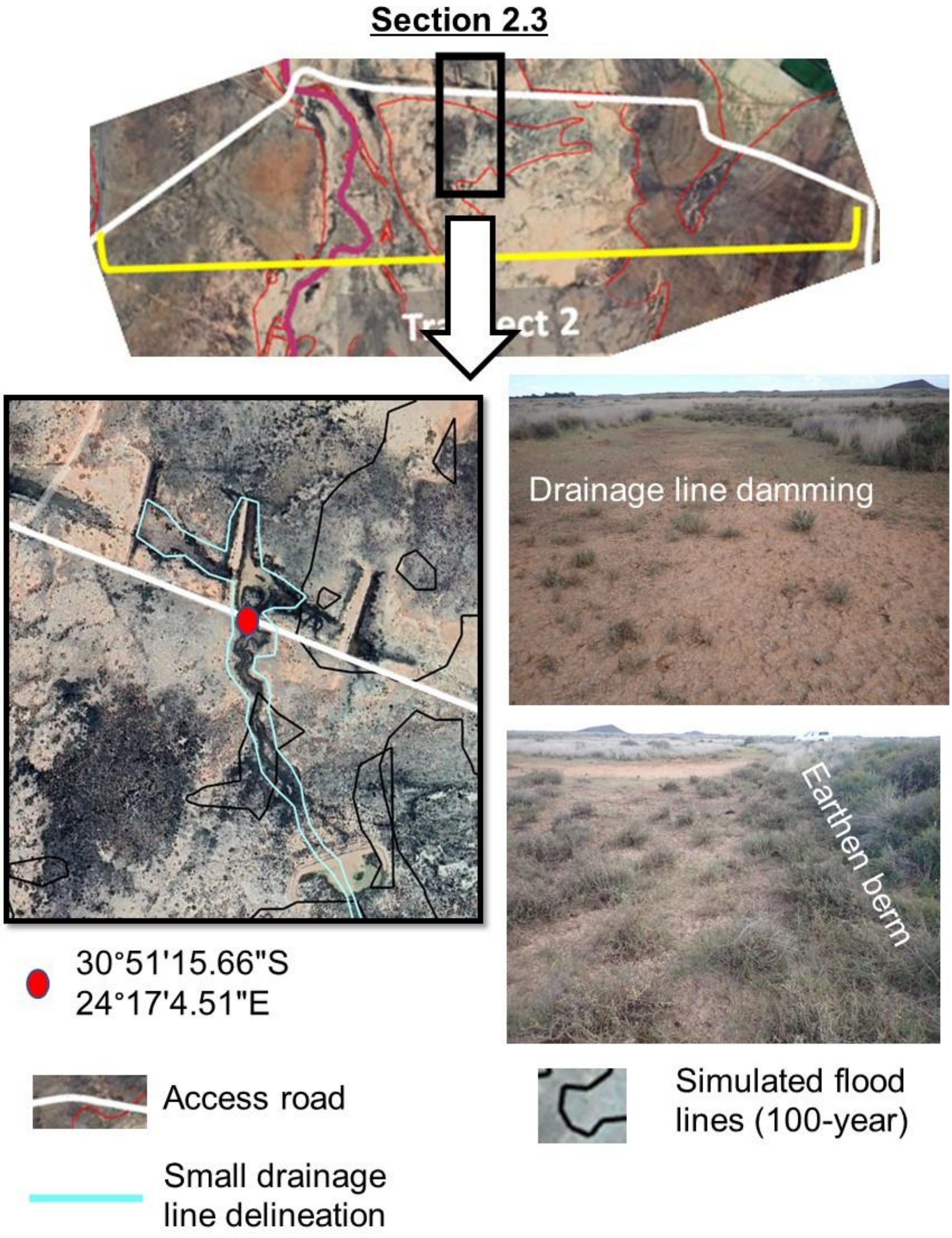


Figure 47: Road Section 2.3 of Transect 2: The small ephemeral drainage line that originates on the Brak River floodplain.

Section 2.4: 30°51'16.23"S 24°17'6.43"E to 30°51'24.52"S 24°17'31.11"E

Road Section 2.4 of Transect 2, crosses an extensive alluvial floodplain. Four more berms, each more that 80m long, have been placed on the 720m of road. During high rainfall periods, the floodplain becomes increasingly water-logged and driving on the road becomes cumbersome.

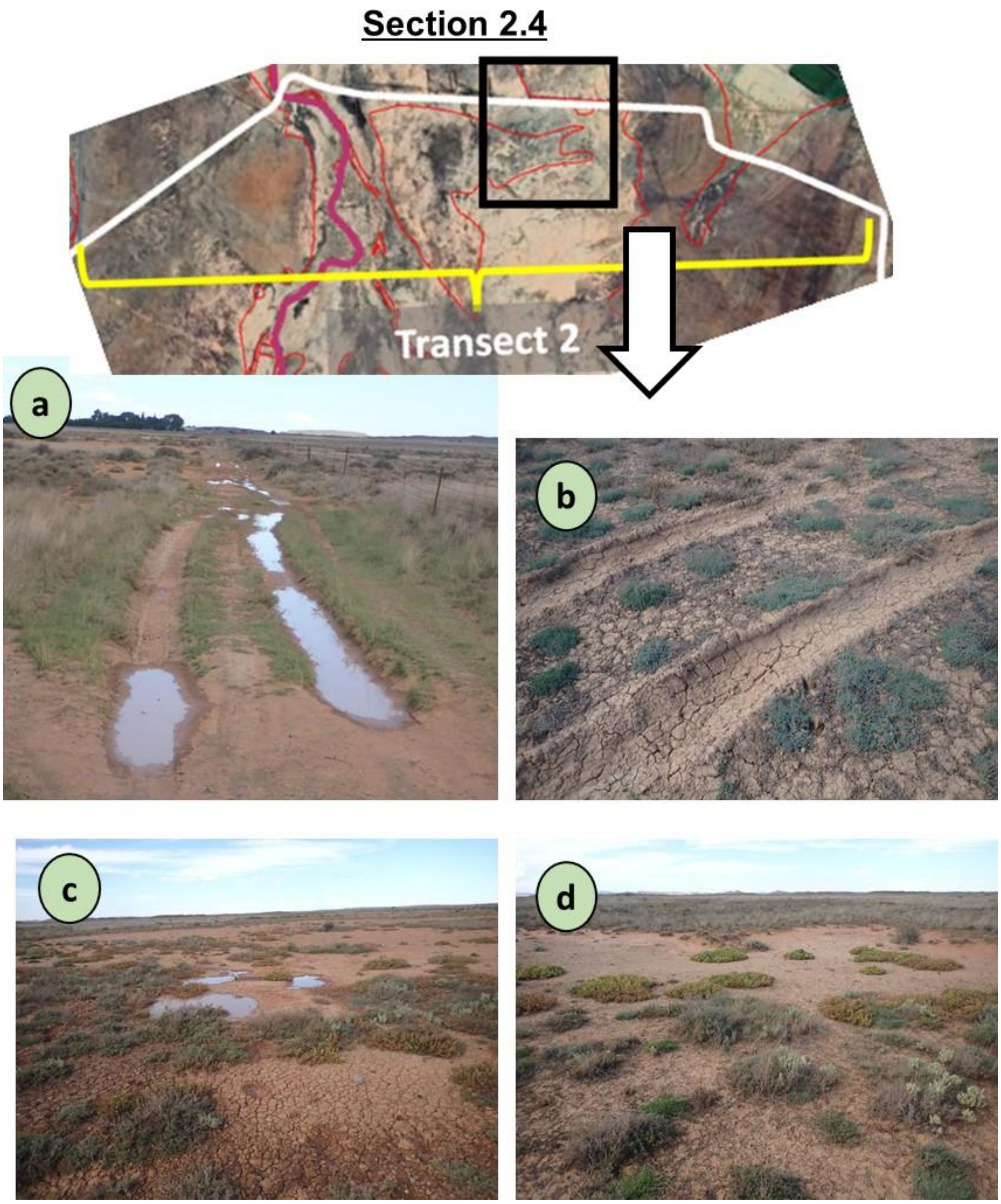


Figure 48: Road Section 2.4

- **48a:** Rainwater and seepage accumulate on the road during the wet season and ponding occurs on the road where the flood line meets the road and deep rutting present due to wheel tracks from traffic on the route.
- **48b:** Leaving the road shows the deep mud.
- **48c:** In certain areas of the floodplain surface water forms pools.
- **48d:** A wet floodplain flat on the alluvial floodplain.

Section 2.5: 30°51'38.05"S; 24°17'49.25"E

At Road Section 2.5 of Transect 2, the road crosses a floodplain area, 64m wide, which is draining an area containing headwater drainage with floodplain flats, into an area with alluvial fans.

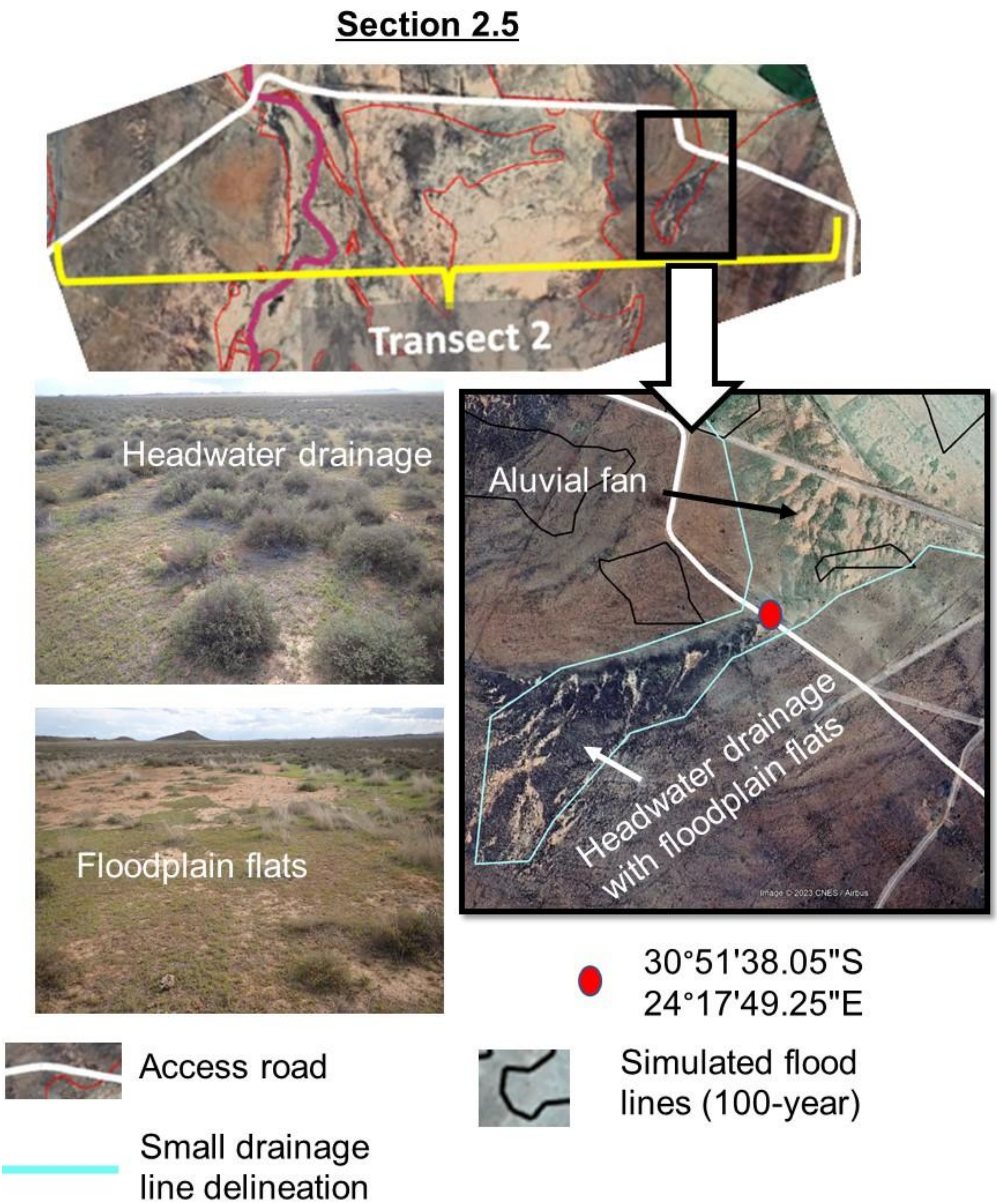


Figure 49: Road Section 2.5 crosses a headwater drainage with floodplain flats draining into an area with alluvial fans.

Section 3.1: 30°53’05.29"S; 24°18'35.81"E

At Road Section 3.1 of Transect 3, the road crosses a man-made berm which divert water from the Brak River for 1.54 km in a north-westerly direction. Whenever water is diverted during higher flows in the river, it is being released through multiple notches in the berm to “irrigate” the adjacent veld to improve grazing for livestock or game.

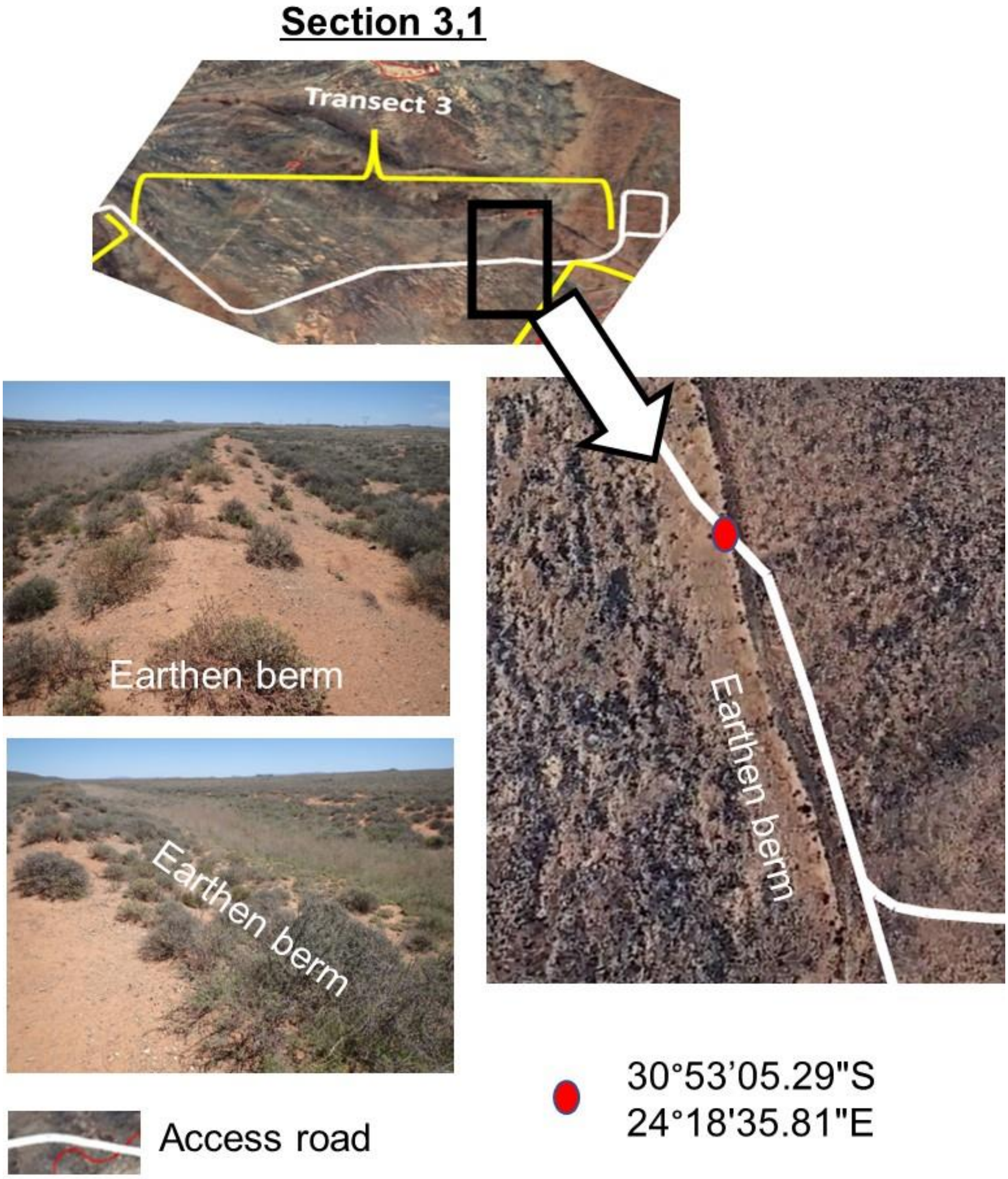


Figure 50: Road Section 3.1 crosses a 1.54 km man-made berm which divert water from the Brak River.

2.5.2.1b Extending the 2.5 km main transmission line

Aspect 2: Extending the 2.5 km main transmission line from the Main Transmission Station (MTS) to Line 1 of the 400 kV Eskom powerline.

Section 4.1:

At Transmission line Section 4.1 of Transect 4, the power lines cross over two drainage lines in an anastomosing section of the Brak River alluvial riverbed. The large drainage line and its alluvial riverbed have been altered considerably by earthen berms and dams.

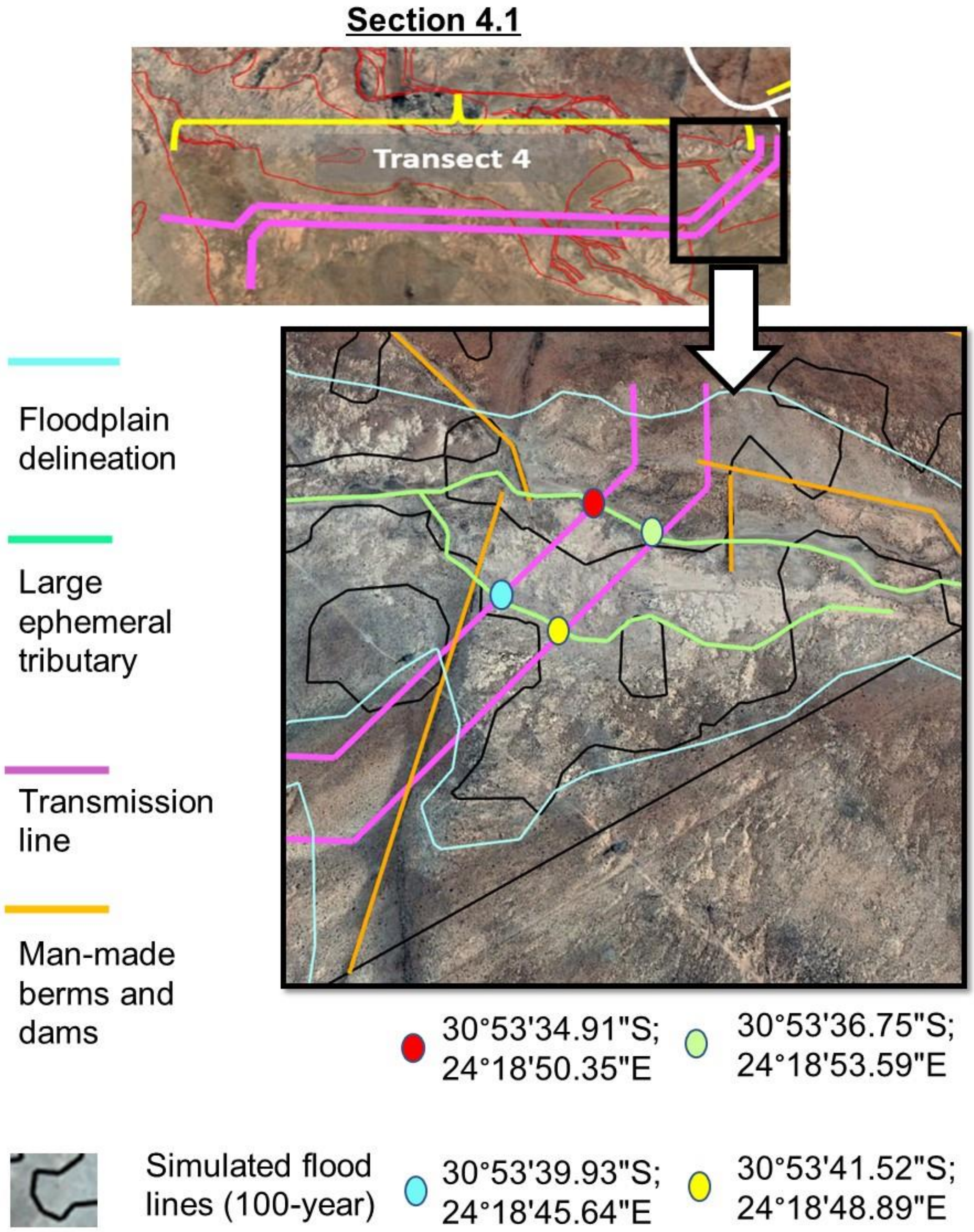


Figure 51: Transmission lines in Section 4.1 cross over two diverged drainage lines of the Brak River in this section.

Section 4.2:

At Transmission line Section 4.2 of Transect 4, the power lines cross over the Brak River and the alluvial floodplain. The large drainage line and its alluvial riverbed have been altered considerably by earthen berms and dams.

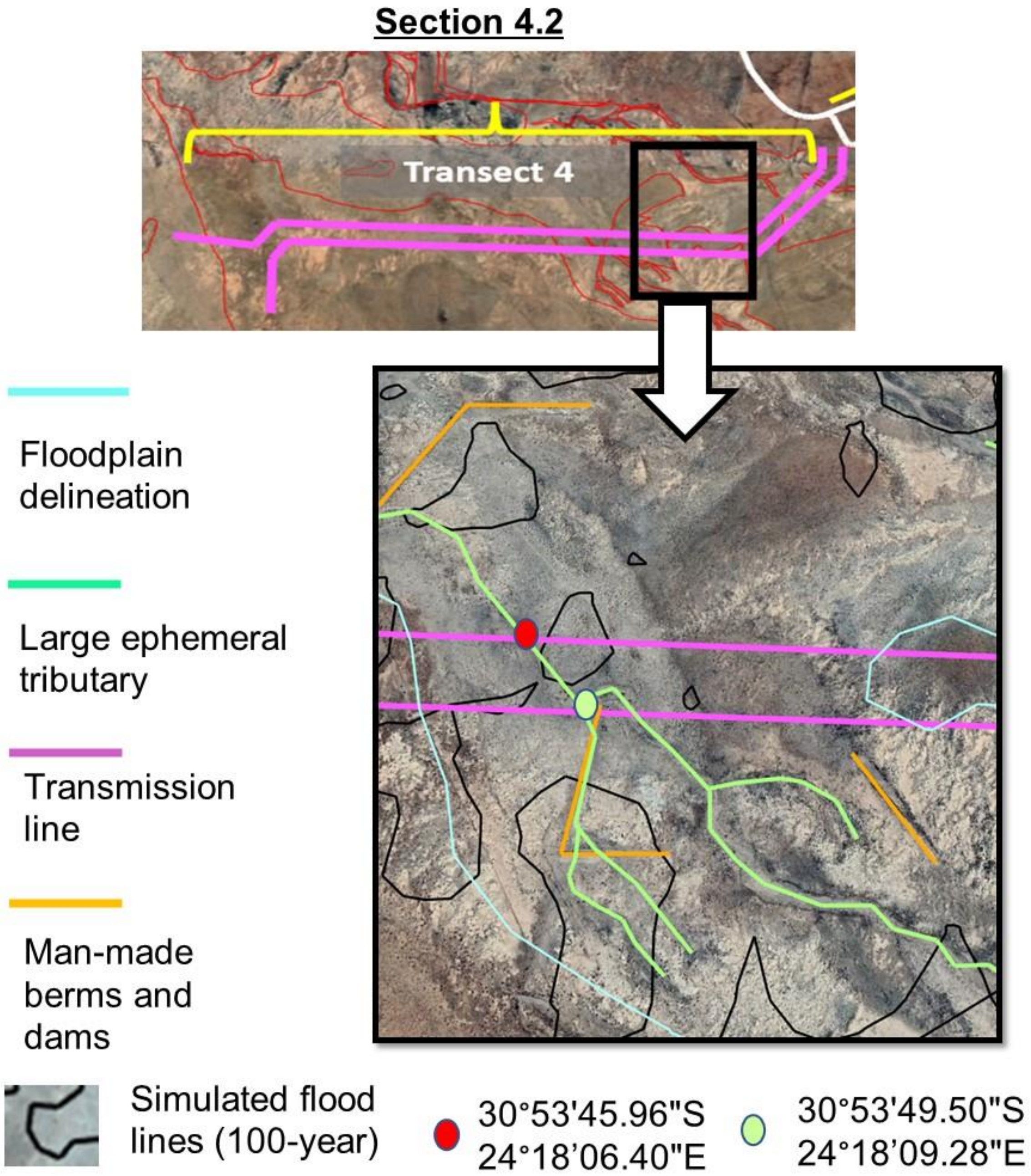


Figure 52: Transmission lines in Section 4.2 cross over the Brak River drainage line which is situated in a wide floodplain.

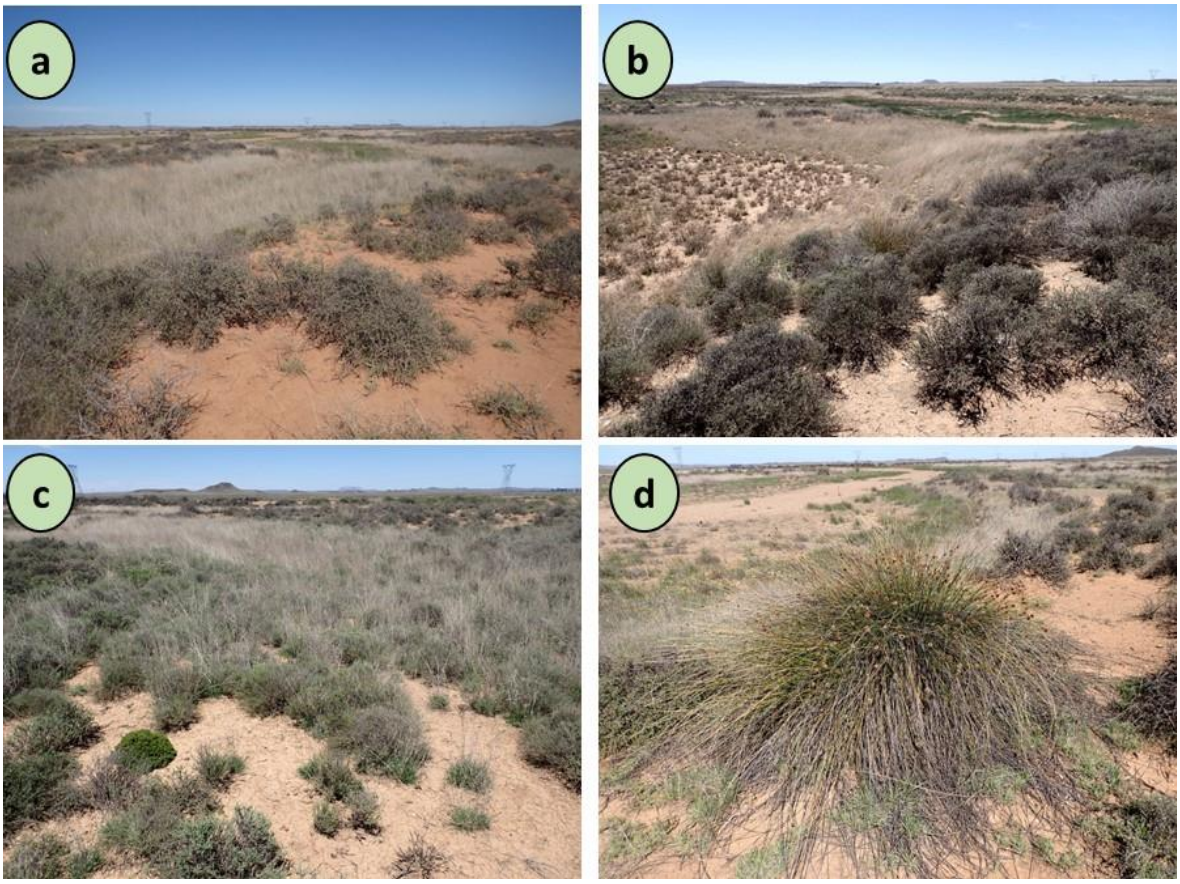


Figure 53a - d: The Brak River drainage line in Section 4.1 and 4.2 consists of an incised drainage line with an alluvial riverbed and flanked by low channel banks.

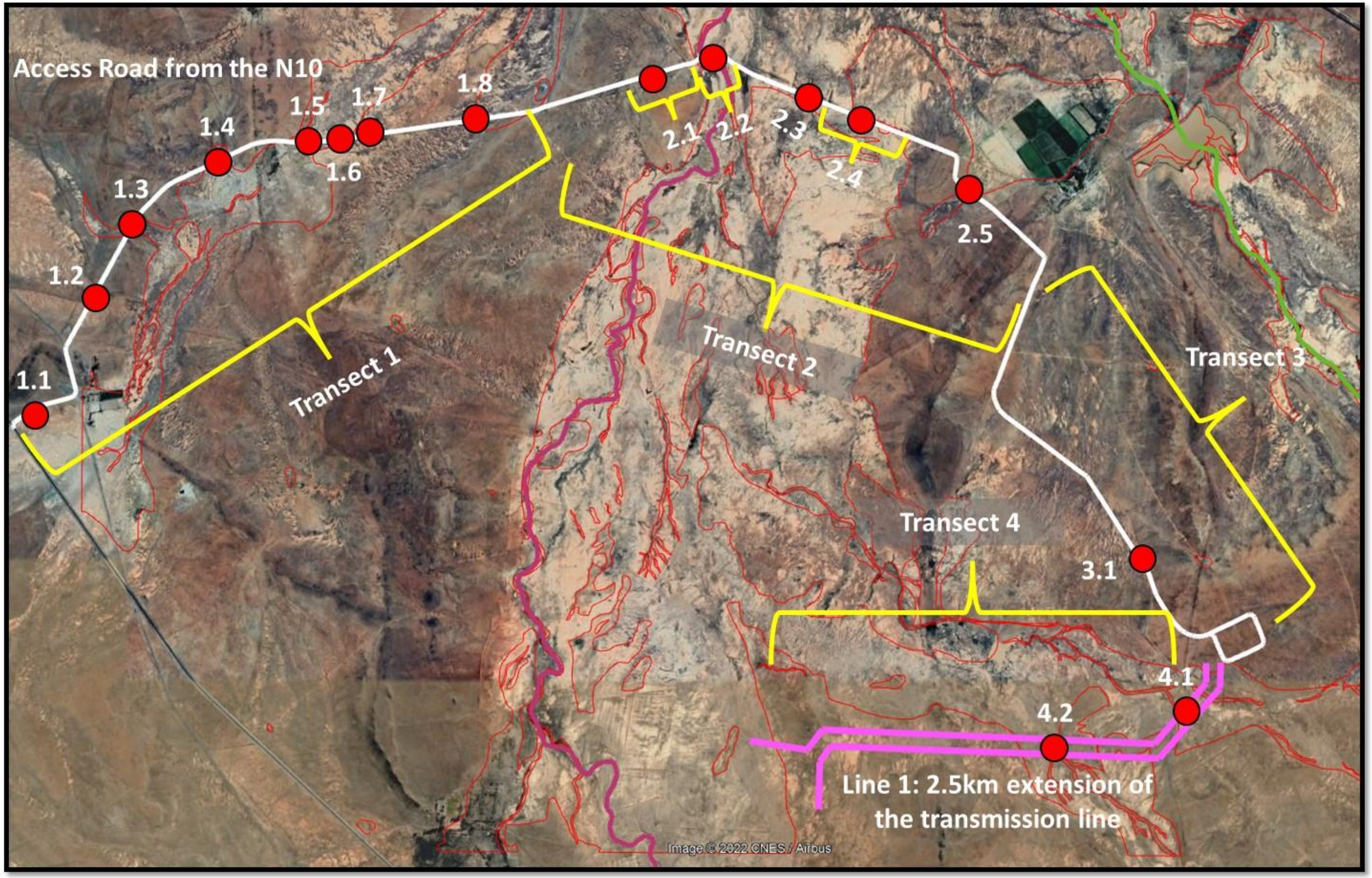


Figure 45: The 16 crossing points or sections of the access road and the 2.5 km transmission line which involves water resource aspects.

2.5.2.1c Summary of the water resource types and ecological importance

The EISC approach in Section 2.3.4.2, estimated and classified the ecological importance and sensitivity of the water resource groups in the project area. The resulting classes per group will be a guideline to the level of threat and degree of mitigation.

Classifying water resource groups according to their Environmental Importance and Sensitivity categories:

"High" ecological and sensitivity classes:

Road Section 1.3: Large ephemeral drainage line.
Road Section 1.5: Large ephemeral drainage line.
Road Section 2.2: Seasonal Brak River.
Transmission lines in Section 4.1: Seasonal Brak River.
Transmission lines in Section 4.2: Seasonal Brak River.

"Moderate**"** ecological and sensitivity classes:

Road Section 1.2: Small ephemeral drainage line.
Road Section 1.4: Headwater drainage.
Road Section 1.7: Floodplain flat.
Road Section 1.8: Floodplain flat.
Road Section 2.3: Small ephemeral drainage line.

"Low" ecological and sensitivity classes:

Road Section 1.1: Edge of headwater drainage.
Road Section 1.6: Alluvial floodplain.
Road Section 2.1: Alluvial floodplain.
Road Section 2.4: Alluvial floodplain.
Road Section 2.5: Headwater drainage.
Road Section 3.1: Artificial wetlands**.**

According to the listing above, the ecological importance and sensitivity of the large ephemeral drainage systems are all being classified as "High" (Table 27). Water resource types with a "High" EISC will be considered as no-go areas for all infrastructure apart from access roads, pipelines and cables. The no-go areas will include the pre-determined 15m buffers (Table 27, Section 2.3.4.2) of the drainage areas in the project footprint.

Figures 46 to 50 represents the major drainage lines to receive the 15m buffers on both sides of the watercourses. The 15m buffers shown on the Google Earth figures are drawn in by hand and thus not precise and are included for demonstrative purposes.

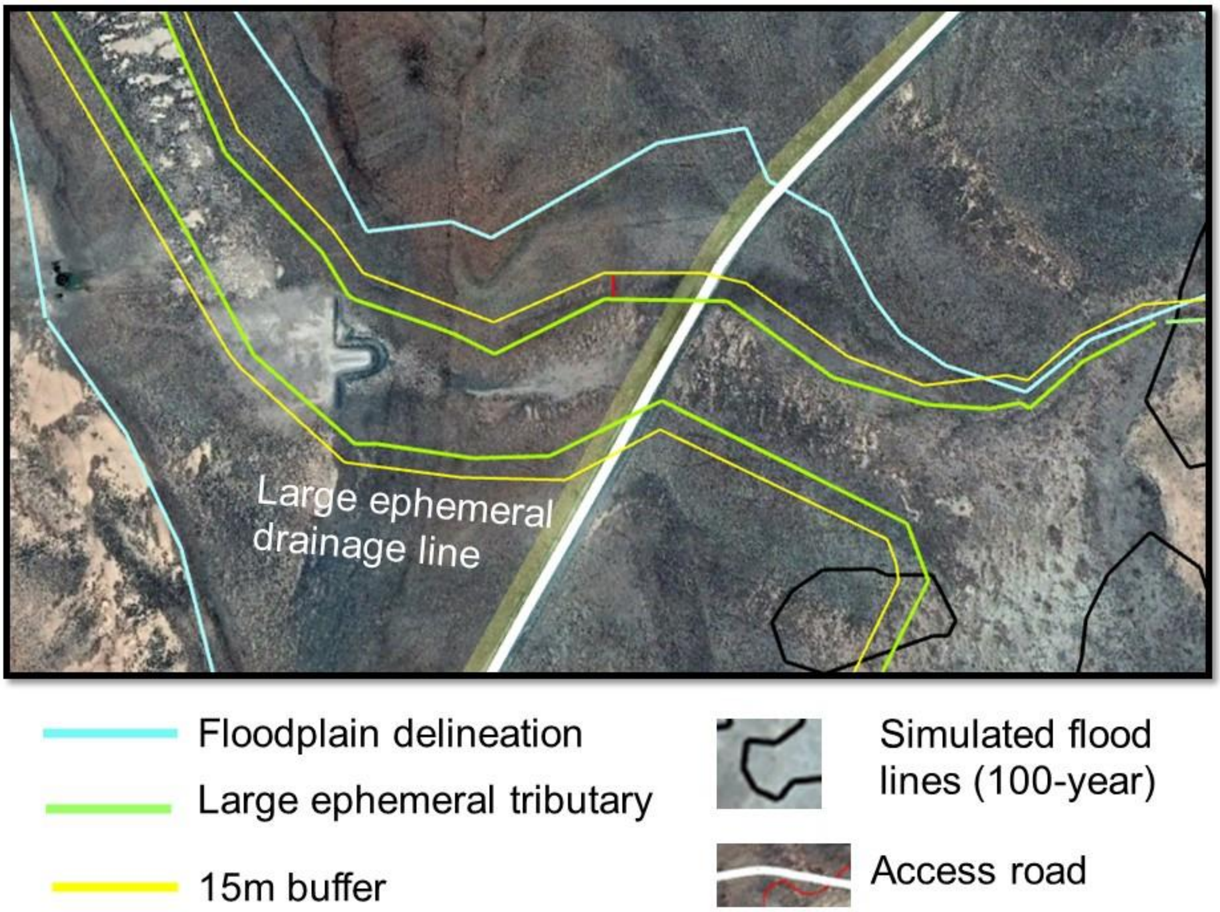


Figure 46: The large ephemeral drainage line at Section 1.3 delineated and buffered by the 15m buffer as determined by the DWS buffer tool.

The 15m buffer will create a no-go zone for all development other than linear systems (access roads, pipelines and cables). With the upgrading of the access road and the development of the transmission line, both are linear systems and thus all the planned activities will take place in a broad strip through the water course and associated buffers.

Although the presence of the buffer zone thus seems futile, the corridor will be put in place to emphasize the importance and sensitivity of the drainage system. That is why the area included between the buffer zones should have explicit and very strict biodiversity conservation management measures and the operating teams should be well aware of this. A level of best practices will be imposed in the riverine environment when the proposed construction gets under way and the process will be overseen by the project management.

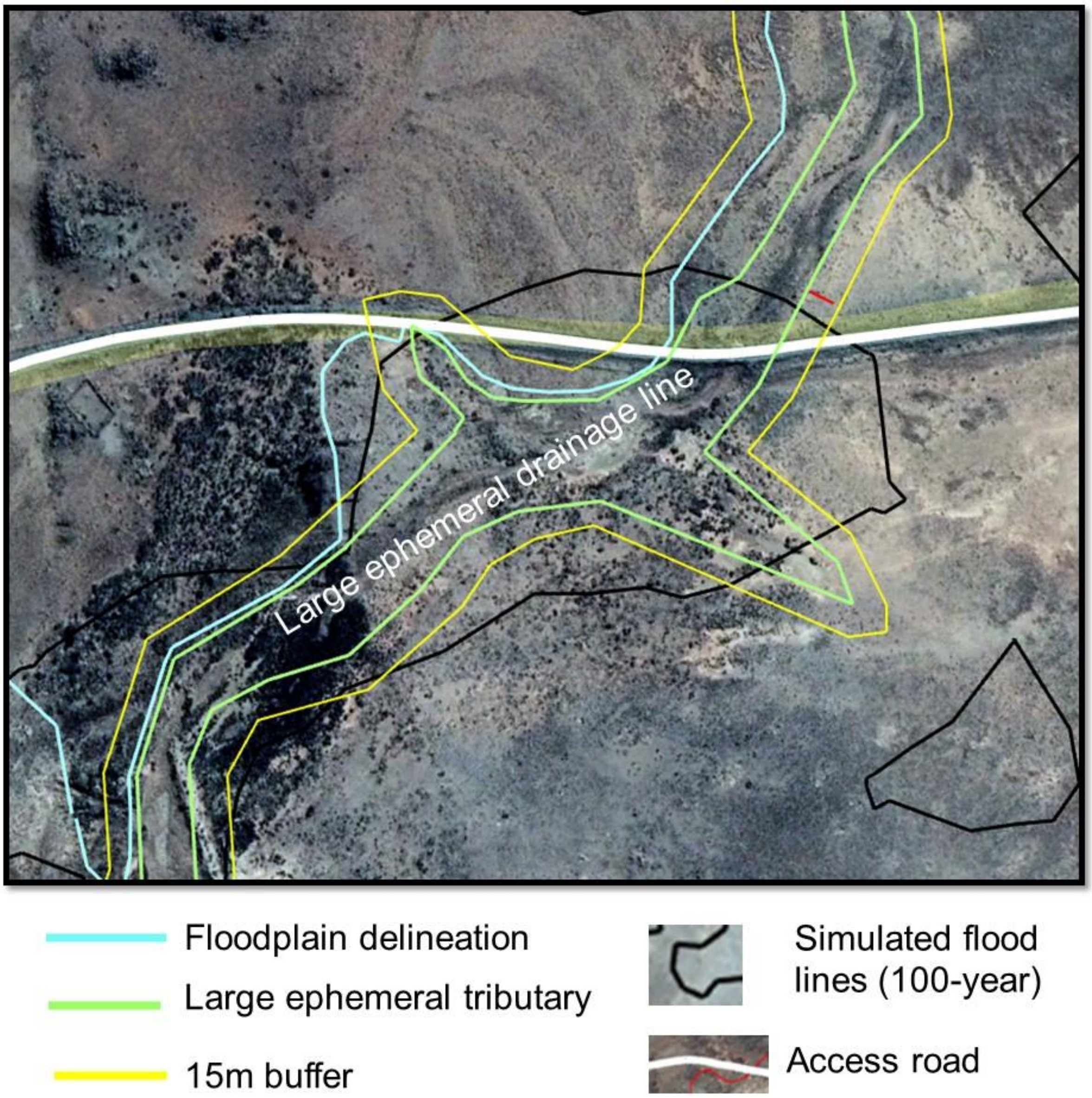


Figure 47: The large ephemeral drainage line at Section 1.5 delineated and buffered by the 15m buffer as determined by the DWS buffer tool.

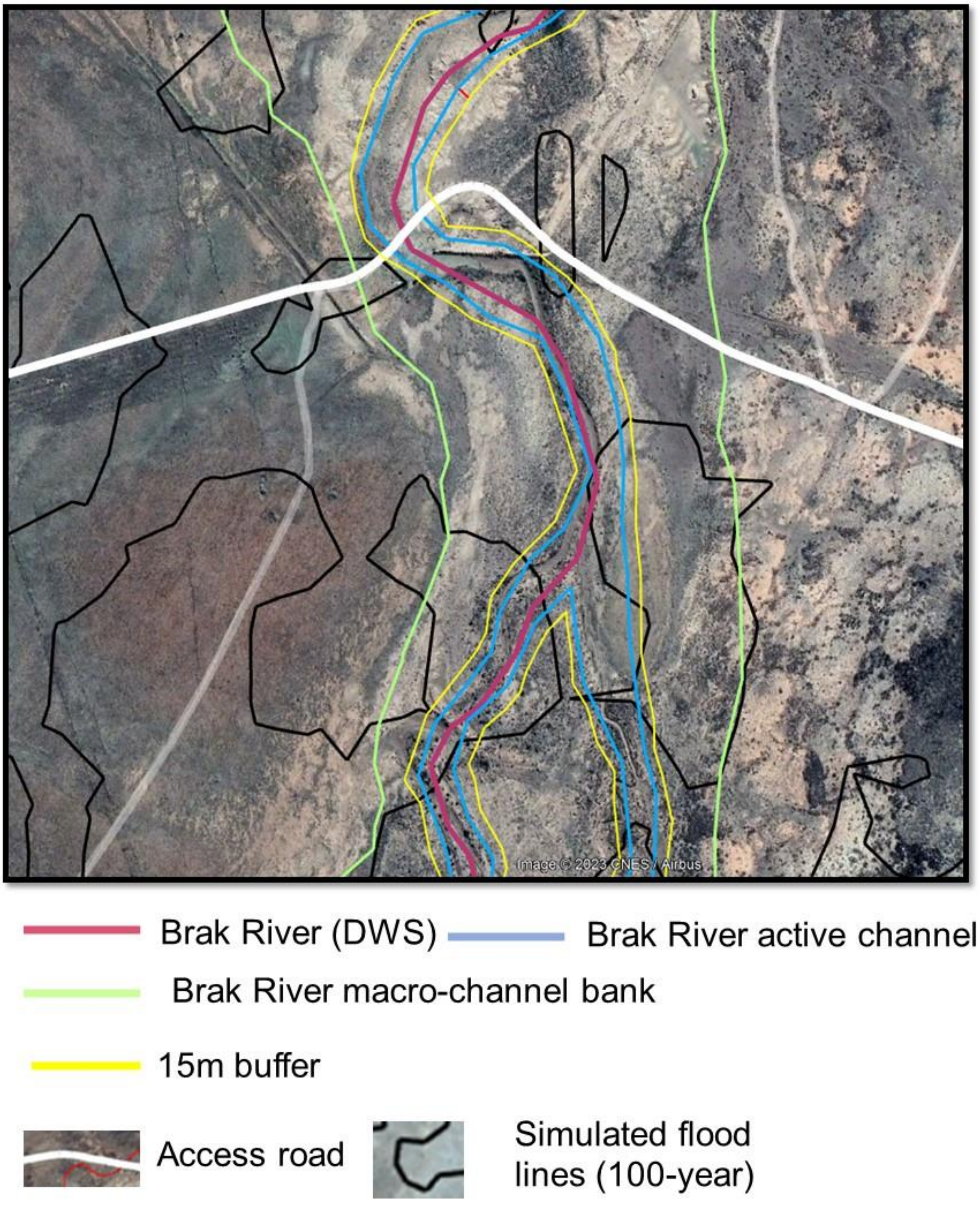


Figure 48: The Brak River drainage line at Section 2.2 with the major drainage lines delineated and buffered by the 15m buffer as determined by the DWS buffer tool.

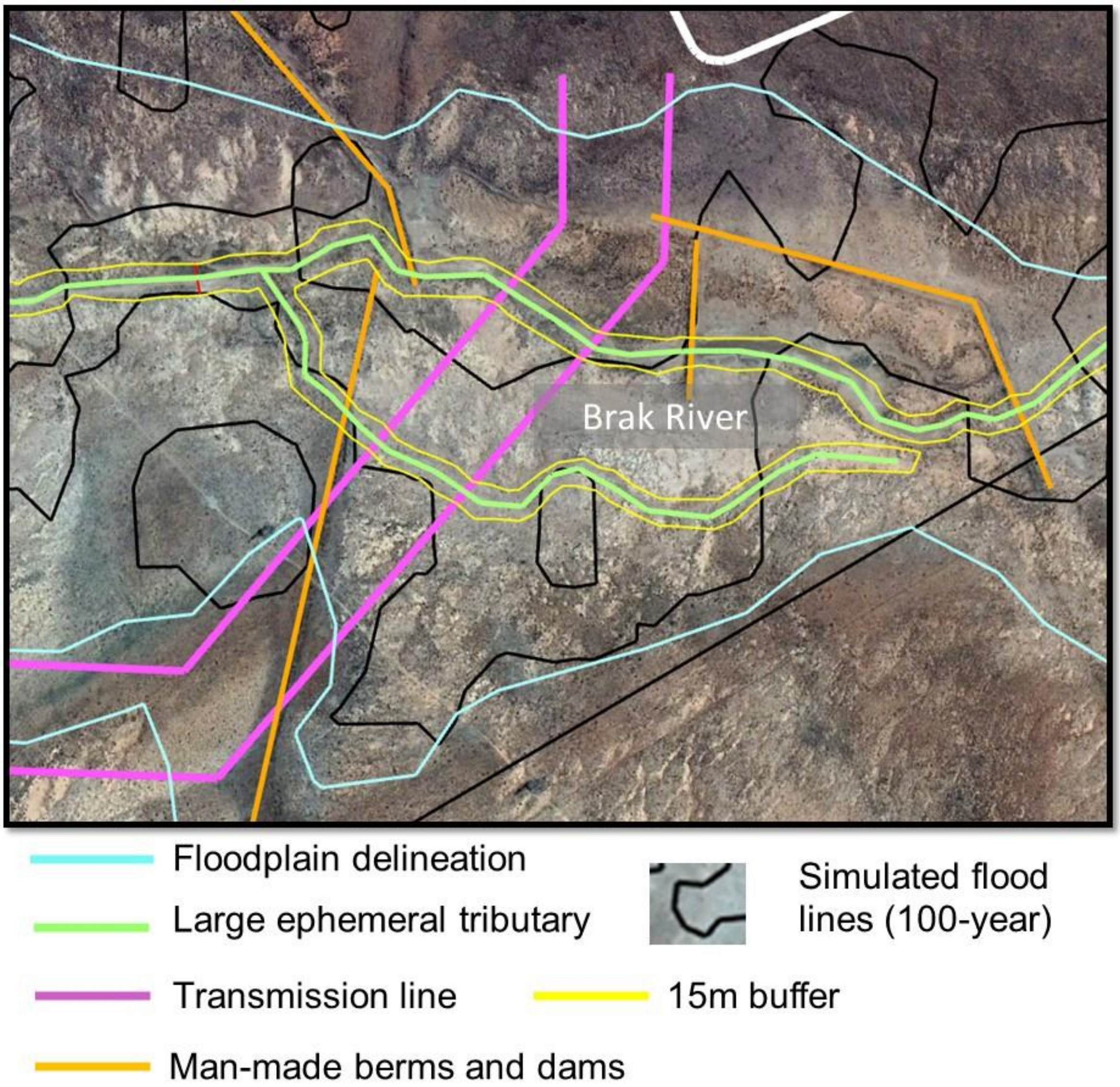


Figure 49: The Brak River drainage line at Section 4.1 with the major drainage lines delineated and buffered by the 15m buffer as determined by the DWS buffer tool.

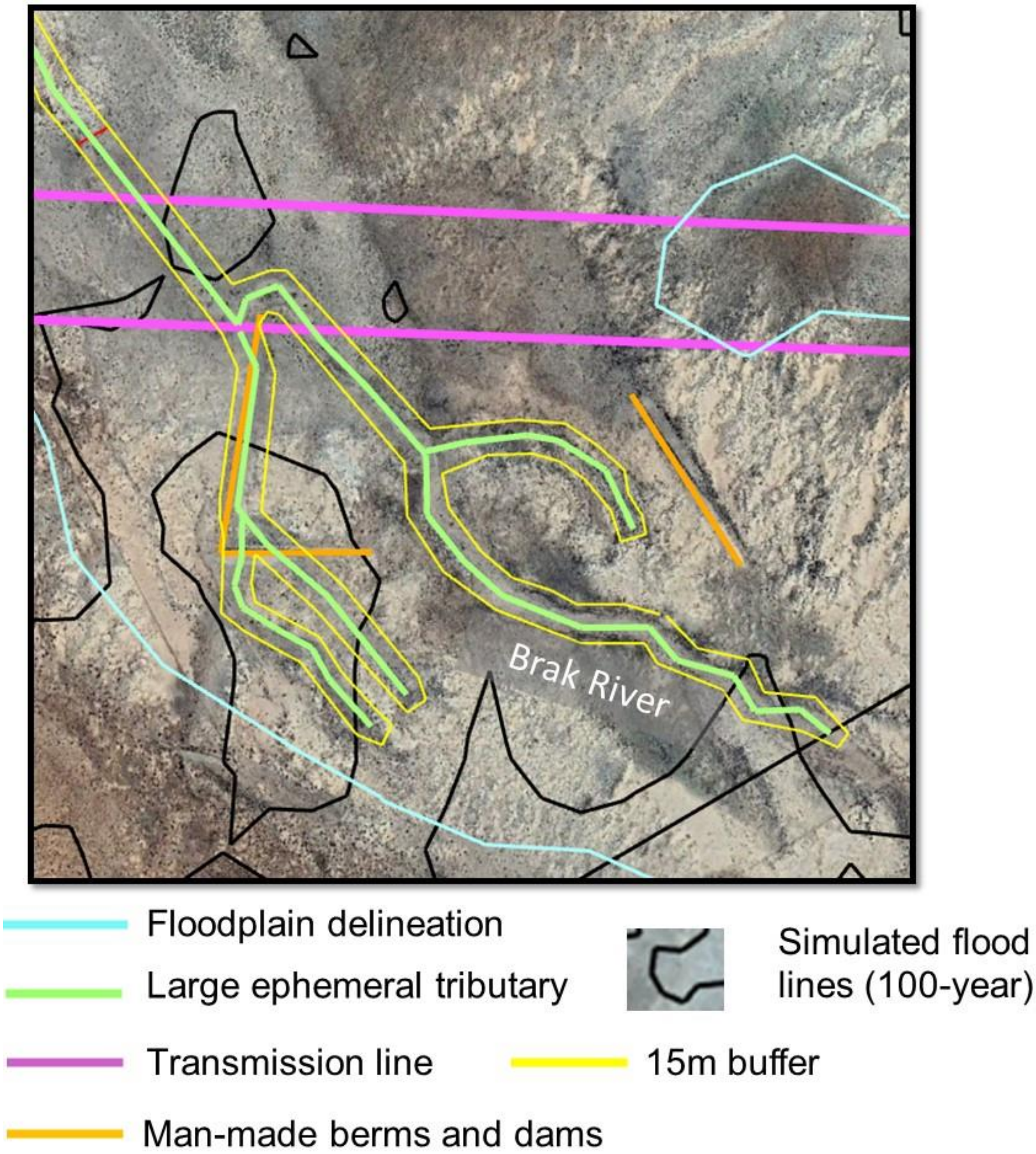


Figure 50: The Brak River drainage line at Section 4.2 with the major drainage lines delineated and buffered by the 15m buffer as determined by the DWS buffer tool.

2.5.2.1d Undertaking a Risk Assessment

Undertaking a Risk Assessment of certain activities associated with the development (to determine if S21(c) and (i) water uses can be authorised under a General Authorisation), specifically:

- Upgrade the access road (new sections of road constructed and widening of roads) from the N10 Burgerville District Road, across the Brak River floodplain and to the MTS and Switching Station development.
- Extending/providing for a 2.5km LILO into Line 1 of the 400kV Eskom Hydra-Poseidon transmission overhead line from the Main Transmission Station (MTS).
- The underground pipeline between the boreholes (BH13/BH14) and the water tank, and between BH5 and the water storage at the MTS.
- Placements and constructions of stations and plants
  - Placing and expansion of the MTS.
  - Placing a 132 kV Dx switching yard and constructing the Switching Station (Dx).
  - Concrete batching
- Boreholes BH13/BH14 along the D62D-05610 drainage line, and BH5 near the solar pump on the ridge.

Table 30: Following is an abstract from the Risk Assessment Matrix for the Sun Central Solar PV facility project area: relating to all current and expected impacts that the project will have on the system, the significance of these impacts, and mitigation through control measures.

No.	Phases	Activity	Aspect	Potential Impact	Significance	Risk Rating	Confidence level
1	Con	Preparing construction areas	1. Vegetation will be cleared on the project footprint for: access road, transmission line, Main Transmission Station, Switching Station and underground pipeline.	1.1 Any permanent clearing close to water sources will be subject to erosion and sedimentation impacts due to the lack of vegetation cover.	27	**Low**	4
2	Con	Upgrading water course crossing	2.1 Construction activities and increased access through drainage lines and riparian zones, have the potential to disturb soil structure.	2.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.	54	**Low**	3
			2.2 Stormwater management.	2.2 Inadequate storm water management and soil stabilisation measures might result in increased suspended solids and thus the siltation of watercourses.	54	**Low**	3
			2.3 Pollution potential.	2.3 Chemical pollution of the water resources.	24	**Low**	4
3	Con	3. Extending/providing for the LILO of 2.5 km into the Eskom overhead transmission line.	3.1 Installation of pylons for transmission lines may cause erosion and sedimentation in the drainage lines.	3.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.	24	**Low**	4

4	Con	4. Laying underground pipelines	4.1 Disturbing topsoil by laying underground pipelines might result in increased erosion, which leads to siltation of watercourses.	4.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.	24	**Low**	4
5	Con	5. Construction of other infrastructure.	5.1 Disturbing topsoil by the placing and expansion of the MTS; constructing the Dx Switching Station; Concrete batching.	5.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.	27	**Low**	4
			5.2 Potential pollution due to effluent from infrastructure.	5.2 Seepage from development areas will influence drainage adversely: the composition and structure of the drainage vegetation (more nutrients and increased ground water seepage) and the quality of the water will deteriorate (dissolved nutrients).	27	**Low**	4
			5.3 Boreholes: On sensitive sites.	5.3 Boreholes: Any extraction of water (surface or groundwater) in the arid Karoo environment will result in impacts on inundation/saturation regimes in drainage lines, and flow regimes in watercourses.	26	**Low**	3
6	Con	6. Alien invasive plants.	6.1 Spreading invasive non-native plants into degraded areas.	6.1 Competing with indigenous plant species.	26	**Low**	3
7	Op	7. Upgrading water course crossing.	7.1 Impacts created by the peak flows and stormwater.	7.1 Water course crossing structures have the potential to increase or concentrate flows which will lead to channel disturbance and erosion.	26	**Low**	3

Con = Construction; Op = Operation

Control measures of these impact are described in detail below.

Table 31: The rating classes for the Risk Assessment Matrix.

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

Following are the control measures applied to mitigate for impacts listed during the Risk Assessment process in Table 30.

Construction phase

Activity 1: Preparing construction areas

Aspect 1. Vegetation will be cleared on the project footprint for: access road, transmission line, Main Transmission Station, Switching Station and underground pipeline.

Impact 1.1 Any permanent clearing close to water sources will be subject to erosion and sedimentation impacts due to the lack of vegetation cover.

Control Measures

1. A construction method statement should be compiled and approved prior to the commencement of construction activities.
2. Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared.
3. A vegetation rehabilitation plan should be implemented.
4. Any areas disturbed during the construction phase should be encouraged to rehabilitate as fast and effective as possible and where deemed necessary by the ECO.
5. Existing roads should be used for access as far as possible. Make use of existing roads and tracks where feasible, rather than creating new routes.
6. Any additional routes and turning areas required by the contractor must be approved by the ECO, in the form of an amended ESM&R Plan indicating the position and extent of the proposed route / area.
7. Ensure that all access roads utilised during construction (which are not earmarked for closure and rehabilitation) are returned to a usable state and / or a state no worse than prior to construction.

2.5.2.1a Upgrade the access road

Activity 2 Upgrading water course crossing

Aspect 2. Construction activities and increased access through drainage lines and riparian zones, have the potential to disturb soil structure.

Impact 2.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.

Control Measures

Vegetation cover

1. Vegetation and soil should be retained in position for as long as possible, and should only be removed immediately ahead of construction / earthworks in any specific area.

2. In areas where construction activities have been completed and no further disturbance is anticipated, rehabilitation and re-vegetation should commence as soon as possible.

3. Where the original vegetation was cleared or severely disturbed, rehabilitation measures should be put in place.

4. Site rehabilitation should aim to restore surface draining patterns, natural soil and vegetation as far as feasible.

5. The 15m buffer around the larger drainage lines should be enforced and adhered to. All construction activities should be conducted with care inside the buffered drainage area. No temporary or permanent structures, such as camps, water treatment facilities, stores or stockpiles should be established inside the buffered area.

Erosion control

1. Ensure erosion control along roads. Existing roads should be used for access as far as possible.

2. The area of disturbance should be kept to a minimum to allow clearing of the construction right of way. Especially the roads that cross the large flood plains and severe gulley erosion (observed outside the three project areas) should be planned well to reduce soil erosion.

3. Where new water course crossings are required, the engineering team must provide an effective means to minimise the potential up- and downstream effect of erosion and sedimentation (erosion protection) as well as minimise the loss of riparian vegetation (reduce footprint as much as possible).

Stormwater

1. Where diversion berms create concentrated flows, as well as in steep and/or sensitive areas (such as wetlands) the use of swales, silt fences or other effective erosion control measures is recommended to attenuate runoff.

2. All storm water management measures should be regularly maintained.

Timing of construction

1. During the rainy season terrain mobility on high clay soils in low lying areas with drainage lines will be difficult and might increase soil erosion when drainage lines are disturbed. However, it is important to note that rainfall is highly unpredictable with frequent droughts for the project areas.

2. There should be reduced activity at the site after rainfall events when the soils are wet. No driving off from hardened roads should occur immediately following large rainfall events until soils had dried out and the risk of bogging down has decreased.

2.5.2.1b Extending the 2.5 km main transmission line

Activity 3: Extending the 2.5 km main transmission line

Aspect 3. Installation of pylons for transmission lines may cause erosion and sedimentation in the drainage lines.

Impact 3.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.

Control Measures

1. No pylons should be located within an area that would be expected to become inundated during a 1:100 flood event.

2. The powerline route should be regularly inspected during the operational phase for erosion.

3. Any erosion channels developing during or after the construction period should be appropriately backfilled (and compacted where relevant) and the areas restored to a condition similar to the condition before the erosion occurred.

2.5.2.1c Pipelines

- The underground pipeline between the boreholes (BH13/BH14) and the water tank, and between BH5 and the water storage at the MTS.

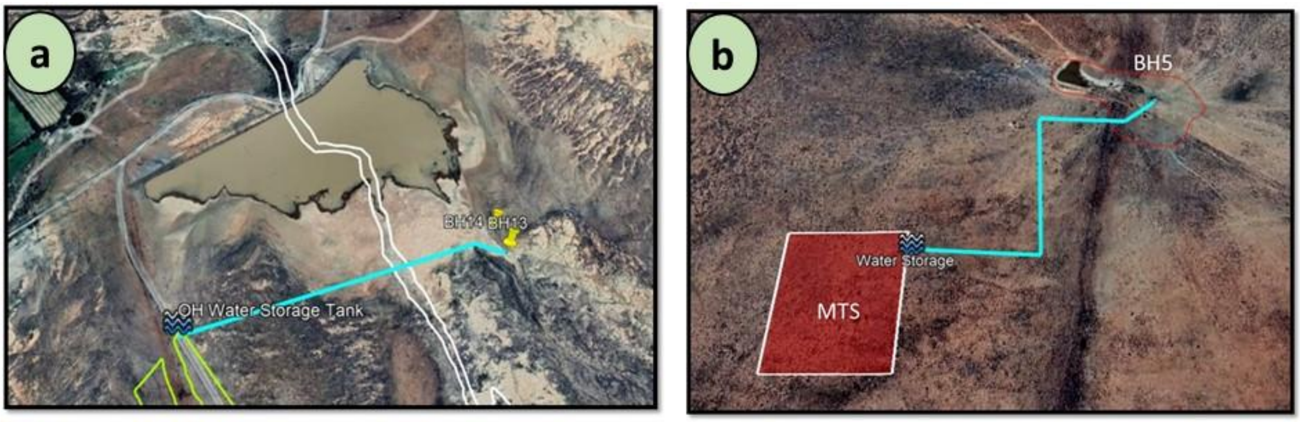


Figure 51: Pipelines

51a. The underground pipeline between the boreholes (BH13/BH14) and the water tank.

51b. The pipeline between BH5 and the water storage at the MTS.

Activity 4: Laying underground pipelines

Aspect 4. Disturbing topsoil by laying underground pipelines might result in increased erosion, which leads to siltation of watercourses.

Impact 4.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.

Control Measures

1. Implement best management practices for underground linear structures (underground pipelines).

2. Suitable demarcation must be erected around the construction area, including the servitude, areas where material is stored and the actual footprint of the development to prevent access to sensitive areas.

3. A rehabilitation plan must be implemented that will restore the natural vegetation to what it was prior to the construction of the pipeline, so that the long-term impact could be negligible.

4. Implement appropriate stormwater management around the excavation areas to prevent the ingress of run-off into the excavation trenches.

2.5.2.1d Placements and constructions of stations and plants

- Placing and expansion of the MTS.
- Placing a 132 kV Dx switching yard and constructing the Dx Switching Station.
- Floodlights and telecommunications tower.
- Concrete batching.

Viewing the current watercourse delineation and referring to the site visit of the site, there are no impacts expected in the process of the placement and expansion of the Main Transmission Station, the 132 kV switching yard and construction of the Switching Station (Dx) and Concrete batching.

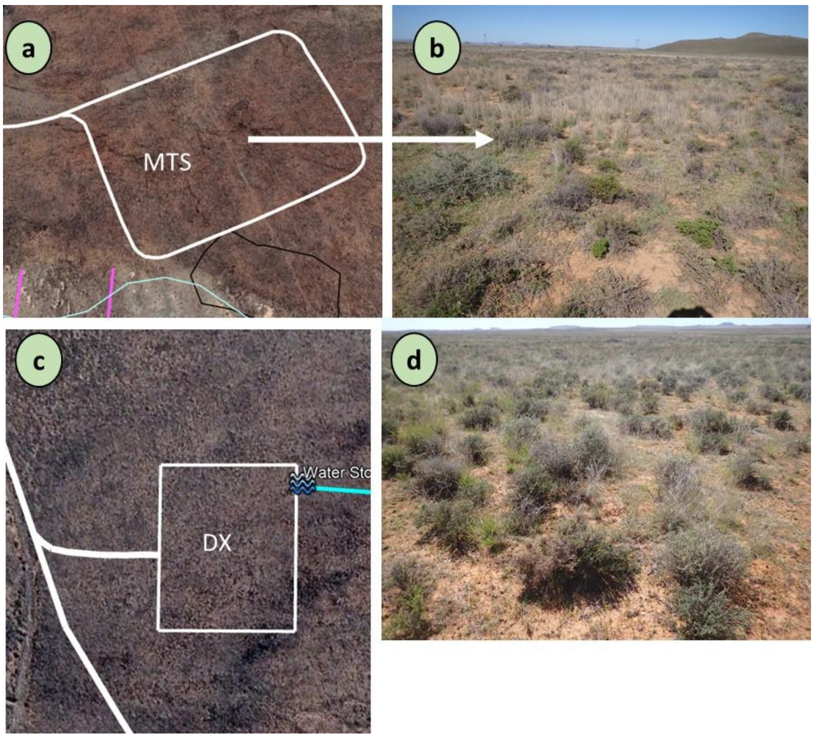


Figure 52 a - d: Both the Main Transmission Station (MTS) (a and b) and the Switching Station (DX) (c and d) are planned in areas outside the delineated drainage area.

Activity 5: Construction of other infrastructure.

Aspect 5.1. Disturbing topsoil by the placing and expansion of the MTS; constructing the Switching Station; Concrete batching.

Impact 5.1 Disturbing topsoil might result in erosion, which will lead to siltation and an increase in turbidity of watercourses.

Control Measures

1. Any erosion channels developing during or after the construction period should be appropriately backfilled (and compacted where relevant) and the areas restored to a condition similar to the condition before the erosion occurred.

2. The proposed complex may need some stormwater systems to manage runoff and prevent erosion and only if erosion and ponding are noted. A vegetated swale or V-drain should be considered that drain to outlets stabilised by rock rip-rap/reno mattresses. Otherwise, free drainage should be sufficient (GCS Water and Environmental Consultants. 2022).

Aspect 5.2. Potential pollution due to effluent from infrastructure.

Impact 5.2 Seepage from development areas will influence wetlands adversely: the composition and structure of the drainage vegetation (more nutrients and increased ground water seepage) and the quality of the water will deteriorate (dissolved nutrients).

Control Measures

Ensure correct placing of concrete batching plants and vehicle servicing areas etc. to avoid areas susceptible to soil and water pollution. Water runoff from the sites should be controlled as far as possible to prevent adverse effects. The seasonal drainage line should be protected from an increased inflow of poor-quality water.

2.5.2.1e Boreholes

BH5 is an existing solar borehole in an area which resembles a wetland, but the surface water draining from the pump to a small dam lower downstream, provides the wetness to the surrounding area.

Activity 5.3: Boreholes: On sensitive sites.

Aspect 5.3 Boreholes: On sensitive sites.

Impact 5.3 Any extraction of water (surface or groundwater) in the arid Karoo environment will result in impacts on inundation/saturation regimes in wetlands, and flow regimes in watercourses.

Control Measures

For the three boreholes with pipelines, it was recommended to install overhead storage tanks on these 3 boreholes from which water bowsers could collect water. Boreholes BH13 and

BH14 are situated within a sensitive watercourse and their use would be dependent on piping water to a more suitable storage and collection point on an existing farm track.

Activity 6: Alien invasive plants.

Aspect 6.1. Spreading invasive non-native plants into degraded areas.

Impact 6.1 Competing with indigenous plant species.

Control Measures

1. A weed and alien invasive species control plan should be implemented during the contract period.
2. Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion.

Operational phase

Activity 7: Upgrading water course crossing.

Aspect 7.1. Impacts created by the peak flows and stormwater.

Impact 7.1 Water course crossing structures have the potential to increase or concentrate flows which will lead to channel disturbance and erosion.

Control Measures

Crossing structures with the least impacts per structure, are proposed as follow (GCS Water and Environmental Consultants. 2022.):

- Small drainage lines and floodplain crossings: Free drainage.
    - Many of the smaller crossings are impeded by the elevation of the road, and it will probably be more so when the road is upgraded. It is proposed that some drainage are supplied to these areas to prevent pooling on the upstream edge of the road.
    - If drainage lines or watercourses cannot be avoided, ensure that road crossings are constructed using riprap, gabion mattresses, and/or other permeable material to minimise the alteration of surface and sub-surface flow.
- Large ephemeral drainage line: Permanent box culvert.
    - All crossings over watercourses should be such that the flow within the channels is not impeded and should be constructed perpendicular to the river channel.
- Large ephemeral Brak River: Concrete drift crossing.
    - Flow of water under roads must be allowed to occur without leading to concentration of surface flow. This can be achieved through designing bridges that span the entire width of aquatic ecosystems where possible, or laying down pipes or culverts to ensure connectivity and avoid fragmentation of surface aquatic ecosystems.

2.5.3 The Impact Mitigation Hierarchy

- Firstly, alternatives must be investigated to avoid negative impacts altogether.
- Secondly, after it has been found that the negative impacts cannot be avoided, alternatives must be investigated to reduce (mitigate and manage) unavoidable negative impacts to acceptable limits.
- Thirdly, alternatives must be investigated to remediate (rehabilitate and restore).
- Fourthly, unavoidable impact that remain after mitigation and remediation must be compensated for through investigating options to offset the negative impacts.
- While throughout, alternatives must be investigated to optimise positive impact.

2.5.3.1 to 2.5.3.5 Impact Assessment Aspects

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 (2.5.1 to 2.5.6 below):

2.5.3.1 Maintaining the priority aquatic ecosystem.

Question: Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?

A: Yes, no significant adverse impact has been predicted during the study and impact assessment that could jeopardise the surrounding environment. Aspects of mitigation prescribed, should maintain the integrity of the system and may even improve it.

2.5.3.2 Maintaining the resource quality objectives.

Question: Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?

A: No RQO was set by DWS for this ephemeral system. Water quality and flows will remain unchanged by the construction and operational phases as the system drains towards the Brak River and it will not change the PES of the mainstem.

2.5.3.3 Impact on fixed and dynamic ecological processes.

Question: 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.

Impact: 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);

A: It is an ephemeral system and it only flows rarely during seasonal downpours. No further damming is envisaged thus flows can proceed towards the Brak River mainstem.

b. Sediment regime.

Impact: 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);

A: Should the mitigation regarding erosion and sedimentation in the project area be adhered to, no significant changes in the sediment regime is expected.

c. Modification in relation to the overall aquatic ecosystem.

Impact: 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.)?

A: No modification is expected. The ephemeral system flows rarely and during these events no interference of flows is foreseen.

d. Risks associated with water uses.

Impact: To what extent will the risks associated with water uses and related activities change?

A: It has already been established that the development will not impact on any of the drainage users due to the project. As such the activity will not affect or impact any broader societal needs, communities or economies.

2.5.3.4 Impact on the functioning of the aquatic feature stated

Question: How will the proposed development impact on the functioning of the aquatic feature? This must include:

a. Base flows.

Impact: On base flows (e.g., too little or too much water in terms of characteristics and requirements of the system).

A: The ephemeral system flows rarely and during these events no interference or manipulation of flows is foreseen.

b. Quantity of water.

Impact: The quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river).

A: The ephemeral system flows rarely and during these events no interference or manipulation of flows is foreseen.

c. Change in the hydrogeomorphic typing.

Impact: The change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland).

A: The presence of pylons will have no impact on flow or associated habitat.

d. Quality of water.

Impact: The quality of water (e.g., due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);

A: None of the project aspects will have any significant outflow of any chemical nature, therefore no chemical contamination is expected.

e. Ecological connectivity.

Impact: The fragmentation (e.g., road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).

A: All probable adverse impacts on the drainage line are well mitigated according to the risk assessment, which will be incorporating all linear developments.

f. Loss or degradation of all or part of any unique or important features.

Impact: 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.);

A: There will be no loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem since.

2.5.3.5 Impact on key ecosystems regulating and supporting services especially:

Question: How will the proposed development impact on key ecosystems regulating and supporting services especially:

(a) Flood attenuation: There are some existing small dams and many berms in the system, but no structure is planned in the project area that will change the current aquatic ecosystem.

(b) Streamflow regulation: No streamflow regulation will take place when the structure is in place. There are currently some existing small dams in the system, but no structure is planned in the system that will impact streamflow.

(c) Sediment trapping: It will remain a free-flow system.

(d) Phosphate assimilation: There is no reason to believe that the construction or operation of the solar system will have an impact on any water quality parameter in the drainage reach.

(e) Nitrate assimilation: There is no reason to believe that the construction or operation of the solar system will have an impact on any water quality parameter in the drainage reach.

(f) Toxicant assimilation: There is no reason to believe that the construction or operation of the solar system will have an impact on any water quality parameter in the drainage reach, including toxicant assimilation.

(g) Erosion control: In areas where construction activities have been completed and no further disturbance is anticipated, rehabilitation and re-vegetation should commence as soon as possible.

(h) Carbon storage: By not interfering with any plant cover and not impacting on the extensive shrubby areas around the project area, will keep the carbon levels similar to before the construction.

2.5.4 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: There is no reason to believe that the proposed development will 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.

2.5.5 In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered.

A: Not applicable to this project.

2.7 Minimum Requirements for Specialist Assessments (see below)

The protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity.

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on aquatic biodiversity for activities requiring environmental authorisation.

Table 31:	Specialist reports Checklist
	Requirements for Specialist Reports: Published in Government Notice No. 320; Government Gazette 43110**;** 20 March 2020
2.7	The findings of the specialist assessment must be written up in an **Aquatic Biodiversity Specialist Assessment Report** that contains, as a minimum, the following information:
2.7.1	contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;
2.7.2.	a signed statement of independence by the specialist;
2.7.3.	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;
2.7.4.	the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;
2.7.5.	a description of the assumptions made any uncertainties or gaps in knowledge or data;
2.7.6.	the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;
2.7.7.	additional environmental impacts expected from the proposed development;
2.7.8.	any direct, indirect and cumulative impacts of the proposed development on site;
2.7.9.	the degree to which impacts and risks can be mitigated;
2.7.10.	the degree to which the impacts and risks can be reversed;
2.7.11.	the degree to which the impacts and risks can cause loss of irreplaceable resources;
2.7.12.	a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;
2.7.13	. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);
2.7.14.	a motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a “low” aquatic biodiversity sensitivity and that were not considered appropriate;
2.7.15	. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and
2.7.16.	any conditions to which this statement is subjected.

2.8 Aquatic Biodiversity Specialist Assessment Report

The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the information summarised in Table 31.

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.

For detail of the Registered Specialist, see Section 2.1.

2.8.1 Details of the Specialist

2.8.1.1 Contact details of the specialist:

Dr Andrew Deacon
Cell: 082 325 5583
Email: andrew@nethog.co.za
PO Box 784, Malalane, 1320

Registered with the South African Council for Natural Scientific Professions (SACNASP). Registration number: 116951

2.8.1.2 Field of expertise: Freshwater Ecologist

2.8.1.3 Curriculum vitae

Dr Andrew Deacon (PhD Zoology) worked as a researcher at Scientific Services, South African National Parks (SANParks, 1989 - 2012). He was initially employed as an Aquatic ecologist to coordinate the multidisciplinary KNP Rivers Research Programme, but later was tasked to manage the monitoring and research programmes for small vertebrate ecology in 15 South African National Parks (including Addo-, Kalahari- and Kruger NP).

As a recognised scientist in the fields of Ichthyology and Terrestrial Ecology, he is currently engaged as a specialist consultant regarding ecological studies. He was involved in numerous research programmes and projects and produced EIA specialist reports (aquatic or terrestrial ecology) for 82 projects. Additionally, he also participated in Aquatic ecosystem projects, Environmental Water Requirement Studies and Faunal and ecosystems monitoring projects.

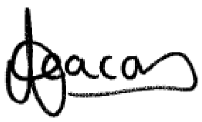
Apart from multiple environmental projects in South Africa, he has worked on assignments in the Democratic Republic of the Congo, Zambia, Mozambique, Zimbabwe, Namibia and Swaziland. He completed: Wetland Introduction and Delineation Course – Centre for Environmental Management: University of the Free State. He is a registered Professional Natural Scientist (Pr. Sci. Nat.) in the fields of Ecological Science (Reg. no. 116951).

2.8.2 A signed statement of independence by the specialist (corresponding with Item 2.7.2 in the protocol for the specialist assessment and minimum report content requirements – see Table 31)

DECLARATION

I, Andrew Richard Deacon, declare that I –

- act as an independent specialist consultant in the field of ecological science;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report; and
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.



ANDREW RICHARD DEACON

2.8.3 A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.

This section corresponds with Item 2.8.3 in the protocol for the specialist assessment and minimum report content requirements (see Table 31)

The field work has taken place over a period of seven days from 29 November 2022 to 4 December 2022 in the Sun Central 300 MW Solar PV project facility area. The season corresponds with middle summer when the riparian zone vegetation in full bloom.

Since seasonal changes do not influence the presence of aquatic fauna (fish and macro-invertebrates) significantly, aquatic surveys are not directed by seasonality. However, flows occur only during the rainy season. During the current survey the place had good rains and some surface water was present in the project area.

2.8.4 Methodology

The methodology used to undertake the site inspection and the specialist assessment, (including equipment and modelling used, where relevant), are described in the following section.

2.8.4.1 Screening Report

The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.

The Screening Tool also provides site specific EIA process and review information, for example, the Screening Tool may identify if an industrial development zone, minimum information requirement, Environmental Management Framework or bio-regional plan applies to a specific area.

Finally, the Screening Tool allows for the generating of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation and as such the tool has been developed in a manner that is user friendly and no specific software or specialised GIS skills are required to operate this system.

A screening report was done for an environmental authorization or for a part two amendment of an environmental authorisation as required by the 2014 EIA regulations, evaluating the proposed development footprint for environmental sensitivity.

2.8.4.2 Site Sensitivity Verification Report

2.7.4.2.1 The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist (Protocol 2.1).

2.7.4.2.2 The site sensitivity verification must be undertaken through the use of (Protocol 2.2):

(a) a desk top analysis, using satellite imagery;

(b) a preliminary on-site inspection; and

(c) any other available and relevant information.

2.7.4.2.3 The outcome of the site sensitivity verification must be recorded in the form of a report that (Protocol 2.3):

(a) confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;

(b) contains a motivation and evidence (e.g., photographs) of either the verified or different use of the land and environmental sensitivity; and

(c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

2.8.4.3 Aquatic biodiversity and ecosystems

2.8.4.3.1 Aquatic ecosystem types

Aquatic Ecosystem Classification

Aquatic ecosystems were classified according to a hierarchical system described by Ollis *et al*. (2013).

Aquatic Habitat Assessments

Habitat assessments, according to the habitats sampled, were performed because changes in habitat can be responsible for changes in SASS5 scores. This was achieved by applying the SASS orientated habitat assessment indices. The indices used are the Integrated Habitat Assessment System (IHAS) score sheet and the Habitat Quality Index (HQI).

Applicable fish habitat assessments such as the Habitat Cover Ratings (HCR) and Site Fish Habitat Integrity Index (SHI) will be used to assess the habitat potential and condition for fish assemblages

2.8.4.3.2 Aquatic biota surveys

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporating the habitat aspects, a proper basis for biological diversity can be obtained.

The different components of the proposed development and its impact on the aquatic environment will be assessed for the river in the project area. The following recognised bio-parameters and methods will be used:

- Aquatic invertebrates: South African Scoring System version 5 (SASS5).
- Fish communities: Fish Response Assessment Index (FRAI).

Aquatic invertebrate assessment

Benthic macro-invertebrate communities of the selected sites were investigated according to the South African Scoring System, version 5 (SASS5) approach. An invertebrate net (30cm x 30cm square with 0.5mm mesh netting) was used for the collection of the organisms. The available biotopes at each site will be identified on arrival. Each of the biotopes was then sampled separately and by different methods. Sampling of the biotopes was done as follows:

Stones in current (SIC): Movable stones of at least cobble size (3 cm diameter) to approximately 20 cm in diameter, within the fast and slow flowing sections of the river. Kick-sampling is used to collect organisms in this biotope. This is done by placing the net on the bottom of the river, just downstream of the stones to be kicked, in a position where the current will carry the dislodged organisms into the net. The stones are then kicked over and against each other to dislodge the invertebrates (kick-sampling) for ± 2 minutes.

Stones out of current (SOOC): Where the river is calm, such as behind a sandbank or ridge of stones or in backwaters. Collection is again undertaken using the kick-sampling method, except in this case the net is swept across the area sampled to catch the dislodged biota. Approximately 1 m^2 is sampled in this way.

Sand: These include sandbanks within the river, small patches of sand in hollows at the side of the river or sand between the stones at the side of the river where flow was slow or no flow was recorded. This biotope is sampled by stirring the substrate, shuffling or scraping of the feet is done for half a minute, whilst the net is continuously swept over the disturbed area.

Gravel: Gravel typically consists of smaller stones (2-3 mm up to 3 cm). Sampling similar to that of sand.

Mud: It consists of very fine particles, usually as dark-coloured sediment. Mud usually settles to the bottom in still or slow flowing areas of the river. Sampling like that of sand.

Marginal vegetation (MV): This represents the overhanging grasses, bushes, twigs and reeds from the riverbank. Sampling is undertaken by holding the net perpendicular to the vegetation (half in and half out of the water) and sweeping back and forth in the vegetation (± 2m of vegetation).

Aquatic vegetation (AQV): Rooted, submerged or floating waterweeds such as *Potamogeton, Aponogeton* and *Nymphaea.* Sampled by pushing the net (under the water) against and amongst the vegetation in an area of approximately one square meter.

The organisms sampled in each biotope were identified and their relative abundance is also noted on the SASS5 datasheet. Habitat assessments, according to the habitats sampled, were performed due to the fact that changes in habitat can be responsible for changes in SASS5 scores. This was achieved by applying the SASS orientated habitat assessment indices. The indices used are the Integrated Habitat Assessment System (IHAS) score sheet and the Habitat Quality Index (HQI).

The SASS5 method was used to establish the macro-invertebrate integrity in all three of the main habitat assemblages: stones, vegetation and sand/mud/gravel. The associated habitats were determined with the Invertebrate Habitat Assessment System (IHAS) and the Habitat Quality Index (HQI).

Although the SASS5 method was used as prescribed by DWS, it must be kept in mind that this method was designed for water quality purposes. Therefore, the macro-invertebrate integrity scores may vary throughout the year as water quality changes, due to flow variation, as should be the case in the pre- and post-construction phases of the monitoring project.

Aquatic invertebrates were sampled using a standard SASS net and identified to at least family level according to the SASS5 sampling technique (Dickens and Graham 2002). The SASS5 results were classified into one of six Present Ecological State categories, ranging from Natural (Category A), to very Critically Modified (Category F).

Fish communities - Fish Response Assessment Index (FRAI)

The biotic assessment method uses a series of fish community attributes related to species composition and ecological structure to evaluate the quality of an aquatic biota. Data on distribution, richness, length frequency and abundance will be collected. The sampling methods include fish traps, seine nets, mosquito nets and electro-fishing.

Due to the ephemeral nature of the system, the lack of flows and absence of surface water, are the reasons why no fish species are able to inhabit and survive in the system. Even during the short-lived surface flows, the distance from permanent water and brief inundation of the system, rules out the presence of these assemblages

a) Riparian habitat surveys (Riparian Vegetation Index — VEGRAI)

The general components of the VEGRAI are specified as following:

- It is a practical and rapid approach to assess changes in riparian vegetation condition.

- It considers the condition of the different vegetation zones separately but allows the integration of zone scores to provide an overall index value for the riparian vegetation zone as a unit.

- The vegetation is assessed based on woody and non-woody components in the respective zones and according to the different vegetation characteristics which include, inter alia:

  - Cover
  - Abundance
  - Recruitment
  - Population structure
  - Species composition

- It provides an indication of the causes for riparian vegetation degradation.
- It is impact based. This means that the reference condition will only be broadly defined and based on the natural situation in the absence of impacts. Where possible, however, reference conditions should be derived based on reference sites or sections.

The index is based on the interpretation of the influence of riparian vegetation structure and function on in-stream habitat.

Although biodiversity characteristics are used in assessing the riparian vegetation condition, it is not a biodiversity assessment index *per se.*

For this study the Level 3 VEGRAI will be used as Level 3 is applied by the River Health Programme (RHP) and for rapid Ecological Reserve purposes. This level will be aimed at general aquatic ecologists.

Ecological State of the Water Course

The determination and categorisation of the Present Ecological State (PES) takes place during the process of the Ecological Classification process. The purpose of the EcoClassification process is to gain insights and understanding into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the river.

During the EcoClassification process, the EcoStatus is also determined. EcoStatus represents an ecologically integrated state representing the **drivers** (hydrology, geomorphology, physico-chemical) and **responses** (fish, aquatic invertebrates and riparian vegetation). The EcoStatus refers to the integration of physical changes by the biota and as reflected by biological responses.

The development of methods to achieve the objectives of this study, focused on a two-step process –

- Devising consistent indices for the assessment of the Ecological Categories of individual biophysical components.
- Devising a consistent process whereby the Ecological Categories of individual components can be integrated at various levels to derive the EcoStatus of the river.

The following index models were developed following a Multi Criteria Decision Making Approach (MCDA):

- Fish Response Assessment Index (FRAI)
- Macro Invertebrate Response Assessment Index (MIRAI)
- Riparian Vegetation Response Assessment Index (VEGRAI)

Riparian delineation

It is important to differentiate between wetlands and riparian habitats. Riparian zones are not wetlands, however, depending on the ecosystem structure, wetlands can be also be classified as riparian zones if they are located in this zone (e.g., valley bottom wetlands). Although these distinct ecosystems will be interactive where they occur in close proximity it is important not to confuse their hydrology and eco-functions.

Riparian delineations are performed according to *"A practical field procedure for identification and delineation of wetlands and riparian areas"* as amended and published by the Department of Water Affairs and Forestry (2005); (Henceforth referred to as DWAF Guidelines (2005).

Aerial photographs and land surveys were used to determine the different features and riparian areas of the study area. Vegetation diversity and assemblages were determined by completing survey transects along all the different vegetation communities identified in the riparian areas.

Riparian areas are protected by the National Water Act (Act 36 of 1998), which defines a riparian habitat as follows:

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

Riparian areas include plant communities adjacent to and affected by surface and subsurface hydrologic features, such as rivers, streams, lakes, or drainage ways. Due to water availability and rich alluvial soils, riparian areas are usually very productive.

Tree growth rate is high and the vegetation is lush and includes a diverse assemblage of species. The delineation process requires that the following be taken into account:

- Topography associated with the watercourse;
- Vegetation;
- Alluvial soils and deposited material.

A typical riparian area according to the DWAF Guidelines (2005) is illustrated in Figure 53.

In addition to the DWAF Guidelines (2005) and DWAF updated manual (2008), the unpublished notes: *Draft riparian delineation methods prepared for the Department of Water Affairs and Forestry, Version 1* (Mackenzie & Rountree, 2007) were used for classifying riparian zones encountered on the property according to the occurrence of nominated riparian vegetation species.

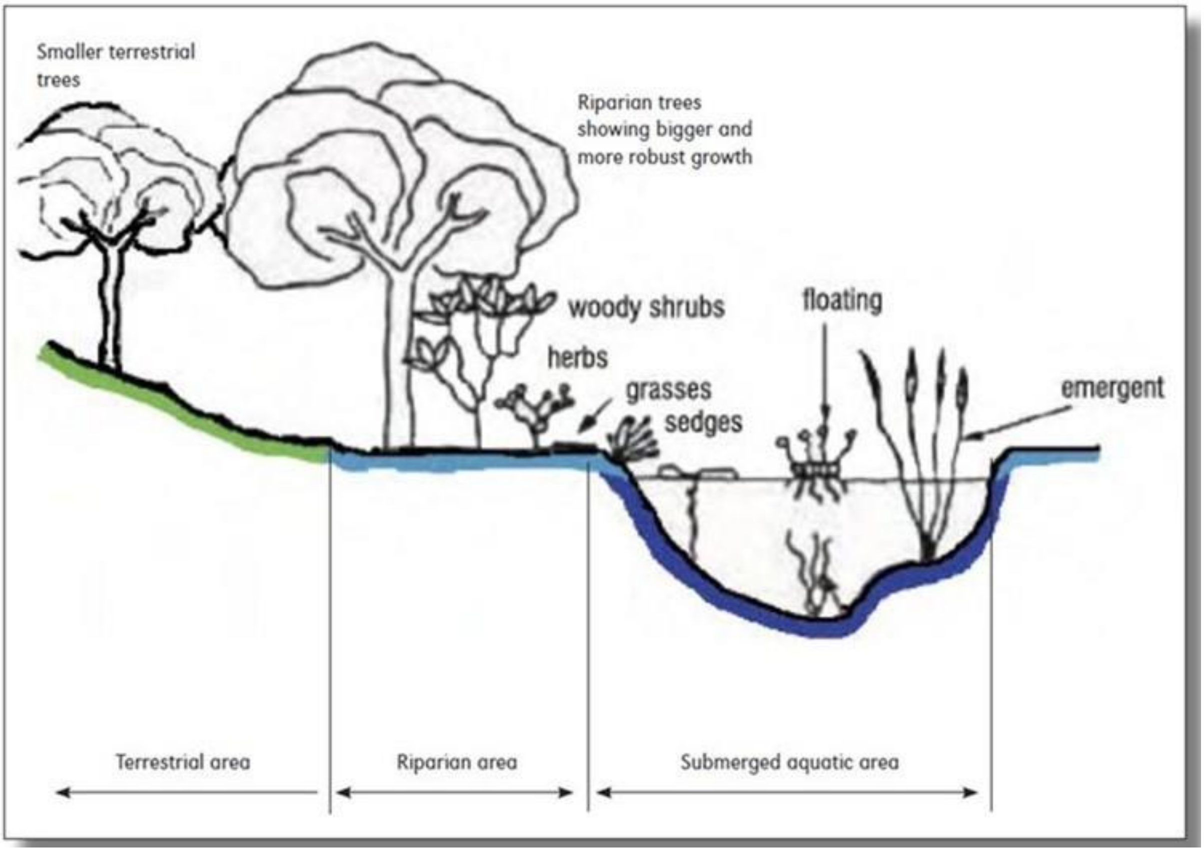


Figure 53: A cross section through a typical riparian area (DWAF Manual, 2008).

Buffers

Aquatic buffer zones are typically designed to act as a barrier between human activities and sensitive water resources thereby protecting them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity (Macfarlane et al, 2015). These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic- and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Due to their positioning adjacent to water bodies, buffer zones associated with streams and rivers will typically incorporate riparian habitat. Riparian habitat, as defined by the NWA, includes the physical structure and associated vegetation of the areas associated with a watercourse. These areas are commonly characterised by alluvial soils (deposited by the current river system) and are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas (Macfarlane et al, 2015).

However, the riparian zone is not the only vegetation type that lies in the buffer zone as the zone may also incorporate stream banks and terrestrial habitats depending on the width of the aquatic impact buffer zone applied. A diagram indicating how riparian habitat typically relates to aquatic buffer zones defined in this guideline is provided in Figure 54.

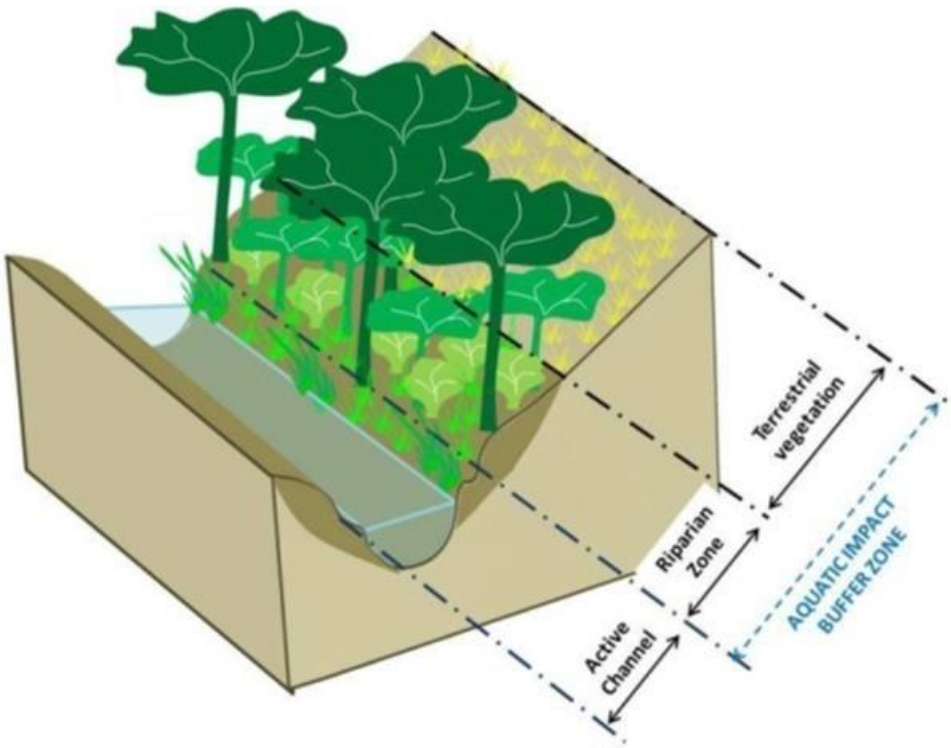


Figure 54: Schematic diagram indicating the boundary of the active channel and riparian habitat, and the areas potentially included in an aquatic impact buffer zone (Macfarlane et al, 2015).

Once an aquatic impact buffer zone has been determined, management measures need to be tailored to ensure buffer zone functions are maintained for effective mitigation of relevant threat/s. Management measures must therefore be tailored to ensure that buffer zone functions are not undermined. Aspects to consider include:

- Aquatic impact buffer zone management requirements;
- Management objectives for the aquatic impact buffer zone; and
- Management actions required to maintain or enhance the aquatic impact buffer zone in line with the management objectives. Activities that should not be permitted in the aquatic impact buffer zone should also be stipulated.

Determining appropriate management and monitoring of buffer zones

A series of Excel based Buffer Zone Tools have been developed to help users determine suitable buffer zone requirements (Macfarlane and Bredin, 2017). These include a rapid desktop tool for determining potential aquatic impact buffer zone requirements together with three site-based tools for determining buffer zone requirements for rivers, wetlands and estuaries. Central to these tools is a buffer model, which is populated automatically from the data capture sheets provided. This is based on best available science and is used to generate buffer zone recommendations as part of the assessment process. The Overview of the stepwise assessment process for buffer zone determination (Macfarlane and Bredin, 2017) is illustrated if Figure 55.

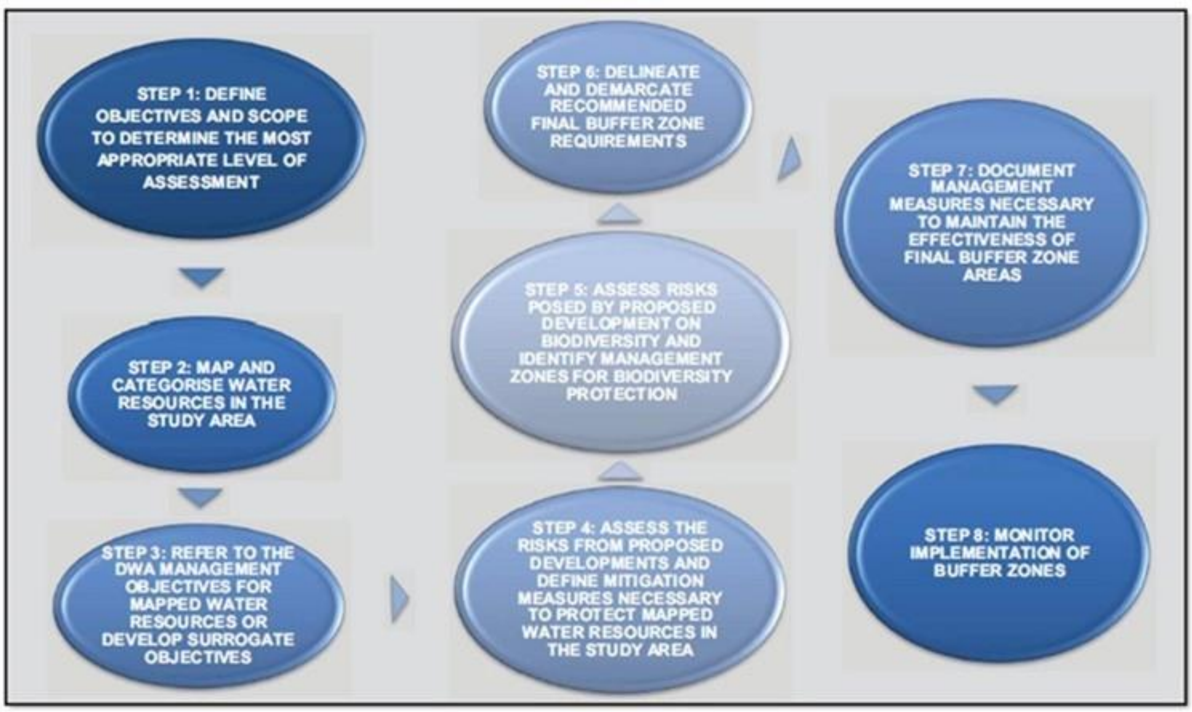


Figure 55: Overview of the step-wise assessment process for buffer zone determination (Macfarlane and Bredin, 2017).

Once a final buffer zone area has been determined, appropriate management measures should be documented to ensure that the water quality enhancement and other buffer zone functions, including biodiversity protection, are maintained or enhanced. Key aspects addressed include:

- Demarcating buffer zones.
- Defining suitable management measures to maintain buffer functions.
- Reviewing the need to integrate protection requirements with social and development imperatives.
  Monitoring to ensure that buffer zones are implemented and maintained effectively.

2.8.4.3 Spatial data sets that indicate Critical Biodiversity Areas

Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Land-Use Decision Support Tool (LUDS)

To establish how important the site is for meeting biodiversity targets, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives (e.g., is it in a **Critical Biodiversity Areas** (CBA) or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

PES & EIS assessment brief

Following is a summary of all the important aspects and processes that play a role in the determination of the Present Ecological State (PES) and Ecological Importance & Sensitivity (EIS), as part of the Environmental Water Requirement (EWR) process in determining the Ecological Reserve.

The **Ecological Reserve** refers to the quantity and quality of water required to (i) supply basic human needs and (ii) protect aquatic ecosystems and the detail of the Reserve is derived from the **Ecological Reserve determination**. The **EcoClassification** process is an integral part of the Ecological Reserve determination method and of any **Environmental Flow Requirement (EFR)** or **Environmental Water Requirement (EWR)** method. Reserve determination methods identify **EWRs** as continuous flows and periodic 'events' of defined magnitudes which are combined as volumes or mean monthly flows.

The term **EcoClassification** is used for the **Ecological Classification (EC)** process and refers to the determination and categorisation of the **Present Ecological State** (**PES**). The PES of the river is expressed in terms of various components i.e., drivers (physico-chemical, geomorphology, hydrology) and biological responses (fish, riparian vegetation and aquatic invertebrates) as well as an integrated state, the **Ecological Status** or **EcoStatus** of a river. The EcoStatus refers to the integration of physical changes by the biota and as reflected by biological responses. The individual drivers and biological responses are referred to as **components** while the individual attributes within each component that are assessed, to determine deviation from the expected natural reference condition, are referred to as ***metrics***.

Ecological Categories (A→F; A = Natural, and F = critically modified) are determined as part of the **EcoClassification** process form an essential part of most of the **Reserve** steps. The **Recommended Ecological Category (REC)** can be recommended as future states depending on the **EIS** and **PES** of the river reach.

Resource Quality Objectives (**RQOs**) are defined as clear goals (numerical or descriptive statements) relating to the quality of a water resource and are set in accordance to the management class (preliminary class in the absence of the classification system) specified for the resource to ensure the water resource is protected.

Risk Assessment using the Risk Matrix

In terms of the new Government Gazette Notice, GN 509 in GG 40229 of 26 August 2016 (*General Authorisations for impeding or diverting of flow or altering the bed, banks, course or characteristics of a watercourse), Regulation 7*:

Assessment of risk and mitigation factors

It is required that the following documents and associated spread sheets be used during the assessment of risk and mitigation of risks:

(a) A Practical Field Procedure for Delineation of Wetlands and Riparian Area (2005) which is available on the Department's website http:/ /www.dws.gov.za, under water use authorization in terms of section 21 (c) or (i) of the Act;

(b) Appendix A (Excel Spreadsheet) and information regarding the method used in Appendix A is contained in the Department of Water and Sanitation 2015 publication: Section 21(c) and (i) water use Risk Assessment Protocol, which is available on the Department's website http: / /www.dws.gov.za, under section 21(c) and (i) water use authorization.

(c) Guideline: Assessment of activities /developments affecting wetlands, which is available on the Department's website http: / /www.dws.gov.za, under section 21 (c) and (i) water use authorization.

(d) Guideline for the determination of buffer zones for rivers, wetlands and estuaries, which is available on the Department's website http: / /www.dws.gov.za, under water use authorization in terms of section 21 (c) and (i) of the Act.

The DWS Risk assessment protocol was obtained from GN 509. Risk posed to "resource quality", as defined in the NWA, must be scored according to the Risk Rating Table for Severity (Table 32). A Severity score is then generated. Consequence, Likelihood and finally Significance scores are automatically calculated with the rest of parameters according to respective Risk Rating Tables (Tables 32 - 36).

Risk is determined after considering all listed control/mitigation measures. Borderline LOW /MODERATE risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to a listing of additional mitigation measures considered and listed in RED font. ONLY LOW RISK ACTIVITIES located within the regulated area of the watercourse will qualify for a General Authorisation (GA) according to GN 509. Medium and High-risk activities will require a Section 21 (c) and (i) water use license. The risk rating is determined by combined scores from the following matrix components (Tables 32 - 36):

Consequence= Severity + Spatial Scale + Duration
Likelihood = Frequency of the Activity+ Frequency of the Impact + Legal Issues + Detection
Risk = Consequence x Likelihood

Table 32: Severity - How severe do the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, and habitat)? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

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

Table 33: Spatial scale - How large is the area that the aspect is impacting on? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

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

Table 34: Duration -How long does the aspect impact on the resource quality? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

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

Table 35: Frequency of the activity - How often do you do the specific activity? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

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

Table 36: Frequency of the incident/impact - How often does the activity impact on the resource quality? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

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

2.8.5 A description of the assumptions made and any uncertainties or gaps in knowledge or data.

- Whilst the author has made every effort to verify that information provided in this report is reliable, accurate and relevant, this report is based on information that could reasonably have been sourced within the time period allocated to the report and is dependent on the information provided by management and/or its representatives.

- Project proponents will always strive to avoid and mitigate potentially negative project related impacts on the environment, with impact avoidance being considered the most successful approach, followed by mitigation. It further assumes that the project proponents will seek to enhance potential positive impacts on the environment.

- The 15 m buffers shown on the Google Earth figures are drawn in by hand and thus not precise and are included for demonstrative purposes.

- Due to the fact that detail mitigation procedures have been presented, it is trusted that the construction team management with the help of the ECO will ensure that these mitigatory measures be implemented where applicable.

2.8.6 to 2.8.16 Minimum information regarding:

2.8.6 The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.

Synopsis: "No-go" zones have already been demarcated. A 15m buffer around the drainage line should be respected as an area of higher sensitivity than the rest of the surrounding environment (Figures 46 to 50).

2.8.7 Additional environmental impacts expected from the proposed development.

Synopsis: All identified impacts have been addressed in detail in the impact assessment section (Section 2.5), and no additional impacts is anticipated.

2.8.8 Any direct, indirect and cumulative impacts of the proposed development on site.

Synopsis: The main issues relating to construction and operation have been addressed and no further direct, indirect and cumulative impacts are anticipated.

2.8.9 The degree to which impacts and risks can be mitigated.

Synopsis: During the risk assessment, 16 potential impacts were identified. All were successfully mitigated to a "Low" risk rating (Tables 30 and 31).

2.8.10 The degree to which the impacts and risks can be reversed.

Synopsis: For 11 potential impacts identified during the risk assessment, all were assigned mitigation measures that reversed potential impacts to "Low" risk rating posed to the resource quality of the watercourse (Tables 30 and 31).

2.8.11 The degree to which the impacts and risks can cause loss of irreplaceable resources.

Synopsis: No impact was identified to cause loss of irreplaceable resources during the risk assessment. All the risk assessed were mitigated to a "Low" risk rating (Tables 30 and 31).

2.8.12 A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.

Synopsis: By making use of the DWS Buffer Tool Kit, a final aquatic impact buffer of 15 m on both sides of the major ephemeral drainage lines on the facility project area was establish. The 15 m buffer is situated directly outside the riparian zone on the outer bank (Figures 46 to 50).

2.8.13 The proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).

Synopsis: All the proposed impact management actions listed in the Risk Matrix (Table 30) in the Environmental Management Programme will be considered and, if applicable, they will be included in the EMPr.

2.8.14 A motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate.

Synopsis: Biotopes with "Moderate" and "Low" ecological and sensitivity classes were not considered as no-go areas. These biotopes included the headwater drainage systems which transport surface flows during high rainfall events and present short-lived aquatic systems. On the other hand, development within these areas shall be subjected to strict mitigation measures. This will include the management of surface water runoff, erosion monitoring, as well as constraints regarding the clearing of vegetation within these areas.

2.8.15 A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.

Synopsis: By implementing all the suggested mitigation measures and managing the system as prescribed, on a continuous basis, all the impacts will be addressed to a satisfactory level. It is the reasoned opinion that the overall project outcome mitigates all listed impacts satisfactory to a "Low" impact level.

2.8.16 Any conditions to which this statement is subjected.

Synopsis: It is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document are, where applicable, included in the EMPr.

Summary: A reasoned opinion

According to the Specialist TOR, a GN509 Risk Assessment was completed for the study. Infrastructural components of the Sun Central Solar PV Facility project were described and assessed. Special mitigation and management measures were determined and the current existing best practice procedures described by the risk assessment report. The following main activities were identified and assessed:

Construction and operational phases

- Linear structures
    - Upgrade the access road
    - Extending the 2.5 km main transmission line
    - Pipelines

- Placements and constructions of stations and plants

- Boreholes

During the risk assessment, 11 potential impacts were identified. For these potential impacts identified during the risk assessment, all were assigned mitigation measures that reversed potential impacts to “Low” risk rating posed to the resource quality of the watercourse. No impact was identified to cause loss of irreplaceable resources.

By implementing all the mitigation measures and managing the system on a continuous basis as prescribed by the Risk Assessment, all the impacts will be addressed to a satisfactory level. Therefore, it is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document, where applicable, are included in the EMPr

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Appendices

Appendix 1: The complete SASS 5 form.

TAXON	Stones	Vegetation	GSM	Total
Porifera 5				
Coelenterata 3				
Turbellaria 3				
Oligochaeta 1				
Leeches 3				
Amphipoda 15				
Potamonautidae 3				
Atyidae (Shrimp) 8				
Palaemonidae 10				
Hydracarinae 8				
Notonemouridae 14				
Perlidae 12				
Baetidae 1 spp 4				
2 spp 6				
>2 spp 12				
Caenidae 6				
Ephemeridae 15				
Heptageniidae 10				
Leptophlebiidae 13				
Oligoneuridae 15				
Polymitarcyidae 10				
Prosopistomatidae 15				
Teloganodidae 12				
Tricorythidae 9				
Calopterydidae 10				
Chlorocyphidae 10				
Chlorolestidae 8				
Coenagrionidae 4				
Lestidae 8				
Platycnemidae 10				
Protoneuridae 8				
Zygoptera 6				
Aeshnidae 8				
Cordulidae 8				
Gomphidae 6				
Libellulidae 4				
Belostomatidae 3				
Corixidae 3				
Gerridae 5				
Hydrometridae 6				
Naucoridae 7				
Nepidae 3				
Notonectidae 3				
Pleidae 4				
Veliidae 5				
Corydalidae 8				
Sialidae 6				
Dipseudopsidae 10				
Ecnomidae 8				
Hydropsychidae 1= 4				
2spp = 6				
>2spp =12				
Philopotamidae 10				

Polycentropodidae 12				
Psychomyiidae/Xip. 8				
Barbarochthonidae 13				
Calamoceratidae 11				
Glossosomatidae 11				
Hydroptilidae 6				
Hydrosalpingidae 15				
Lepidostomatidae 10				
Leptoceridae 6				
Petrothrincidae 11				
Pisuliidae 10				
Sericostomatidae 13				
Dytiscidae 5				
Elmidae/Dryopidae 8				
Gyrinidae 5				
Haliplidae 5				
Helodidae 12				
Hydraenidae 8				
Hydrophilidae 5				
Limnichidae 8				
Psephenidae 10				
Athericidae 13				
Blepharoceridae 15				
Ceratopogonidae 5				
Chironomidae 2				
Culicidae 1				
Dixidae 13				
Emphididae 6				
Ephydridae 3				
Muscidae 1				
Psychodidae 1				
Simuliidae 5				
Syrphidae 1				
Tabanidae 5				
Tipulidae 5				
Ancylidae 6				
Bulininae 3				
Hydrobidae 3				
Lymnaeidae 3				
Physidae 3				
Planorbidae 3				
Thiaridae 3				
Viviparidae 5				
Corbiculidae 5				
Spaeridae 3				
Uniondae 6				
SASS Score				
No of families				
ASPT				

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Appendix 2: Finer detail EC rating table.

Rating	Deviation from reference conditions	A- F Categories	Natural – Poor categories	Score
0	No change	A	Natural	≥ 92.01
		A/B		>87.4 and <92.01
1	Small change	B	Good	82.01 – 87.4
		B/C		>77.4 and <82.01
2	Moderate change	C	Fair	62.01 – 77.4
		C/D		>57.4 and <62.01
3	Large change	D		42.01 – 57.4
		D/E		>37.4 and <42.01
4	Serious change	E	Poor	22.01 – 37.4
		E/F		>17.4 and <22.01
5	Extreme change	F		0 - 17.4