SOYUZ 3 WIND ENERGY FACILITY, NORTHERN CAPE

RIVER AND WETLAND ECOSYSTEM SPECIALIST REPORT

Prepared for:

SOYUZ 3 (Pty) Ltd

14th Floor Pier Place, Heerengracht Street, Foreshore, Cape Town, 8001

Prepared by:

CES
ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES

CENTURION

Also in Cape Town, East London, Grahamstown, Port Elizabeth and Maputo (Mozambique)

www.cesnet.co.za

In a joint-venture with:

Verdant
Environmental

2nd Floor, Golden Oak House, Ballyoaks Office Park
35 Ballyclare Drive
Bryanston, 2191
Also in Durban
www.verdantenv.co.za

FEBRUARY 2023

REVISIONS TRACKING TABLE

CES Report Revision and Tracking Schedule

Document Title:	River and Wetland Ecosystem Specialist Report for the Proposed Soyuz 3 Wind Energy Facility, Northern Cape			
Client Name & Address:	Soyuz 3 (Pty) Ltd 14th Floor Pier Place, Heerengracht Street, Foreshore, Cape Town, 8001			
Status:	Draft			
Issue Date:	February 2023			
Lead Author:	Mr Aidan Gouws	Wetland Ecologist (CES)		
Reviewer:	Mr Ryan Edwards	Principal Wetland Ecologist (Verdant Environmental)		
Report Distribution	***Circulated to***		***No. of hard copies***	***No. electronic copies***
	Michael Johnson			1
Report Version	***Date***			
	February 2023			

CES
ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES
Info@cesnet.co.za
www.cesnet.co.za

PROJECT TEAM EXPERTISE AND DECLARATIONS

In terms of Section 2 of the Aquatic Biodiversity Protocol (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.

2.7. 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; [and]

2.7.2. A signed statement of independence by the specialist.

Name of Specialist	Aidan Gouws
Position	Principal Environmental Consultant, Terrestrial Ecologist & Wetland Ecologist (CES)
Contact Details	Email: a.gouws@cesnet.co.za | Tel: +27 10 045 1372
Role on Project	Wetland Ecologist, Field Assistance and Report Author
Highest Qualification	MSc. Environmental Science (Dissertation Topic: Invasion Ecology)
SACNASP Registration No.	*Pri.Sci.Nat.* 121901
SACNASP Field of Practice	Environmental Science
Experience (no. of years)	4 years in environmental consulting and terrestrial biodiversity assessments

Aidan obtained his MSc in Environmental Science (*Cum laude*) from Rhodes University, having conducted research on the spatio-temporal dynamics of *Acacia dealbata* invasions and broader land-use and cover changes in the northern Eastern Cape, funded through a study bursary awarded by the Agricultural Research Council (ARC). Prior to this, he obtained his BSc Honours in Geographical and Environmental Sciences (*Cum laude*) from the University of Pretoria, studying plant ecology and EIA methodology amongst others. Since joining CES in 2018, Aidan has been involved in several projects, including Basic Assessments, Full Scoping and Environmental Impact Assessments, Environmental Amendment Applications, Environmental Audits and Terrestrial Biodiversity Assessments. He is registered with the South African Council for Natural Scientific Professions (SACNASP) as a Candidate Natural Scientist and with the International Association for Impact Assessments (IAIA). Aidan received his certificate of competence in wetland assessments after completing the Tools for Wetland Assessment (TWA) Course in 2020, hosted by Rhodes University in association with GroundTruth, The Water Research Commission and Verdant Environmental. He has since been involved in a number of wetland assessments under the mentorship of Mr Ryan Edwards of Verdant Environmental.

Declaration of Independence

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 40772 Government Gazette, 4 December 2014 (as amended); and
- The Department of Human Settlements, Water & Sanitation for Water Use Licensing and wetland/aquatic assessment, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017.

I, **Aidan Gouws**, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Forestry, Fisheries and the Environment (DFFE) and Department of Human Settlements, Water and Sanitation (DHSWS).

Signed: 

Date: 1 August 2022

Name of Specialist	Ryan Edwards
Position	Director, Owner, Principal Environmental Scientist & Wetland Ecologist (Verdant Environmental)
Contact Details	Email: ryan@verdantenv.co.za | Cell: +27 73 121 3392
Role on Project	Principal Wetland Ecologist, Fieldwork and Report Review
Highest Qualification	MSc. Environmental Science (Dissertation Topic: Wetland Origin and Evolution)
SACNASP Registration No.	*Pr.Sci.Nat* 400089/13
SACNASP Field of Practice	Environmental Science
Experience (no. of years)	13 years conducting wetland and river ecosystem related scientific assessments

Ryan is a wetland ecosystem specialist and environmental scientist with thirteen (13) years of experience in the natural scientific and environmental management consulting sector. His core field of focus, specialisation and passion is wetland and riparian ecosystem ecology and has conducted over 100 specialist assessments for a wide variety of clients and sectors in South Africa. Ryan also has over ten (10) years of experience in wetland rehabilitation and management, wetland offset planning and implementation and vegetation assessments. Ryan is one of the leading wetland ecologists in the field of wetland offset planning and implementation in SA and has been involved in several high-profile offset projects and the development of novel offset solutions. Ryan's highest qualification is a Master of Science (MSc) in Environmental Science (Research Masters) and his Masters dissertation was on wetland geomorphology. Ryan is currently accredited as a professional natural scientist by the South African Council for Natural Scientific Professions (SACNASP) under the field of practice – 'environmental science'.

Declaration of Independence

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 40772 Government Gazette, 4 December 2014 (as amended); and
- The Department of Human Settlements, Water & Sanitation for Water Use Licensing and wetland/aquatic assessment, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017.

I, **Ryan Edwards**, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Forestry, Fisheries and the Environment (DFFE) and Department of Human Settlements, Water and Sanitation (DHSWS).

Signed:

Date:

Please refer to the Curricula vitae in Appendix A for more information.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF TERMS

TERM	DEFINITION
Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment	The area contributing to runoff at a particular point in a river system.
Chroma	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland)	To determine the boundary of a wetland based on soil vegetation and/or hydrological indicators.
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Groundwater	Subsurface water in the saturated zone below the water table.
Hydromorphic soil	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Indigenous vegetation	Vegetation occurring naturally within a defined area.
Obligate species	Species almost always found in wetlands (>99% of occurrences).
Perennial	Flows all year round.
Ramsar	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.

LIST OF ACRONYMS

ACRONYM	TERM
BESS	Battery Energy Storage System
CBA	Critical Biodiversity Area
CES	CES Environmental and Social Advisory Services
DFFE	Department of Forestry, Fisheries and the Environment
DHSWS	Department of Human Settlement, Water and Sanitation
ECO	Environmental Control Officer
EI	Ecological Importance
ES	Ecological Sensitivity
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GIS	Geographical Information System
IAP	Invasive Alien Plant
IHI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
NEMBA	National Environmental Management Biodiversity Act
PES	Present Ecological State
QDS	Quarter Degree Square
SA	South Africa
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SQR	Sub Quaternary Reach

1 INTRODUCTION

In terms of Section 1 of the Aquatic Biodiversity Protocol (2020):

1.1. 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:

1.1.1. "Very high sensitivity" for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment.

1.4. If any part of the proposed development footprint falls within an area of "very high" sensitivity, the assessment and reporting requirements prescribed for the "very high" sensitivity apply to the entire footprint . . . In the context of this protocol, development footprint means the area on which the proposed development will take place and includes any area that will be disturbed.

1.1 PROJECT LOCATION AND DESCRIPTION

The applicant Soyuz 3 (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located approximately 35 km South of Britstown within the Emthanjeni Local Municipality and the Pixley ka Seme District Municipality in the Northern Cape Province.

Five additional WEF's (refer to Figure 1.1) are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Soyuz 1 WEF, Soyuz 2 WEF, Soyuz 4 WEF, Soyuz 5 WEF and Soyuz 6 WEF (Figure 1.1).

A preferred project site with an extent of approximately 125 000 ha has been identified as a technically suitable area for the development of the six WEF projects. It is proposed that each WEF will comprise of up to 75 turbines with a contracted capacity of up to 480 MW. It is anticipated that each WEF will have an actual (permanent) footprint of up to 150 ha (Figure 1.1).

The Soyuz 3 project site (Figure 1.2) covers approximately 23 800 ha and comprises the following farm portions:

- Portion 4 of the Farm No. 143
- Remaining Extent of Portion 1 of the Farm No. 143
- Portion 9 of the Farm Combuisfontein No. 142.
- Portion 8 of the Farm Combuisfontein No. 142
- Portion 4 of the Farm Combuisfontein No. 142
- Portion 3 (a portion of Portion 1) of the Farm Combuisfontein No. 142
- Portion 6 (a portion of Portion 1 – Gemsbokdam) of the Farm Combuisfontein No. 142
- Portion 2 of the Farm Combuisfontein No. 142
- Portion 2 of the Farm No. 2
- Portion 0 of Farm No. 144.
- Portion 1 of the Farm No. 2
- Remaining Extent of the Farm No. 2
- Remaining Extent of Portion 13 of the Farm Welgedagt No. 3

The Soyuz 3 WEF project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 480 MW:

- Up to 75 wind turbines with a maximum hub height of up to 160 m and a rotor diameter of up to 200 m;
- A transformer at the base of each turbine;
- Concrete turbine foundations of up to 1024 m^2 each;
- Permanent Crane hardstand / blade and tower laydown area / crane boom erection area with a combined maximum footprint 5000 m^2 at each WTG;
- Temporary concrete batch plants to be located at the construction camp area and the satellite laydown areas;
- Battery Energy Storage System (with a footprint of up to 5 ha);
- Internal up to 132 kV overhead lines between substations. A 300m wide corridor (150m on either side of the proposed route) has been considered to allow for any technical and environmental sensitivity constraints identified during micro-siting prior to layout finalisation. Permanent service roads will be required for the construction and maintenance of the overhead lines. In areas where these overhead lines do not follow an existing or proposed road, additional roads of up to 3m in width will be required. Temporary construction areas beneath each overhead line tower position will also be required;
- Medium voltage (33 kV) cables/powerlines running from wind turbines to the facility substations. The routing will follow existing/proposed access roads and will be buried where possible. If the use of overhead lines is required, the Avifaunal Specialist will be consulted timeously to ensure that a raptor friendly pole design are used, and that appropriate mitigation is implemented pro-actively.
- Up to six permanent met masts;
- Three substations and operation and maintenance facilities (up to 4 ha each) as well as a laydown area (8 000 m^2) at each substation for the electrical contractor. Operation and maintenance facilities include a gate house, security building, control centre, offices, warehouses and workshops.
- Three temporary main construction camp areas (up to 12.25 ha each);
- Twelve temporary satellite laydown areas (5 000 m^2 each).
- Access roads to the site and between project components inclusive of stormwater infrastructure. A 200 m road corridor is being applied for to allow for slight realignments pending technical and environmental sensitivity constraints identified during micro-siting prior to layout finalisation. The final road will have maximum width of 12 m (within the 200 m corridor).

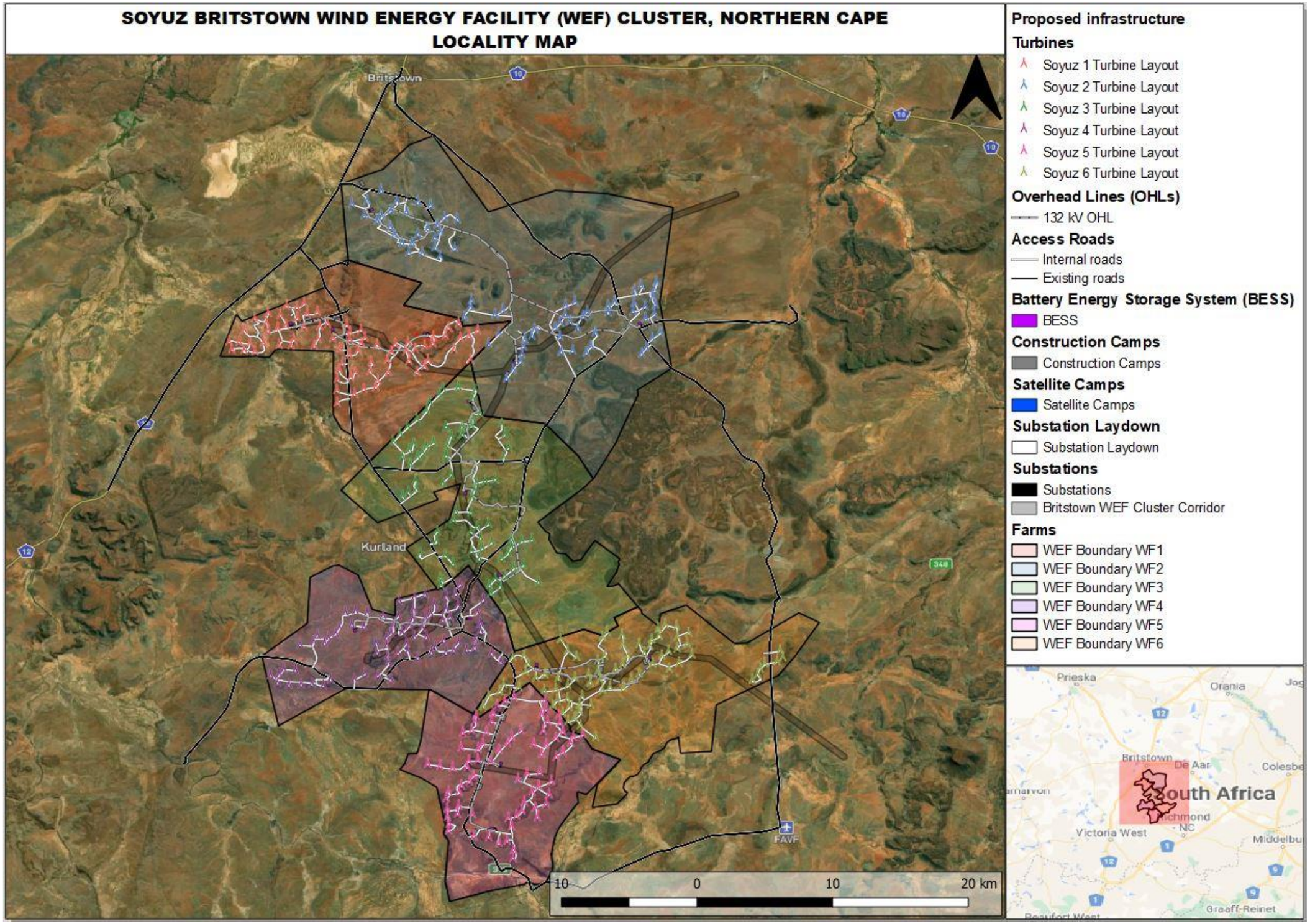


Figure 1.1: Locality of the proposed Soyuz Wind Energy Facility (WEF) Cluster, near Britstown, Northern Cape

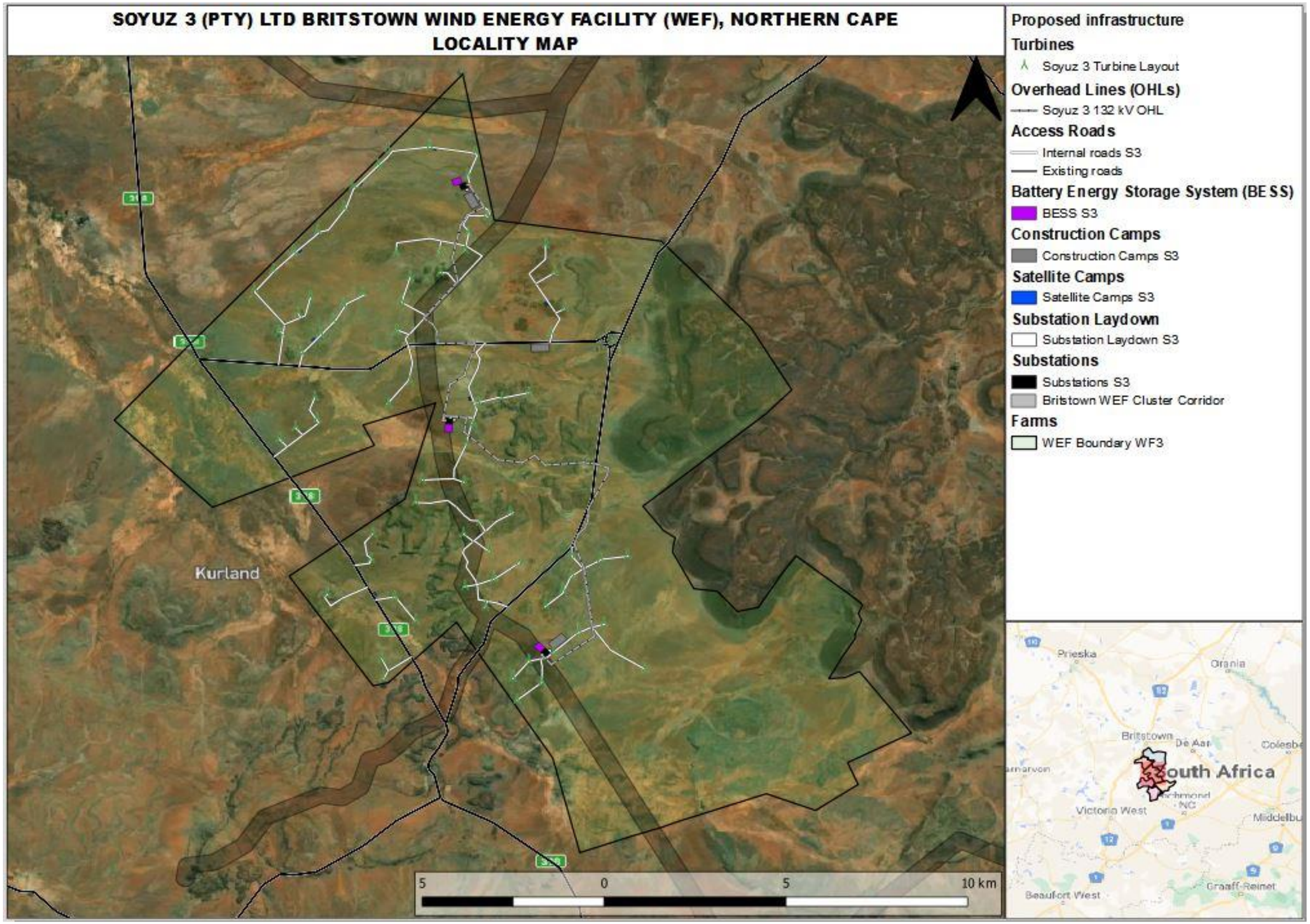


Figure 1.2: Locality of the proposed Soyuz 3 WEF, near Britstown, Northern Cape

1.2 PURPOSE OF THIS REPORT

In accordance with the Environmental Impact Assessment (EIA) Regulations (as amended) published under the National Environmental Management Act (Act No. 107 of 1998) (NEMA), the issuing of an Environmental Authorisation (EA) requires the undertaking of a Basic Assessment (BA) or Environmental Impact Assessment (EIA) process, with associated Public Participation Process (PPP) and a specialist studies. The need for a particular specialist study is determined based on the environmental sensitivities of the site, identified using the Department of Forestry, Fisheries and the Environment's (DFFE's) national web-based environmental screening tool.

The screening tool identified areas of "Very High Sensitivity" for Aquatic Biodiversity, due to the presence of Rivers, Wetlands and Freshwater Ecosystem Priority Area (FEPA) Quinary Catchments within the project development area. This triggered the need for a full Aquatic Biodiversity Assessment, as per the Biodiversity Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (hereafter referred to as the "Aquatic Biodiversity Protocol"), published in Government Notice No. 320 on 20 March 2020. Additionally, in accordance with the Section 21 of the National Water Act (NWA), 1998 (Act 36 of 1998) and the Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals 2017, a Delineation Report will be required in support of a Water Use License Application (WULA) for water uses associated with development within 100 m of a watercourse and/or 500 m of a wetland.

1.3 SCOPE OF ASSESSMENT AND CONTENTS OF THE SPECIALIST REPORT

The specialist assessment sought to identify and delineate all watercourses within 100 m and wetland ecosystems within 500 m of the project site that stand to be negatively impacted by the proposed activities and assess these in terms of their health / functionality and functional / ecological importance. Other watercourses directly impacted upon by the project were also delineated and assessed. The terms of reference for the Aquatic Biodiversity and Wetland Ecosystem Assessment were therefore specified as follows, to:

- Undertake a desktop assessment of the freshwater ecosystem (river and wetland) context using available national and regional spatial datasets, assessments, and classifications;
- Undertake a desktop screening of all wetlands, rivers and other watercourses within 500 m of the project site that are likely to be negatively impacted by the project and confirmation of the study area for infield investigation. The remaining watercourses within 500 m were mapped and classified at a desktop level only;
- Delineate the wetlands and riparian zones according to the national wetland and riparian zone delineation guidelines (DWAF, 2005);
- Classify the wetlands and rivers according to the national aquatic ecosystem classification system (Ollis et al., 2013);
- Assess of the Present Ecological State (PES) of the delineated wetland units and river reaches using published assessment tools;
- Assess the importance of the ecosystem services provided by the delineated wetland and riparian zones;

- Assess of the Ecological Importance and Sensitivity (EIS) of the delineated wetlands and rivers using published assessment tools;
- Determine the recommended ecological category (REC) for each of the delineated wetland and river units using a generic matrix for the determination of RECs for water resources (DWAF);
- Provide recommended best practice and site-specific project design (layout and design) measures to avoid and minimise impacts to wetland and freshwater / aquatic ecosystems;
- Identify, describe and assess the potential and likely direct and indirect impacts of the project on local wetlands and rivers, including cumulative impacts;
- Provide the project design, construction phase and operational phase mitigation measures to avoid, minimize and/or rehabilitate the potential impacts;
- Assess the significance of the potential impacts of the project on wetland and river ecosystems using a structured assessment method;
- Assess the qualitative risk of the proposed development activities on wetlands and rivers using the DHSWS risk matrix for Section 21(c) and 21(i) water uses; and
- Determine any outright fatal flaws associated with the project.

The Aquatic Biodiversity and Wetland Ecosystem Specialist Assessment was conducted in accordance with the Aquatic Biodiversity Protocol (2020). This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on aquatic biodiversity for activities requiring EA. This protocol replaces the requirements of Appendix 6 of the EIA Regulations 2014, GN R. 982 (as amended), published under NEMA. Table 1.1 below indicates how the assessment complied with the requirements of the Aquatic Biodiversity Protocol, with reference to specific sections in this report. This report was also compiled in accordance with the requirements of a Watercourse/Wetland Delineation Report, as published under the National Water Act, 1998 (Act 36 of 1998) (refer to Table 1.2).

Table 1.1: Requirements of an Aquatic Biodiversity Specialist Assessment Report

AQUATIC BIODIVERSITY SPECIALIST ASSESSMENT REPORT REQUIREMENTS		SECTION IN REPORT
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;	Page vi and Appendix A
2.7.2.	A signed statement of independence by the specialist;	Page vii-viii
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;	Section 2.1.2
2.7.4.	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Chapters 2
2.7.5.	A description of the assumptions made, any uncertainties or gaps in knowledge or data;	Section 2.3
2.7.6.	The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;	Chapter 4
2.7.7.	Additional environmental impacts expected from the proposed development;	Chapter 5
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;	

AQUATIC BIODIVERSITY SPECIALIST ASSESSMENT REPORT REQUIREMENTS		SECTION IN REPORT
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;	Chapter 4
2.7.13.	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	Chapter 6
2.7.14.	A motivation must be provided if there were development footprints identified as per paragraph 2.4 [of the Aquatic Biodiversity Protocols] that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate;	Chapter 4
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	Section 0 and 7.5
2.7.16.	Any conditions to which this statement is subjected.	Chapter 6

Table 1.2: Requirements of a Wetland Delineation Report

REQUIREMENTS OF A WETLAND DELINEATION REPORT		SECTION IN REPORT
1.	Introduction	Chapter 1
2.	Terms of reference	Section 1.3
3.	Knowledge gaps	Section 2.3
4.	Study area	Chapter 3
5.	Expertise of the specialist	Page vi
6.	Aims and objectives	Chapter 1.3
7.	Methodology	Chapters 2
7.1.	Wetland identification and mapping	Section 3.2.1
7.2.	Wetland delineation	Table 2.1 and Section 3.2.1
7.3.	Wetland functional assessment	Table 2.1 and Section 4.1
7.4.	Determining the ecological integrity of the wetlands	Table 2.1 and Section 3.2.2
7.5.	Determining the Present Ecological State of wetlands	Table 2.1 and Section 3.2.2
7.6.	Determining the Ecological Importance and Sensitivity of wetlands	Table 2.1 and Section 4.2
7.7.	Ecological classification and description	Section 3.2.1
8.	Results	Chapters 3 and 4
8.1.	Wetland delineation	Section 3.2.1
8.2.	Wetland unit identification	Section 3.2.1
8.3.	Wetland unit setting	Section 3.2.1
8.4.	Wetland soils	Section 3.2.1
8.5.	Description of wetland type	Section 3.2.1
8.6.	General functional description of wetland types	Section 3.2.1
8.7.	Wetland ecological functional assessment	Section 4.1
8.8.	The ecological health assessment of the affected area	Section 3.2.2
8.9.	The PES assessment of the remaining wetland areas	Section 3.2.2
8.10.	The EIS assessment of the remaining wetland areas	Section 4.2
9.	Impact assessment discussions	Chapter 5 and Section 7.1
10.	Conclusions and recommendations	Chapters 6 and 7
11.	References	Chapter 0

1.4 RELEVANT LEGISLATION

This specialist assessment was conducted in alignment with the regulatory and legislative requirements for environmental management in South Africa. The environmental legislation relevant to the proposed development is summarised in Table 1.3 below.

Table 1.3: Environmental legislation considered in the preparation of this report

LEGISLATION	DESCRIPTION	RELEVANCE
The Constitution, 1996 (Act No. 108 of 1996).	The Constitution of the Republic of South Africa is the supreme law of the land. As a result, all laws, including those pertaining to this Management Plan, must conform to the Constitution. The Bill of Rights - Chapter 2 of the Constitution, includes an environmental right (Section 24) according to which, everyone has the right: *a) To an environment that is not harmful to their health or well-being; and* *b) To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that:* *i. Prevent pollution and ecological degradation;* *ii. Promote conservation; and* *iii. Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*	The proponent has an obligation to ensure that the proposed activity will not result in pollution and ecological degradation, as well as an obligation to ensure that the proposed development is ecologically sustainable, while demonstrating economic and social development.
National Environmental Management Act (NEMA), 1998 (Act No. 108 of 1998)	The objective of NEMA is: *"To provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state; and to provide for matters connected therewith."* This report has been guided by the NEMA Principles detailed in Section 2 of the Act. NEMA introduces the "duty of care" concept, which is based on the policy of strict liability. This duty of care extends to the prevention, control and rehabilitation of significant pollution and environmental degradation. It also dictates a duty of care to address emergency incidents of pollution. A failure to perform this duty of care may lead to criminal prosecution, and may lead to the prosecution of responsible persons, including companies, for the conduct of the legal persons.	The undertaking of a specialist study, in this case, the aquatic and wetland study, in order to identify potential impacts on the aquatic environment and to recommend mitigation measures to minimise these impacts, complies with Section 28 of NEMA. The developer must apply the NEMA principles, the fair decision-making and conflict management procedures that are provided for in NEMA.
NEMA EIA Regulations (2014, as amended)	The NEMA EIA Regulations (2014, as amended) aim to avoid detrimental environmental impacts through the regulation of specific activities that cannot commence without prior environmental authorisation. Authorisation either requires a Basic Assessment or a Full Scoping and Environmental Impact Assessment, depending on the type of activity. These assessments specify mitigation and management guidelines to minimise negative environmental impacts and optimise	An application for Environmental Authorisation (as triggered by the EIA 2014 Regulations, as amended) is required to be submitted to the Competent Authority.

LEGISLATION	DESCRIPTION	RELEVANCE
	positive impacts. Should any portion of an area be proposed for development (after proclamation) these Regulations should be consulted.	
Aquatic Biodiversity Protocol (2020)	This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on aquatic biodiversity for activities requiring EA. This protocol replaces the requirements of Appendix 6 of the EIA Regulations 2014, GN R. 982 (as amended), published under NEMA.	This assessment and report complies with Aquatic Biodiversity Protocol.
NEMBA: Alien Invasive Species Regulations (2014)	The Alien and Invasive Species Regulations (2014) categorises the different types of alien and invasive plant and animal species and how they should be managed: • Category 1a Listed Invasive Species – species which must be combatted or eradicated. • Category 1b Listed Invasive Species – species which must be controlled. • Category 2 Listed Invasive Species – species which require a permit and must not be allowed to spread outside of the designated area. • Category 3 Listed Invasive Species – species which are subject to exemptions in terms of section requiring a permit, but where such a species occurs in riparian areas, must, for the purposes of these regulations, be considered to be a Category 1b Listed Invasive Species and must be managed according to regulation 3.	An invasive species management, control and eradication plan for land/activities under their control should be developed, as part of their environmental plans in accordance with Section 11 of NEMA.
National Water Act (36 of 1998)	Provides details of measures intended to ensure the comprehensive protection of all water resources, including the water reserve and water quality.	All necessary Water Use Licence Applications must be submitted to the Department of Human Settlements, Water and Sanitation for approval.
Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals (2017)	In accordance with the Section 21 of the National Water Act (NWA), 1998 (Act 36 of 1998) and the Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals 2017, a Wetland Delineation Report will be required in support of any GA application for water uses associated with development within 500 m of a wetland.	This report was compiled in accordance with the requirements of a Watercourse/Wetland Delineation Report, as outlined in the Water Use Regulations.

1.5 INTERNATIONAL FINANCE CORPORATION PERFORMANCE STANDARDS COMPARED TO THE NEMA EIA PROCESS

The IFC published its Performance Standards (PS) on Environmental and Social Sustainability in April 2006, and then revised them in 2012 (cf. IFC, 2012). In addition to these standards, the IFC also published supporting Guidance Notes (GN) on each standard. The IFC performance standards have become the international benchmark for Environmental and Social Impact Assessments (ESIAs) and are used to measure the environmental performance and management of large international projects. Table 3.1 provides an overview of the applicable performance standard and indicates its relevance to this project.

Table 3.1: Description of applicable IFC Performance Standard

DESCRIPTION	RELEVANCE
Performance Standard 6: **Biodiversity Conservation & Sustainable Natural Resource Management** The primary objectives of PS 6 are to: • Protect and conserve biodiversity; • Maintain the benefits from ecosystem services; and • Promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities.	In this instance, Performance Standard 6 is applicable as the project could occur within either modified, natural or critical habitat or a combination of the above. This report focuses on river and wetland ecosystems within the proposed project area. The assessment was conducted to determine the Present Ecological State (PES) of these freshwater ecosystems to determine whether these should be classified as modified, natural or critical habitat based on the guidelines presented in PS 6. The assessment also considers the functional importance of these rivers and wetlands in terms of the provisioning, regulating, cultural and biodiversity maintenance ecosystem services they offer. In turn, this informs the overall Ecological Importance and Sensitivity (EIS) of these ecosystems, the potential impact of the proposed WEF and the recommended mitigation measures to prevent, minimise, remediate and/or offset these impacts. This report, along with the floral and faunal assessments, will inform the critical habitat determination within the broader ESIA report, as well as the possible requirement for establishing no-go areas, biodiversity offsets and a biodiversity monitoring plan for the construction and operational phase.

2 ASSESSMENT METHODOLOGY

In terms of Section 2 of the Aquatic Biodiversity Protocol (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:

2.7.3. 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;

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

The aim of the study was to identify and delineate all watercourses within 100 m and wetland ecosystems within 500 m of the project site that will potentially be measurably negatively impacted by the project activities, evaluate these in terms of their present functionality and health, and assess the potential impacts and risks associated with the proposed development.

It should be noted that many of the features / units assessed on site were terrestrial in nature and cannot be considered watercourses or wetlands as such. The National Water Act (NWA), 1998 (Act No. 36 of 1998, as amended in 2013) defines a 'watercourse' as:

a) "A river or spring;
b) 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, and a reference to a watercourse includes where relevant, its bed and banks."

The NWA further defines 'wetlands' as "*Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*."Many of the features assessed therefore lacked true wetland conditions. The number of true wetlands within Soyuz 3, as well as the broader area, are extremely limited.

2.1 DATA COLLECTION AND ASSESSMENT APPROACH

2.1.1 DESKTOP ASSESSMENT

A desktop assessment of the project area was conducted in terms of current surface water classifications and biodiversity programmes and plans. This included the consideration of the following base data:

- DWS Desktop Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) Model (2014);
- Department of Water Affairs and Forestry: Level 2 River Ecoregional Classification System for South Africa, Lesotho and Swaziland (2005);
- The National Freshwater Ecosystem Priority Areas (NFEPA) project (2011 - 2014); and

- National Biodiversity Assessment (NBA) – South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (2018).

2.1.2 DATA COLLECTION AND ANALYSIS

Upon the completion of the desktop assessment a site visit was undertaken to determine the actual condition of the watercourse and wetland features within the study area. The site assessment was conducted between 9-16 May 2022, during the late summer / early autumn season. The season during which the assessment was conducted influenced the conditions on site at the time. The site falls within a summer rainfall area, with only 9 mm of precipitation typically falling in the month of May (Meteoblue, 2022). However, soil wetness indicators are identified based on field observation of soil morphology, and which in practice are the primary indicators of hydromorphic soils, are generally a very reliable indicator of wetlands, even when assessed during the dry season (Tiner, 1993). The site assessment fell near at the end of the flowering season of many species, so some early flowering species may have gone undetected. Input from the terrestrial biodiversity assessment, conducted by Biodiversity Africa in March 2022, provided invaluable insights into the flora on site.

Transect were conducted across the desktop-identified watercourses and wetlands. The GPS coordinates were captured, observations and photographs were recorded, and a soil auger was used to extract soil to a depth of up to 50 cm.

The methods and tools that were used as part of the baseline river and wetland ecosystem assessment are summarised in Table 2.1 below.

Table 2.1. Summary of methods used in the assessment of the affected rivers and wetlands

METHOD/ TECHNIQUE	REFERENCE FOR METHODS/ TOOLS USED
Wetland and river /riparian delineation	'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
Classification of Aquatic Ecosystems (rivers & wetlands)	National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis et al., 2013).
Present Ecological State (PES)	River Index of Habitat Integrity (IHI) Tool (Kleynhans, 2012) and Level 1 WET-Health assessment (Macfarlane et al., 2020)
Functional Importance	Level 2 WET-EcoServices assessment (Kotze et al., 2020).
Ecological Importance & Sensitivity (EIS)	Riverine EIS (Kleynhans, 1999) and Wetland EIS assessment (Kotze et al., 2020).
Buffer Zone Assessment	Buffer Zone Guidelines for Rivers, Wetlands and Estuaries (Macfarlane & Bredin, 2017).

2.2 IMPACT AND RISK ASSESSMENT

The impacts and risks associated with the proposed development were assessed in accordance with the NEMA's Aquatic Biodiversity Protocol and the NWA Section 21 Risk Assessment Matrix, respectively. These were broadly characterised into one of the four impact types described in Section 2.2.1, then assessed using the impact assessment criteria described in Section 2.2.2 and risk assessment criteria in Section 2.2.4.

Projects of this nature rarely, if ever, progress without any form of environmental management. The impact assessment was therefore undertaken for the following mitigation scenarios:

- **Realistic Poor Mitigation Scenario**: This scenario involves the implementation of the proposed development plan and designs that are currently proposed with the associated implementation of standard construction and operational phase mitigation measures. In terms of implementation success, this scenario assumes a realistic / likely poor implementation scenario based on the author's experience with such activities.
- **Realistic Good Mitigation Scenario**: This scenario involves the implementation of the development plan and designs that incorporate all the project planning and design, construction, operational and decommissioning phase mitigation measures recommended by the author. In terms of implementation success, this scenario assumes a realistic best-case scenario for implementation based on the author's experience with such activities.

2.2.1 IMPACT CHARACTERISATION

Watercourse and wetland ecosystem impacts can be grouped into the following broad impact types:

- **Direct ecosystem modification or destruction / loss impacts** – This impact refers to the direct physical destruction and/or modification of river or wetland vegetation communities, habitat and associated biota. Such impacts may be attributed to a range of activities including vegetation / habitat clearing (stripping / grubbing), earthworks (i.e. excavation and infilling) and deep flooding by impoundments.
- **Alteration of hydrological and geomorphological processes** – This impact refers to all the indirect impacts resulting from human activities within the watercourse or catchment that alter hydrological and geomorphological processes i.e. rates of erosion and sedimentation. This includes activities that:
  (i) Modify landcover characteristics that alter the quantity and pattern of catchment runoff and sediment inputs e.g. earthworks, surface hardening, plantations, etc.; and
  (ii) Activities that regulate, reduce or increase flows e.g. impoundment / dams, abstraction, return flows and decant flows; and activities alter wetland flow hydraulics e.g. establishment of drains, flow canalisation, flow constrictions and flow diversions.
- **Ecological connectivity and edge disturbance impacts** – This impact refers to the alteration of local and regional ecological processes resulting from the transformation of land and disturbance within and/or surrounding a watercourse. Key ecological processes of relevance in this regard include ecological connectivity and edge effects edge effects that are impacted by habitat fragmentation, patch size reduction, increased alien invasive plant invasion, noise pollution, vibrations, light pollution, and the occurrence of barriers to propagule and animal movement.
- **Water pollution impacts** – This impact refers to the alteration of the chemical and biological characteristics of soil and water within watercourses and the associated ecological impacts. In the context of this impact assessment, water quality is assessed in relation to changes to its fitness for use (e.g. for domestic, recreational or agricultural purposes) and ability to maintain the health of aquatic ecosystems. This impact includes a full spectrum of activities ranging from direct inputs (e.g. spillages / point source discharges) through to diffuse source inputs from landuse activities that affects the quality of water entering watercourses (e.g. hazardous substances handling, storage and transport; urban stormwater management; irrigation return

flows and acid mine drainage).

2.2.2 IMPACT ASSESSMENT METHODOLOGY

CES has developed the following impact rating methodology which has been developed in line with the Aquatic Biodiversity Protocol, as well as the content requirements of Appendix 6 and the impact ratings required in Appendix 1 and 3 of the EIA Regulations (2014, as amended). This scale takes into consideration the following variables:

- **Nature**: negative or positive impact on the environment.
- **Type**: direct, indirect and/or cumulative effect of impact on the environment.
- **Significance**: The criteria in Table 2.2 are used to determine the overall significance of an activity. The impact effect (which includes duration; extent; consequence and probability) and the reversibility/mitigation of the impact are then read off the significance matrix in order to determine the overall significance of the issue. The overall significance is either negative or positive and will be classified as low, moderate or high (Table 2.2).
- **Consequence:** the consequence scale is used in order to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.
- **Extent:** the spatial scale defines the physical extent of the impact.
- **Duration:** the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- **Probability:** the likelihood of impacts taking place as a result of project actions arising from the various alternatives. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development and alternatives. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.
- **Reversibility:** The degree to which an environment can be returned to its original/partially original state.
- **Irreplaceable loss:** The degree of irreplaceable loss which an impact may cause, e.g. loss of non-regenerative vegetation or removal of rocky habitat or destruction of wetland.
- **Mitigation potential:** The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table 2.2 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

Table 2.2: Impact rating criteria

CRITERIA	CATEGORIES	DESCRIPTION
Overall nature	**Negative**	Beneficial/positive impact.
	Positive	Detrimental/negative impact.
Type	**Direct**	Direct interaction of an activity with the environment.
	Indirect	Impacts on the environment that are not a direct result of the project or activity.
	Cumulative	Impacts which may result from a combination of impacts of this project and similar related projects.
Duration	**Short term**	Less than 5 years.

CRITERIA	CATEGORIES		DESCRIPTION
	Medium term		Between 5-20 years.
	Long term		More than 20 years.
	Permanent		Over 40 years or resulting in a permanent and lasting change that will always be there.
Extent	**Localised**		Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
	Study area		The proposed site and its immediate environments.
	Municipal		Impacts affect the municipality, or any towns within the municipality.
	Regional		Impacts affect the wider district municipality or the Eastern Cape Province as a whole.
	National		Impacts affect the entire country.
Consequence	**Slight**		Slight impacts or benefits on the affected system(s) or party(ies).
	Moderate		Moderate impacts or benefits on the affected system(s) or party(ies).
	Severe/Beneficial		Severe impacts or benefits on the affected system(s) or party(ies).
Probability	**Definite**		More than 90% sure of a particular fact. Should have substantial supportive data.
	Probable		Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
	Possible		Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
	Unsure		Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.
Reversibility	**Reversible**		The activity will lead to an impact that can be reversed provided appropriate mitigation measures are implemented.
	Irreversible		The activity will lead to an impact that is permanent regardless of the implementation of mitigation measures.
Irreplaceable Loss	**Resource will not be lost**		The resource will not be lost/destroyed provided mitigation measures are implemented.
	Resource may be partly lost		The resource will be partially destroyed even though mitigation measures are implemented.
	Resource will be lost		The resource will be lost despite the implementation of mitigation measures.
Mitigation Potential	**Easily achievable**		The impact can be easily, effectively and cost effectively mitigated/reversed.
	Achievable		The impact can be effectively mitigated/reversed without much difficulty or cost.
	Difficult		The impact could be mitigated/reversed but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs.
	Very Difficult		The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly.
Impact Significance	**Low negative**	**Low positive**	The impacts on this issue are acceptable and mitigation, whilst desirable, is not essential. The impacts on the issue by themselves are insufficient, even in combination with other low impacts, to prevent the development being approved. Impacts on this particular issue will result in either positive or negative medium to short term effects on the social and/or natural environment.

CRITERIA	CATEGORIES		DESCRIPTION
	Moderate negative	Moderate positive	The impacts on this issue are important and require mitigation. The impacts on this issue are, by themselves, insufficient to prevent the implementation of the project, but could in conjunction with other issues with moderate impacts, prevent its implementation. Impacts on this particular issue will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.
	High negative	High positive	The impacts on this issue are serious, and if not mitigated, they may prevent the implementation of the project (if it is a negative impact). Impacts on this particular issue would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment, and will result in severe effects or if positive, substantial beneficial effects.

In terms of the NEMA EIA Regulations (2014), a cumulative impact are defined as:
"The past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities".

Project induced cumulative impacts should be considered, along with direct and indirect impacts, in order to better inform the developer's decision making and project development process. Cumulative impacts may be categorised into one or more of the following types:

- **Additive:** the simple sum of all the effects (e.g. the accumulation of ground water pollution from various developments over time leading to a decrease in the economic potential of the resource);
- **Synergistic:** effects interact to produce a total effect greater than the sum of individual effects. These effects often happen as habitats or resources approach capacity (e.g. the accumulation of water, air and land degradation over time leading to a decrease in the economic potential of an area);
- **Time crowding:** frequent, repetitive impacts on a particular resource at the same time (e.g. multiple boreholes decreasing the value of water resources);
- **Neutralizing:** where effects may counteract each other to reduce the overall effect (e.g. infilling of a wetland for road construction, and creation of new wetlands for water treatment); and,
- **Space crowding:** high spatial density of impacts on an ecosystem (e.g. rapid informal residential settlement).

Cumulative impacts are, however, difficult to accurately and confidently assess, owing to the high degree of uncertainty, as well as their often being based on assumptions. It is therefore difficult to provide as detailed an assessment of cumulative impacts as is the case for direct and indirect project induced impacts. This is usually because of the absence of specific details and information related to cumulative impacts. In these situations, the EAP will need to ensure that any assumptions made as part of the assessment are made clear. Accordingly, this includes an overview and analysis of cumulative impacts related to a variety of project actions, and does not provide a significance rating for these impacts, as was done for direct project induced impacts. The objective is to identify and

focus on potentially significant cumulative impacts so these may be taken into consideration in the decision-making process. It is important to realise these constraints, and to recognise that the assessment will not, and indeed cannot, be perfect. The potential for cumulative impacts will, however, be considered, rather than omitted from the decision making-process and is therefore of value to the project and the environment.

Within the proposed WEF development area and a 100 km radius around it, the following renewable energy facilities are applicable:

- Soyuz 1 WEF (DFFE Ref: 14/12/16/3/3/2/2205)
- Soyuz 2 WEF (DFFE Ref: 14/12/16/3/3/2/2206)
- Soyuz 3 WEF (DFFE Ref: 14/12/16/3/3/2/2207)
- Soyuz 4 WEF (DFFE Ref: 14/12/16/3/3/2/2208)
- Soyuz 5 WEF (DFFE Ref: 14/12/16/3/3/2/2209)
- Soyuz 6 WEF (DFFE Ref: 14/12/16/3/3/2/2210)
- Taaibos North WEF (DFFE Ref: TBA)
- Taaibos South WEF (DFFE Ref: TBA)
- Soutrivier Central WEF (DFFE Ref: TBA)
- Soutrivier South WEF (DFFE Ref: TBA)
- Soutrivier North WEF (DFFE Ref: TBA)
- Mainstream Victoria West Wind and Solar (DFFE Ref: 12/12/20/1788)
- Modderfontein Solar PV Facility (DFFE Ref: 14/12/16/3/3/1/917)
- Noblesfontein Wind Energy Facility (DFFE Ref: 12/12/20/1993/2) (operational)
- Ishwati Emoyeni Wind Energy Facility (DFFE Ref: 14/12/16/3/3/2/411)
- Brakpoort PV Solar PV Facility (DFFE Ref: 14/12/16/3/3/2/331)
- Nuweveld North Wind Energy Facility (DFFE Ref: 14/12/16/3/3/2/2042)
- Nuweveld West Wind Energy Facility (DFFE Ref: 14/12/16/3/3/2/2043)
- Nuweveld East Wind Energy Facility (DFFE Ref: 14/12/16/3/3/2/2044)
- De Aar Wind Energy Facility 1 (DFFE Ref: 12/12/20/2463/1)
- De Aar Wind Energy Facility 2 (DFFE Ref: 12/12/20/2463/2)

2.2.3 NO-GO ALTERNATIVE IMPACT APPROACH

It is mandatory to consider the “no-go” option in the EIA process. The “no-go” alternative refers to the current status quo and the risks and impacts associated with it. Some existing activities may carry risks and may be undesirable (e.g. an existing contaminated site earmarked for a development). The no-go is the continuation of the existing land use, i.e. maintain the status quo.

2.2.4 RISK ASSESSMENT MATRIX

Watercourse and wetlands have been confirmed within 100 m and 500 m of the proposed development activities / site, respectively. Therefore, the project activities are likely to constitute Section 21(c) and 21(i) water uses in terms of the NWA, as described as follows:

- 21(c) impeding or diverting the flow of water in a watercourse (relevant to the construction occurring in close proximity to drainage lines); and
- 21(i) altering the bed, banks, course or characteristics of a watercourse.

Low risk projects qualify for a General Authorisation (GA) in terms of Government Notice 509 for Section 21(c) and 21(i) water uses. The Department of Human Settlements, Water and Sanitation (DHSWS) have developed a Risk Assessment Matrix to assess water risks associated with development activities. The tool uses the following approach to calculating risk:

RISK = CONSEQUENCE X LIKELIHOOD

whereby:

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The risk rating is used to determine the risk class, which in turn is used to determine the permitting and management requirements (Table 2.3).

Table 2.3: Risk Assessment Rating Classes

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

The key risk stressors associated with each of the four (4) impact groups / types considered were:

- Direct ecosystem modification or destruction / loss impacts – **Physical disturbance**
- Alteration of hydrological and geomorphological processes – **Erosive surface runoff, sediment and increased and/or reduced water inputs**
- Water pollution impacts – **Chemical, organic and biological pollutants**
- Alteration of ecological connectivity and edge effect processes – **Alien invasive plants, noise pollution, dust pollution**

For each of the above stressors, risk was assessed qualitatively using the DHSWS risk matrix tool. It is important to note that the risk matrix also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty-five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses was used to inform WUL requirements for the proposed development.

2.3 ASSUMPTIONS, LIMITATIONS AND GAPS IN KNOWLEDGE

This report is based on current available information and, as a result, the following limitations and assumptions are implicit:

- The report is based on a project description received from the client;

- Species of Conservation Concern (SCC) are difficult to find and difficult to identify, thus species described in this report do not comprise an exhaustive list. It is almost certain that additional SCCs will be found during construction and operation of the development;
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- A Soil Munsell Colour Chart was used to determine the soil matrix colour of the soil sampled. However, it is important to note that the recording of the colours using the soil chart is subjective and varies significantly depending on soil moisture and the prevailing light conditions. In this case, all the soils sampled were dry and sampling was undertaken in sunny conditions. It should be noted that chroma, which is the most critical dimension of colour when making wetland determinations is relatively robust under varying moisture and light conditions, whereas the colour value, which is less critical from a wetland determination perspective, is much more dependent on moisture and light.
- Soil wetness indicators (i.e. soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are generally a very reliable indicator of wetlands, even when assessed during the dry season (Tiner, 1993).
- No instream biomonitoring assessments were undertaken i.e. SASS5 (Dickens & Graham, 2002).
- Sampling could only be carried out at one stage in the annual or seasonal cycle. The survey was conducted in early winter, outside of the flowering season of many plant species. However, the time available in the field, and information gathered during the survey was sufficient to provide enough information to determine the status of the affected area. However, it should be noted that from a climatic cycle perspective, the timing of the sampling in May (late autumn/early winter) was favourable in terms of the main rainfall season being late summer to autumn, as is indicated in the report. The terrestrial ecological assessment, conducted by Biodiversity Africa from 10-20 March 2022 also provided invaluable insights into the flora and fauna of the project area, compensating for this limitation.

3 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

In terms of Section 2 of the Aquatic Biodiversity Protocol (2020):

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, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and

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 (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and

(b) The historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).

This chapter provides a description of the affected environment within the vicinity of the proposed infrastructure. This information is provided to assist the reader in understanding the possible effects of the project on the environment within which it is proposed to be developed. This information has been sourced from existing information available for the area. This chapter aims to provide the context within which this assessment is being conducted.

3.1 DESKTOP ASSESSMENT

3.1.1 CLIMATE

The proposed WEF falls approximately 35 km south of Britstown (Figure 1.1). The region is characterised by late summer to autumn rainfall, with generally dry winters (Mucina & Rutherford, 2018). The Mean Annual Precipitation (MAP) and Mean Annual Potential Evaporation (MAPE) of the area is 275 mm and 2 615 mm, respectively (Mucina & Rutherford, 2018). The Annual Precipitation Coefficient of Variation (APCV) of the area is recorded at 36 % (Mucina & Rutherford, 2018), with the highest average rainfall occurring in October (22 mm) and lowest in July (4 mm) (Meteoblue, 2022). The Mean Annual Temperature (MAT) of the area is 16.5 ºC (Mucina & Rutherford, 2018), with the highest mean daily temperatures occurring in January (32 ºC), and lowest occurring in July (2 ºC) (Meteoblue, 2022). An average of 37 days of frost is recorded in the area per year (Mucina & Rutherford, 2018). A summary of the climate at Britstown is provided in Figure 3.1 below.

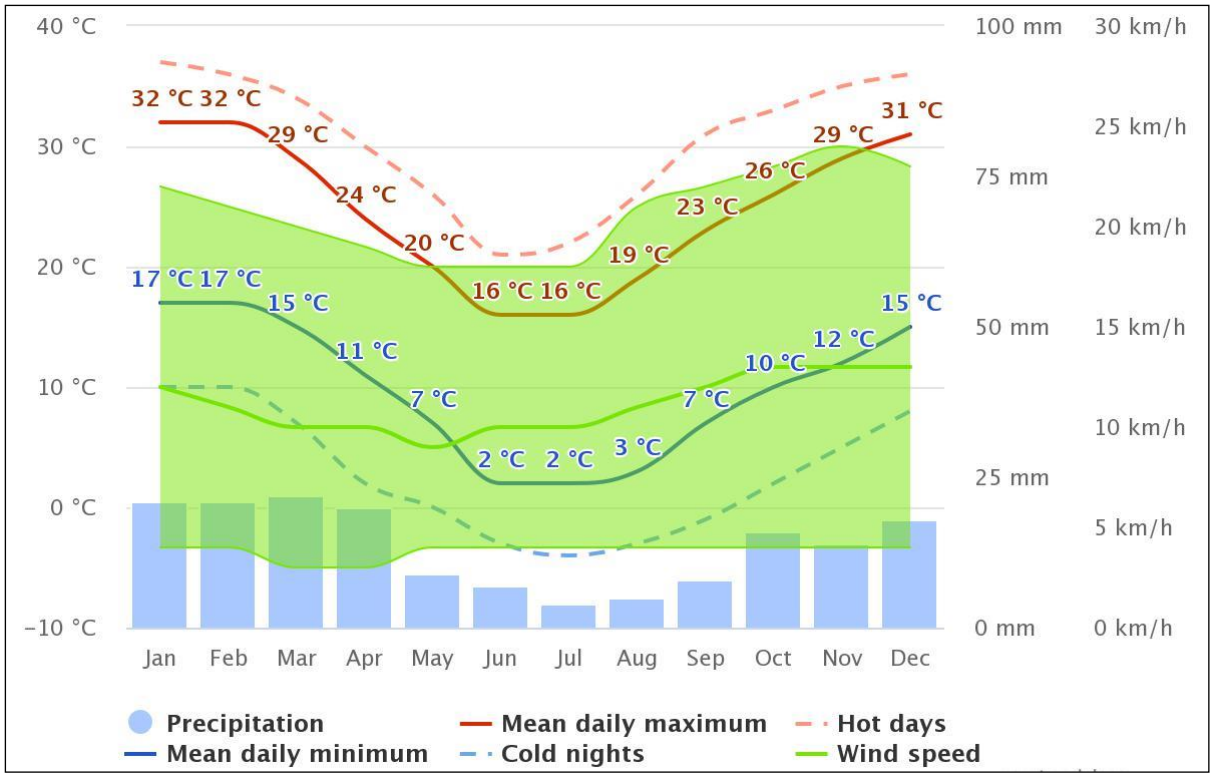


Figure 3.1: Climatic data for Britstown, Northern Cape (Meteoblue, 2022).

3.1.2 TOPOGRAPHY

The topography of the area is characterised as flat to gently sloping, with isolated hills and interspersed pans, as well as discretely distributed on slopes and ridges (Mucina & Rutherford, 2018). The terrain along the proposed WEF site tends to slope towards the south and east, with an average slope of 1.3-3.4 %, several steep slopes reaching gradients of more than 10 %, and elevations ranging from 1 193-1 544 m above sea level. The topographical profiles and map of the site are provided in Figure 3.2 and Figure 3.3, respectively.

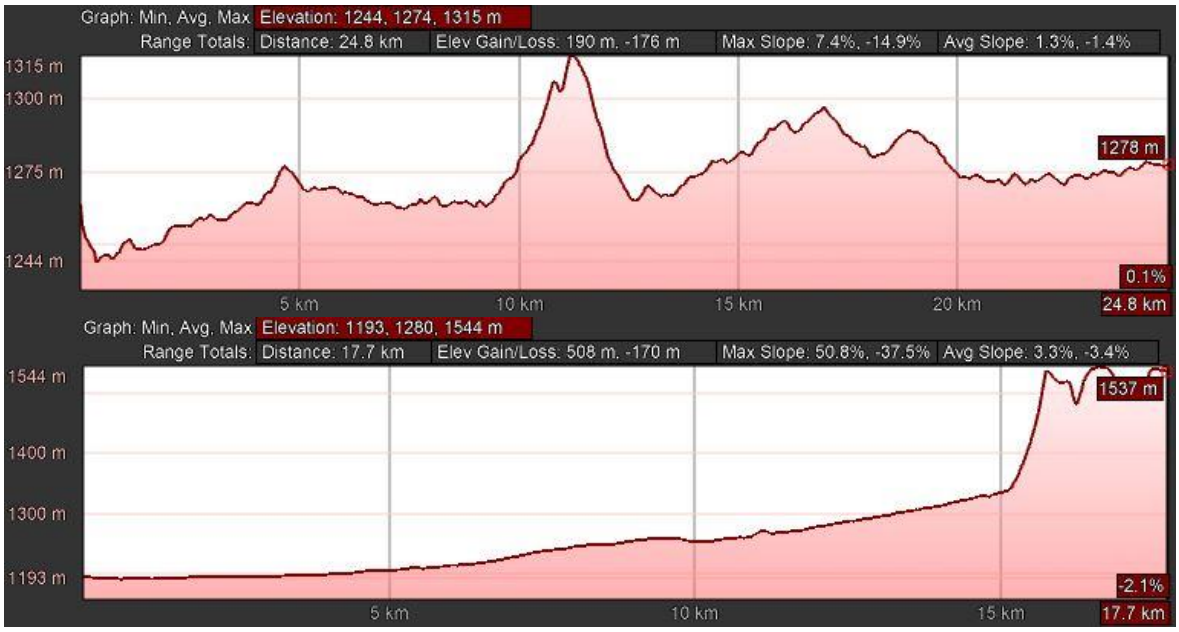


Figure 3.2: Topographic profile of the study area (north to south – top, west to east – bottom)

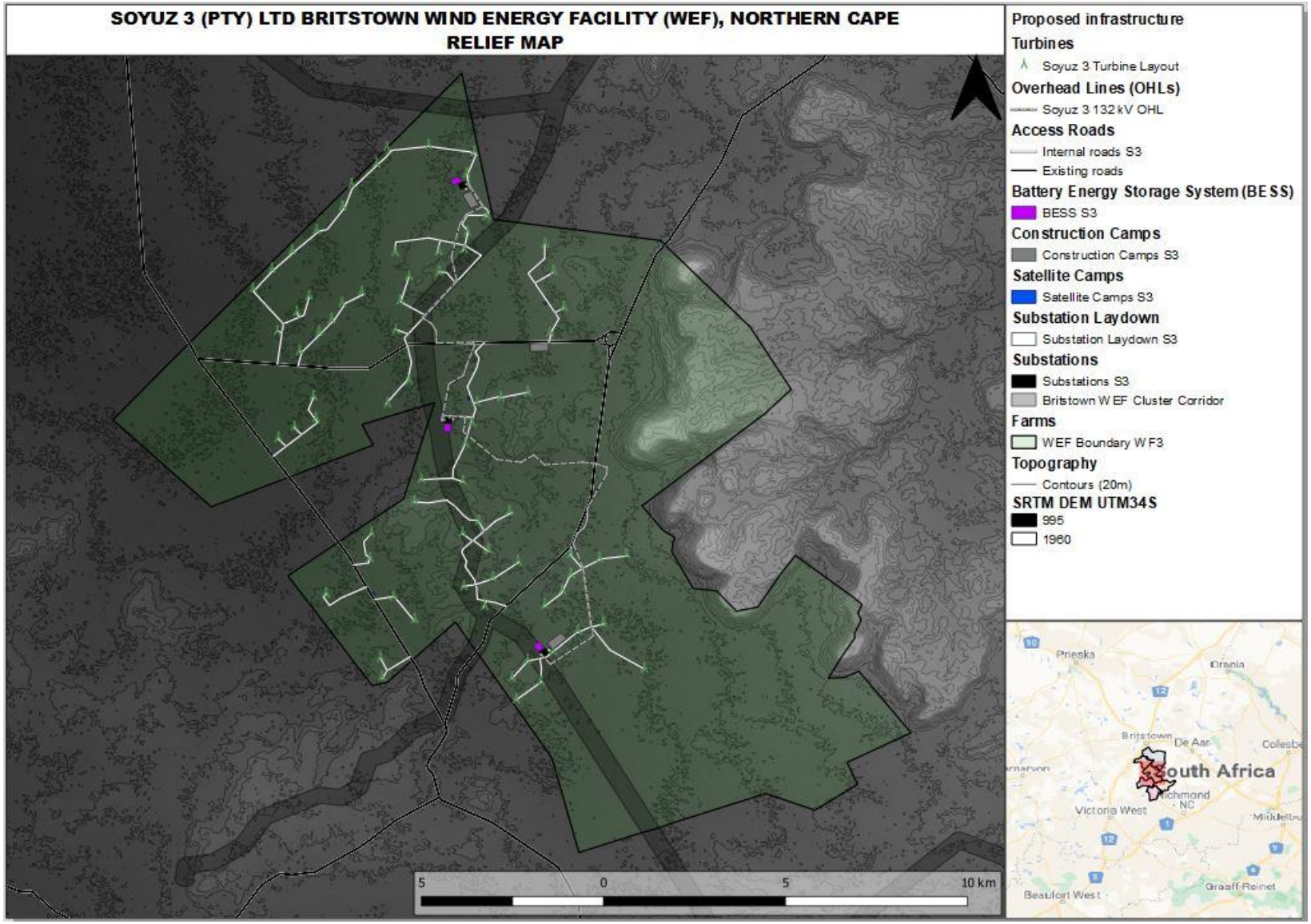


Figure 3.3: Relief map of the study area.

3.1.3 GEOLOGY AND SOILS

The geology of the area consists of mainly arenite and shales of the Koedoesberg Formation, interspersed with Karoo Dolerite (Figure 3.4). According to the SOTER Soil Association map, the WEF site is comprised of mostly type A4 and C1 soils, with areas of type G1 and E1 soils occurring to the east and north west of the site, respectively (**Figure** 3.5). A description of these soils types has been provided in Table 3.1 below.

Table 3.1: Description of SOTER soil association soil types

SOIL TYPE	DESCRIPTION
A4	Red, massive or weakly structured soils with high base status. Association of well drained Lixisols, Cambisols, Luvisols.
C1	Soils with a marked clay accumulation. Association of Luvisols, Planosols and Solonetz. In addition, one or more of Plinthosols, Vertisols and Cambisols may be present.
E1	Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils. Association of Leptosols, Regosols, Calcisols and Durisols. In addition, one or more of Cambisols and Luvisols.
G1	Rock with limited soils. Association of Leptosols, Regosols, Durisols, Calcisols and Plinthosols.

3.1.4 LAND USE AND COVER

The land use and cover of the area consists of predominantly low shrubland, with strips of natural grasslands, eroded lands and other bare areas, as well as small, isolated pockets of commercial annual crops, fallow lands, herbaceous wetlands and mining (Figure 3.6).

3.1.5 VEGETATION AND FLORISTICS

The study area falls within several vegetation types according to the SANBI Vegetation Map of South Africa (Mucina & Rutherford, 2018). The most relevant vegetation types within the project study area, as shown in Figure 3.7 below, are described as follows.

The **Northern Upper Karoo** vegetation type is distributed in the Northern Cape and Free State, along the northern Upper Karoo Plateau at altitudes of 1 000-1 500 m. It is generally flat to gently sloping, with isolated hills and interspersed pans, vegetated by dwarf Karoo shrubland, grasses and low trees. The vegetation is dominated by shrubs such as *Lycium cinereum, Chrysocoma 23iliate, Gnidia polycephala* and several *Pentzia* spp., and grasses such as *Aristida congesta*, *A. diffusa* and *Eragrostis lehmanniana.* Other notable shrubs include *Eriocephalus ericoides* subsp. *Ericoides, Pteronia glauca* and *Zygophullum lichtensteinianum*. This vegetation type is of **LEAST CONCERN**, with 94% of its extent still remaining and 0.5% formally protected.

The **Eastern Upper Karoo** vegetation type is distributed in the Northern, Eastern and Western Cape Provinces. The landscape is characterised by flats and gently sloping plains, interspersed with hills and rocky areas, and vegetated by dwarf microphyllous shrubs (as above), *Aristida* and *Eragrostis*. This vegetation type is of **LEAST CONCERN**, with 97% of its extent still remaining and 2.9% formally protected.

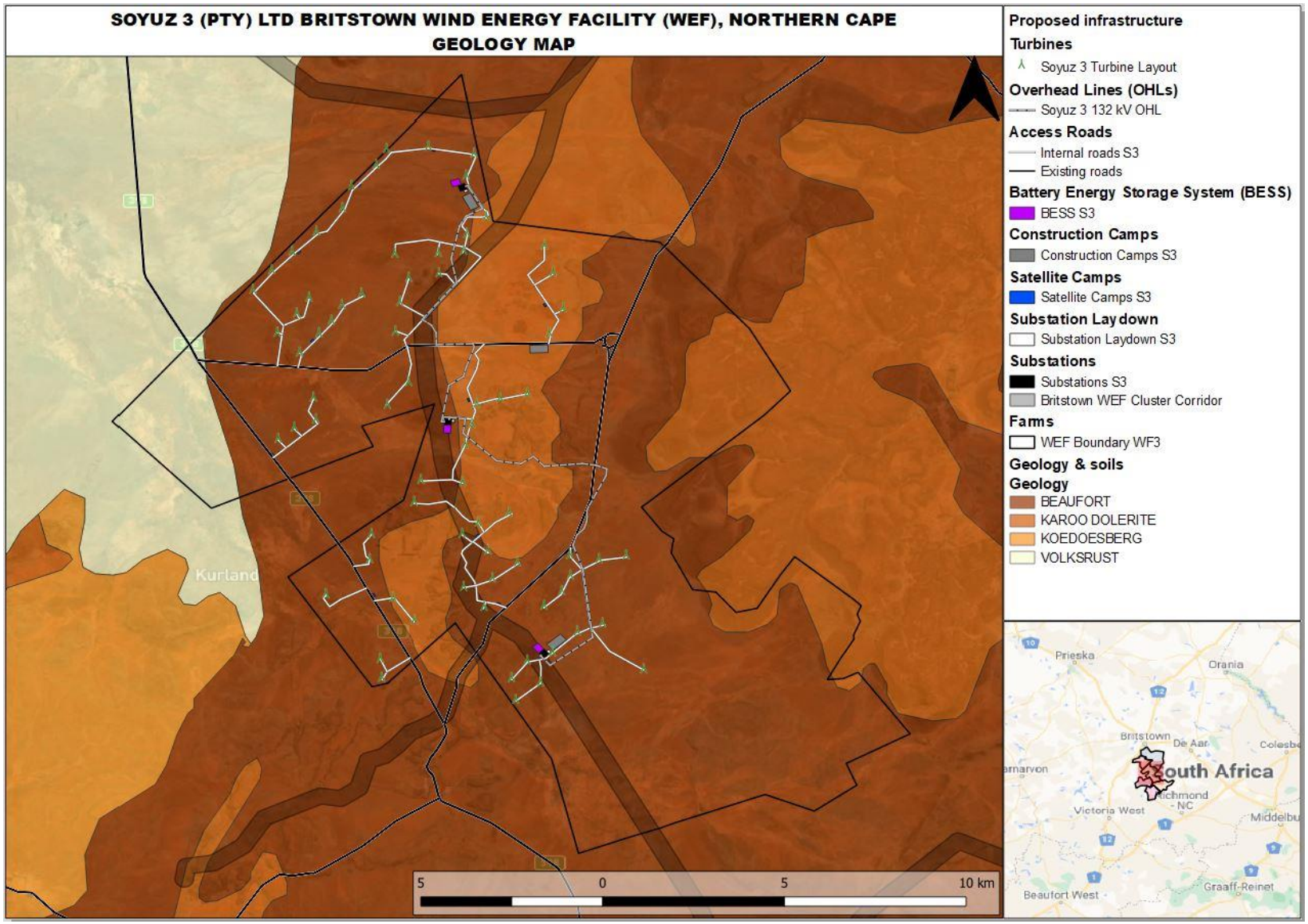


Figure 3.4: Geology map of the study area.

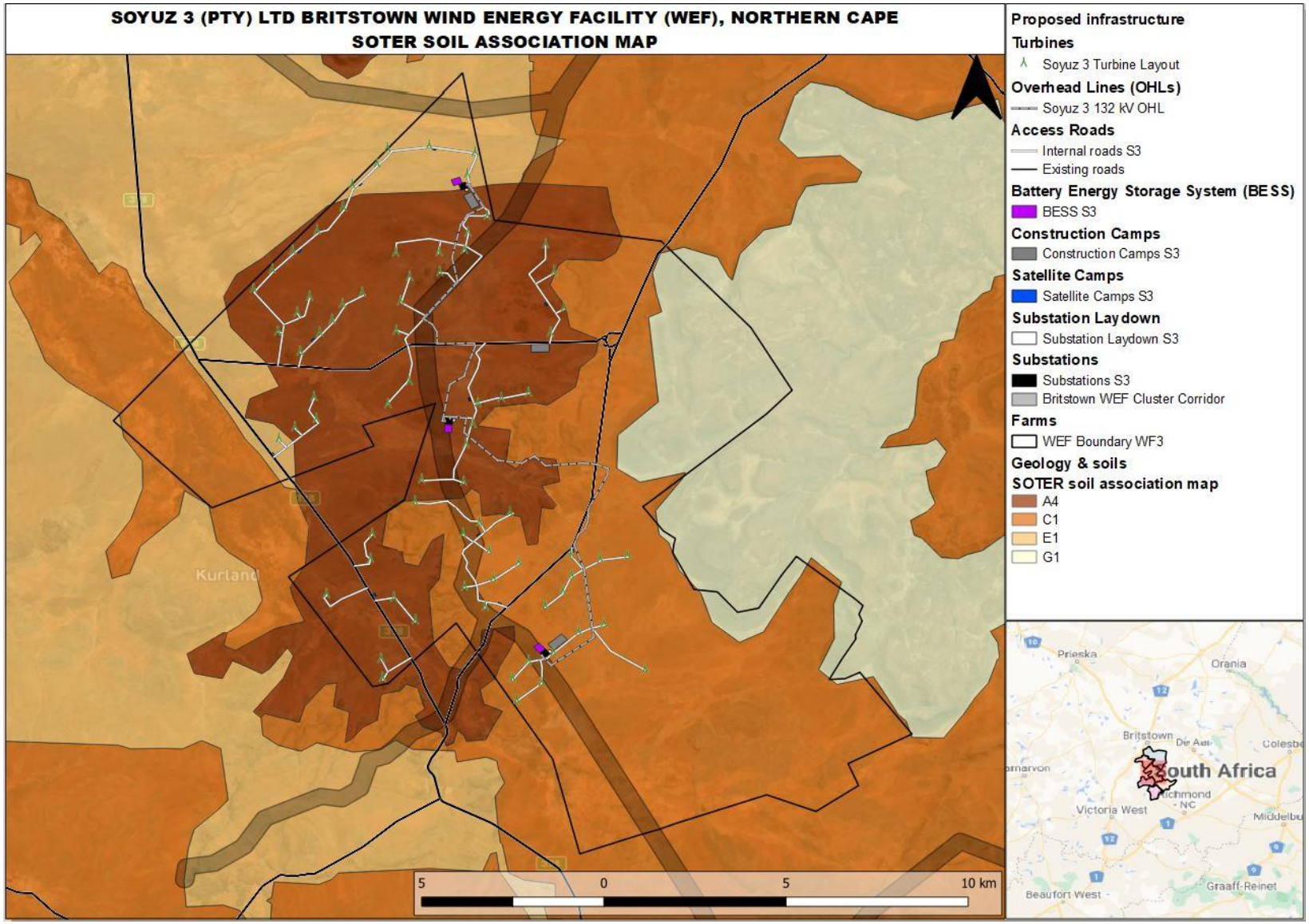


Figure 3.5: SOTER Soil Association map of the study area.

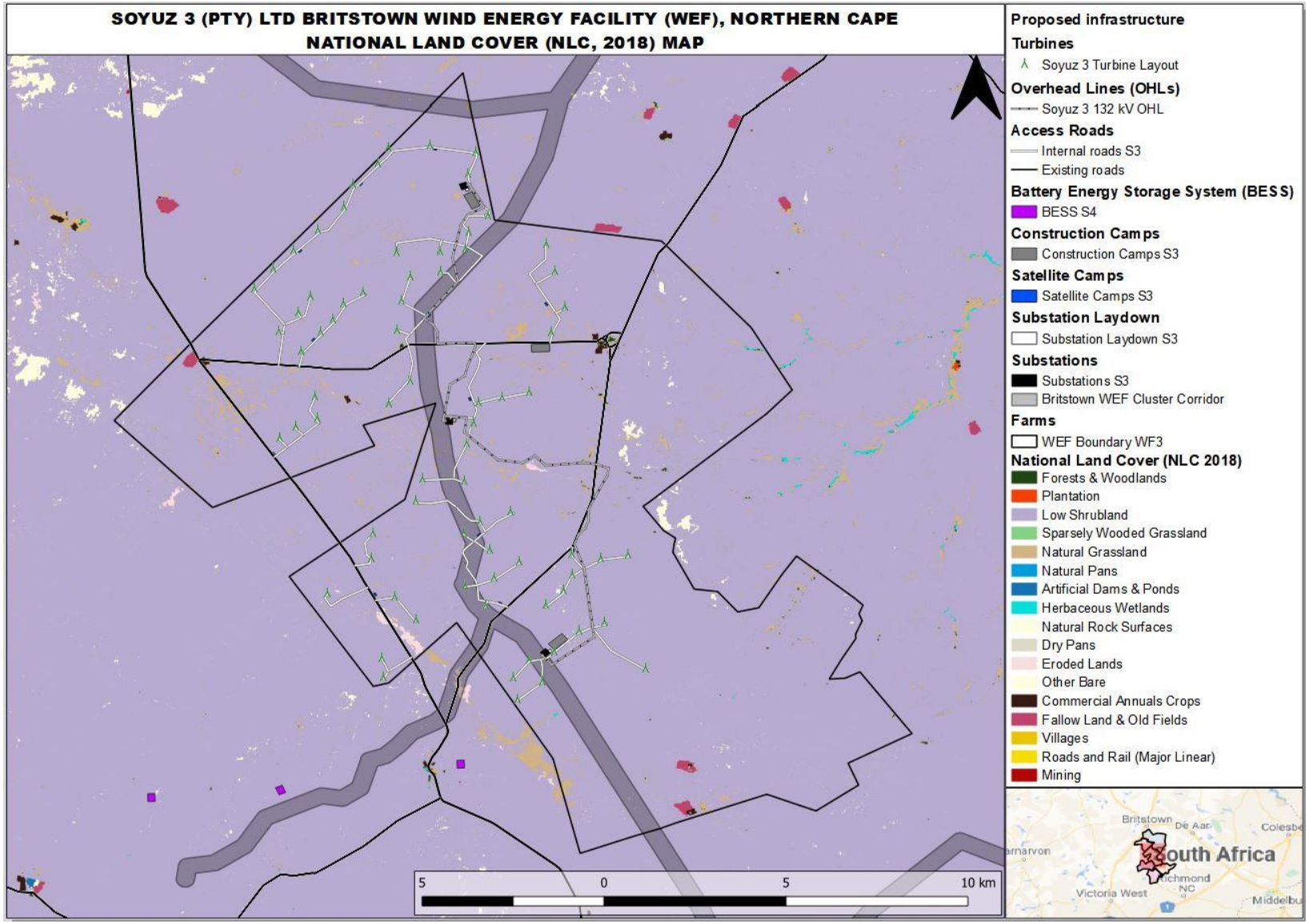


Figure 3.6: Land use and cover map of the study area.

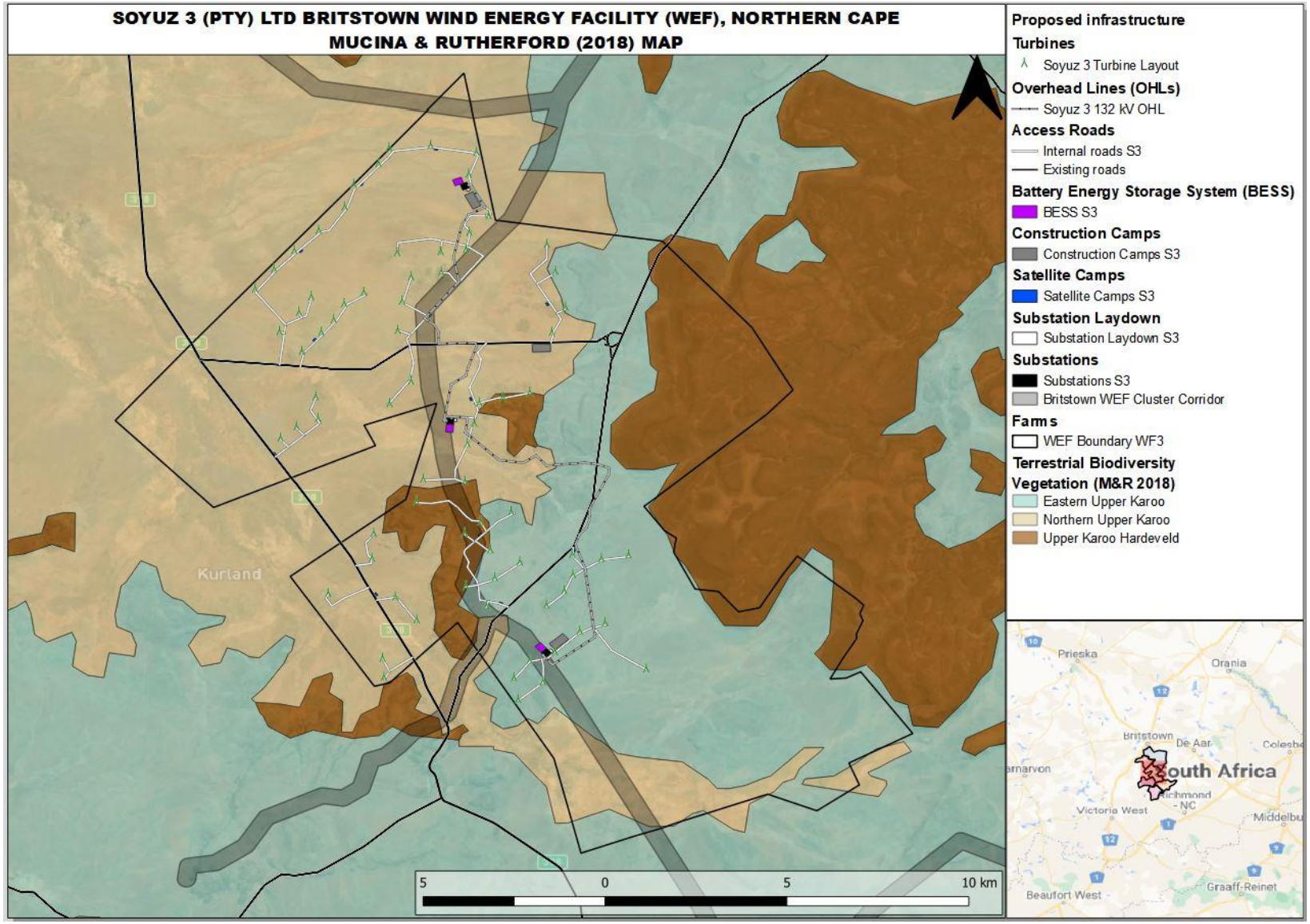


Figure 3.7: Mucina & Rutherford Vegetation map of the study area.

Upper Karoo Hardeveld is discretely distributed on slopes and ridges (including dykes and sills) within the Northern, Eastern and Western Cape Provinces. It is characterised by the steep slopes of koppies, buttes and mesas, vegetated by dwarf Karoo shrubs, *Aristida*, *Eragrostis* and *Stipagrostis*. This vegetation type is of **LEAST CONCERN**, with 100% of its extent still remaining and 5.8% formally protected.

3.1.6 NORTHERN CAPE BIODIVERSITY SPATIAL PLAN (2016)

The Northern Cape Biodiversity Spatial Plan (2016) identifies biodiversity priority areas, including Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which together with protected areas provides an important spatial planning tool which ensures the persistence of viable representative sample of all ecosystem types and species and the long-term ecological functioning at the landscape level. In terms of the National Biodiversity Assessment (NBA, 2018), CBAs are areas required to meet biodiversity targets for ecosystems, species and ecological processes, including those areas in a natural condition (CBA 1) and those in a degraded condition (CBA 2). On the other hand, ESAs are not essential for biodiversity targets, but do play an important supporting role in maintain the functioning of protected areas and/or CBAs. Other Natural Areas (ONAs) include those areas that have not been identified as current biodiversity priority areas, but do retain most of their natural character and perform biodiversity and ecological functions. Most of the proposed Soyuz 3 WEF site is classified as an ONA, with strips of an ESA (associated with tributaries of the Graafwaterspruit and Ongers River) from the north and crossing the south of the site, as well as a patch of Upper Karoo Hardeveld in the south east (Figure 3.8). A section of Graafwaterspruit near the western boundary of the WEF is classified as a CBA (Figure 3.8)

3.1.7 ECOREGIONS

Ecoregional classification allows the grouping of aquatic environments according to similarities based on a top-down nested hierarchy. The principle of river and wetland typing is that these are grouped together at a particular level of the typing hierarchy will be more similar to one another than rivers and wetlands in other groups. Ecological regions are regions within which there is relative similarity in the mosaic of ecosystems and ecosystem components (biotic and abiotic, aquatic and terrestrial). All of the rivers and wetlands in the area fall within Level 1 Ecoregion 26: Nama Karoo (Figure 3.9), with the following attributes:

- Diverse topography, including a moderate to high relief, lowlands, hills and mountains.
- Mean annual precipitation: Moderate/low in the east, decreasing to arid in the west.
- Coefficient of variation of annual precipitation: Moderate/high in the east to very high in the west.
- Drainage density: Generally low, but medium to high in some parts.
- Stream frequency: Low/medium but significant areas with low/high and high frequencies.
- Slopes <5%: Mostly >80% to 50-80%, but significant areas with 20-50% and <20%.
- Median annual simulated runoff: Moderate/low in the east, decreasing to arid in the west.
- Mean annual temperature: Moderate/low in the east, increasing to moderate/high in the west.

Within the Level 1 Ecoregion, the rivers and wetlands fall within Level 2 Ecoregion 26.02 in the west and 26.03 in the east of the WEF project area (Figure 3.9). Table 3.2 provides attributes of the Level 2 Ecoregion.

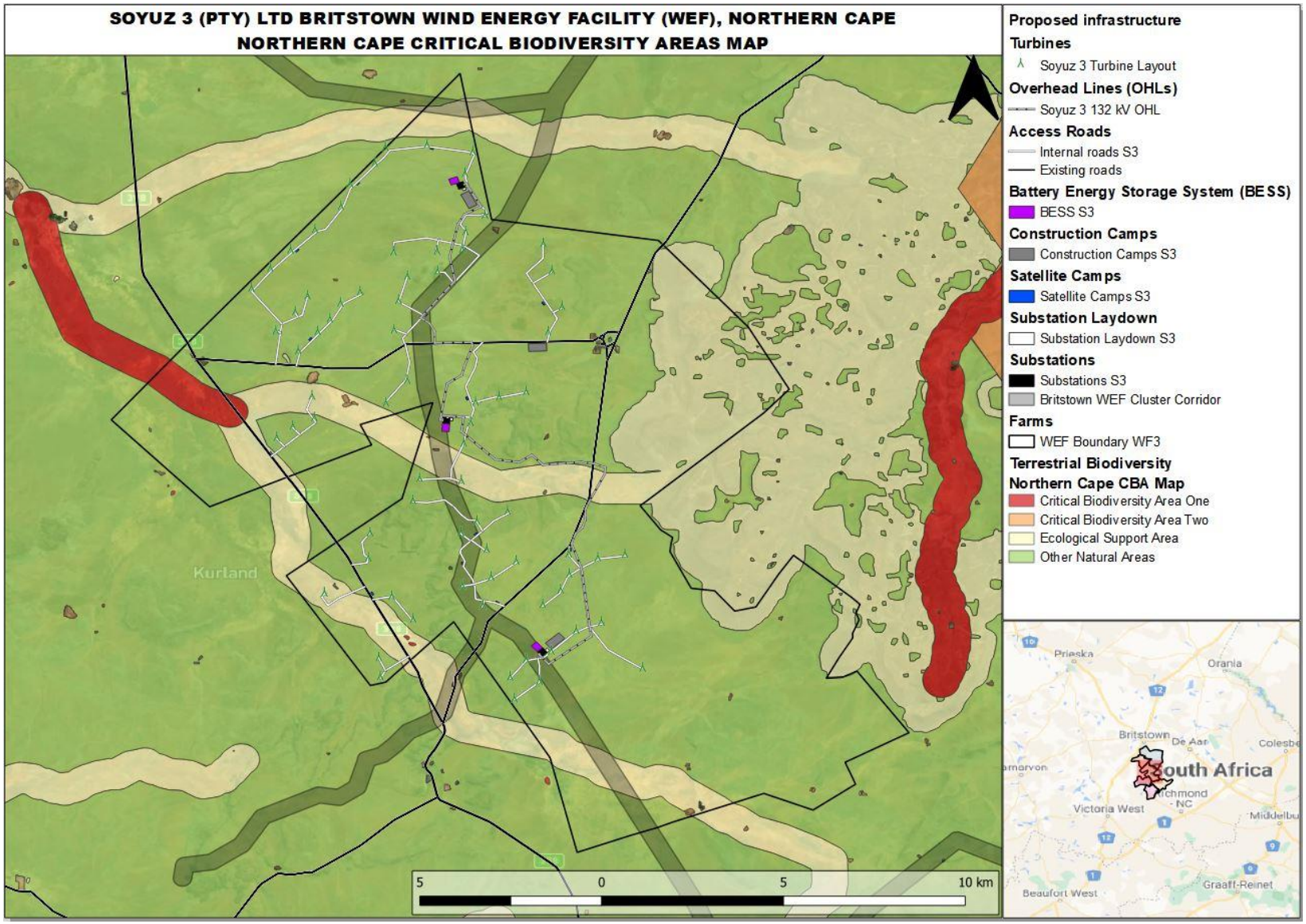


Figure 3.8: Northern Cape Critical Biodiversity Areas map of the study area.

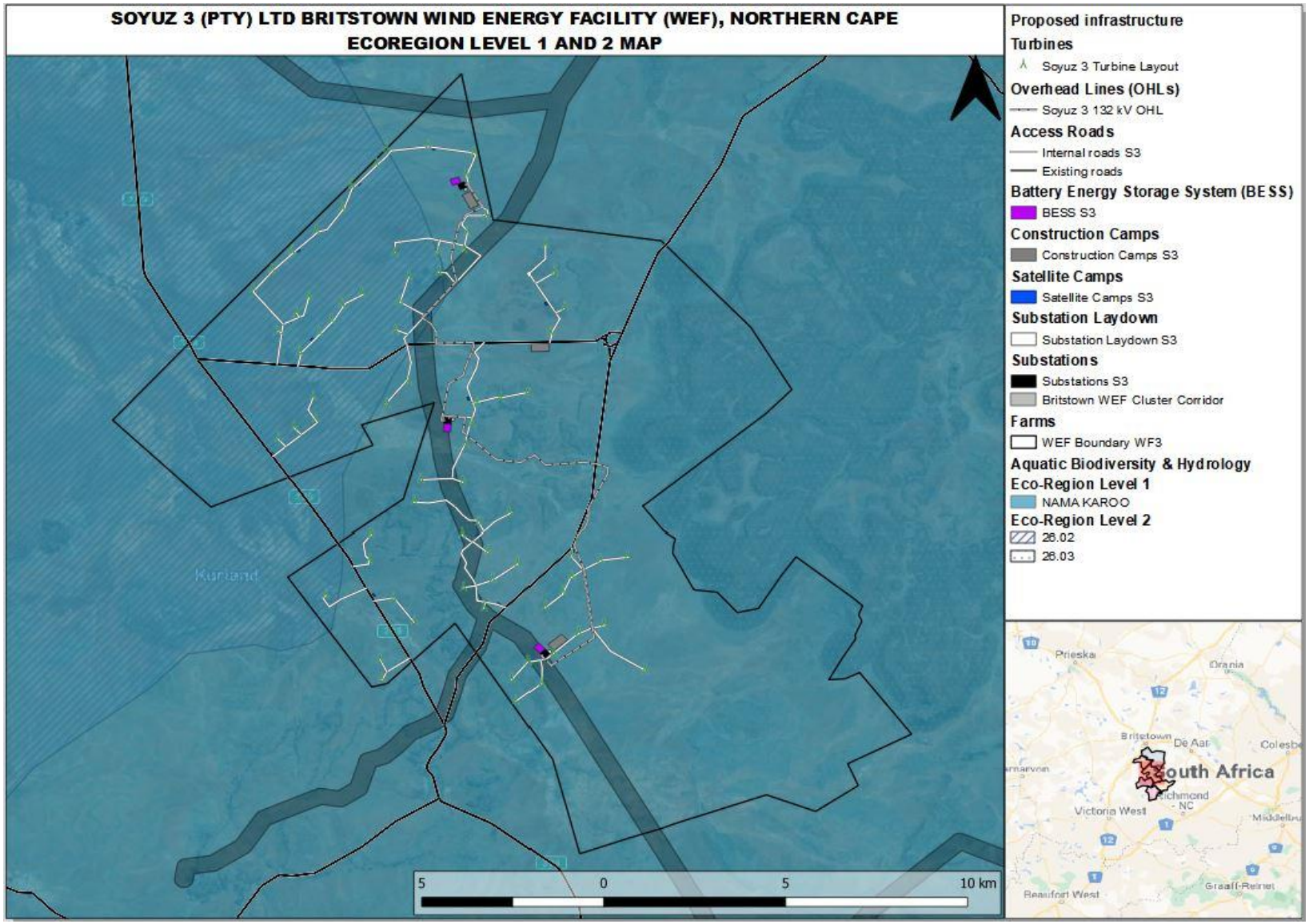


Figure 3.9: Ecoregion Level 1 and 2 map of the study area.

Table 3.2: Attributes of the Level 2 Ecoregion 26.02 and 26.03

MAIN ATTRIBUTES	26.02	26.03
Terrain Morphology	• Plains; moderate relief, Plains • Low relief, Closed Hills, mountains • Moderate and high relief	• Lowlands, Hills and mountains • Moderate and high relief, Open hills, lowlands, mountains • Moderate and high relief
Vegetation type	• Orange Rive Nama Karoo, • Bushmanland Nama Karoo • Upper Nama Karoo.	• Eastern Mixed Nama Karoo • Upper Nama Karoo • Bushmanland Nama Karoo • Upland Succulent Karoo • Escarpment Mountain Renosterveld
Altitude (m a.m.s.l.)	500 – 1 300	1 100 – 1 500
MAP (mm)	0 – 300	0 – 500
Coefficient of variation (% of annual precipitation)	35 – >40	30 – 40
Rainfall concentration index	45 – 65	15 – 55
Rainfall seasonality	Very late Summer, Winter	Very late Summer, Late Summer, Winter
Mean annual temp (°C)	16 – 20	14 – 18
Mean daily max temp (°C) Feb	28 – 32	26 – 30
Mean daily max temp (°C) Jul	16 – 20	12 – 18
Mean daily min temp (°C) Feb	14 – 18	12 – 16
Mean daily min temp (°C) Jul	-2 – 4	0 – 2
Median annual simulated runoff (mm) for quaternary catchment	<5 – 10	<5 – 40

3.1.8 DRAINAGE AND RIVER ECOSYSTEM CONTEXT

The proposed windfarm falls primarily within quaternary catchment D61L, associated with the Graafwaterspruit, a tributary of the Ongers River (Figure 3.10), which falls within the Orange River Water Management Area (WMA). Tributaries of the Graafwaterspruit flow in a north-westerly direction, intersecting the WEF boundary in the central interior and south, before coalescing in the north west of the development area. Numerous smaller drainage lines occur across the proposed development area.

According to the NBA (2018), sections of these tributaries near the western boundary of the site are classified as Endangered, with the remaining classified as Least Threatened. Endangered ecosystems are ecosystem types that are close to becoming Critically Endangered (Nel & Driver, 2012). Any further loss of natural habitat or deterioration of condition in these ecosystem types should be avoided, and the remaining healthy examples should be the focus of conservation action (Nel & Driver, 2012). Most of these reaches have a "Data Deficient" Present Ecological State (PES) allocation, with only a small section formally assessed as having a PES of "F: Critically Modified". Much of the Karoo was largely under-sampled during the NBA (2018) assessment. Two springs also occur to on the mesas, approximately 2-4 km to the east of the WEF boundary (NBA, 2018). In terms of the National Freshwater Ecosystem Priority Areas (NFEPA) project (2014), sections of the Graafwaterspruit tributaries are Upstream Management Areas. These are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. The north-western section, downstream of the confluence point, is classified as a river FEPA.

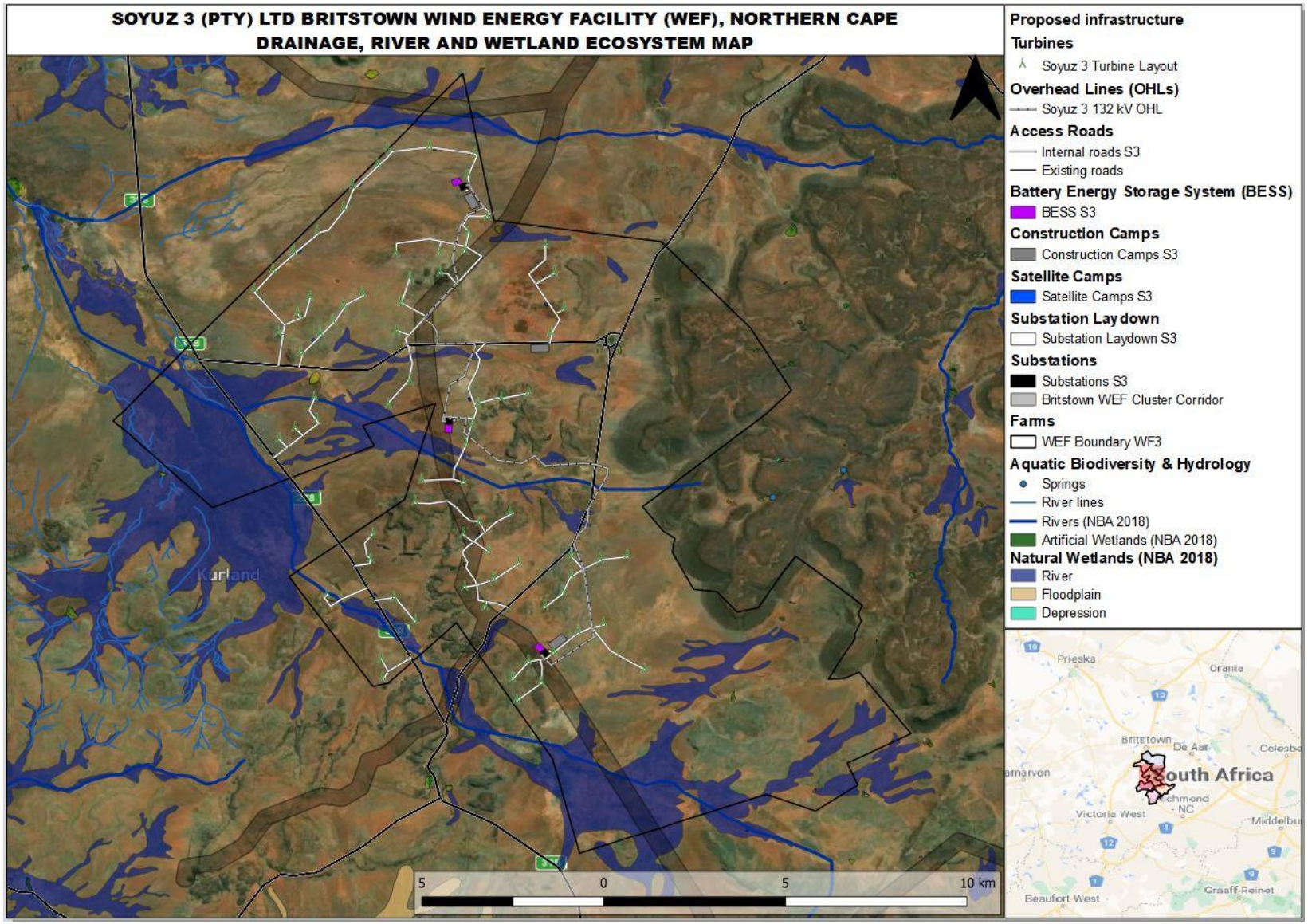


Figure 3.10: Drainage, River and Wetland Ecosystem map of the study area (NFEPA, 2014; NBA, 2018).

3.1.9 WETLAND ECOSYSTEM CONTEXT

According to the National Wetland Map Version 5 (2018), 16 wetlands fall within the WEF boundary, all of which are valley-bottom wetlands associated with rivers, with an additional three rivers and one depression wetland within 500 m of the boundary (Figure 3.10). With the exception of the depression wetland, which is classified as Vulnerable, the remaining wetlands all lack a threat status classification. There are also 18 artificial wetlands within the WEF boundary and an additional six within 500 m of the boundary, all of which are classified as dams (Figure 3.10). Although no NFEPA wetland clusters fall within 500 m of the WEF boundary, several occur approximately 20-40 km to the north (Figure 3.10).

3.2 SITE ASSESSMENT

On completion of the desktop assessment, a site visit was undertaken from 9-15 May 2022 (autumn). The purpose of the site visit was to gather data regarding the surrounding watercourses, ground truth the desktop study, delineate watercourses and wetlands, and assess the state of the aquatic and wetland environment. This included identifying any potential impacts that the development may have on the aquatic and wetland environment and the significance of those impacts.

3.2.1 DELINEATION, CLASSIFICATION AND HABITAT CHARACTERISATION OF WATERCOURSES

A generalised categorisation of the various assessment units assessed within the Soyuz 3 WEF and broader cluster study area provided and broadly described in Table 3.3 below, along with photographic examples. A detailed description of each assessment unit is provided in Appendix B. The delineation map is provided in Figure 3.11 - Figure 3.12. Seventy-six (76) assessment units were identified and delineated and classified (see Table 3.3), including:

- Eighteen longitudinal washes, including Badlands, and four lateral washes;
- Four mesa-top and four lowland flats;
- Fourteen channelled and ten unchannelled lower order drainage lines; and
- Twenty-two artificial wetlands (dams).

Despite the large number of assessment units, it should be reiterated that many of these are terrestrial in nature and cannot be considered watercourses or wetlands in terms of the NWA, 1998 (Act 36 of 1998). The number of true wetlands within Soyuz 3, as well as the broader area, are extremely limited. This was confirmed through extensive infield sampling, including a considerable number of auger points and descriptions of vegetation, to verify the absence of hydric conditions. Furthermore, based on the field verification, it was concluded that the NBA (2018) National Wetland Map 5 (NWM5) (included in Figure 3.10) substantially over-mapped the extent of wetlands in Soyuz 3 and the broader area. A confirmation of which assessment units are considered watercourses / wetlands in terms of the NWA, 1998 (Act 36 of 1998), and which are considered purely terrestrial, has been provided in Table 3.3 and Appendix B.

Table 3.3: Generalised categorisation of assessment units

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
Washes	Longitudinal (A01-13) and Badlands (A14-18)	Wash features derived from higher order drainage, dominated by active **alluvial** transportation and deposition of sediment via sheet overland flow, though often with at least some localised, discontinuous and/or weakly-defined active channelling in their natural condition. Occurs along the valley floor. Evidence of longitudinal, down-valley sheet flow. May or may not include localised seepage areas, supporting limited hydric conditions. Common within the Soyuz 3 WEF and broader cluster study area. In their heavily-impacted state, these washes are characterised by networks of deeply-incised erosion gullies, resembling Badlands (A14-18). According to a local farmer, much of this erosion occurred during the floods of 1988. More extensive gully networks have been targeted for erosion control, which includes a series of concrete weirs. **Soils:** Typically high chroma, red to reddish brown (5 YR 5/6) silty sandy loams, with or without nodules and/or occasional low contrast mottles. **Vegetation:** Largely bare, with patches of *Aristida* spp., *Chloris virgata,* and low shrubs such as *Caryoxylon aphyllum, Chrysocoma ciliata, Lycium* spp. and/or *Pteronia* spp. Localised wetter areas also including *Aizoon namaense, Cotula* sp., *Eragrostis* sp., *Rumex* sp., *Scirpoides dioecus, Stipagrostis namaquensis, Tragus berteronianus* and *Xanthium spinosum.* **NWA Classification:** Most units, particularly those with at least some active channelling and/or limited hydric conditions, meet the NWA definition of a **watercourse**.	

Plate 3.1: Natural longitudinal wash (top), with localised, weakly-defined channelling (middle) and impacted wash, with network of gullies (bottom)

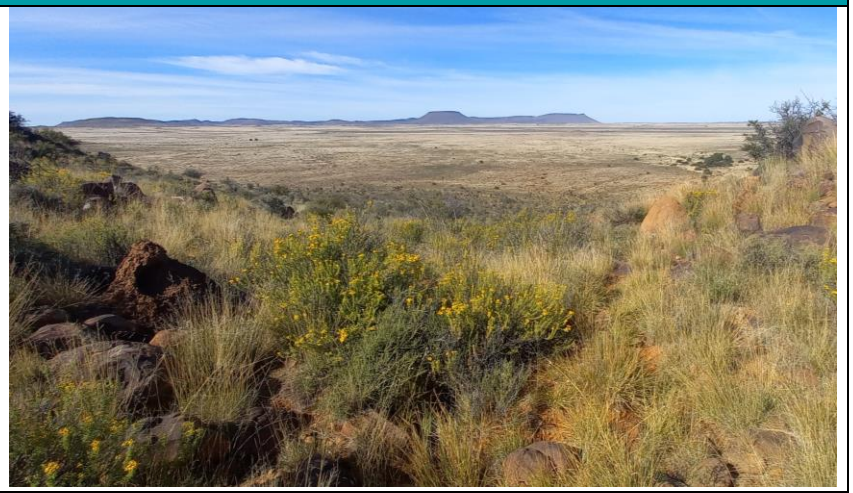
CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
	Lateral (B01-04)	Wash features derived from lower order drainage, dominated by active **colluvial** transportation and deposition of sediment via sheet overland flow, with little to no active channelling in their natural condition. Occurs along mesa foot slopes, often coalescing and joining longitudinal washes at or near the valley bottom, giving the appearance of fans. Evidence of lateral, down-slope sheet flow. May or may not include localised seepage areas, though rarely (if ever) support any hydric conditions. Although none were encountered during the site survey of Soyuz 3, a number of features suspected to be lateral washes were delineated at the desktop level. The following characteristics are noted from lateral washes within the Soyuz 1 study area. **Soils:** Mostly uniform, red silty loams (0-50 cm), becoming slightly redder with depth. **Vegetation:** Moderately to sparsely vegetated by *A. congesta, C. virgata, C. usitatus, C. ciliata, E. ericoides, L. cinereum* and *R. intricata.* **NWA Classification:** Units do not have any active channelling, nor do they support any hydric conditions, therefore do not meet the NWA definition of a watercourse and are considered **terrestrial** features.	  **Plate 3.2: Natural (top) and impacted (bottom) lateral wash along the base of a mesa**

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
Flats	Lowland (C01-04) and Pans	Brackish flats, typically occurring within unchannelled lower order drainage areas. Bare or sparsely vegetated by salt tolerant species. Common within the Soyuz 3 WEF study area. Pans are a subtype of the lowland flats, sometimes occurring within the broader boundary of the flat. These are more-or less round flat basins, completely devoid of vegetation, typically fringed by sparse salt tolerant vegetation. No lowland pans were noted within the Soyuz 3 WEF, however one was noted in the adjacent Soyuz 1 WEF study area. **Soils:** Red-brown silty loams. **Vegetation:** Typically sparse, sporadic or fringing *A. namaense, A. congesta, Asparagus laricinus, C. glabrescens, C. virgata, E. ericoides, Lycium horidum, P. glauca, T. berteronianus* and *Zygophyllum incrustatum.* **NWA Classification:** Units do not have any active channelling, nor do they support any hydric conditions, therefore do not meet the NWA definition of a watercourse and are considered **terrestrial** features.	  **Plate 3.3: Lowland flat (top) and pan (bottom)**

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
	Mesa-top (D01-04)	Shallow soil flats occurring at the top of mesas, dominated by sparse *Cyperus usitatus*[1] and short grass. Lacking hydric conditions. Notable disturbance of soils in some mesa-top flats, assumed to be caused by porcupines. Although none were encountered during the site survey of Soyuz 3, a few features suspected to be mesa-top flats were delineated at the desktop level. The following characteristics are noted from mesa-top flats within the Soyuz 1 study area. **Soils:** Shallow (<25 cm), high chroma, red-brown silty clay loams, perched above a weathering dolerite layer. **Vegetation:** Depression with generally shortly-grazed *C. usitatus* and *Eragrostis* sp., with *Ammocharis sp.* and *Oxalis obliquifolia,* and fringing *A. congesta, Asparagus laricinus, E. lehmanniana, Rhigozum obovatum* and/or *R. intricata.* **NWA Classification:** Units do not have any active channelling, nor do they support any hydric conditions, therefore do not meet the NWA definition of a watercourse and are considered **terrestrial** features.	   **Plate 3.4: Mesa-top flat (top) and *C. usitatus* (bottom)**

[1] This species appears to be a facultative species and is by no means confined to wetlands. While Collins (2011) identifies it as a component of some of the wetland plant communities in the Free State, Manning and Goldblatt (2012) do not identify its habitat as specifically confined to wetlands/marshes/streams (as they do for many of the other *Cyperus* species in the publication) and Winterbach (1999) identifies it as one of the characteristic species of the plant communities on shallow soil overlying dolerite rather than being a characteristic species of the hygrophilous plant communities. This ties in with the lack of hydromorphic soil indicators which were noted for the mesa-top flats, despite the impeded drainage on the shallow soils.

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
Low-order drainage lines	Unchannelled (E01-10)	Gently-sloped, topographically-defined areas of ephemeral flow accumulation, rarely supporting any hydric conditions. Lacking a well-defined channel. Only a few were encountered during the site survey of Soyuz 3. Several more of these features were delineated at the desktop level, typically concentrated around mesas. **Soils:** Yellowish red-brown or yellow-brown silty sandy loam, becoming red-brown with depth and mixing with dark red concretions. **Vegetation:** Well-vegetated by, *inter alia*, *A. congesta, A. laricinus, A. semibaccata, C. glabrescens, D. lycoides, Eragrostis* sp., *Hermannia desertorum, L. horidum, R. intricata, T. berteronianus* and *Z. incrustatum.* **NWA Classification:** Units do not have any active channelling, nor do they support any hydric conditions, therefore do not meet the NWA definition of a watercourse and are considered **terrestrial** features.	  **Plate 3.5: Unchannelled areas of flow accumulation**

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
	Channelled (F01-14)	Steep- or moderately- sloped channelled ephemeral drainage lines, occasionally supporting localised hydric conditions. Occurs on steep upper slopes of mesas, characterised by cobble and boulder channel beds, or on more gradual mid-slopes where channels may become accentuated by livestock tracks. The more mesic conditions are associated with mesa runoff. These are also in the best condition, vegetated by *Heteropogon contortus* and *Themeda triandra.* Only a few were encountered during the site survey of Soyuz 3. Several more of these features were delineated at the desktop level, typically concentrated around mesas. Channelled drainage lines typically lose confinement near the base of the mesas. Depending on the shape of the receiving basin, sediment either converges or diverges, forming an alluvial fan of deposition. These alluvial fans often overlap with lateral washes. **Soils:** Brown sandy loams, becoming a dark grey-brown silty loam with white flecks, overlaying bedrock. **Vegetation:** *A. congesta, D. lycoides, Eragrostis sp., R. intricata, T. berteronianus* and *Z. incrustatum.* **NWA Classification:** All units have active channelling and experience at least intermittent flow, therefore meeting the NWA definition of a **watercourse**.	  **Plate 3.6: Channelled drainage (top) and converging basin (bottom)**

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
Wetlands	Natural channelled valley bottom (CVB)	Gradual, gentle, CVB wetland with narrow active flow, stream, exhibiting redoximorphic soils and supporting wetland plant species. None were encountered within Soyuz 3 and only one was encountered within the broader WEF cluster, namely within Soyuz 2. The below is taken from the description of the wetland in Soyuz 2. **Soils:** Wetland soils comprised of dark brown-grey (10 YR 5/2) silty loams with abundant low contrast orange-brown mottles (0-20 cm), becoming greyer and lighter (10 YR 6/1) with an abundance of orange mottles and black nodules (20-28 cm), before striking bedrock at 28 cm. Marginal soils comprised of dark grey-brown sandy loam with few orange mottles. **Vegetation:** Wetland vegetation includes *Aponogeton* sp., *A. vestita, Diospyros lycoides, Heteropogon contortus, Isolepis setacea*[2]*, O. obliquifolia, Pycreus sp. and S. burchelii.* Wettest areas dominated by *I. setacea*. Fringing vegetation comprised of *A. congesta, E. ericoides, R. intricata and T. triandra.* **NWA Classification:** Units with redoximorphic soils, supporting wetland species, thus meeting the NWA definition of a **wetland**.	

Plate 3.7: Channel (top), broader wetted area (middle) and wetland species (bottom) - *Aponogeton* sp. (left) and *Isolepis setacea* (right)

[2] *Isolepis setacea* is an obligate wetland species, inhabiting waterlogged soils, sometimes occurring in water or watercourses (Van Ginkel & Cilliers, 2020; Van Ginkel, et al., 2011).

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
	Artificial (dams)	Dams, characterised by an earthen, typically vegetated, or concrete dam wall. Evidence of impounded water, including generally bare or sparsely vegetated areas, with either open water or cracked, moist or dry, clayey surfaces. Often accompanied by windmills, pumps and/or livestock water troughs. Some support localised hydric soils, as well as some aquatic and/or wetland vegetation. Somewhat common within the Soyuz 3 WEF and broader cluster study area. **NWA Classification:** All units are dams into which, or from which, water flows and are at least periodically covered with shallow water. The dams generally support at least some hydric soils and a few aquatic or wetland species. However, these hydric conditions are often highly localised to the areas of the dams subject to the most prolonged saturation, with most of the full supply areas lacking these conditions. Although artificial, the dams are generally considered **wetlands** under NWA.	  **Plate 3.8: Dams, with earthen (top) or concrete (bottom) walls**

CATEGORY	SUBCATEGORY	DESCRIPTION	PHOTOGRAPHIC EXAMPLES
Rivers		Mixed alluvial and bedrock active rivers, with gentle to moderate flow, seasonal pools and often algae, especially downstream of high grazing areas. The rivers are presumably fed by natural springs. No rivers were noted within the Soyuz 3 study area. However, a number of rivers were noted within the broader WEF cluster, particularly to the south. **NWA Classification:** All units have active channelling and experience at least intermittent flow, therefore meeting the NWA definition of a **watercourse**.	  **Plate 3.9: Alluvial (top) and bedrock (bottom), spring-fed rivers**

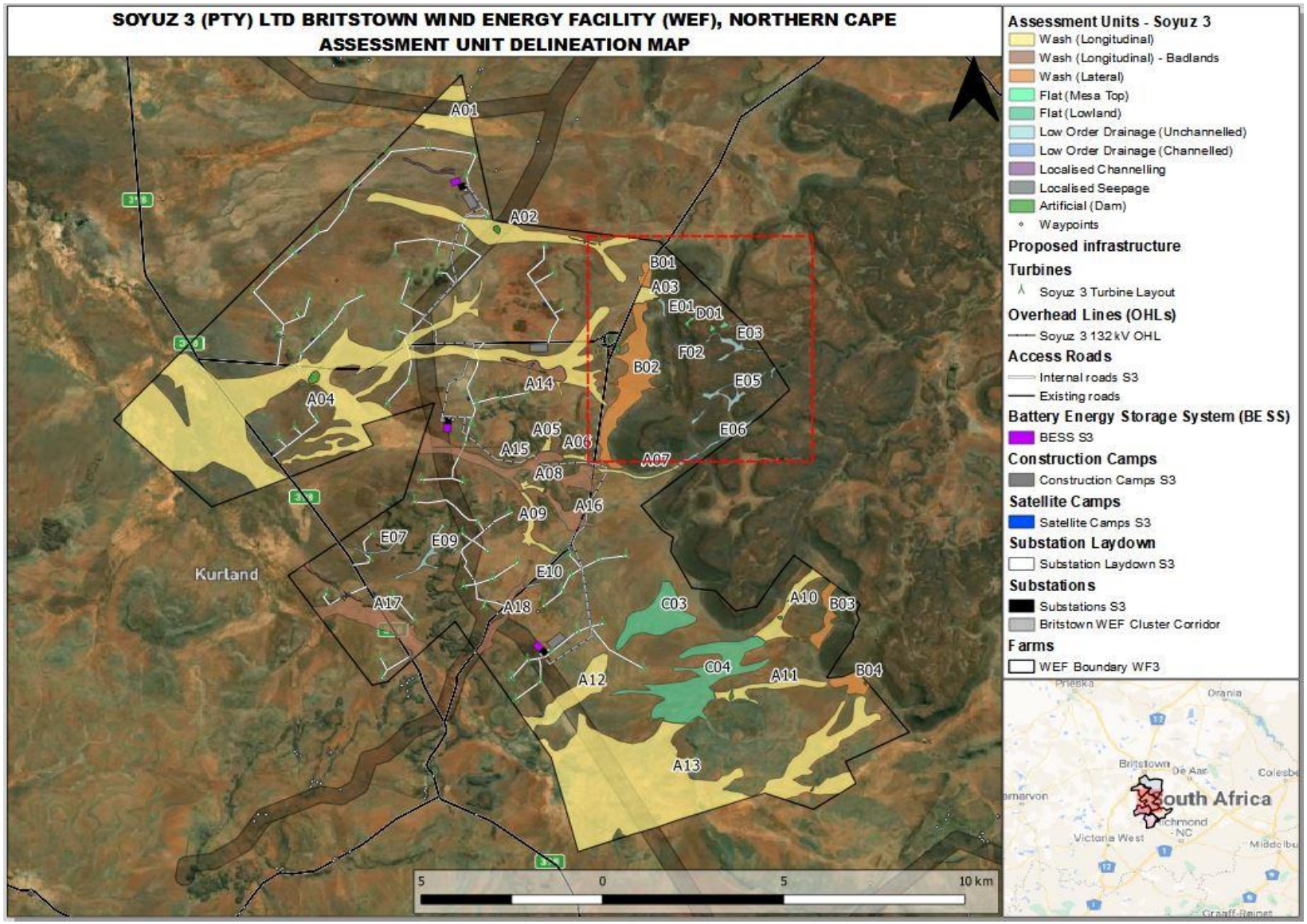


Figure 3.11: Assessment units surveyed during the site visit to the study area.Red box indicates zoomed in areas in below figure.

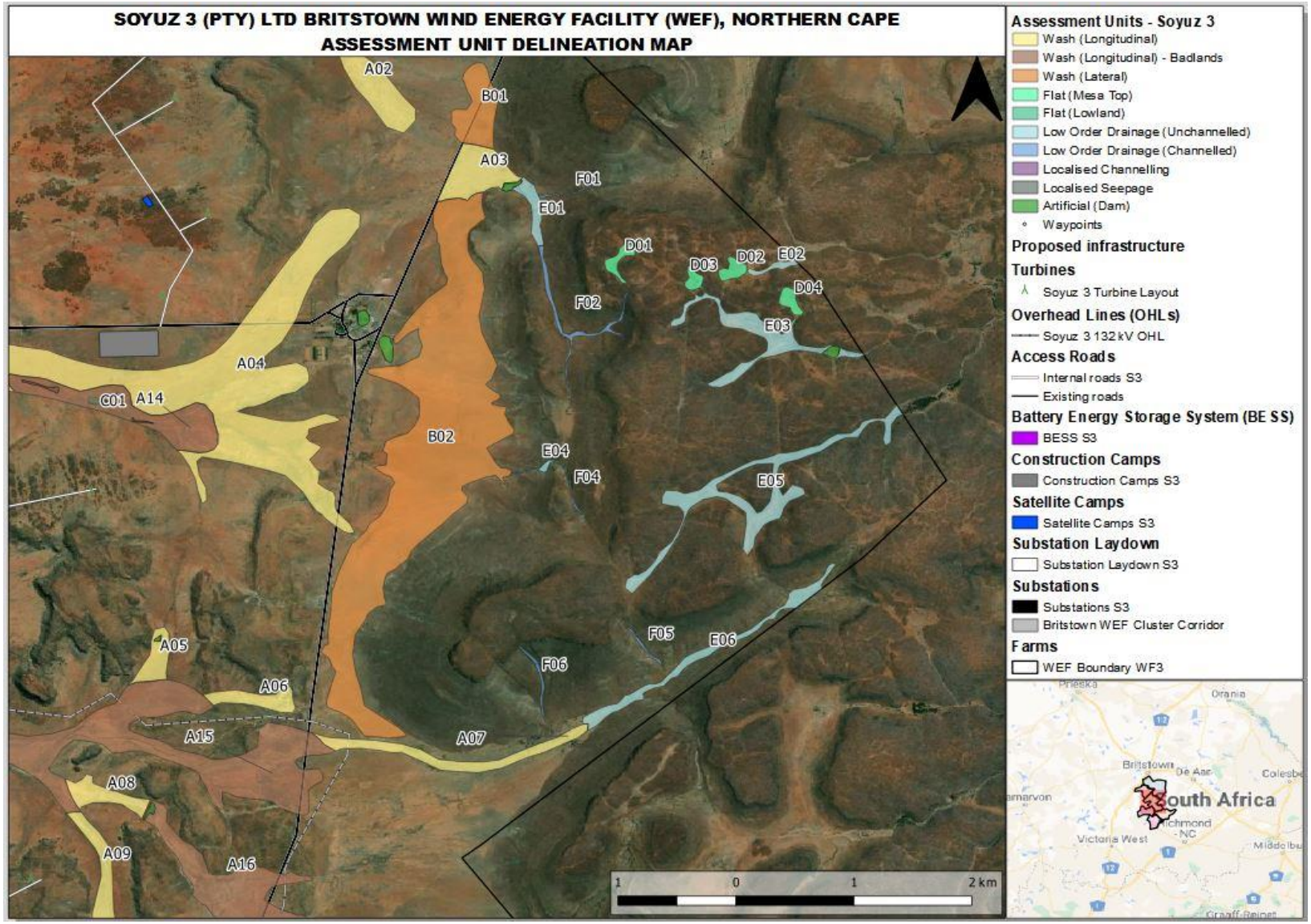


Figure 3.12: Assessment units within north-eastern section of the study area.

3.2.2 PRESENT ECOLOGICAL STATE OF THE WATERCOURSES AND WETLANDS

This section presents and discusses the results of the drainage line, river and wetland Present Ecological State (PES) assessments. The PES of a watercourse is defined as a measure of its similarity or deviation from a natural or reference state (Macfarlane, et al., 2020). The impact scores were interpreted using the PES and impact categories provided in Table 3.4 below.

Table 3.4: PES and Impact Categories

PES CATEGORY	IMPACT SCORE	IMPACT CATEGORY	IMPACT DESCRIPTION
A: Natural	0-0.9	None	No discernible modification or the modification is such that it has no impact on wetland integrity.
B: Largely Natural	1-1.9	Small	Although identifiable, the impact of this modification on wetland integrity is small.
C: Fair	2-3.9	Moderate	The impact of this modification on wetland integrity is clearly identifiable, but limited.
D: Poor	4-5.9	Large	The modification has a clearly detrimental impact on wetland integrity. Approximately 50% of wetland integrity has been lost.
E: Very Poor	6-7.9	Serious	The modification has a clearly adverse effect on this component of habitat integrity. Well in excess of 50% of the wetland integrity has been lost.
F: Very Poor	8-10	Critical	The modification is present in such a way that the ecosystem processes of this component of wetland health are totally / almost totally destroyed.

The River Index of Habitat Integrity (IHI) Version 2 Tool (Kleynhans, 2012) was used to determine the PES score of the unchannelled and channelled low order drainage lines. The tool assesses the present state of instream and riparian habitats, including existing impacts, by comparing this to an estimated natural, non-impacted reference state. The assessment involves rating a range of standard impacts to instream and riparian habitats (e.g. water abstraction and flow modification, and vegetation removal and channel modification, respectively). For the purposes of the PES assessment, the low order drainage lines were grouped into their subcategories (unchannelled and channelled) and level of impact, given their similarity in terms of their morphology and overall condition. The results of the IHI assessment are summarised in Table 3.5 below.

The habitat integrity of the drainage lines in the project area are all in a fair to largely natural condition, with a few relatively minor impacts. The unchannelled drainage lines (E01-10) and channelled drainage lines occurring gentler hills tend to be more susceptible to impacts, such as vegetation loss and erosion, due to their generally flatter terrain and accessibility to grazing livestock. Additionally, some of the riparian areas associated with these drainage lines on flatter terrain are likely to have been subject to anthropogenic disturbance from historical cultivation. Units E03 and E10 are further impacted an existing dam and the existing road network, respectively. Existing dams impound flow, while the existing road network and crossings have modified flow within these units through localised infilling, surface compaction and hardening, resulting in decreased vegetation cover and increased run-off, erosion and sedimentation. Channelled drainage lines (F01-14), occurring in the steeper, rocky upper slope of the mesas, are typically in a better condition.

Table 3.5: Summary results of the stream and riparian IHI assessment

CATEGORY	UNITS	INSTREAM IHI		RIPARIAN IHI		OVERALL PES	
		SCORE	CLASS	SCORE	CLASS	SCORE	CLASS
Unchannelled	E03 & E10	1.88	C/B	1.95	C/B	1.90	C: Fair
	E01, E02 & E04-09	1.26	B	2.54	C	1.77	B: Largely Natural
Channelled	F01-14	1.05	A/B	1.58	B	1.26	B: Largely Natural

The Level 1 WET-Health Tool (Macfarlane, et al., 2020) was used to assess the PES of the washes and flats. A Level 1 Rapid Assessment involves evaluating specific indicators pertaining to four drivers of wetland health, namely hydrology, geomorphology, water quality and vegetation. The four drivers are assessed by taking into account the extent, intensity and magnitude of an impact which then produces a health score. Evaluation scores within each driver are then combined to produce an overall impact of activities on the system. For reporting purposes, the results of the WET-Health assessment have been averaged in Table 3.6 below per subcategory (longitudinal, Badlands, lateral, lowland and mesa-top), given their similarity in terms of their morphology and overall condition. The overall PES score and rating per individual assessment unit is provided in Appendix B. The PES scores were not quantified for the dams.

The mesa-top flats are in a fair condition (PES rating of “C”), while the lowland flats and washes are in a poor to very poor condition (PES rating of “D” to “E”).

The longitudinal washes are inherently vulnerable to erosion due to their naturally low vegetation cover, coupled with the flashy nature of their hydrological regimes. Sediment movement, sedimentation and some erosion is a natural process in these system. However, these systems have become largely impacted by widespread overgrazing, resulting in the formation of preferential flow paths, soil compaction and further reduced vegetation cover, collectively resulting in increased gully erosion within systems. In addition to being the most easily accessed by livestock, with most affected by degradation of the upstream catchment, the longitudinal washes also have the highest occurrence of dams and berms, which have altered water flow patterns. Furthermore, although the extent of cultivation of the longitudinal washes is currently very limited, it is suspected that historically they were more extensively cultivated. In the Karoo generally, cultivation of alluvial soils was practiced to some extent even in pre-colonial times, and with the scale of this cultivation increasing in post-colonial times and declining more recently (Milton & Dean, 2021). In Soyuz 3 specifically, such alluvial areas are most prevalent in the longitudinal washes.

The historical impacts of cultivation, overgrazing, flooding and severe erosion are particularly evident in the mostly heavily impacted units, A14-A18, which have been classified as Badlands. These units comprise of a series of deeply-incised erosion gullies, concrete weirs and erosion control dams.

In general, the washes and flats within the project area have been impacted by widespread historical and ongoing overgrazing, historical cultivation and historical flood events, particularly the floods of 1998.

Table 3.6: Average Present Ecological State (PES) of the washes and flats

CATEGORY	UNIT	HYDROLOGY IMPACT RATING	GEOMORPHOLOGY IMPACT SCORE	WATER QUALITY IMPACT SCORE	VEGETATION IMPACT SCORE	OVERALL PES SCORE & RATING
Longitudinal washes	A01-13	5.1	3.9	2.1	6.2	**4.4 (D)**
Longitudinal washes (Badlands)	A14-18	6.6	6.1	3.6	7.5	**6.2 (E)**
Lateral washes	B01-04	4.7	5.0	1.8	5.4	**4.3 (D)**
Lowland flats	C01-04	4.5	4.7	2.1	6.1	**4.4 (D)**
Mesa-top flats	D01-04	3.3	3.7	1.0	4.7	**3.2 (C)**

4 SITE IMPORTANCE AND SENSITIVITY

In terms of Section 2 of the Aquatic Biodiversity Protocol (2020):

2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.

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:

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

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

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.

4.1 ECOSYSTEM SERVICES OF THE WETLANDS

The importance of wetlands and riparian areas in terms of their regulating, supporting, provisioning and cultural ecosystem services was assessed using the Level 2 WET-EcoServices tool (Kotze, et al., 2020). The tool provides guidelines for scoring the importance of a wetland in delivering of 15 different ecosystem services, including regulating and supporting services, provisioning services, cultural services and biodiversity maintenance services. The first step is to characterise wetlands according to their hydrogeomorphic setting. Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors. Where there are characteristics relating to effectiveness and opportunity WET-Ecoservices calculates an average for each of the groups and an overall score is calculated from these averages. The overall score is then rated according to Table 4.1 below.

Table 4.1. Ecosystem services importance categories and descriptions

IMPORTANCE CATEGORY		DESCRIPTION
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

For the purposes of the ecosystem services assessment, the assessment units were generally grouped into their subcategories (longitudinal, lateral, lowland, mesa-top, unchannelled, channelled and dams), given their similarity in terms of their morphology, condition and the services they offer. The

overall importance scores for the goods and services provided by the units are provided below (Table 4.2). The rating of the extent to which a benefit is being supplied for each ecosystem service is also listed.

The longitudinal washes obtained moderate importance ratings for their flood attenuation and sediment trapping services, as well as moderately low to moderate importance ratings for nitrate and toxicant assimilation services. This is largely attributed to the relatively high supply of sediment within these systems, as well as their gentle slopes, dispersed low flow patterns and relatively high level of surface roughness, attributed to their generally moderate cover of low shrubs. The units with the largest catchments and better connectivity to the stream network (A01-04, A07-09 and A12-13), scored somewhat higher for these services than those with smaller catchments and lower connectivity to the stream network (A05-06 and A10-11). This is because larger catchments are predicted to intercept more surface water than smaller catchment and thus process and regulate a high volume of water, sediment and pollutants, which increases regulating services supply.

The Badlands (A14-A18) scored lower in these aspects, due to their concentrated flow paths and generally lower vegetation, even as compared to the other washes, offering low to moderately-low flood attenuation and sediment trapping services. Similarly, these regulating services were generally of lower relative importance within lateral washes with smaller catchments, steeper longitudinal slopes along mesas, and generally lower surface roughness compared to longitudinal washes.

Longitudinal and lateral washes obtained moderately-high and moderate importance ratings for their provision of food for livestock services, respectively, due to the availability of palatable grazing and browsing vegetation within these units, as well as the high level of current use for grazing that results in a high demand for these services. The Badlands scored low in terms of their food for livestock services, given their generally low availability of vegetation for grazing.

Biodiversity maintenance scores were rated as moderately-high to high for the longitudinal washes, including the Badlands. Longitudinal washes in particular make up much of the riparian corridors in an otherwise arid landscape and are likely to be key resource areas for a variety of fauna, in some locations potentially even for Red listed species such as the critically endangered Riverine Rabbit (*Bunolagus monticularis*). This is supported by Biodiversity Africa (2022), noting that these washes have high botanical and very high faunal sensitivities, due to the possible occurrence of the vulnerable species *Tridentia virescens* and critically endangered *B. monticularis*, respectively, coupled with the habitat's medium resilience to disturbance. Biodiversity scores were higher for units A01-03, A07-09 A12-13 and A15-17, compared to the other longitudinal washes, as these units form part of the Graafwaterspruit and the Upper Karroo Hardeveld Ecological Support Areas (ESAs), thus playing a greater role in meeting conservation targets. Longitudinal wash A04 scored the highest in terms of its biodiversity maintenance services, as its lower reaches form part of the Graafwaterspruit Critical Biodiversity Area (CBA).

Lateral washes scored moderately-low in terms of biodiversity maintenance, as these are less critical for faunal species of conservation concern (SCC), despite falling within the Graafwaterspruit and the Upper Karroo Hardeveld ESAs. The remaining services offered by the longitudinal and lateral washes were all rated as low to very low.

The mesa-top and lowland flats generally scored low to very low for all ecosystem services. These units typically have at least some vegetation for grazing and/or browsing, though this is of low importance due to the shallow and saline soils of the mesa-top and lowland flats, respectively. The lowland flats also offer some limited flood attenuation, sediment trapping, nitrate and toxicant assimilation, and biodiversity maintenance services. However, these are of low importance due to their relatively low level of surface roughness, attributed to their generally low vegetation cover.

Channelled and unchannelled low-order drainage lines offer moderate and moderately-low importance biodiversity maintenance services, respectively, given their relatively good condition of their vegetation, intact buffers and moderate diversity of habitats, as well as some of these units falling within the Graafwaterspruit and the Upper Karroo Hardeveld ESAs. The unchanelled subtype scored slightly lower than the channelled subtype due to their generally lower connectively to the stream network. Both channelled and unchannelled low order drainage lines also offer moderate food for livestock services.

Although artificial, the dams offer moderately-low importance services in terms of sediment trapping and water for human use. This is because they typically occur throughout larger washes and flats, acting as sinks for sediment and water during storm events. Similarly, the dams also offer nutrient and toxicant assimilation services, though of relatively low, yet not negligible, importance. In terms of biodiversity, some dams also offer biodiversity maintenance services, though limited, given that their marginally higher habitat diversity and heterogeneity in an otherwise arid environment.

Table 4.2: Ecosystem Services provided by the assessment units

ECOSYSTEM SERVICE		Longitudinal washes			Badlands		Lateral washes	Lowland flats	Mesa-top flats	Unchannelled drainage			Channelled drainage		Dams
		A01-03, A07-09 & A12-13	A04	A05-06, A10-11	A14 & A18	A15-17	B01-06	C01-04	D01-04	E01 & E04-06	E02, E07-09	E03 & E10	F01-06 & F10-14	F07-09	
Regulating and supporting services	Flood attenuation	2.0 (M)	2.0 (M)	1.7(ML)	1.0 (L)	1.3 (ML)	1.3 (L)	1.4 (ML)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.3 (VL)	0.0 (VL)	0.0 (VL)
	Stream flow regulation	1.2 (L)	1.2 (L)	1.2 (L)	1.2 (L)	1.5 (ML)	0.5 (VL)	0.2 (VL)	0.0 (VL)	-	-	-	-	-	0.7 (VL)
	Sediment trapping	2.0 (M)	2.3 (M)	1.8 (M)	1.3 (ML)	1.3 (ML)	1.8 (M)	1.3 (L)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	1.5 (ML)
	Erosion control	0.5 (VL)	0.5 (VL)	0.3 (VL)	0.0 (VL)	0.0 (VL)	0.4 (VL)	0.5 (VL)	0.4 (VL)	1.5 (ML)	1.1 (L)	1.1 (L)	1.6 (ML)	1.3 (L)	0.6 (VL)
	Phosphate assimilation	0.8 (L)	1.1 (L)	0.8 (VL)	0.0 (VL)	0.0 (VL)	0.5 (VL)	0.8 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	1.2 (L)
	Nitrate assimilation	1.4 (ML)	1.7 (M)	1.3 (ML)	0.0 (VL)	0.0 (VL)	0.8 (L)	0.8 (L)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	1.3 (L)
	Toxicant assimilation	1.5 (ML)	1.5 (ML)	1.4 (ML)	0.0 (VL)	0.0 (VL)	1.4 (ML)	1.2 (L)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	1.1 (L)
	Carbon storage	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.0 (VL)	0.0 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.2 (VL)	0.2 (VL)	0.2 (VL)	0.5 (VL)	0.5 (VL)	0.8 (L)
	Biodiversity maintenance	2.7 (H)	3.1 (H)	2.2 (M)	2.2 (M)	2.7 (H)	1.3 (ML)	0.8 (L)	1.0 (L)	2.0 (M)	1.5 (ML)	1.3 (ML)	2.2 (M)	1.7 (M)	1.1 (L)
Provisioning services	Water for human use	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	1.3 (ML)
	Harvestable resources	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)
	Food for livestock	2.5 (MH)	2.5 (MH)	2.5 (MH)	1.2 (L)	1.2 (L)	2.2 (M)	1.2 (L)	1.2 (L)	2.2 (M)	2.2 (M)	2.2 (M)	2.2 (M)	2.2 (M)	0.7 (VL)
	Cultivated foods	1.0 (L)	1.0 (L)	1.0 (L)	1.0 (L)	1.0 (L)	1.0 (L)	0.5 (VL)	0.5 (VL)	1.0 (L)	1.0 (L)	1.0 (L)	1.0 (L)	1.0 (L)	0.7 (VL)
Cultural services	Tourism and Recreation	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)
	Education and Research	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)	0.0 (VL)
	Cultural and Spiritual	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)	0.5 (VL)

4.2 ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) ASSESSMENT

This section discusses the results of the Ecological Importance and Sensitivity (EIS) assessment. The EIS assessment is comprised of two metrics, namely:

- **Ecological Importance (EI)**, which is the expression of the importance of wetlands and rivers in terms of the maintenance of biological diversity and ecological functioning at a local and landscape level (Kotze, et al., 2020); and
- **Ecological Sensitivity (S)**, which refers to ecosystem fragility or the ability to resist or recover from disturbance (Kotze, et al., 2020).

The Riverine EIS tool (Kleynhans, 1999) was used to assess the ecological importance and sensitivity of the delineated low order drainage lines. This involved rating riparian and instream biota characteristics, including species diversity, the presence of rare/endangered species, endemics and species that are sensitive to changes in flows/water quality, as well as riparian and instream habitat characteristics, including habitat diversity, the sensitivity of habitats to changes in flow and water quality, the importance of riparian areas as ecological corridors and the conservation importance of these areas. The overall riverine EIS rating is derived from the median score of the various instream and riparian biota and habitat scores. However, the Riverine EIS tool does not take into account the importance of biodiversity maintenance ecosystem services. It is therefore important to integrate the importance of biodiversity maintenance when considering the Riverine EIS ratings.

The Wetland EIS tool (Kotze, et al., 2020) was used to assess the ecological importance and sensitivity of the delineated washes, flats and dams. This method was designed for both wetlands and non-wetland riparian areas. The EIS scores for the assessment units were determined as the highest score amongst their EI scores, i.e. biodiversity maintenance, regulating services, and provisioning and cultural services importance scores (calculated using the WET-Ecoservices Tool), and their ES score (Kotze, et al., 2020). The River and Wetland EIS scores were interpreted using the categories and descriptions provided in Table 4.3 below. The River and Wetland EIS assessment results are summarised in Table 4.4 below.

Table 4.3. River and wetland EIS rating categories.

RIVER EIS CATEGORY (Kleynhans, 1999)		**WETLAND EIS CATEGORY** (Kotze, et al., 2020)	
0	None	0-0.79	Very Low
1	Low	0.8 – 1.29	Low
2	Moderate	1.3 – 1.69	Moderately-Low
		1.7 – 2.29	Moderate
		2.3 – 2.69	Moderately-High
3	High	High	2.7 – 3.19
4	Very High	Very High	3.2 - 4.0

The longitudinal washes (including Badlands) associated with the Graafwaterspruit CBA and ESA, as well as the Upper Karroo Hardeveld ESA, obtained high EIS ratings. On the other hand, longitudinal washes and Badlands that are not associated with an ESA obtained moderately-high and moderate EIS scores, respectively. Lateral washes, offering moderately important food for livestock services, obtained a moderate EIS score. The channelled low order drainage lines and unchannelled drainage

within an ESA obtained moderate EIS scores, mainly due to the moderate importance of their biodiversity maintenance. The lowland flats, the unchannelled low order drainage lines outside of ESAs and dams obtained moderately-low EIS scores, due to their ecological sensitivity, biodiversity maintenance and sediment trapping services, respectively. The mesa-top flats obtained low EIS ratings.

Table 4.4: Summary of EIS scores and ratings

CATEGORY	UNITS	ECOLOGICAL IMPORTANCE SCORE			ECOLOGICAL SENSITIVITY	EIS SCORE	EIS RATING
		BIODIVERSITY MAINTENANCE	REGULATING SERVICES	PROVISIONING AND CULTURAL SERVICES			
Longitudinal washes	A01-03, A07-09 & A12-13	2.7	2.0	2.5	1.65	2.7	High
	A04	3.1	2.3	2.5	1.65	3.1	High
	A05-06, A10-11	2.2	1.8	2.5	1.65	2.5	Mod-high
Badlands	A14 & A18	2.2	1.3	1.2	1.2	2.2	Moderate
	A15-17	2.7	1.5	1.2	1.2	2.7	High
Lateral washes	B01-06	1.3	1.8	2.2	1.1	2.2	Moderate
Lowland flats	C01-04	0.8	1.4	1.2	1.4	1.4	Mod-low
Mesa-top flats	D01-04	1.0	0.5	1.2	1.0	1.2	Low
Unchannelled	E01 & E04-06	2.0	N/A	N/A	1.0	2.0	Moderate
	E02, E07-09	1.5	N/A	N/A	1.0	1.5	Mod-low
	E03 & E10	1.3	N/A	N/A	1.0	1.3	Mod-low
Channelled	F01-06 & F10-14	2.2	N/A	N/A	1.0	2.2	Moderate
	F07-09	1.7	N/A	N/A	1.0	1.7	Moderate
Dams		1.1	1.5	1.3	1.3	1.5	Mod-low

4.3 SENSITIVITY MAPPING

A sensitivity map (Figure 4.1) was developed based on the above EIS ratings.

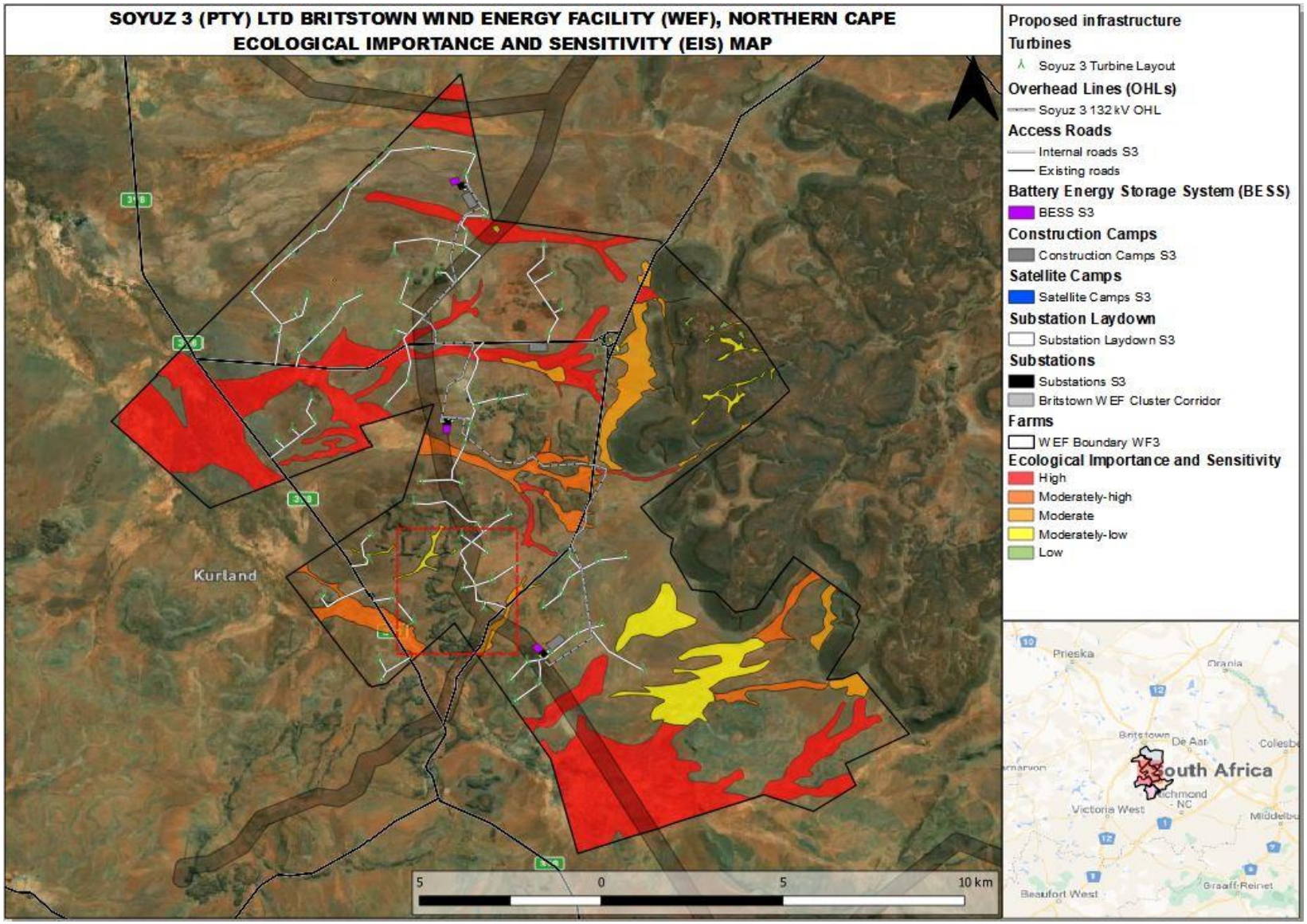


Figure 4.1: River and Wetland Ecological Importance and Sensitivity (EIS) map of the study area.

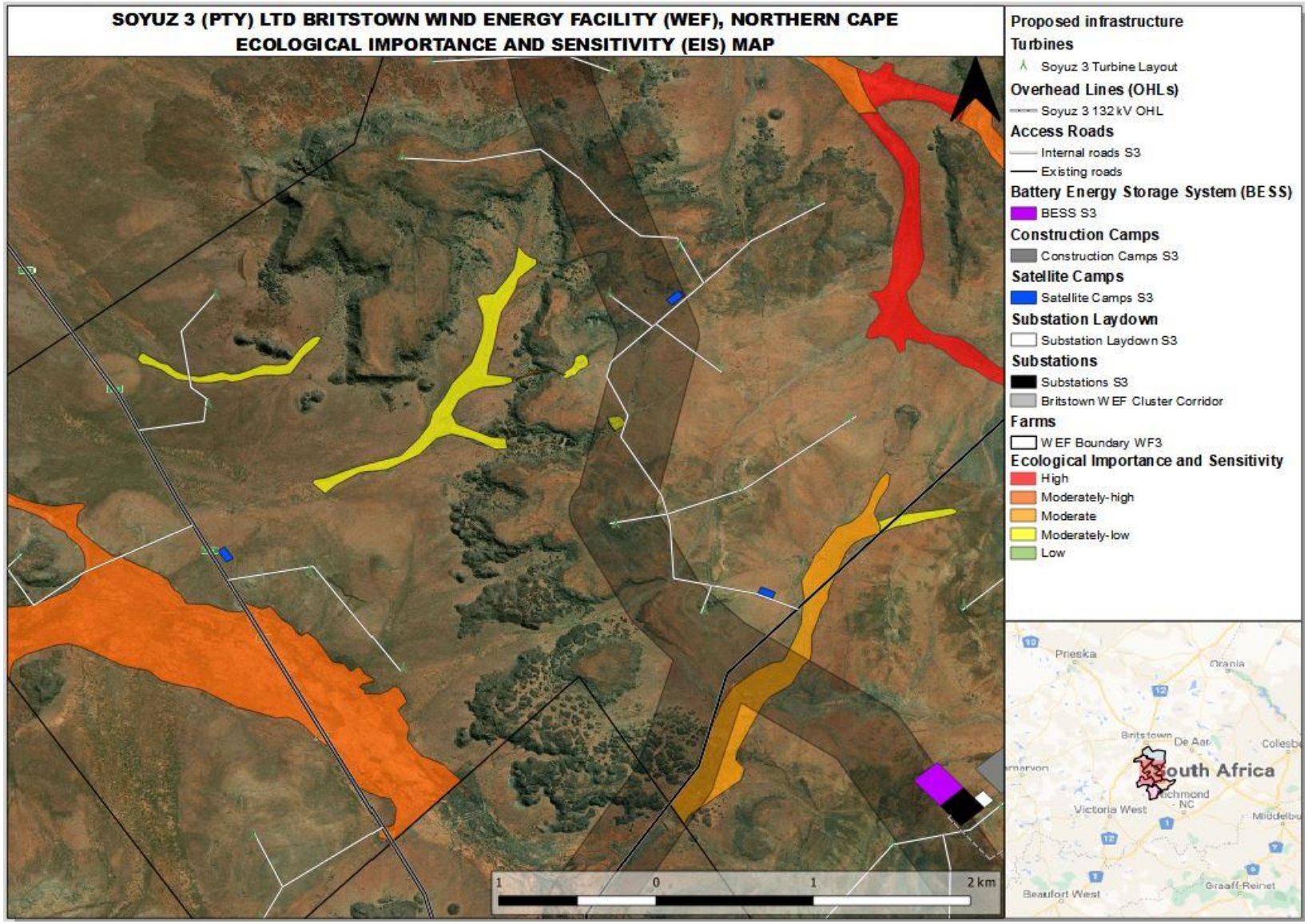


Figure 4.2: River and Wetland Ecological Importance and Sensitivity (EIS) map of assessment units in the south-western section of the study area.

4.4 RECOMMENDED ECOLOGICAL CATEGORY (REC)

The recommended ecological category (REC) is the target or desired state of freshwater ecosystems required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES that is driven by the context / setting.

The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the watercourse (Kleynhans & Louw, 2007). However, the causes related to a PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs for water resources is shown in Table 4.5 below.

Table 4.5: Generic matrix for the determination of REC for water resources (Kleynhans & Louw, 2007)

CATEGORY			EIS			
			Very high	High	Moderate	Low
PES	A	Pristine/Natural	A Maintain	A Maintain	A Maintain	A Maintain
	B	Largely Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good - Fair	B Improve	B/C Improve	C Maintain	C Maintain
	D	Poor	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Very Poor	D Improve	E/F Improve	E/F Maintain	E/F Maintain

The PES, EIS, REC categories and management objectives are summarised in Table 4.6. Units A01-04, A07-09, A12-13 and A15-17 have a PES lower than their REC. The regional management objective is to improve these units where possible. In particular, the proposed access road crossing sites should be flagged for targeted mitigation. The proposed access roads should serve a dual function, namely as a crossing of the washes and a means of stabilising the longitudinal slope of the watercourses. All of the other assessment units have a PES that equals their REC (Table 4.6). Thus, the regional water resource management objective is to maintain the PES of these units. Although impacts to some of the assessment units will be unavoidable, since a number have access road crossings, resulting in the lowering of their PES scores, the management objective of the project should be to ensure that all impacts are minimised such that there is no change in the overall PES category for all units assessed.

Table 4.6 Summary of REC for assessed units

CATEGORY	UNITS	PES	EIS RATING	REC	OBJECTIVE
Longitudinal washes	A01-03, A07-09 & A12-13	D	High	C/D	Improve
	A04	D	High	C/D	Improve
	A05-06, A10-11	D	Mod-high	D	Maintain
Badlands	A14 & A18	E	Moderate	E/F	Maintain
	A15-17	E	High	E/F	Improve
Lateral washes	B01-06	D	Moderate	D	Maintain
Lowland flats	C01-04	D	Mod-low	C	Maintain
Mesa-top flats	D01-04	C	Low	C	Maintain
Unchannelled	E01 & E04-06	B	Moderate	B	Maintain
	E02, E07-09	B	Mod-low	B	Maintain
	E03 & E10	C	Mod-low	C	Maintain
Channelled	F01-06 & F10-14	B	Moderate	B	Maintain
	F07-09	B	Moderate	B	Maintain
Dams		N/A	Mod-low	N/A	N/A

5 IMPACT AND RISK ASSESSMENT

In terms of Section 2 of the Aquatic Biodiversity Protocol (2020):

2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development . . . must be undertaken.

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:

2.7.7. 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.

An impact assessment was conducted, using the methodology outlined in Section 2.2.2 and the data collected during the desktop and site assessments, for the construction, operational and decommissioning phases of the proposed development. A breakdown of the assessment and mitigation measures is provided for each of these phases in Table 5.3, Table 5.4 and Table 5.5, respectively, with the impacts associated with the no-go alternative provided in Table 5.6. Similarly, the risk assessment was conducted, using the methodology outlined in Section 2.2, for all phases of the proposed development. A breakdown of the risk assessment is provided in Table 5.7.

The assessment focuses on the impacts of the proposed development on the watercourses and wetlands within the Soyuz 3 project area. As previously discussed, of the assessment units, only the longitudinal washes and channelled drainage can be considered watercourses and only the dams can be considered wetlands in terms of the NWA, 1998 (Act 36 of 1998). The lateral washes, mesa-top and lowland flats, and unchannelled drainage areas are all considered terrestrial in nature. These terrestrial units were therefore excluded from this river and wetland impact assessment.

The following impacts to watercourses are anticipated during the construction phase:

- **C1:** The direct, permanent modification and/or loss of up to 2.89 ha of moderately-low to high EIS watercourses for the construction of 12 m wide access roads through A02, A04, A15, A17 and a dam (Table 5.1). A realistic poor scenario assumes that no further changes will be made to the proposed layout and the full extent of these losses will occur, resulting in direct impacts of moderate significance for the construction/upgrading of the access roads. A realistic good mitigation scenario assumes that all the recommended planning and design mitigation provided in Section 6.1 will be incorporated into the project layout. The avoidance pathway will prevent the loss of 0.78 ha to the access roads. The application of best practice linear crossing guidelines and targeted rehabilitation will further mitigate all direct impacts, leading to a low residual significance. A residual loss of 2.10 ha to the access roads will occur under the realistic good mitigation scenario (Table 5.1).

Table 5.1: Summary of direct impacts of the Soyuz 3 WEF infrastructure on watercourse units

UNIT	ACCESS ROADS (HA)	REALISTIC POOR IMPACTED AREA (HA)	REALISTIC GOOD IMPACTED AREA (HA)	AVOIDED LOSS (HA)
A02	0.2361	0.2361	0.2361	0.0000
A04	1.8798	1.8798	1.0976	0.7822
A15	0.3262	0.3262	0.3262	0.0000
A17	0.4378	0.4378	0.4378	0.0000
Dam	0.0070	0.0070	0.0070	0.0000
Total	**2.8869**	**2.8869**	**2.1047**	**0.7822**

- **C2:** The alteration of hydrological and geomorphological processes, including widespread alterations at and downstream of the new and/or upgraded access road crossings during construction. Activities like soil and vegetation stripping / grubbing will expose bare soils to the elements can increase the risk of erosion and sedimentation. Temporary flow impoundment may also be needed at road crossings. Such alteration in flow patterns will result in increased rates of erosion and sedimentation to downstream. Under a realistic poor mitigation scenario, this impact is of moderate significance. If all the mitigation measures are adopted and effectively implemented, the significance of this impact will be reduced to low under a realistic good mitigation scenario.
- **C3:** The temporary reduction of ecological connectivity between up- and downstream sections of watercourses during construction of access road crossings. This carries a low significance rating if poorly mitigated and a very low significance rating if all minimizing and remediating mitigation measures are adopted and effectively implemented under a realistic good mitigation scenario.
- **C4:** The possible pollution of watercourses due to the mishandling of hazardous substances and/or improper maintenance of machinery during construction. This carries a low significance rating if poorly mitigated and a very low significance rating if all preventative and remediating mitigation measures are adopted and effectively implemented under a realistic good mitigation scenario.
- **C5:** Cumulative direct modification and/or loss of up to 16.78 ha of watercourse units across the entire Soyuz WEF Cluster during the construction phase. This includes 0.31 ha to turbine foundations, 1.50 ha to hardstands, 14.46 ha to 12 m wide access roads and 0.51 ha to satellite camps (Table 5.2). A realistic poor scenario assumes that no further changes will be made to the proposed layout and the full extent of these losses will occur, resulting in direct impacts of moderately-high significance. A realistic good mitigation scenario assumes that all the recommended planning and design mitigation provided in Section 6.1 will be incorporated into the project layout. The avoidance pathway will prevent the loss of 7.45 ha. The application of best practice linear crossing guidelines and targeted rehabilitation will further mitigate all direct impacts, leading to a moderately-low residual significance. A residual loss of 9.33 ha to the access roads will occur under the realistic good mitigation scenario (Table 5.2).

Table 5.2: Summary of cumulative direct impacts of the WEF cluster infrastructure on watercourse units

WEF	TURBINES			ACCESS ROADS (HA)	SATELLITE CAMP (HA)	REALISTIC POOR IMPACTED AREA (HA)	REALISTIC GOOD IMPACTED AREA (HA)	AVOIDED LOSS (HA)
	NO.	FOUNDATION (HA)	HARDSTANDS (HA)					
Soyuz 1	2	0.2048	1.0000	0.3622	0.0000	1.5670	0.3622	1.2048
Soyuz 2	0	0.0000	0.0000	3.4717	0.0000	3.4717	2.2468	1.2249
Soyuz 3	0	0.0000	0.0000	2.8869	0.0000	2.8869	2.1047	0.7822
Soyuz 4	0	0.0000	0.0000	2.8019	0.4711	3.273	2.610	0.6632
Soyuz 5	0	0.0000	0.0000	0.5426	0.0408	0.5834	0.2392	0.3442
Soyuz 6	1	0.1024	0.5000	4.3970	0.0000	4.9994	1.7702	3.2292
Cumulative	3	0.3072	1.5000	14.4622	0.5119	16.7814	9.3329	7.4485

- **C6:** Cumulative widespread, permanent alteration of hydrological and geomorphological processes within watercourses across the entire Soyuz WEF Cluster at and downstream of the proposed infrastructure. Under a realistic poor mitigation scenario, these impacts are of moderate significance. If all the mitigation measures are adopted and effectively implemented, the significance of these impacts will be reduced to low significance under a realistic good mitigation scenario.

The following impacts to watercourses are anticipated during the operational phase:

- **O1:** The alteration of hydrological and geomorphological processes, including localised stormwater management, and with the establishment of new and/or upgraded access road crossings. Such impacts include the long-term alteration of natural flow patterns in the form of flow concentration through culverts and/or flow upstream of road crossings. Such alteration in flow patterns will result in increased rates of erosion and sedimentation. Under a poor mitigation scenario, these impacts will be of low and moderate significance, respectively. Under a realistic good mitigation scenario, the effective implementation of all minimizing and remediating mitigation measures will reduce these impacts to very low and low, respectively.
- **O2:** The long-term reduction of ecological connectivity and degradation of the surrounding environment should the rehabilitation of disturbed areas prove inadequate. This carries a low significance rating if poorly mitigated and a very low significance rating if all remediating mitigation measures are adopted and effectively implemented.
- **O3:** Water pollution impacts, namely due to possible leaks and spills of chemical / hazardous substances during routine maintenance. This carries a low significance rating if poorly mitigated and a very low significance rating if all preventative and remediating mitigation measures are adopted and effectively implemented.

The following impacts to watercourses are anticipated during the decommissioning phase:

- **D1:** The direct disturbance of watercourse soil and vegetation during the decommissioning of the proposed infrastructure and rehabilitation. Under a realistic poor mitigation scenario, this impact is of low significance and of low significance under a realistic good mitigation scenario, provided that all preventative, minimizing and remediating measures are adopted and effectively implemented.
- **D2:** Increased localised run-off, erosion and sedimentation at and downstream of

infrastructure and linear crossings during decommissioning. Under a realistic poor mitigation scenario, this impact is of low significance. The effective implementation of all minimizing and remediating mitigation measures will reduce this impact to very low.

- **D3:** The temporary reduction of ecological connectivity between up- and downstream sections of watercourses during decommissioning. This carries a low significance rating if poorly mitigated and a very low significance rating if all minimizing and remediating measures are adopted and effectively implemented.
- **D4:** The possible pollution of watercourses due to the mishandling of hazardous substances and/or improper maintenance of machinery during decommissioning. This carries a low significance rating if poorly mitigated and a very low significance rating if all preventative and remediating mitigation measures are adopted and effectively implemented.

The no-go alternative in the context of this project implies that the proposed WEF would not be developed and the current land uses would persist. If the project does not proceed, the negative impacts (i.e. **NG1:** direct losses, **NG2:** altered hydrological and geomorphological processes, **NG3:** reduced ecological connectivity and **NG4:** reduced water quality) would be avoided. However, under the no-go alternative, it is anticipated that the watercourses would continue to degrade over the long-term, due to widespread overgrazing, cultivation and other land uses, as well as more localised disturbances such as the use of existing access roads, collectively leading to decreased vegetation cover and increased run-off, erosion and sedimentation, particularly during storm and flood events.

5.1 IMPACT ASSESSMENT

Table 5.3: Impacts and mitigation measures for the construction phase of the proposed development

POTENTIAL ISSUE	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE UNDER A POOR MITIGATION SCENARIO	MITIGATION MEASURES	SIGNIFICANCE UNDER A GOOD MITIGATION SCENARIO
C1: Direct ecosystem modification or destruction / loss impacts	Direct, permanent modification and/or loss of up to 2.89 ha of moderately-low to high EIS watercourses for the construction of 12 m wide access roads through A02, A04, A15, A17 and a dam.	Negative	Direct	Moderate	Study area	Medium-term	Definite	Reversible	Resource will be partially lost	Achievable	**MODERATE -**	**Avoid/prevent:** - The following buffers should be applied to all watercourses and wetlands (i.e. channelled drainage lines and longitudinal washes) based on their EIS rating: o High EIS – 50 m; o Moderate to moderately-high EIS – 30 m; and o Moderately-low EIS– 15 m (refer to Section 6.1.1). - No turbines, pylons, substation, batching plant and auxiliary buildings, temporary laydown and warehousing areas should be placed within these watercourses or their buffers (refer to Sections 6.1.1 and 6.1.2). - In accordance with the best practice guidelines, unnecessary watercourse powerline and road crossings (i.e. proposed crossings that can be re-aligned) must be re-aligned and avoided. - Construction materials must not be stored within the moderate to high EIS areas or their buffers. - Stockpiles must not be stored within the moderate to high sensitivity areas or their buffers.	**LOW -**
C2: Alteration of hydrological and geomorphological processes	Widespread, permanent alteration of hydrological and geomorphological processes within moderately-low to high EIS watercourses (A02, A04, A15, A17 and a dam) at and downstream of the new and/or upgraded access road crossings during construction.	Negative	Indirect, cumulative	Moderate	Study area	Permanent	Definite	Irreversible	Resource will be partially lost	Achievable	**MODERATE -**		**LOW -**

POTENTIAL ISSUE	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE UNDER A POOR MITIGATION SCENARIO	MITIGATION MEASURES	SIGNIFICANCE UNDER A GOOD MITIGATION SCENARIO
C3: Ecological connectivity and edge disturbance impacts	Temporary reduction of ecological connectivity between up- and downstream sections of moderately-low to high EIS watercourses (A02, A04, A15, A17 and a dam) during construction of access road crossings.	Negative	Direct	Slight	Localised	Medium-term	Possible	Reversible	Resource will not be lost	Achievable	**LOW -**	**Minimize/reduce:** - If possible, construction activities should be undertaken during the driest part of the year to minimize erosion and downstream sedimentation due to excavation, etc. - Appropriate stormwater structures must be implemented during construction to control run-off and minimize erosion. - Vegetation clearing must be kept a minimum and only to the site footprint. - Erosion controls and sediment trapping measures must be put in place. - Stockpiles must be monitored for erosion and mobilisation of materials towards watercourses. - Stockpiles must not exceed 1.5m in height. Stockpiles must be covered during windy periods. - Best practice powerline and access road crossing alignment measures must be implemented (refer to Sections 6.1.3 and 6.1.4). Where watercourse crossings are required, every effort should be made to minimize the impacts by considering the following: o Crossing points should be aligned along areas or corridors of existing disturbance e.g. along existing road crossings. o The length of watercourse at each crossing must be minimised by adjusting alignments to coincide with narrower sections and ensuring that crossings cross perpendicular to flow. **Remediate/rehabilitate:** - Disturbed areas must be monitored for erosion channels and these must be rehabilitated. - All trenches/excavations must be backfilled and all disturbed areas backfilled, compacted and revegetated, where applicable. - Road crossings should be used to assist in re-instating some of the lost base level as a result of historical erosional incision. The proposed access roads should serve a dual function, namely as a crossing of the washes and a means of stabilising the longitudinal slope of the watercourses. - Anchored brush packs should be used in Badlands to assist with their rehabilitation. - Within Soyuz 3, targeted rehabilitation at road crossings should be concentrated within units A04, A14, A17 and A18 in particular. Several other assessment units within the broader WEF cluster can also be targeted for rehabilitation.	**VERY LOW -**

POTENTIAL ISSUE	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE UNDER A POOR MITIGATION SCENARIO	MITIGATION MEASURES	SIGNIFICANCE UNDER A GOOD MITIGATION SCENARIO
C4: Water pollution impacts	Pollution of watercourses due to the mishandling of hazardous substances and/or improper maintenance of machinery during construction e.g. oil and diesel leaks and spills.	Negative	Direct	Slight	Localised	Long-term	Possible	Reversible	Resource will not be lost	Achievable	**LOW -**	**Avoid/prevent:** - No concrete mixing must take place within 50 m of any watercourse. - No machinery must be parked overnight within 50 m of the watercourses. - All stationary machinery must be equipped with a drip tray to retain any oil leaks. - Chemicals used for construction must be stored safely on bunded surfaces in the construction site camp. - No ablution facilities must be located within 50 m of any watercourse. - Chemical toilets must be regularly maintained/ serviced to prevent ground or surface water pollution. - Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. - All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site. **Remediate/rehabilitate:** - Emergency plans must be in place in case of spillages onto bare soil or within watercourses.	**VERY LOW -**
C5: Cumulative direct impacts	Cumulative direct modification and/or loss of up to 16.78 ha of watercourse units across the entire Soyuz WEF Cluster during the construction phase. This includes 0.31 ha to turbine foundations, 1.50 ha to hardstands, 14.46 ha to 12 m wide access roads and 0.51 ha to satellite camps.	Negative	Direct, cumulative	Moderate	Municipal	Permanent	Probable	Irreversible	Resource will be partially lost	Achievable	**MODERATELY-HIGH -**	Application of all recommended mitigation measures to avoid, minimize and rehabilitate impacts across all WEF projects within the Soyuz Cluster.	**MODERATELY-LOW -**
C6: Cumulative indirect impacts	Cumulative widespread, permanent alteration of hydrological and geomorphological processes within watercourses across the entire Soyuz WEF Cluster at and downstream of the proposed infrastructure.	Negative	Indirect, cumulative	Moderate	Municipal	Permanent	Possible	Irreversible	Resource will be partially lost	Achievable	**MODERATE -**		**LOW -**

Table 5.4: Impacts and mitigation measures for the operational phase of the proposed development

POTENTIAL ISSUE	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE UNDER A POOR MITIGATION SCENARIO	MITIGATION MEASURES	SIGNIFICANCE UNDER A GOOD MITIGATION SCENARIO
O1: Alteration of hydrological and geomorphological processes	Alteration of hydrological and geomorphological processes within moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16) at and downstream of the access road crossings during operational use of road for maintenance of infrastructure.	Negative	Indirect, cumulative	Moderate	Localised	Permanent	Probable	Reversible	Resource will not be lost	Achievable	**MODERATE -**	**Minimize/reduce:** - Stormwater infrastructure must be maintained and monitored for effectiveness with respect to controlling and minimising erosion and sedimentation of watercourses. - Given that water flows in the washes generally occur across a very wide front and are usually as very infrequent and very brief events, it is recommended that "drift-type" road crossings be used where appropriate and designed for flow over the road surface rather than directing it under the road with culverts. Where access road crossings of defined channels is required, box culverts must be stablished across the width of the watercourse. **Remediate/rehabilitate:** - The site must be monitored for erosion and should be rehabilitated where applicable.	**LOW -**
O2: Ecological connectivity and edge disturbance impacts	Inadequate rehabilitation of disturbed areas may lead to the reduction of ecological connectivity and degradation of the surrounding environment.	Negative	Direct, indirect	Slight	Study area	Long-term	Possible	Reversible	Resource will not be lost	Achievable	**LOW -**	**Remediate/rehabilitate:** - Disturbed areas should be rehabilitated and re-vegetated.	**VERY LOW -**
O3: Water pollution impacts	Routine maintenance may lead to the introduction of chemical / hazardous substances (e.g. oil spills from vehicles, etc.) into the watercourses, soil and/or groundwater, adversely affecting the watercourses in the broader area.	Negative	Direct	Slight	Localised	Long-term	Possible	Reversible	Resource will not be lost	Easily achievable	**LOW -**	**Avoid/prevent impact:** - No machinery must be parked overnight within 50 m of the watercourses. - All stationary machinery must be equipped with a drip tray to retain any oil leaks. - Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. - All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site. **Remediate/rehabilitate:** - Emergency plans must be in place in case of spillages onto bare soil or within water courses.	**VERY LOW -**

Table 5.5: Impacts and mitigation measures for the decommissioning phase of the proposed development

POTENTIAL ISSUE	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE UNDER A POOR MITIGATION SCENARIO	MITIGATION MEASURES	SIGNIFICANCE UNDER A GOOD MITIGATION SCENARIO
D1: Direct ecosystem modification or destruction / loss impacts	Direct disturbance of watercourse soil and vegetation during the decommissioning of the proposed access roads within moderately-low to high EIS watercourses (A02, A04, A15, A17 and a dam).	Negative	Direct	Slight	Study area	Medium-term	Probable	Reversible	Resource will not be lost	Achievable	**LOW -**	**<u>Avoid/prevent:</u>** - Decommissioned materials and rubble must not be stored within the moderate to high sensitivity areas. - Stockpiles must not be stored within the moderate to high sensitivity areas. **<u>Minimize/reduce:</u>** - If possible, decommissioning activities should be undertaken during the driest part of the year to minimize erosion and downstream sedimentation due to excavation, etc. - Appropriate stormwater structures must be implemented during decommissioning to control run-off and minimize erosion. - Erosion controls and sediment trapping measures must be put in place. **<u>Remediate/rehabilitate:</u>** - Disturbed areas must be monitored for erosion channels and these must be rehabilitated. - All trenches/excavations must be backfilled and all disturbed areas backfilled, compacted and revegetated, where applicable.	**LOW -**
D2: Alteration of hydrological and geomorphological processes	Alteration of sections of moderately-low to high EIS watercourses (A02, A04, A15, A17 and a dam) at and downstream of infrastructure and linear crossings during decommissioning, resulting in increased run-off, erosion and sedimentation.	Negative	Indirect, cumulative	Slight	Study area	Medium-term	Possible	Reversible	Resource will not be lost	Achievable	**LOW -**		**VERY LOW -**
D3: Ecological connectivity and edge disturbance impacts	Temporary reduction of ecological connectivity between up- and downstream sections of moderately-low to high EIS watercourses (A02, A04, A15, A17 and a dam) during decommissioning.	Negative	Direct	Slight	Localised	Medium-term	Possible	Reversible	Resource will not be lost	Achievable	**LOW -**		**VERY LOW -**
D4: Water pollution impacts	Pollution of watercourse units due to the mishandling of hazardous substances and/or improper maintenance of machinery during decommissioning e.g. oil and diesel leaks and spills.	Negative	Direct	Slight	Localised	Long-term	Possible	Reversible	Resource will not be lost	Achievable	**LOW -**	**<u>Avoid/prevent:</u>** - No machinery must be parked overnight within 50 m of the watercourses. - All stationary machinery must be equipped with a drip tray to retain any oil leaks. - Chemicals used for construction must be stored safely on bunded surfaces in the construction site camp. - No ablution facilities must be located within 50 m of any watercourse. - Chemical toilets must be regularly maintained/ serviced to prevent ground or surface water pollution. - Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. - All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site. **<u>Remediate/rehabilitate:</u>** - Emergency plans must be in place in case of spillages onto bare soil or within watercourses.	**VERY LOW -**

Table 5.6: Impacts for the no-go alternative

POTENTIAL ISSUE	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE
NG1: Alteration of hydrological and geomorphological processes	Ongoing alteration and disturbance of the watercourses over the long-term, due to widespread overgrazing, cultivation and other land uses, as well as more localised disturbances such as the use of existing access roads, collectively leading to decreased vegetation cover and increased run-off, erosion and sedimentation, particularly during storm and flood events.	Negative	Indirect, cumulative	Moderate	Study area	Long-term	Probable	Reversible	Resource will be partially lost	Achievable	**LOW -**	Mitigation measures are not prescribed for the no-go alternative, as the developer would not be involved in the implementation of these measures. Rather, the responsibility would fall to the landowner and/or managing authority to implement measures to address existing impacts.	**N/A**
NG2: Ecological connectivity and edge disturbance impacts	Reduction of ecological connectivity between sections of watercourse units at and downstream over the long-term due to existing land uses.	Negative	Indirect, cumulative	Slight	Study area	Long-term	Probable	Reversible	Resource will not be lost	Achievable	**LOW -**		**N/A**
NG3: Water pollution impacts	Reduction of water quality over the long-term due to existing land uses (particularly livestock grazing and cultivation), as well as ongoing erosion and sedimentation of watercourses.	Negative	Indirect, cumulative	Slight	Study area	Long -term	Probable	Reversible	Resource will not be lost	Achievable	**LOW -**		**N/A**

5.2 DHSWS RISK ASSESSMENT MATRIX

Table 5.7: DHSWS risk scores and ratings for construction, operational and decommissioning phases of the proposed development.

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
C1		Temporary laydown and warehousing.	Clearance of vegetation during site preparation. Excavation, infilling and shaping of landscape to accommodate temporary laydown and warehousing areas.	Direct, permanent modification and/or loss of up to 3.47 ha of moderate to moderately-high EIS watercourses for the construction of 12 m wide access roads through A03, A12, A13, A15 and A16	**2.5**	**2**	**2**	**1.5**	**2**	**1.5**	**2**	**5.5**	**2**	**2**	**5**	**2**	**11**	**60.5**	**MODERATE RISK**	**90-100**	Avoid/prevent: - A buffer of 15 m should be applied to all moderate to moderately-high ecologically important and sensitive watercourses and wetlands (i.e. channelled drainage lines, CVB wetland and longitudinal washes) (refer to Section 6.1.1). - No turbines, pylons temporary laydown or warehousing areas should be placed within these watercourses or their buffers (refer to Sections 6.1.1 and 6.1.2). - In accordance with the best practice guidelines, unnecessary watercourse powerline and road crossings (i.e. proposed crossings that can be re-aligned) must be re-aligned and avoided. - Construction materials must not be stored within the moderate to high EIS areas or their buffers. - Stockpiles must not be stored within the moderate to moderately-high sensitivity areas or their buffers. Minimize/reduce: - If possible, construction activities should be undertaken during the driest part of the year to minimize erosion and downstream sedimentation due to excavation, etc. - Appropriate stormwater structures must be implemented during construction to control run-off and minimize erosion. - Vegetation clearing must be kept a minimum and only to the site footprint. - Erosion controls and sediment trapping measures must be put in place. - Stockpiles must be monitored for erosion and mobilisation of materials towards watercourses. - Stockpiles must not exceed 1.5m in height. Stockpiles must be covered during windy periods.	**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
C2		Construction of new access roads and upgrading of existing roads.	Clearance of vegetation during site preparation. Excavation, infilling and shaping of landscape to accommodate the access roads.	Widespread, permanent alteration of hydrological and geomorphological processes within moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16) at and downstream of the new and/or upgraded access road crossings during construction.	**1.5**	**0.5**	**1.5**	**0.5**	**1**	**1.5**	**3**	**5.5**	**1**	**2**	**5**	**4**	**12**	**66**	**MODERATE RISK**	**90-100**		**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
C3		Construction of new access roads and upgrading of existing roads.	Clearance of vegetation during site preparation. Excavation, infilling and shaping of landscape to accommodate the access roads.	Temporary reduction of ecological connectivity between up- and downstream sections of moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16) during construction of access road crossings.	**2**	**0.5**	**2**	**2**	**1.625**	**1**	**1**	**3.625**	**1**	**3**	**5**	**4**	**13**	**47.13**	**LOW RISK**	**90-100**	- Best practice powerline and access road crossing alignment measures must be implemented (refer to Sections 6.1.3 and 6.1.4). Where watercourse crossings are required, every effort should be made to minimize the impacts by considering the following: o Crossing points should be aligned along areas or corridors of existing disturbance e.g. along existing road crossings. o The length of watercourse at each crossing must be minimised by adjusting alignments to coincide with narrower sections and ensuring that crossings cross perpendicular to flow. Remediate/rehabilitate: - Disturbed areas must be monitored for erosion channels and these must be rehabilitated. - All trenches/excavations must be backfilled and all disturbed areas backfilled, compacted and revegetated, where applicable. - Road crossings should be used to assist in re-instating some of the lost base level as a result of historical erosional incision. The proposed access roads should serve a dual function, namely as a crossing of the washes and a means of stabilising the longitudinal slope of the watercourses. - Anchored brush packs should be used in Badlands to assist with their rehabilitation. - Within Soyuz 2, targeted rehabilitation at road crossings should be concentrated within units A12 and A18 in particular. Several other assessment units within the broader WEF cluster can also be targeted for rehabilitation.	**LOW RISK**	**<u>Units A02 & A04:</u>** - PES: D - EIS: High - REC: C/D (Improve) **<u>Units A15 & A17:</u>** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
C4		Preparation, storage and transportation of construction materials. Potential oil leaks from construction vehicles and equipment	Accidental spillages of wet concrete and chemical / hazardous substances	Pollution of watercourses due to the mishandling of hazardous substances and/or improper maintenance of machinery during construction e.g. oil and diesel leaks and spills.	**0.5**	**2.5**	**0.5**	**1**	**1.125**	**1**	**2**	**4.125**	**1**	**3**	**5**	**4**	**13**	**53.63**	**LOW RISK**	**90-100**	Avoid/prevent: - No concrete mixing must take place within 32 m of any watercourse. - No machinery must be parked overnight within 50 m of the watercourses. - All stationary machinery must be equipped with a drip tray to retain any oil leaks. - Chemicals used for construction must be stored safely on bunded surfaces in the construction site camp. - No ablution facilities must be located within 50 m of any watercourse. - Chemical toilets must be regularly maintained/ serviced to prevent ground or surface water pollution. - Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. - All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site. Remediate/rehabilitate:	**LOW RISK**	**<u>Units A02 & A04:</u>** - PES: D - EIS: High - REC: C/D (Improve) **<u>Units A15 & A17:</u>** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
																					- Emergency plans must be in place in case of spillages onto bare soil or within watercourses.		
C5		Construction of turbines, hardstands and new access roads and upgrading of existing roads.	Clearance of vegetation during site preparation. Excavation, infilling and shaping of landscape to accommodate the access roads.	Cumulative direct modification and/or loss of up to 16.78 ha of watercourse units across the entire Soyuz WEF Cluster during the construction phase. This includes 0.31 ha to turbine foundations, 1.50 ha to hardstands, 14.46 ha to 12 m wide access roads and 0.51 ha to satellite camps.	**3**	**1**	**3**	**2**	**2.25**	**3**	**2**	**7.25**	**2**	**2**	**5**	**2**	**11**	**79.75**	**MODERATE RISK**	**90-100**	Application of all recommended mitigation measures to avoid, minimize and rehabilitate impacts across all WEF projects within the Soyuz Cluster.	**LOW RISK**	**<u>Units A02 & A04:</u>** - PES: D - EIS: High - REC: C/D (Improve) **<u>Units A15 & A17:</u>** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
C6		Construction of turbines, hardstands and new access roads and upgrading of existing roads.	Clearance of vegetation during site preparation. Excavation, infilling and shaping of landscape to accommodate the access roads.	Widespread, permanent alteration of hydrological and geomorphological processes within watercourses across the entire Soyuz WEF Cluster at and downstream of the proposed infrastructure.	**2.5**	**1**	**2.5**	**2**	**2**	**3**	**2**	**7**	**2**	**2**	**5**	**2**	**11**	**77**	**MODERATE RISK**	**90-100**	Application of all recommended mitigation measures to avoid, minimize and rehabilitate impacts across all WEF projects within the Soyuz Cluster.	**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
O1	OPERATIONAL PHASE	Operation of turbines and pylons.	Removed vegetation and introduction of hardened surfaces.	Localised alteration of hydrological and geomorphological processes around the turbines and pylons within the watercourses A13, A16 and A18, resulting in increased localised run-off, erosion and sedimentation.	**1.5**	**0.5**	**1.5**	**1**	**1.125**	**1**	**2**	**4.125**	**2**	**2**	**5**	**4**	**13**	**53.63**	**LOW RISK**	**90-100**	Minimize/reduce: - Stormwater infrastructure must be maintained and monitored for effectiveness with respect to controlling and minimising erosion and sedimentation of watercourses. - Given that water flows in the washes generally occur across a very wide front and are usually as very infrequent and very brief events, it is recommended that "drift-type" road crossings be used where appropriate and designed for flow over the road surface rather than directing it under the road with culverts. Where access road crossings of defined channels is required, box culverts must be stablished across the width of the watercourse. Remediate/rehabilitate: - The site must be monitored for erosion and should be rehabilitated where applicable.	**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
		Operational use of road network during routine maintenance.	Removed vegetation and introduction of hardened surfaces.	Alteration of hydrological and geomorphological processes within moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16) at and downstream of the access road crossings during operational use of road for maintenance of infrastructure.	**2.5**	**0.5**	**2.5**	**1**	**1.625**	**1**	**3**	**5.625**	**3**	**2**	**5**	**4**	**14**	**78.75**	**MODERATE RISK**	**90-100**		**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
O2		Inadequate and/or ineffective rehabilitation and monitoring.	Removed vegetation and introduction of hardened surfaces.	Inadequate rehabilitation of disturbed areas may lead to the reduction of ecological connectivity and degradation of the surrounding environment.	**1.5**	**0.5**	**1.5**	**0.5**	**1**	**2**	**2**	**5**	**1**	**1**	**5**	**4**	**11**	**55**	**LOW RISK**	**90-100**	Remediate/rehabilitate: - Disturbed areas should be rehabilitated and re-vegetated.	**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
O3		Operational use of road network during routine maintenance.	Accidental spillages of chemical / hazardous substances	Routine maintenance may lead to the introduction of chemical / hazardous substances (e.g. oil spills from vehicles, etc.) into the watercourses, soil and/or groundwater, adversely affecting the watercourses in the broader area.	**0.5**	**2.5**	**0.5**	**1**	**1.125**	**1**	**2**	**4.125**	**2**	**2**	**5**	**4**	**13**	**53.63**	**LOW RISK**	**90-100**	Avoid/prevent impact: - No machinery must be parked overnight within 32 m of the watercourses. - All stationary machinery must be equipped with a drip tray to retain any oil leaks. - Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. - All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site. Remediate/rehabilitate: - Emergency plans must be in place in case of spillages onto bare soil or within water courses.	**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
D1	**DECOMMISSIONING PHASE**	Decommissioning of turbines, pylons and access roads.	Disturbance of vegetation. Excavation, infilling and shaping of landscape.	Direct disturbance of watercourse soil and vegetation during the decommissioning of the proposed access roads within moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16).	**2**	**1**	**2**	**2**	**1.75**	**2**	**1**	**4.75**	**1**	**2**	**5**	**2**	**10**	**47.5**	**LOW RISK**	**90-100**	Avoid/prevent: - Decommissioned materials and rubble must not be stored within the moderate to moderately-high sensitivity areas. - Stockpiles must not be stored within the moderate to moderately-high sensitivity areas. Minimize/reduce: - If possible, decommissioning activities should be undertaken during the driest part of the year to minimize erosion and downstream sedimentation due to excavation, etc. - Appropriate stormwater structures must be implemented during decommissioning to control run-off and minimize erosion. - Erosion controls and sediment trapping measures must be put	**LOW RISK**	**Units A02 & A04:** - PES: D - EIS: High - REC: C/D (Improve) **Units A15 & A17:** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
D2		Decommissioning of turbines, pylons and access roads.	Disturbance of vegetation. Excavation, infilling and shaping of landscape.	Alteration of sections of moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16) at and downstream of infrastructure and linear crossings during decommissioning, resulting in increased run-off, erosion and sedimentation.	**2**	**0.5**	**2**	**1**	**1.375**	**2**	**1**	**4.375**	**1**	**2**	**5**	**4**	**12**	**52.5**	**LOW RISK**	**90-100**	in place. Remediate/rehabilitate: - Disturbed areas must be monitored for erosion channels and these must be rehabilitated. - All trenches/excavations must be backfilled and all disturbed areas backfilled, compacted and revegetated, where applicable.	**LOW RISK**	**<u>Units A02 & A04:</u>** - PES: D - EIS: High - REC: C/D (Improve) **<u>Units A15 & A17:</u>** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
D3		Decommissioning of turbines, pylons and access roads.	Disturbance of vegetation. Excavation, infilling and shaping of landscape.	Temporary reduction of ecological connectivity between up- and downstream sections of moderate to moderately-high EIS watercourses (A03, A12, A13, A15 and A16) during decommissioning.	**1.5**	**0.5**	**1.5**	**1**	**1.125**	**1**	**1**	**3.125**	**1**	**2**	**5**	**4**	**12**	**37.5**	**LOW RISK**	**90-100**		**LOW RISK**	**<u>Units A02 & A04:</u>** - PES: D - EIS: High - REC: C/D (Improve) **<u>Units A15 & A17:</u>** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)
D4		Decommissioning of turbines, pylons and access roads.	Accidental spillages of chemical / hazardous substances	Pollution of watercourse units due to the mishandling of hazardous substances and/or improper maintenance of machinery during decommissioning e.g. oil and diesel leaks and spills.	**0.5**	**2.5**	**0.5**	**1**	**1.125**	**1**	**2**	**4.125**	**1**	**2**	**5**	**4**	**12**	**49.5**	**LOW RISK**	**90-100**	Avoid/prevent: - No machinery must be parked overnight within 50 m of the watercourses. - All stationary machinery must be equipped with a drip tray to retain any oil leaks. - Chemicals used for construction must be stored safely on bunded surfaces in the construction site camp. - No ablution facilities must be located within 50m of any watercourse. - Chemical toilets must be regularly maintained/ serviced to prevent ground or surface water pollution. - Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. - All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site.	**LOW RISK**	**<u>Units A02 & A04:</u>** - PES: D - EIS: High - REC: C/D (Improve) **<u>Units A15 & A17:</u>** - PES: E - EIS: Moderately-high - REC: E/F (Maintain)

NO.	PHASES	ACTIVITY	ASPECT	IMPACT	FLOW REGIME	PHYSICO & CHEMICAL (WATER QUALITY)	HABITAT (GEOMORPH + VEGETATION)	BIOTA	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	FREQUENCY OF ACTIVITY	FREQUENCY OF IMPACT	LEGAL ISSUES	DETECTION	LIKELIHOOD	SIGNIFICANCE	RISK RATING	CONFIDENCE LEVEL	CONTROL MEASURES	BORDERLINE LOW MODERATE RATING CLASSES	PES AND EIS OF WATERCOURSE
																					Remediate/rehabilitate: - Emergency plans must be in place in case of spillages onto bare soil or within watercourses.		

6 RECOMMENDATIONS FOR THE PROPOSED ACTIVITY

In terms of Section 2 of the Aquatic Biodiversity Protocol (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:

2.7.13. Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).

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.

The mitigation measures provided below are to be implemented in the Planning and Design, Construction, Operational and Decommissioning Phases of the proposed activity.

6.1 PLANNING AND DESIGN PHASE

- All legal matters pertaining to permitting must be completed prior to any construction activity.
- In particular, all necessary Water Use Authorisations must be in order for any construction and operational activities within 100 m of a watercourse (i.e. longitudinal washes and channelled drainage lines) or 500 m of a wetland (i.e. dams).
- An Erosion and Stormwater Management Plan should be developed during the planning and design phase, and implemented during the construction, operational and decommissioning phases.
- An Emergency Spillage and Hazardous Waste Management Plan should be developed during the planning and design phase, and implemented during the construction, operational and decommissioning phases.

6.1.1 RECOMMENDED NO-GO AREAS AND BUFFER ZONES

Only the longitudinal washes and channelled drainage lines can be considered watercourses and only the dams can be considered wetlands in terms of the NWA, 1998 (Act 36 of 1998). As far as is feasible, the proposed development should avoid establishing infrastructure within watercourses, wetlands and their associated buffers. Although no formalised buffer distance have been published by the relevant competent authorities at the time of reporting, the Buffer Zone Guidelines for Rivers, Wetlands and Estuaries is typically used to suggest the appropriate size of the buffers surrounding wetlands (Macfarlane & Bredin, 2017). The procedure takes the aquatic impact buffer zone, potential core habitats and ecological corridors, and mitigation measures into account. The standard Buffer Tool Datasheet was used to determine the appropriate buffer zones for the longitudinal washes, channelled drainage lines and dams.

Table 6.1 provides the recommended construction and operational phase for these watercourses and wetlands based on their respective sensitivities. The proposed infrastructure must not be established within the channelled low order drainage lines (F01-14) or their buffers. With the exception of linear crossings, the proposed infrastructure should not occur within the longitudinal washes, Badlands, dams or their buffers. If such cannot be adhered to for well substantiated reasons, the mitigation

hierarchy (Section 6.1.2) must be applied to provide justification for the consideration of alternatives and an offset may be required to compensate for direct losses.

Table 6.1: Recommended buffers for watercourses and wetlands based on EIS ratings

EIS RATING	CATEGORY	UNITS	SENSITIVITY TO PROTECT	RECOMMENDED BUFFER (M)
High	Longitudinal washes	A01-04, A07-09 & A12-13	Biodiversity	50
	Badlands	A15-17		
Moderately-high	Longitudinal washes	A05-06 & A10-11	Regulating / provisioning services	30
Moderate	Badlands	A14 & A18	Biodiversity	
	Channelled drainage lines	F01-14		
Moderately-low	Dams		Regulating / provisioning services	15

All activities within moderate to high sensitivity areas must be closely monitored by a qualified ECO to ensure that all proposed mitigation measures are implemented to manage and minimize potential impacts on the watercourses and wetlands. The following activities may have an indirect impact on moderate to high sensitivity areas and should not occur within their proposed buffers:

- Stockpiling of topsoil, subsoil, etc.;
- Temporary ablution facilities;
- Site camp establishment;
- Temporary laydown areas for equipment/materials;
- Overnight parking of heavy machinery/vehicles;
- Concrete batching; and
- Storage of chemicals/hazardous substances.

6.1.2 APPLICATION OF THE MITIGATION HIERARCHY AND THE NEED FOR ONSITE REHABILITATION AND WETLAND OFFSETS

Development planning for the project must adhere to the 'mitigation hierarchy' outlined in Figure 6.1 below. This means that project planning must first investigate alternative project designs that avoid watercourses, wetlands and their buffers.

None of the 75 proposed turbines fall within the prescribed buffers of watercourses. Micro-siting in accordance with the mitigation hierarchy is recommended to ensure that the entire footprints of all turbines remain outside of the watercourses and their buffers to avoid direct losses.

Several proposed roads will cross moderate to high EIS watercourses, namely a four longitudinal washes (A02, A04, A15, A17) and a dam. This will result in the permanent loss of 2.89 ha of these watercourse. It is recommended that at least three of the proposed access roads crossings be realigned / amended to avoid and/or reduce impacts to watercourses. The proposed layout amendments are illustrated in Figure 6.2. The avoidance and minimisation pathway will prevent the loss of 0.78 ha to the access roads. Efforts to minimize and rehabilitate should also be employed to

reduce the significance of the impacts. A residual loss of 2.10 ha to the access roads will occur under the realistic good mitigation scenario.

Powerline and access road crossings of some of the watercourses and wetlands are inevitable and unavoidable. Where linear crossings cannot be avoided for well substantiated reasons, the impacts of such crossings should be minimised by ensuring that the length/extent of crossings is minimised as far as practically possible and that best practice designs are applied to the crossing design. The best practice guidelines and recommendations in Sections 6.1.3 and 6.1.4 below should be adhered to. The areas adjacent to the linear crossings should be rehabilitated and monitored in accordance with Sections 6.2.2.5, 6.2.8 and 6.2.9.

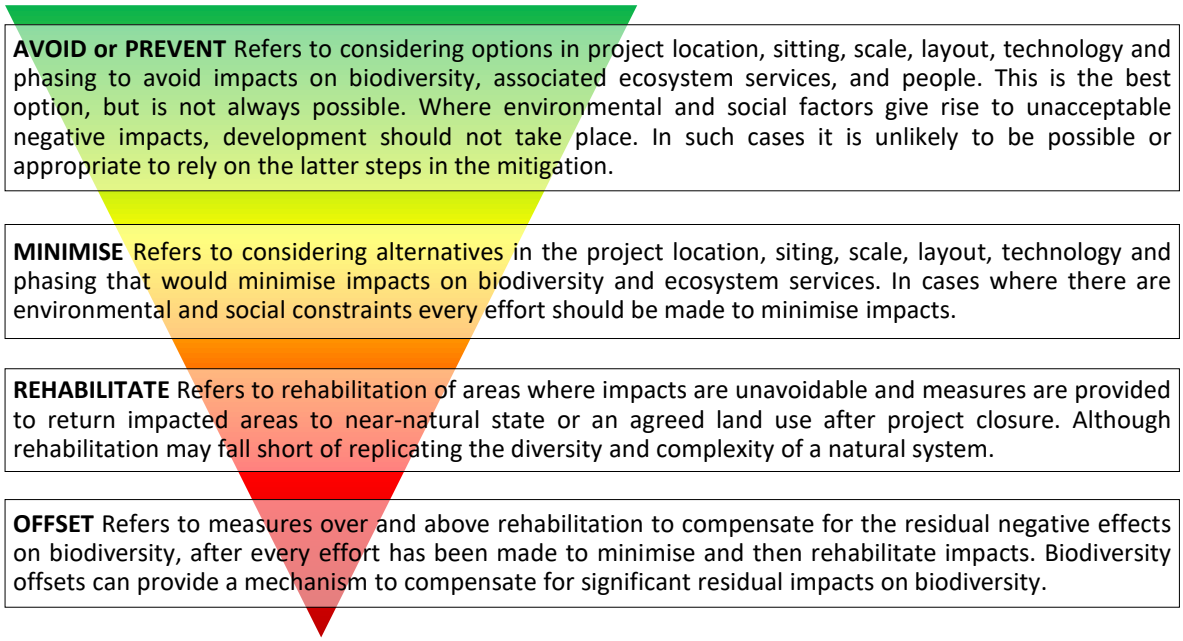


Figure 6.1: Diagram illustrating the 'mitigation hierarchy' (after DEA et al., 2013).

Cumulative, the proposed Soyuz WEF cluster will result in the direct modification and/or loss of up to 16.78 ha of watercourse units. This includes 0.31 ha to turbine foundations, 1.50 ha to hardstands, 14.46 ha to 12 m wide access roads and 0.51 ha to satellite camps. The avoidance pathway will prevent the loss of 7.45 ha. The application of best practice linear crossing guidelines and targeted rehabilitation will further mitigate all direct impacts.

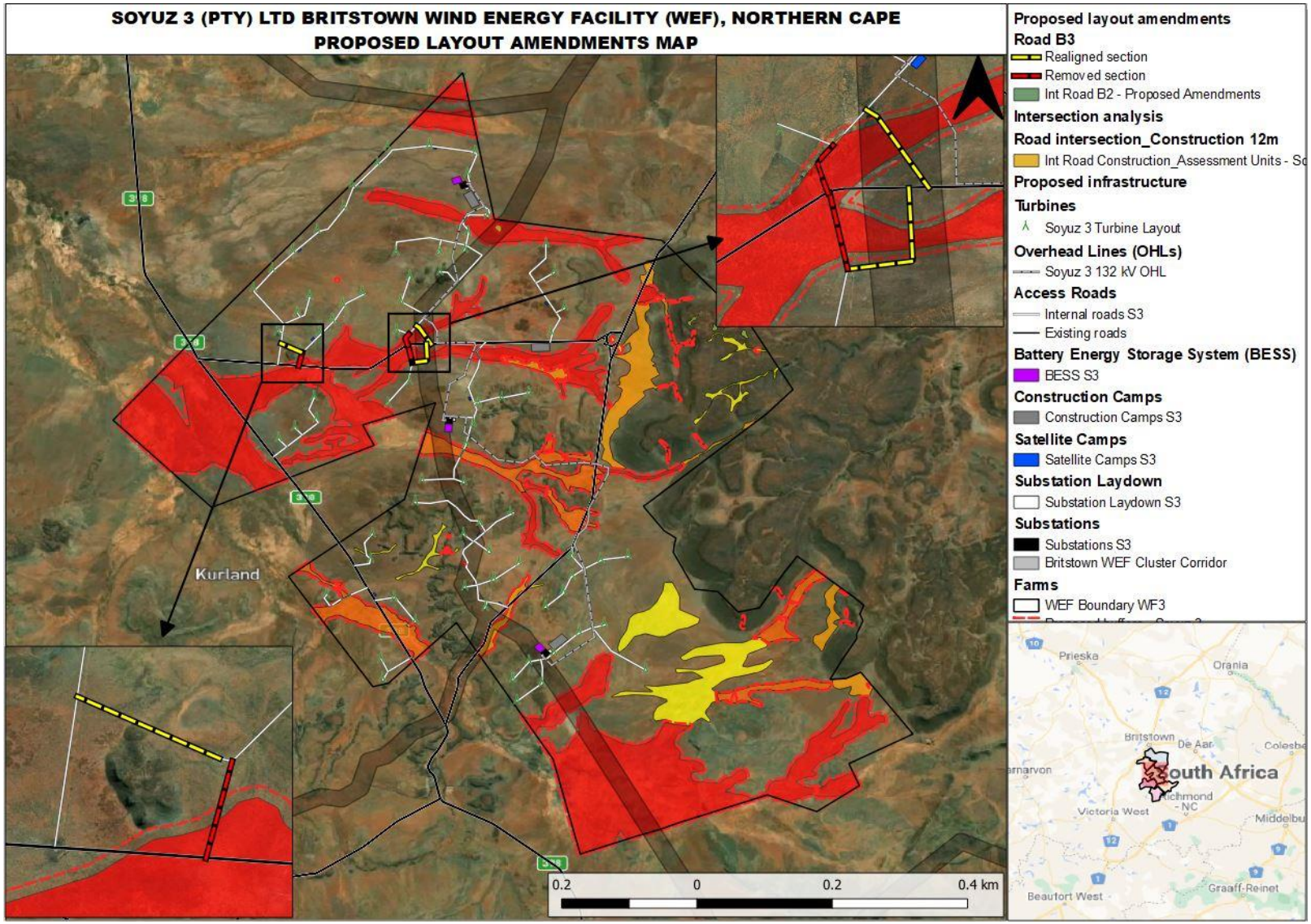


Figure 6.2: Proposed layout amendments.

6.1.3 POWERLINE CROSSINGS

The following best practice planning and design measures should be investigated for inclusion into the project design:

- The number of watercourses crossings by powerlines must be minimised as far as practically possible.
- The length of watercourse crossings must be minimised as far as practically possible. Unnecessary watercourses crossings (i.e. proposed crossings that can be re-aligned) must be re-aligned and avoided.
- Where watercourses and wetland crossings are required, every effort should be made to minimize the impacts by considering the following:
    - Crossing points should be aligned along areas or corridors of existing disturbance e.g. along existing road crossings.
    - The length of watercourses and wetlands crossed at each crossing must be minimised by adjusting alignments to coincide with narrower sections and ensuring that crossings cross perpendicular to flow.
    - No pylons must be located within watercourses or their prescribed buffers.
    - All mitigation measures recommended by the Avifaunal Specialist (Arcus, 2022) must be adopted and implemented, including recommendations regarding *inter alia* recommended buffers, flight diverters and pylon anti-nesting features.

6.1.4 ACCESS AND SERVICE ROADS

The following best practice planning and design measures should be investigated for inclusion into the project design:

- All service roads should follow the existing road network as far as practically possible.
- If new watercourse crossings are required, the number of new watercourse and wetland crossings must be minimised as far as practically possible. Unnecessary watercourse crossings (i.e. proposed crossings that can be re-aligned) must be re-aligned and avoided.
- Except at planned watercourse crossings, where new service roads are aligned near watercourses and wetlands, a buffer of 15-50 m (depending on the EIS of the watercourse) should be maintained between the watercourse and the edge of the road as far as practically possible.
- Where new watercourse crossings are required, every effort should be made to minimize the impacts by considering the following:
    - For all crossing types and designs, flow through road crossings should not be unnecessarily concentrated (or impeded) and flow velocity should not be increased.
    - Given that water flows in the washes generally occur across a very wide front and are usually as very infrequent and very brief events, it is recommended that “drift-type” road crossings be used where appropriate and designed for flow over the road surface rather than directing it under the road with culverts.
    - Where access road crossings of defined channels or intact wetlands (in dams) is required, box culverts must be established across the width of the watercourse.

  - Crossing points should be aligned along areas or corridors of existing disturbance e.g. along existing informal road crossings or cattle crossing routes.
  - The length/extent of watercourses and wetlands crossed at each crossing must be minimised by adjusting alignments to coincide with narrower sections and ensuring that crossings are straight and do not involve using long curves and are aligned at right angles to flow.
  - Crossings should be realigned to avoid the bends of erosion gullies and channels.
- For existing watercourse crossings, every effort should be made to minimize the impacts by considering the following:
  - Undersized or under-designed pipe culverts, if any, must be replaced with sufficiently sized box or pipe culverts.
  - Erosion protection and energy dissipation measures should be established at road crossing outlets e.g. stilling basins and reno-mattresses.
  - Every effort must be made to minimise the upgraded footprint of the existing roads at watercourse crossings.

The following road stormwater management measures are recommended:

- Stormwater generated by the upgraded and new roads should be discharged at regular intervals and many small outlets should be favoured over few large.
- Stormwater outlets must not be established within watercourses and wetlands.
- As far as practically possible, stormwater conveyance should be via open drains rather than pipes. Conveyance from the road drains to the outlets also be should via open drains, with vegetated or rough surfaces that are armoured with erosion protection.
- All outlets must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. In this regard, suitably designed energy for gravel roads will need to be installed at appropriate locations.
- All erosion protection measures must be established to reflect the natural slope of the surface and located at the natural ground-level.

6.2 CONSTRUCTION PHASE

6.2.1 DEMARCATION OF 'NO-GO' AREAS AND CONSTRUCTION CORRIDORS

- Prior to the commencement of any construction activities, the following features must be staked out by a surveyor and demarcated using brightly coloured shade cloth:
  - Outer edge of delineated perennial rivers, channelled low order drainage lines, dams and natural wetlands occurring within 15-50 m (depending on the EIS of the watercourse) of the proposed powerlines and associated pylons / towers.
- Access to and from the project area should be either via existing roads or within the construction servitude.
- Demarcation of all identified access, haulage and service roads. The alignment and routes for these roads need to be reviewed by the wetland ecologist.
- All excavated soils and soil stockpiles must be stored / sited outside of the watercourses.

- The demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- Demarcations are to remain until construction and rehabilitation is complete.
- All areas outside of this demarcated working servitude must be considered no-go areas for the entire construction phase. Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project.
- No equipment laydown or storage areas must be located within delineated wetland or riparian habitats.
- No equipment laydown or storage areas must be located within delineated watercourses and wetlands.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.

6.2.2 METHOD STATEMENTS FOR WORKING IN WATERCOURSES

A detailed method statement for the construction activities within all watercourses must be compiled and appended to the construction (EMPr) prior to construction commencing. The final method statement must be reviewed by a wetland specialist prior to commencement and must include all measures provided in this section where relevant and applicable. The following guidelines should be included in the method statement:

6.2.2.1 SITE SETUP

- All demarcation measures provided in Section 6.2.1 above applicable to the demarcation of the construction corridor/servitude across the watercourse must be implemented.
- A photographic record of the state of the watercourse prior to the commencement of clearing/construction must be kept for reference and rehabilitation monitoring purposes.
- The location of the topsoil and subsoil stockpile areas and equipment laydown areas must be agreed to and demarcated to the satisfaction of the ECO prior to any clearing. These areas must be located outside of all watercourses and sufficiently removed from them that in the event of heavy rainfall, the soil will not be carried into the watercourse.
- Before any work commences in the watercourses and wetlands, sediment control/silt capture measures (e.g. bidim/silt curtains) must be installed downstream of the working areas within the following features: the active channels (typically incised gullies) of the longitudinal washes, channelled drainage lines, artificial wetlands (dams), or natural wetlands. Quantities of silt fences/curtains shall be decided on site with the engineer, contractor and ECO. The ECO should be present during the location and installation of the silt curtains.

6.2.2.2 SITE CLEARING AND STRIPPING

- Indigenous vegetation within the watercourses and wetlands that are desirable for re-vegetation must be identified upfront before clearing.
- For vegetation within the watercourses and wetlands that is not desirable for re-vegetation, this vegetation can be stripped.
- Topsoil and subsoil excavated and stripped must not be mixed and must be stored separately.

6.2.2.3 RUNNING TRACK AND SOIL STOCKPILE CORRIDOR ESTABLISHMENT (IF APPLICABLE)

- Firstly, geotextile/geofabric must be laid down along the soil stockpile corridors and running track corridors. This is to avoid the mixing of foreign material with the watercourse and wetland soils.
- The running track must be established upstream of the road and must double up as a dam wall / berm / bund wall for flow diversion purposes.
- Where applicable, the active channel banks along the running track should be re-graded to a slope that will allow for safe access by workers to the channel bed.

6.2.2.4 RUNOFF, EROSION AND SEDIMENT CONTROL

- The duration of construction work within the watercourses must be minimised as far as practically possible through proper planning and phasing.
- Construction work within the watercourses and wetlands should be limited to the dry winter season wherever possible.
- When working within the active channels (typically incised gullies) of the longitudinal washes, channelled drainage lines, artificial wetlands (dams), or natural wetlands, downstream silt traps / curtains should be installed to capture sediment eroded from the working area prior to construction activities commencing within the watercourses. These silt traps must be regularly monitored and maintained and replaced / repaired immediately as and when required. These measures regularly checked, maintained and repaired when required to ensure that they are effective.

6.2.2.5 REHABILITATION (WHERE APPLICABLE)

- Once works within the watercourses are completed, subsoils and topsoils must be reinstated. Where applicable, the channel bed and banks, or wetland surface, must be reshaped.
- Road crossings should be used to assist in re-instating some of the lost base level as a result of historical erosional incision. The proposed access roads should serve a dual function, namely as a crossing of the washes and a means of stabilising the longitudinal slope of the watercourses. Anchored brush packs should be used in Badlands to assist with their rehabilitation. Within Soyuz 3, targeted rehabilitation at road crossings should be concentrated within units A04, A14, A17 and A18 in particular. Several other assessment units within the broader WEF cluster can also be targeted for rehabilitation.
- All surfaces must be adequately ripped/loosened where compacted, as informed by the ECO.
- The bund wall and running track within the watercourse must be removed systematically moving backwards out of the wettest areas. All foreign material (e.g. sand bags, rock fill, imported soils, aggregate, geofabric, etc.) must be removed from the watercourse, taking care not to remove natural sediment/rock from the watercourse.
- For dryland areas adjoining watercourses, the construction right-of-way should be re-vegetated by hydroseeding with a locally suitable grass mix that must be approved by the ECO or wetland specialist / ecologist.
- The re-vegetation should be timed to occur before the wet season (ideally at the onset of the wet season in early spring – September to October) so that watering requirements are minimized and plant growth is most vigorous.
- Alien and weed vegetation that colonize the rehabilitation areas must be removed and eradicated immediately via hand pulling and should be adequately disposed of.

- Once the initial re-vegetation is completed, the planting contractor will need to conduct weekly site visits to remove alien plants (in accordance with the latest revised NEMBA requirements) and address any re-vegetation concerns until re-vegetation is considered successful. Thereafter, the rehabilitation must be signed off by the ECO.

6.2.3 RUNOFF, EROSION AND SEDIMENT CONTROL

- Wherever possible, existing vegetation cover on the development site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- Bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2 m) to break the energy of surface flows.
- Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
- If re-vegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.
- Regular maintenance of sediment control dams must be undertaken during the construction / establishment period to ensure that these structures continue to function appropriately.

6.2.4 HAZARDOUS SUBSTANCES / MATERIALS MANAGEMENT

- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 50 m of any watercourse.
- No vehicles transporting concrete, asphalt or any other bituminous product may be washed on site.

- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period following the appropriate SANS codes. The bund wall should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.

6.2.5 INVASIVE ALIEN PLANT CONTROL

- All alien invasive vegetation that colonise the construction site must be removed, preferably by uprooting. The contactor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for IAPs every two weeks and IAPs removed by hand pulling/uprooting and adequately disposed.
- Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in wetlands by independent testing authority are to be used. The ECO must be consulted in this regard.

6.2.6 NOISE, DUST AND LIGHT POLLUTION MINIMISATION

- Temporary noise pollution due to construction works should be minimized by ensuring the proper maintenance of equipment and vehicles and tuning of engines and mufflers as well as employing low noise equipment where possible.
- Water trucks will be required to suppress dust by spraying water on affected areas producing dust. This will likely be required daily in the drier months or during dry periods.
- No lights must be established within the construction area near the watercourses and buffer zones.

6.2.7 PROHIBITIONS RELATED TO ANIMALS

- The handling and/or killing of any animal species present is strictly prohibited and all staff/personnel must be notified of such incidents.
- Wetland fauna (e.g. snakes, frogs, small mammals) that are encountered during the construction phase must be relocated to other parts of the wetland under the guidance of the EO or ECO.
- Poaching/snaring is strictly prohibited.

- All mitigation measures recommended by the Avifaunal Specialist (Arcus, 2022) and Faunal Specialist (Biodiversity Africa, 2022) must be adopted and implemented.

6.2.8 GENERAL REHABILITATION GUIDELINES

- All land impacted by the proposed development must be rehabilitated by undertaking the following general tasks:
  - All foreign material must be removed from site.
  - Land must be regraded / reshaped and topsoils must be reinstated.
  - Compacted soils must be adequately ripped/loosened where compacted, as informed by the ECO.
  - Re-vegetation should be undertaken via hydroseeding using an appropriate indigenous seed mix as advised by a wetland ecologist.
- Road crossings should be used to assist in re-instating some of the lost base level as a result of historical erosional incision. The proposed access roads should serve a dual function, namely as a crossing of the washes and a means of stabilising the longitudinal slope of the watercourses. Anchored brush packs should be used in Badlands to assist with their rehabilitation. Within Soyuz 3, targeted rehabilitation at road crossings should be concentrated within units A04, A14, A17 and A18 in particular. Several other assessment units within the broader WEF cluster can also be targeted for rehabilitation.

6.2.9 CONSTRUCTION PHASE MONITORING MEASURES

- Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EO's (Environmental Officers) having the required competency skills and experience to ensure that monitoring is undertaken effectively and appropriately.
- A photographic record of the state of the watercourse prior to the commencement of clearing/construction must be kept for reference and rehabilitation monitoring purposes.
- The ECO must undertake bi-monthly compliance monitoring audits. Freshwater ecosystem aspects that must be monitored related to monitoring freshwater ecosystem impacts include:
  - The condition of the demarcation fence.
  - Evidence of any no-go area incursions.
  - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures.
  - Evidence of sedimentary deposits / plumes and elevated rates of sedimentation (i.e. vegetation smothering / burial).
  - Evidence of elevated river / stream turbidity levels.
  - Evidence of gully or bed/bank erosion.
  - Visual assessment of stormwater quality and instream water quality.
  - The condition of waste bins and the presence of litter within the working area.
  - Evidence of solid waste within the no-go areas.
  - Evidence of hazardous materials spills and soil contamination.
  - Presence of alien invasive and weedy vegetation within the working area.
  - Rehabilitation and re-vegetation methods and success.

- Once the construction and rehabilitation has been completed, the ECO should conduct a close out site audit 1 month after the completion of rehabilitation.

6.3 OPERATIONAL PHASE

6.3.1 MAINTENANCE AND MANAGEMENT

- It is the applicant's responsibility to ensure the proper functioning of all infrastructure that is likely to require regular on-going maintenance.
- It is important that the location and extent of the wetlands and rivers in the vicinity of project activities be incorporated into all formal maintenance and repair plans for the project.
- The wetland and river areas occurring within the powerline servitude must not be too regularly burnt or cut.
- In terms of management, alien invasive plant control must be practiced on an on-going basis in line with the requirements of Section 2(2) and Section 3 (2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on their property.

6.3.2 MONITORING

It will be important that long-term monitoring of the potential freshwater ecosystem impacts be undertaken to proactively to identity any environmental issues and impacts that may arise as a result of the operational phase of the project. The following key aspects should be monitored:

- Erosion and/or sedimentation in the wetland downslope of the substation.
- Erosion and/or sedimentation in the wetland upstream and downstream of service road crossings and powerline crossings.
- Presence of alien invasive plants.
- Powerline bird mortalities at wetland crossings.

6.4 DECOMMISSIONING PHASE

6.4.1 WATERCOURSE / WETLAND REHABILITATION

If applicable, a detailed watercourse and wetland rehabilitation plan must be prepared to inform the dismantling and decommissioning of structures within wetlands i.e. access / service roads, turbines and powerline pylons.

6.4.2 ECOLOGICAL MONITORING

It will be important that long-term monitoring of the potential freshwater ecosystem impacts be undertaken to proactively identity any environmental issues and impacts that may arise as a result of the decommissioning and post-closure project. The following key aspects should be monitored:

- A photographic record of the state of the watercourse prior to the commencement of decommissioning must be kept for reference and rehabilitation monitoring purposes.
- During decommissioning:
  - Erosion and/or sedimentation in the watercourses downslope of the substation.

- Erosion and/or sedimentation in the wetland upstream and downstream of service road crossings and powerline crossings.
- Presence of alien invasive plants.
- Rehabilitation and re-vegetation methods and success.
- Once the rehabilitation has been completed, the ECO should conduct a close out site audit 1 month after the completion of rehabilitation.

- After decommissioning:
  - Erosion and/or sedimentation in the wetland / river downslope of pylons.
  - Erosion and/or sedimentation in the wetland / river upstream and downstream of service road crossings and powerline crossings.
  - Presence of alien invasive plants.

7 IMPACT STATEMENT, CONCLUSION AND RECOMMENDATIONS

In terms of Section 2 of the Aquatic Biodiversity Protocol (2020):

2.8. 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:

2.7.14. Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).

2.7.17. 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

2.7.18. Any conditions to which this statement is subjected.

7.1 SUMMARY

Soyuz 3 (Pty) Ltd is proposing the development of a 480 MW commercial WEF, comprised of up to 75 turbines, internal cabling, substations, BESS, batching plants, auxiliary buildings and access roads.

Seventy-six assessment units, including washes, flats, low-order drainage lines and dams, fall within the proposed 150 ha project area. According to the PES assessment, the condition of these range from "B: Largely Natural" to "E: Very Poor". A number of the assessment units offer moderately-low to moderately-high importance ecosystem services, including flood attenuation, sediment and nutrient trapping, biodiversity maintenance and food for livestock. Twelve units (A01-04, A07-09, A12-13 and A15-17) offer high biodiversity services, due to their role in conservation as part of the Graafwaterspruit CBA and ESA, and/or the Upper Karroo Hardeveld ESA. The combined Ecological Importance and Sensitivity (EIS) ratings of the units range from low to high.

Despite the large number of assessment units, only the 18 longitudinal washes and 14 channelled drainage lines can be considered watercourses and the 22 dams considered (artificial) wetlands in terms of the NWA, 1998 (Act 36 of 1998). Of these, only four longitudinal washes (A02, A04, A15 and A17) and one dam are anticipated to be directly impacted by the proposed development, due to the access roads and/or powerlines crossing through them. A few additional watercourses and wetlands fall within 100 m and 500 m of the proposed infrastructure, respectively (please refer to Section 7.3).

With the exception of linear crossings, the proposed infrastructure should not occur within the longitudinal washes, channelled drainage lines, or their buffers. If such cannot be adhered to for well substantiated reasons, the mitigation hierarchy (Section 6.1.2) must be applied to provide justification for the consideration of alternatives and an offset may be required to compensate for the direct losses. Access roads should follow the existing road network as far as practically possible. Where new watercourse crossings are required, the length/extent of new watercourse crossings must be minimised as far as practically possible. Unnecessary watercourse crossings must be re-aligned and avoided where possible.

7.2 SUMMARY OF IMPACT SIGNIFICANCE

Table 7.1 provides a summary of the negative impacts of the proposed development on the aquatic and wetland environment along the project route, under realistic poor and realistic good mitigation scenarios, during the construction, operational and decommissioning phases. Under a realistic poor mitigation scenario, the proposed development is anticipated to have one impact of MODERATELY-HIGH significance, four impacts of MODERATE significance and eight impacts of LOW significance. All impacts will be reduced to VERY LOW to MODERATELY-LOW, provided that all recommended mitigation measures are implemented under the realistic good mitigation scenario.

Table 7.1: Assessment of impact significance under realistic poor and realistic good mitigation scenarios.

PHASE	REALISTIC POOR MITIGATION SCENARIO			REALISTIC GOOD MITIGATION SCENARIO		
	LOW	MOD	MOD-HIGH	VERY LOW	LOW	MOD-LOW
Construction	-2	-3	-1	-2	-3	-1
Operational	-2	-1		-2	-1	
Decommissioning	-4			-3	-1	
TOTAL	**-8**	**-4**	**-1**	**-7**	**-5**	**-1**
No-go Alternative	**-3**			**N/A**		

The no-go alternative in the context of this project implies that the proposed WEF would not be developed and the current land uses would persist. If the project does not proceed, the negative impacts (i.e. direct losses, altered hydrological and geomorphological processes, reduced ecological connectivity and reduced water quality) would be avoided. However, under the no-go alternative, it is anticipated that the watercourses would continue to degrade over the long-term, due to widespread overgrazing, cultivation and other land uses, as well as more localised disturbances such as the use of existing access roads, collectively leading to decreased vegetation cover and increased run-off, erosion and sedimentation, particularly during storm and flood events.

7.3 WATER USE LICENCING

The proposed infrastructure falls within close proximity to a number of watercourses and wetlands, as defined by the NWA, 1998 (Act 36 of 1998). The project will therefore require a Water Use Authorisation (WUA) under Section 21(c) and 21(i) of the NWA. Under Section 21 of the NWA, the proposed development would require either a General Authorisation (GA) or full Water Use Licence (WULA) (depending on the level of risk) for any development occurring within 100 m of a watercourse or 500 m of wetland, due to the triggering of the following water uses:

- 21(c) impeding or diverting the flow of water in a watercourse (relevant to the construction occurring in close proximity to drainage lines); and
- 21(i) altering the bed, banks, course or characteristics of a watercourse (relevant to the construction occurring in close proximity to drainage lines).

The level of risk associated with the water use activities were assessed using the DHSWS Risk Assessment Matrix. Activities carrying a LOW risk rating are generally eligible for a GA, whereas activities with a MODERATE or HIGH risk rating require a full WULA. The following was considered when completing the risk assessment in accordance with the NWA, 1998 (Act 36 of 1998):

- None of the 75 proposed turbines fall within 100 m of the delineated boundaries of watercourses (longitudinal washes and channelled drainage lines). However, one falls within 100 m of a watercourse and three within 500 m of an artificial wetland (dam);
- The proposed access roads cross four longitudinal washes (A02, A04, A15 and A17) and one dam. Several watercourses and dams fall within 100 m and 500 m of a proposed road, respectively;
- Various supporting infrastructure (BESS, substation, construction camps, satellite camps, etc.) also all fall within 100 m of watercourses and 500 m of dams; and
- The proposed cluster powerline corridor crosses seven watercourses (A01, A02, A04, A12, A13, A15 and A18) at one to two crossing points each, with at least two sections also falling within 500 m of dams.

The risk assessment found that the project carries five impacts of MODERATE risk and eight of LOW risk, under the realistic poor mitigation scenario. The adoption and effective implementation of the all the recommended mitigation measures will reduce all of these to low risk. The proposed development is therefore eligible to register for a GA, subject to the confirmation and decision of DHSWS.

7.4 FATAL FLAWS

It is the opinion of the specialist that **NO FATAL FLAWS** exist with the proposed development as long as all recommended mitigation measures are adopted and effectively implemented. If any of the recommended mitigation measures provided in Chapter 6 cannot be adhered to, the impact and risk assessments will need to be revised.

7.5 ENVIRONMENTAL STATEMENT AND OPINION OF THE SPECIALIST

The river and wetland impacts of all aspects for the development were assessed. Impacts are rated as LOW to MODERATELY-HIGH under a realistic poor mitigation scenario. The adoption and effective implementation of all the recommended mitigation measures, coupled with a comprehensive rehabilitation and monitoring in terms of re-vegetation and restoration is an important element of the mitigation strategy. Effectively implementing the recommended mitigations measures will reduce all impacts to VERY LOW to MODERATELY-LOW significance.

8 REFERENCES

Arcus, 2022. *Avifaunal Specialist Report for the Proposed Soyuz 3 Wind Energy Facility near Britstown, Northern Cape Province,* Cape Town: Arcus.

Biodiversity Africa, 2022. *Botanical Specialist Report for the Proposed Soyuz 3 Wind Energy Facility, Northern Cape,* Cape Town: Biodiversity Africa.

Biodiversity Africa, 2022. *Faunal Specialist Report for the Proposed Soyuz 3 Wind Energy Facility, Northern Cape,* Cape Town: Biodiversity Africa.

Collins, N. B., 2011. *Phytosociology and ecology of selected depression (pan) and valley-bottom wetlands of the Free State Province. PhD Thesis,* Bloemfontein: University of the Free State.

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

Department of Water Affairs and Forestry, 2005. *A level 1 and 2 Ecoregional Classification System for South Africa, Lesotho and Swaziland,* South Africa: DWAF.

Department of Water and Sanitation, 2014. *A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: A2 Crocodile West. Compiled by RQIS-RDM..* [Online] Available at: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx [Accessed 18 December 2019].

Driver, A. S. K. et al., 2012. *National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report,* Pretoria.: South African National Biodiversity Institute and Department of Environmental Affairs. http://biodiversityadvisor.sanbi.org/wp-content/uploads/2016/07/NBA-2011-Synthesis-Report-low-resolution.pdf.

DWAF, 2007. *Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types. Report no. N/0000/00/WEI/0407.,* Pretoria: Resource Quality Services, Department of Water Affairs and Forestry.

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

Kleynhans, C. J., 1999. Appendix R3: Desktop Level Estimate of the Present Ecological Status for use inthe National Water Balance Model. In: DWAF, ed. *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0.* Pretoria: DWAF.

Kleynhans, C. J., 1999. Appendix R7: Assessment of Ecological Importance and Sensitivity. In: DWAF, ed. *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0.* Pretoria: DWAF.

Kleynhans, C. J. & Louw, M. D., 2007. *Module A: EcoClassification and EcoStatus determination in River EcoClassification: Manual for EcoStatus Determination (version 2). WRC Report No. TT 329/08,* Pretoria: DWAF & WRC.

Kotze, D. C., Macfarlane, D. M. & Edwards, R. J., 2020. *WET-EcoServices (Version 2): A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas. Final Report. WRC Project K5/2737. ,* Pretoria, South Africa: Water Research Commission.

Macfarlane, D. & Bredin, I., 2017. *Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. WRC Report No. TT 715-1-17,* South Africa: Water Research Commision (WRC).

Macfarlane, D. M., Ollis, D. J. & Kotze, D. C., 2020. *WET-Heath (Version 2): A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems. WRC Report No. TT 820/20,* Pretoria: Water Research Commission.

Manning, J. & Goldblatt, P., 2012. *Plants of the Greater Cape Floristic Region 1: The Core Cape Flora, Strelitzia 29.* Pretoria: South African National Biodiversity Institute.

Meteoblue, 2022. *Meteoblue Climate Britstown.* [Online]
Available at:
https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/britstown_south-africa_1015612
[Accessed 29 April 2022].

Milton, S. J. & Dean, R. W., 2021. Anthropogenic impacts and implications for ecological restoration in the Karoo, South Africa. *Anthropocene,* 36(https://doi.org/10.1016/j.ancene.2021.100307), pp. 1-17.

Mucina, L. & Rutherford, M. C., 2018. *The Vegetation of South Africa, Lesotho and Swaziland.* Pretoria: South African National Biodiversity Institute (SANBI).

Mucina, L. & Rutherford, M. C., 2018. *The Vegetation of South Africa, Lesotho and Swaziland.* Pretoria: South African National Biodiversity Institute (SANBI).

Nel, J. L. & Driver, A., 2012. *National Biodiversity Assessment 2011: Technical Report. Volume 2: Freshwater Component. Council for Scientific & Industrial Research (CSIR) Report No. CSIR/NRE/ECO/IR/2012/0022/A.,* Stellenbosch: CSIR.

Ollis, D., Snaddon, K., Job, N. & Mbona, N., 2013. *Classification system for wetlands and other aquatic ecosystems in South Africa,* Pretoria: South African National Biodiversity Institute.

South African National Biodiversity Institute, 2006-2018. *The Vegetation Map of South Africa, Lesotho and Swaziland, Mucina, L., Rutherford, M.C. and Powrie, L.W. (Editors), Version 2018.* [Online]
Available at: http://bgis.sanbi.org/Projects/Detail/186
[Accessed 18 December 2019].

South African National Biodiversity Institute, 2009. *Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report,* South Africa: Freshwater Consulting Group (FCG) for SANBI.

Tiner, R. W., 1993. The primary indicators method – a practical approach to wetland recognition and delineation in the United States. *Wetlands,* Volume 13, pp. 50-64.

Van Ginkel, C. E. & Cilliers, C. J., 2020. *Aquatic and Wetland Plants of Southern Africa.* 1st ed. Pretoria: Briza Publications.

Van Ginkel, C. E. et al., 2011. *Easy identification of some South African Wetland Plants(grasses, restios, sedges, rushes, bulrushes, eriocaulons and yellow-eyed grasses). WRC Report No TT 479/10,* South Africa: Water Research Commission.

Winterbach, H. E. K., 1999. *Habitat utilization, activity patterns and management of Cape Buffalo in the Willem Pretorius Game Reserve. MSc thesis,* Pretoria: University of Pretoria.

9 APPENDIX A – CURRICULUM VITAE

AIDAN JOHN GOUWS
Curriculum Vitae

CES
ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES

CONTACT DETAILS

Name of Company	**CES – Environmental and Social Advisory Services**
Designation	Centurion Branch
Profession	Senior Environmental Consultant
Years with firm	4 Years
E-mail	a.gouws@cesnet.co.za
Office number	+27 (0)10 045 1372
Nationality	South African
Professional Affiliations	• South African Council for Natural Scientific Professions (SACNASP) (*Cand.Sci.Nat* 121901) • International Association of Impact Assessment (IAIAsa)
Key areas of expertise	• Environmental Authorisations • Geographical Information Systems (GIS) • Terrestrial Ecology • Wetland Ecology • Database Management

PROFILE

Mr Aidan Gouws

Aidan obtained his MSc in Environmental Science (*Cum laude*) from Rhodes University, having conducted research on the spatio-temporal dynamics of *Acacia dealbata* invasions and broader land-use and cover changes in the northern Eastern Cape, funded through a study bursary awarded by the Agricultural Research Council (ARC). Prior to this, he obtained his BSc Honours in Geographical and Environmental Sciences (*Cum laude*) from the University of Pretoria, studying plant ecology and EIA methodology amongst others. Since joining CES in 2018, he has been involved in several projects, including Basic Assessments (BA), Full Scoping and Environmental Impact Assessments (S&EIA), Environmental Amendment Applications, Environmental Audits and Resettlement Action Plan (RAP) Audits. He works from the Centurion office as a Senior Environmental Consultant. His interests include the general Environmental Impact Assessment (EIA) process, terrestrial and wetland ecology, and database management. Aidan is registered with the South African Council for Natural Scientific Professions (SACNASP) as a Candidate Natural Scientist (*Cand.Sci.Nat*. 121901) and with the International Association for Impact Assessments (IAIA).

AIDAN JOHN GOUWS
Curriculum Vitae

EMPLOYMENT EXPERIENCE	**Senior Environmental Consultant – Coastal and Environmental Services (Centurion)** *August 2020 – Current* • Consulting, project management and conducting assessments in the broad field of Environmental Management, including Basic Assessments, full Scoping and Environmental Impact Assessments, Environmental Management Programmes and Environmental Auditing. • Ecological Impact Assessments • Wetland Impact Assessments • GIS Mapping • Database Management **Environmental Consultant – Coastal and Environmental Services (Centurion)** *July 2018 – July 2020* • Consulting, project management and conducting assessments in the broad field of Environmental Management, including Basic Assessments, full Scoping and Environmental Impact Assessments, Environmental Management Programmes and Environmental Auditing. • Ecological Impact Assessments • GIS Mapping • Database Management **Volunteer – Khulisa Social Solutions (Johannesburg)** *May 2018 – July 2018* **Departmental tutor - Department of Environmental Science, Rhodes University (Grahamstown)** *January 2016 – December 2017* **Demonstrator - Department of Plant Science, University of Pretoria (Pretoria)** *July 2015 – December 2015*
ACADEMIC QUALIFICATIONS	• 2014 - BSc Environmental Science (University of Pretoria) • 2015 - BSc (Hons) Geographical and Environmental Science (University of Pretoria) • 2018 - MSc Environmental Science (Rhodes University)
COURSES	• 2020 - Tools for Wetland Assessment (Rhodes University, in association with GroundTruth, The Water Research Commission and Verdant Environmental) *August 2020*
PUBLICATIONS	• Gouws, A. J., & Shackleton, C. M. (2019). A spatio-temporal, landscape perspective on *Acacia dealbata* invasions and broader land use and cover changes in the northern Eastern Cape, South Africa. Environmental Monitoring and Assessment, 191(2), 74. • Gouws, A. J., & Shackleton, C. M. (2019). Abundance and correlates of the *Acacia dealbata* invasion in the northern Eastern Cape, South Africa. Forest Ecology and Management, 432, 455-466.

AIDAN JOHN GOUWS
Curriculum Vitae

PROFESSIONAL EXPERIENCE	**BASIC ASSESSMENTS**

SANRAL R573 Section 1 Phase 2A and 3A Road Upgrade from Baviaanspoort Road to PWV2 the Interchange, Pretoria, Gauteng Province, 2022–
Basic Assessment for the upgrade of the R573 Section 1 Road Upgrade from Baviaanspoort Road to PWV2 the Interchange in Pretoria, Gauteng Province. Assigned the role of project manager.

SANRAL Masekwaspoort N1 Road Upgrade BAR Authorisation, Musina, Limpopo Province, 2018–2019, 2022–
Basic Assessment for the upgrade of the N1 between Louis Trichardt and Musina. Assigned the role of project manager and co-author of the Basic Assessment Report.

Eskom Mesong 400Kv Loop in Loop-out Powerline, Gauteng Province, 2021–2022
Basic Assessment for the development of the 400 kV LILO Powerline in the Modderfontein area, Gauteng Province. Assigned the role of Terrestrial Ecologist, Wetland Ecologist and co-author of the Basic Assessment Report.

Eskom 132 kV Ganspan Pering powerline in the Pampierstad area, in the Northern Cape and North West Provinces, 2021–2022
Basic Assessment for the development of the 132 kV Powerline in the Pampierstad area, in the Northern Cape and North West Provinces. Assigned the role of Wetland Ecologist and co-author of the Basic Assessment Report.

Sturdee Energy Solar PV Plants at PPC Cement Facilities, South Africa, 2020–
Two Basic Assessments for the proposed solar PV plants at the PPC Dwaalboom and PPC Slurry Facilities, located in the Limpopo and North West Provinces, respectively. Assigned the roles of co-project manager, Terrestrial Ecologist and Wetland Ecologist.

SANRAL R516 Section 1 Road Upgrade (R511-Tooyspruit and Tooyspruit-Bela Bela), Limpopo Province, 2021–
Two Basic Assessments for the upgrade of two sections of the R516-01 (namely from R511 to Tooyspruit and from Tooyspruit to Bela Bela), as well as a Basic Assessment for the associated mining of a quarry. Assigned the role of project manager.

Ramotshere Moiloa Local Municipality Residential Extensions, Zeerust, North West Province, 2019–2020
Two Basic Assessments for the proposed extension of two residential extensions in Zeerust, North West. Assigned the roles of project manager, PPP manager, Terrestrial Ecologist and lead author of the Basic Assessment Report.

SANRAL Koster R52 Road Upgrade, Koster, North West Province, 2018–2021
Basic Assessment for the road upgrade of the R52 route between Koster and the N4 Rustenburg. Assigned the roles of project manager, PPP manager, Terrestrial Ecologist, Wetland Ecologist and lead author of the Basic Assessment Report.

Transnet Freight Rail Installation of Telecommunications Masts and Associated Infrastructure at Various Locations in South Africa, 2019–2020
Three Basic Assessments for the installation of telecommunications masts in Gauteng, Mpumalanga and KwaZulu-Natal. Assigned the roles of project manager, PPP manager and lead author of the Basic Assessment Report.

PRASA CRES Establishment of Township Leralla Extension 1, Tembisa, Gauteng Province, 2019–2020
Basic Assessment for the proposed township establishment at Leralla Station in Tembisa, Gauteng Province. Assigned the roles of project manager, PPP manager and lead author of the Draft Basic Assessment Report.

FULL SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENTS

SANRAL Zandkraal-Winburg N1 Road Upgrade Quarry S&EIR Authorisation, Winburg, Free State Province, 2018–2022
Full Scoping and Environmental Impact Assessment for the mining of borrow pits and quarries associated with the upgrade of the N1 between Zandkraal and Winburg South. Assigned the roles of project manager, PPP manager and lead author of the Scoping Report and Environmental Impact Assessment Report.

SANRAL Masekwaspoort N1 Road Quarry S&EIAR Authorisation, Musina, Limpopo Province, 2018–2019, 2022–
Full Scoping and Environmental Impact Assessment for the mining of borrow pits and quarries associated with the upgrade of the N1 between Louis Trichardt and Musina, Limpopo Province. Assigned the role of project manager and co-author of the Scoping Report.

ENVIRONMENTAL SCREENING

Eskom Lesokwana Substation and Associated Powerlines, Gauteng Province, 2021–2022
Detailed environmental screening process for the development of the Lesokwana substation and associated powerlines in the Gauteng Province. Assigned the roles of project manager, Terrestrial Ecologist, Wetland Ecologist and lead author of the detailed screening report.

ENVIRONMENTAL AMENDMENT APPLICATIONS

SANSA Space Operations Installation of Satellite Antennae on Farm Hartebeesthoek 502JQ, Gauteng Province, 2019–2021
Amendment of Environmental Authorisation for the installation of satellite antennae at the South African National Space Agency (SANSA) Space Operations facility. Assigned the roles of client liaison, Terrestrial Ecologist, Assistant Wetland Ecologist and lead author of the Amendment Report.

WATER USE AUTHORISATON (WUA) APPLICATIONS

Door of Hope Village Estate for Abandoned and Orphaned Children on Farm Hartsenbergfontein 332, De Deur, Gauteng, 2020–
Integrated Water Use Licence Application (WULA) under Section 21(a)(c)(e)(f)(g) of the National Water Act, 1998 (Act 36 of 1998) for the development of a village estate for abandoned and orphaned children. Assigned the role of WULA manager.

SANRAL Koster R52 Road Upgrade, Koster, North West Province, 2021–
Section 21(c)(i) General Authorisation Application for the road upgrade of the R52 route between Koster and the N4 Rustenburg. Assigned the roles of project manager, Wetland Ecologist and WUA manager.

Sturdee Energy Solar PV Plants at PPC Slurry Cement Facility, North West Province, 2021–2022
Section 21(c)(i) General Authorisation Application for the proposed solar PV plants at the PPC Slurry Facility, located near Mahikeng in the North West Province. Assigned the roles of co-project manager, WUA manager and Wetland Ecologist.

ENVIRONMENTAL AUDITING

SANRAL R510 Section 2 Thabazimbi-Bierspruit, Limpopo Province, 2021–
Environmental Auditing for the upgrade of the R510-02 road between Thabazimbi and Bierspruit. Assigned the roles of project manager and reviewer of audit reports.

SANRAL R33 Section 14 Vaalwater-Lephalale Road Upgrade ECO Audits, Limpopo Province, 2021–
Environmental Auditing for the upgrade of the R33-14 road and associated bridges and culverts between Vaalwater and Lephalale. Assigned the roles of project manager and lead ECO.

SANRAL Hendrina N11 Road Upgrade ECO Audits, Hendrina, Mpumalanga Province, 2018–2019
Environmental Auditing for the construction of the road and mining of borrow pits associated with the upgrade of the N11 route between Hendrina and Hendrina Power Station. Assigned the roles of ECO, author of ECO audit reports and author of the borrow pit closure report

South African National Biodiversity Institute (SANBI) Office Complex Development, Pretoria, Gauteng Province, 2018
Environmental Auditing for the construction of the Office Complex at the Pretoria National Botanical Gardens. Assigned the roles of interim ECO and co-author of ECO audit reports.

AIDAN JOHN GOUWS
Curriculum Vitae

RISK ASSESSMENTS

PRASA CRES Inhlanzane Risk Assessment, Jabulani (Soweto), Gauteng, 2019
Social and Environmental Risk Assessment of the Illegal Occupation of the Rail Reserve near Inhlanzane Station - Jabulani (Soweto), Gauteng. Assigned the roles of project manager and lead author of the Risk Assessment Report.

RESETTLEMENT ACTION PLAN (RAP) AUDITING

Millennium Challenge Account Malawi (MCA-M) RAP Audits, 2018–2019
Completion audits for six Resettlement Action Plans (RAPs) conducted for the Infrastructure Development Project in Malawi. These RAPs documented the physical and economic displacement impacts and compensation for assets of people affected by wayleave corridors along 400kV, 132kV, 66kV and 33kV OHLs, as well as for substations and permanent access roads. Assigned the roles of database support, auditor, training assistant and assistant author. Later assigned the role of database manager.

DATABASE MANAGEMENT

Eswatini Electricity Company (EEC) 132kV Powerline ESIA and RAP, 2020–
Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for the proposed 132kV powerline in the Shiselweni Region of Swaziland. Assigned the roles of data analyst and database co-manager.

SPECIALIST ASSESSMENTS

Terrestrial biodiversity and ecological impact assessments:

- SANRAL Masekwaspoort N1 Road BAR and Quarry S&EIAR Authorisation, Musina, Limpopo Province, 2022–
- Anglo American Borwa Vent Shaft Construction, Limpopo, 2021–2022
- Eskom Mesong 400Kv Loop in Loop-out Powerline, Gauteng, 2021–2022
- Eskom Lesokwana Substation and Associated Powerlines, Gauteng Province, 2021
- Sturdee Energy Solar PV Plants at PPC Cement Facilities, South Africa, 2021
- SANRAL Koster R52 Road Upgrade, Koster, North West Province, 2020
- SANSA Space Operations Installation of Satellite Antennae on Farm Hartebeesthoek 502JQ, Gauteng Province, 2020
- Ramotshere Moiloa Local Municipality Residential Extensions, Zeerust, North West Province, 2019

River and wetland impact assessments:

- FG Gold Baomahun Gold Project Supplementary ESIA Addendum, Baomahun. Sierra Leone, 2022-
- Atlantic Energy Britstown Wind Energy Facility (WEF) Cluster, Northern Cape, 2022-
- Anglo American Borwa Vent Shaft Construction, Limpopo, 2021–2022
- Diamcor Diamond Mine Mining Expansion Project, Limpopo, 2021–2022

AIDAN JOHN GOUWS
Curriculum Vitae

- Bosch Projects Jan Kleynhans Water Treatment Works Subsoil Drain, Grahamstown, Eastern Cape, 2021–
- Eskom 132 kV Ganspan Pering powerline in the Pampierstad area, in the Northern Cape and North West Provinces, 2021
- Eskom Lesokwana Substation and Associated Powerlines, Gauteng Province, 2021
- De Beers Venetia Mine Stormwater Management Project, Limpopo, 2021
- Sturdee Energy Solar PV Plant at PPC Slurry, North West, 2021
- T4 Mining Project in the Dr Pixley Ka Isaka Seme Local Municipality, Mpumalanga, 2021
- Birmingham Mining Project in the Steve Tshwete Local Municipality, Mpumalanga, 2020-2021
- SANSA Space Operations Installation of Satellite Antennae on Farm Hartebeesthoek 502JQ, Gauteng, 2020
- SANRAL Koster R52 Road Upgrade, Koster, North West, 2020

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

Aidan John Gouws Date: July 2022

Ryan Edwards | Wetland Ecologist & Environmental Scientist

M.Sc., B.Sc. (Hons), B.Sc. UKZN
SACNASP Reg. No.: 400089/13

96 Edmonds Road, Glenwood, 4001
Cell no.: +27 73 121 3392
Email: ryan@verdantenv.co.za

PROFILE

- I am a highly motivated wetland ecosystem specialist and environmental scientist with twelve (12) years experience in the natural scientific and environmental management consulting sector.
- My core field of focus, specialisation and passion is wetland and freshwater ecosystem ecology.
- I regularly conduct wetland and river ecosystem assessments and develop wetland rehabilitation and management plans and wetland offset plans for private, commercial and industrial clients as well as for provincial and national government departments and municipalities.
- My highest qualification is a Master of Science (MSc) in Environmental Science (Research Masters). My Masters dissertation was on wetland geomorphology and as such I have expertise in the methods of data collection and analysis in the discipline of fluvial geomorphology.
- I have developed a wide range of skills and knowledge over my career. I am competent in data collection and analysis methods related to wetland and river ecosystem assessments that include soil and vegetation sampling, description and analysis; ecosystem services assessments; biodiversity / ecological importance assessments; ecological health / condition assessments; and freshwater ecosystem impact assessment.
- I have notable experience in wetland rehabilitation and management (±10yrs), wetland and biodiversity offset planning (±5yrs), and vegetation / biodiversity assessments (±8yrs).
- I have some experience in the compilation of constructed wetland feasibility assessments.
- I have considerable project management experience (±10yrs) having successfully led, managed and completed a diverse range of specialist freshwater ecosystem and environmental management related projects.
- I am one of the leading wetland ecologists in the field of wetland offset planning in SA and have been involved in a number of high profile offset projects, two of which I have lead and managed.
- I have completed over 100 specialist wetland assessments.
- I am competent in the basic use of Geographical Information Systems (GIS) for the purpose of mapping wetlands, rivers (riparian zones) and vegetation communities as well as environmental impacts.

1

- As a senior scientist in my current post, my role involves the mentorship, management and oversight of junior scientists, a managerial role that I fulfilled over the last five years.
- I am currently accredited as a professional natural scientist by the South African Council for Natural Scientific Professions (SACNASP) under the field of practice – 'environmental science'.
- My professional interests are wetland ecosystems, ecosystem restoration and rehabilitation, ecosystems services, sustainability, climate resilience, market internalisation of negative environmental externalities, and the mainstreaming of environmental management and sustainability into strategic development planning and governance.

SKILLS PROFILE

A. Technical Scientific Skills:

Proficient in the following ecological / biophysical specialist assessments and plans:

- Wetland and River / Riparian Ecosystem Delineation and Classification
- Wetland and River / Riparian Ecosystem Service/Functional Assessments
- Wetland and River / Riparian Ecosystem Health/Ecological State Assessments
- Wetland and River / Riparian Ecosystem Vegetation Assessments
- Wetland and River / Riparian Ecosystem Geomorphology Assessments
- Wetland and River / Riparian Ecosystem Rehabilitation Plans
- Wetland and River / Riparian Ecosystem Management and Conservation Plans
- Wetland and Biodiversity Offset Plans
- Freshwater ecosystem (wetland and river) impact assessments
- Strategic freshwater ecosystem / wetland management planning
- Terrestrial ecosystem impact assessments (typically in collaboration with botanists and zoologists)
- Alien Plant Eradication and Control Programmes
- Wetland training presentations and courses

Proficient in the following scientific sampling methods and analysis:

- Soil sampling for hydric (wetland / alluvial) soil identification
- Vegetation sampling (plots / quadrats) and wetland / riparian plant identification
- Wetland surface cross-sectional and longitudinal surveys using a dumpy level and a staff
- Wetland sedimentary fill sampling and interpretation

Proficient in the following specialist ecological assessment tools and techniques:

- WET-Health (Macfarlane et al., 2008) – co-author of the current revision of the tool (in preparation)
- WET-EcoServices (Kotze et al., 2007) – co-author of the current revision of the tool (in preparation)
- Wetland Ecological Importance and Sensitivity Assessment (DWAF, 1999)

- Riverine Index of Habitat Integrity Assessment (Kleyhans & Louw, 2008)
- Riverine Ecological Importance and Sensitivity Assessment (DWAF, 1999)

Have experience with the following river ecosystem assessment techniques:

- Riparian Vegetation Response Assessment Index (VEGRAI) (Kleynhans et al., 2007)
- SASS 5 (not an accredited practitioner but have undertaken the course)
- Mini-SASS

Proficient in the following environmental management activities:

- Leading, managing and compiling Environmental Impact Assessments (EIAs) and Basic Environmental Assessments (BAs)
- Leading, managing and compiling Water Use License Applications (WULAs)
- Environmental Prefeasibility Assessments
- Environmental Auditing/Compliance Monitoring

Proficient in the use of Geographical Information Systems (GIS) for mapping and basic analysis purposes.

B. Project Management and Managerial Skills:

Proficient in the following project management tasks:

- Leading, coordinating and managing specialist ecological assessments.
- Leading and managing the development of wetland rehabilitation and offset plans that often require multi-stakeholder engagement.
- Leading, facilitating and managing Environmental Impact Assessments and Water Use License Applications.

Proficient in the following managerial tasks:

- Managing and mentoring a small team of scientists.
- Consulting business strategic planning.

CV: Ryan Edwards

EDUCATION

1. MSc Environmental Science

University of KwaZulu-Natal, Durban | **2006 – 2009**

Thesis / Dissertation Title: The Origin and Evolution of Dartmoor Vlei in the KwaZulu-Natal Midlands.

Supervisor: Prof. Fred Ellery

2. BSc (Hons) Geography and Environmental Management

University of KwaZulu-Natal, Durban | **2005 - 2006**

3. BSc Geography and Environmental Management

University of KwaZulu-Natal, Durban | **2001 - 2004**

4. Senior Certificate

Northwood Boys High School, Durban-North, Durban | **1996 - 2000**

CAREER HISTORY

Verdant Environmental (Pty) Ltd March 2020 – Present ***Owner and Director*** ***Principal Environmental Scientist and Wetland Ecologist***	Duties and Responsibilities: • Directing and managing a small environmental consulting business. • Data collection and analysis for specialist ecological assessments, plans and programmes. • Project management and compilation of specialist freshwater ecological assessments (wetlands and rivers). • Project management and compilation of specialist ecological plans and programmes including wetland and river rehabilitation plans, wetland and biodiversity offset plans, wetland and river management plans, ecological monitoring programmes, alien invasive plant control plans. • Project management and compilation of Basic Assessments (BAs), Environmental Impact Assessments (EIAs), Water Use License Applications (WULAs), Strategic Environmental Assessments (SEAs), Environmental Management Frameworks (EMFs) and Integrated Environmental Management Plans (IEMPs). • Undertaking ecological monitoring. • Undertaking environmental compliance monitoring.
Eco-Pulse Consulting Services cc Aug 2014 – Feb 2020	Duties and Responsibilities: • Data collection and analysis for specialist ecological assessments, plans and

Senior Environmental Scientist and Wetland Ecologist	programmes. • Project management and compilation of specialist freshwater and terrestrial ecological assessments and plans. • Project management and compilation of specialist ecological plans and programmes including wetland and river rehabilitation plans, wetland and biodiversity offset plans, wetland and river management plans, ecological monitoring programmes, alien invasive plant control plans. • Sign-off on specialist freshwater and terrestrial ecological assessments and plans, and WULA reports. • Project management and compilation of Water Use License Applications (WULAs). • Management and mentorship of junior ecological / scientist staff.
GCS (Pty) Ltd Nov 2012 – August 2014 ***Wetland Specialist and Environmental Scientist***	Duties and Responsibilities: • Data collection and analysis for specialist ecological assessments, plans and programmes. • Project management and compilation of specialist freshwater and terrestrial ecological assessments and plans. • Project management and compilation of specialist ecological plans and programmes including wetland and river rehabilitation plans, wetland and biodiversity offset plans, wetland and river management plans, ecological monitoring programmes, alien invasive plant control plans. • Project management and compilation of Basic Assessments (BAs), Environmental Impact Assessments (EIAs), Water Use License Applications (WULAs).
School of Environmental Science, University of KwaZulu-Natal Sept – Nov 2012 ***First Year Atmospheric Science Module Lecturer***	Duties and Responsibilities: • Lectured atmospheric science module as part of the first year environmental systems course (ENVS102). • Facilitated module practicals. • Marked atmospheric section of final course exam.
SiVEST SA (Pty) Ltd March 2008 – Nov 2012 ***Wetland Specialist and Environmental Scientist***	Duties and Responsibilities: • Project management of specialist wetland ecological assessments and Basic Assessments / Environmental Impact Assessments. • Data collection and analysis for specialist wetland ecological assessments and plans • Reporting for Basic Assessments (BAs) and Environmental Impact Assessments (EIAs).
SiVEST SA (Pty) Ltd May 2007 – March 2008	Duties and Responsibilities: Assisted in the review of backlogged EIA's and in the compilation of a number of draft Record of Decisions (ROD's) for large residential

Internship - DEAT Review Mentorship Program (Part Time)	developments in KwaZulu-Natal.
Private Wetland Consulting April 2007 – May 2007 ***Wetland Specialist***	Duties and Responsibilities: Undertook private wetland assessments for small development projects supervised by Professor Fred Ellery of the School of Environmental Sciences at the University of KwaZulu-Natal.

SELECTED PROJECT EXPERIENCE

1. **Wetland & River (Freshwater Ecosystem) Impact Assessments:**
   - Freshwater Habitat Impact Assessment for the Proposed Luhlanga Open Cast Pit Expansion at Somkheke Mine in the Hlabisa Local Municipality, Kwazulu-Natal (2018-2019) | Role: Lead author and project manager | Client: Black Rock Consulting
   - Freshwater Habitat Impact Assessment for the Proposed Disposal of Mine Residue Deposits to the KwaQubuka and Luhlanga Open Cast Pits at Somkheke Mine in the Hlabisa Local Municipality, Kwazulu-Natal (2018-2019) | Role: Lead author and project manager | Client: Black Rock Consulting
   - Wetland & River Impact Assessment for the Cato Ridge Intermodal Development in KwaZulu-Natal, South Africa (2018) | Role: Lead author and project manager | Client: SiVEST SA (Pty) Ltd
   - Freshwater Habitat Impact Assessment for the proposed TradeZone2 Development in La Mercy, KwaZulu-Natal, South Africa (2017) | Role: Lead author and project manager | Client: Dube Tradeport Corporation
   - Freshwater Habitat Impact Assessment for the proposed AgriZone2 Development in La Mercy, KwaZulu-Natal, South Africa (2017) | Role: Lead author and project manager | Client: Dube Tradeport Corporation
   - Freshwater Habitat Impact Assessment Report for the proposed White iMfolozi Bridge and Link Road in the Ulundi Local Municipality, KwaZulu-Natal, South Africa (2017) | Role: Project manager, senior report review, co-author and report sign-off | Client: Royal HaskoningDHV
   - Freshwater Habitat Impact Assessment and Conceptual Rehabilitation plan for the proposed Avoca South Business Estate in the eThekwini Municipality, KwaZulu-Natal, South Africa (2015) | Role: Lead author and project manager | Client: GCS (Pty) Ltd
   - Wetland Impact Assessment Report & Conceptual Rehabilitation Plan for the commencement of unauthorised activities within the Balamhlanga wetland associated with bulrush eradication, Jozini, KwaZulu-Natal, South Africa (2015) | Role: Lead author and project manager | Client: Nzingwe Consultancy
   - Wetland Impact Assessment Report for the Longridge Mine Closure in the eDumbe Local Municipality, KwaZulu-Natal (2013) | Role: Lead author and project manager | Client: Kangra Coal (Pty) Ltd

2. **Wetland Rehabilitation Plans, Management Plans, Monitoring Plans & Offset Plans:**
   - Wetland and riparian zone rehabilitation plan for the Dube TradePort Automotive Supply Park Development in Illovo, Durban, KwaZulu-Natal, South Africa (2019) | Role: Lead author and project manager | Client: Dube Tradeport Corporation
   - Wetland management and monitoring plan for high conservation value wetlands at World Hardwood Rockvale Plantation near Ixopo, KZN (2019) | Role: Project management, senior report review, co-author and report sign-off | Client: World Hardwood (Pty) Ltd
   - River and Buffer Zone Revegetation Plan for the Kudumane Manganese Resources Mine in Hotazel, Northern Cape (2019) | Role: Project manager, senior report review, co-author and report sign-off | Client: Kudumane Manganese Resources (Pty) Ltd
   - Baseline Wetland Habitat Monitoring Assessments for four priority wetlands in the eThekwini Municipality hosting the endangered *Hyperolius pickersgillii* (Pickersgill's Reed frog) (2015-2016 & 2018-2019) | Project manager, lead author and assessor | Endangered Wildlife Trust
   - Wetland and riparian zone rehabilitation plan for the Dube TradePort TradeZone 2 Development Offset Site in La Mercy, KwaZulu-Natal, South Africa (2017) | Role: Lead author and project manager | Dube TradePort Corporation
   - Piseang River floodplain wetland rehabilitation plan, offset strategy and funding plan for the Bridge City-KwaMashu Open Space Project, KwaZulu-Natal, South Africa (2015-2017) | Role: Project manager and lead author | Client: eThekwini Municipality Architects Department
   - Wetland offset plan for the proposed Clairwood Racecourse Logistics Development in South Durban, KZN (2015-2017) | Role: Project manager and lead author | Client: Capital Property Fund
   - Strategic Wetland Offset Plan for the eThekwini Municipality Northern Region, KwaZulu-Natal, South Africa (2016) | Role: Co-author | Client: Dube TradePort Corporation and Tongaat Hulett Developments
   - Baseline (Tier 2) Monitoring Assessment for the Ivanhoe Wetland (T32B-05) in KwaZulu-Natal, South Africa (as part of the Monitoring and Evaluation Programme for Working for Wetlands) (2015) | Role: Lead author | Client: Working for Wetlands
   - Interim Wetland Rehabilitation Plan for the commencement of unauthorised activities within the Balamhlanga wetland associated with bulrush eradication, Jozini, KwaZulu-Natal, South Africa (2015) | Role: Lead author and project manager | Client: Nzingwe Consultancy
   - Foskor Rock Phosphate Storage Facility Wetland Offset Mitigation Study and Wetland Rehabilitation and Management Plan (2013) | Role: Lead author and project manager | Client: GIBB
   - Cornubia Mixed Use Development Phase 1 Wetland Rehabilitation Plan in Verulam/Umhlanga, KZN (2011-2012) | Role: Co-author | Tongaat Hulett Developments

3. **Constructed Wetland Feasibility Assessments:**
   - Constructed Wetland Feasibility Assessment for the proposed Kangra Longridge Mine Closure in KwaZulu-Natal (2014) | Role: Lead author and project manager | Client: Kangra Coal (Pty) Ltd

4. **Development of Wetland Assessment Tools & Management Guidelines:**
   - Revision of the WET-EcoServices and Ecological Importance and Sensitivity (EIS) assessment tools for South African wetlands (2017-2019) | Role: Contributing author and developer | Client: Water Research Commission
   - Development of wetland management guidelines for South African municipalities (2017-2018) | Role: Lead author, technical content development, sub-consultant coordination | Client: ICLEI: Africa

5. **Terrestrial Ecological / Vegetation Assessments:**
   - Terrestrial ecosystem impact assessment for the Proposed Umlass Gates Light Industrial Development in Umlaas Road, KwaZulu-Natal (2018-2019) | Project manager, senior report review, co-author and report sign-off | Client: Super Digger Holdings (Pty) Ltd
   - Vegetation Assessment for the Proposed Apron Stands and Bravo Taxiway at King Shaka International Airport (KSIA) (2018) | Role: Co-author and project manager | Client: BMK Consulting Engineers
   - Terrestrial Habitat Impact Assessment Report for the proposed White iMfolozi Bridge and Link Road in the Ulundi Local Municipality, KwaZulu-Natal, South Africa (2017) | Role: Project manager, senior report review, co-author and report sign-off | Client: Royal HaskoningDHV

6. **Alien Invasive Plant Eradication and Control Plans / Programmes:**
   - Alien Invasive Plant Eradication and Control Programme for the Kudumane Manganese Resources (KMR) Mine near Hotazel, Northern Cape (2019) | Role: Project manager, senior report review, co-author and report sign-off | Client: Kudumane Manganese Resources (Pty) Ltd
   - Alien Plant Eradication and Control Programme Implementation Plan for the King Shaka International Airport (KSIA) (2014) | Role: Lead author and project manager | Client: Airports Company of South Africa (ACSA)

Selected Environmental Assessment Practitioner (EAP) Experience:

1. **Basic Assessments and Environmental Impact Assessments:**
   - Environmental Impact Assessment for the Proposed Magdalena Colliery Discard Dump Extension (2013-2014) | Role: Project manager and lead author | Client: Forbes Coal (Pty) Ltd
   - Environmental Impact Assessment for the Proposed Kingthorpe Equestrian Estate in Lynfield Park, KZN (2011-2012) | Role: Lead author and project assistant | Client: Stars Away Investments (Pty) Ltd
   - Basic Assessment for the Proposed Lungisisa Indlela Village (LIV) Development in Hazelmere, KwaZulu-Natal (2011-2012) | Role: Project manager and co-author | Client: LIV
   - Environmental Impact Assessment for the Proposed Madimeni Low Cost Housing Project in Molweni, KwaZulu-Natal (2009-2011) | Role: Lead author and project assistant | Client: eThekwini Municipality
   - Environmental Impact Assessment for the Proposed Lower Langefontein 5 Low Cost Housing Project in Molweni, KwaZulu-Natal (2009-2011) | Role: Lead author and project assistant | Client: eThekwini Municipality

- Environmental Impact Assessment for the Proposed Umzinto Slums Clearance Low Income Housing Project, KwaZulu-Natal (2009-2011) | Role: Lead author and project assistant | Client: Umdoni Municipality
- Environmental Impact Assessment for the Proposed Motala Farm Affordable Housing Project in Tongaat, KZwaZulu-Natal (2009-2010) | Role: Lead author and project assistant | Client: Shield Homes

2. **Water Use License Applications:**
   - R61 Road Upgrade WULA (2018-2019) | Role: Project manager, senior review and report sign-off | Client: SANRAL

3. **Desktop Environmental Feasibility Investigations:**
   - Desktop Environmental Feasibility Assessment for the eThekwini Wards 99 & 100 Rural Housing Project, KwaZulu-Natal (2011) | Role: Lead author and assessor | Client: MGM Holdings (Pty) Ltd
   - Desktop Environmental Feasibility Assessment for the Umzumbe Wards 8 & 9 Rural Housing Project, KwaZulu-Natal (2011) | Role: Lead author and assessor | Client: MGM Holdings (Pty) Ltd
   - Desktop Environmental Feasibility Assessment for the KwaYanguye Rural Housing Project, KweaZulu-Natal (2011) | Role: Lead author and assessor | Client: Ilima Rural Housing

4. **Environmental Compliance Monitoring / Auditing:**
   - Zimbali Lakes Estate Golf Course in Ballito, KwaZulu-Natal (2011-2012) | Role: Environmental Control Officer | Client: IFA Hotels & Resorts
   - Rocky Park Integrated Housing Project in Stanger, KwaZulu-Natal (2011) | Role: Environmental Control Officer | Client: KwaDukuza Municipality
   - Philani Valley Redevelopment Phases 17-25 in Umlazi, KwaZulu-Natal (2008-2009) | Role: Environmental Control Officer | Client: eThekwini Municipality

PROFESSIONAL MEMBERSHIPS

- Professional Natural Scientist (Reg. No. 400089/13) under the South African Council for Natural Scientific Professions (SACNASP)
- South African Wetland Society (SAWS)

PUBLICATIONS

- Edwards, R. J., Ellery, W. N. and Dunlevey, J. 2014. The role of the insitu weathering of dolerite in the formation of a peatland: the origin and evolution of Dartmoor Vlei in the KwaZulu-Natal Midlands, South Africa. *Catena* 143: 232-243.

- Lead author for: ICLEI Africa[1]. 2018. Wetland Management Guidelines: Building Capacity and Supporting Effective Management of Wetlands within South African Municipalities.

CONFERENCE AND SYMPOSIA PRESENTATIONS

- Implementing a wetland offset: application of the Draft Wetland Offset Guidelines and lessons learnt: The case of the Clairwood Logistics Park Development – National Wetlands Indaba 2017 (Port Edward)
- Understanding the Origin and Evolution of Dartmoor Vlei in KwaZulu-Natal Midlands – National Wetlands Indaba 2006 (Johannesburg)
- Social and environmental justice in environmental decision making: The case of Wolraad Park in Wentworth, KwaZulu-Natal, South Africa – National IAIA Conference 2005 (Free State)

AWARDS

- International Association for Impact Assessment South Africa (IAIASA) 'Young Person' Award for: Best Paper and Presentation at the 2005 IAIAsa Conference.

INTERESTS

Personal fields of interest:

- Wetland ecology and conservation
- Wetland origin and evolution (geomorphology)
- Restoration ecology
- Botany
- Environmental / ecological sustainability and sustainable development
- Ecosystem services and their value
- Climate resilience
- Ecological economics
- Addressing market failures related to the environment (e.g. internalisation of negative environmental externalities)
- Social and environmental justice

[1] (ICLEI) Local Governments for Sustainability – Africa Secretariat

REFERENCES

Prof. Fred Ellery	Head of Geography Department
Company/Institution:	Rhodes University
Relationship:	Master of Science (MSc) Supervisor (2006 – 2009)
Tel:	046 603 7453
Email:	f.ellery@ru.ac.za
Greg Mullins	Senior Environmental Scientist
Company/Institution:	eThekwini Municipality Environmental Planning Department
Relationship:	Colleague (2008 – 2012)
Tel:	031 322 4560
Email:	greg.mullins@durban.gov.za
Adam Teixeira-Leite	Principal Wetland Ecologist & Environmental Scientist
Company/Institution:	Eco-Pulse Environmental Consulting Services
Relationship:	Colleague (2014 – Present)
Tel:	082 310 6769
Email:	ateixeira@eco-pulse.co.za

10 APPENDIX B – DETAILED DESCRIPTIONS OF ALL ASSESSMENT UNITS

UNIT	WAYPOINTS	FEATURES	SOILS	VEGETATION	KEY EXISING UNIT AND CATCHMENT IMPACTS	PES	KEY ECOSYSTEM SERVICES	EIS	REC
LONGITUDINAL WASHES (NWA CLASSIFCATION: WATERCOURSE)									
A02	Desktop delineated	Assessment units were delineated at the desktop level using topographic data and Google Earth imagery. The topographic, soil and vegetation characteristics of these units are assumed to resemble those in the field-verified conditions found within the sampled longitudinal washes described below and within the broader WEF cluster study area. The WET-Health, WET-Ecoservices and EIS assessments, as well as the REC determination, were based on Google Earth imagery, land cover maps and similar conditions at the sampled units within the broader study area. Please refer to the general description provided in Table 3.3.				4.5 (D)	• Biodiversity maintenance (2.7 H); • Food for livestock (2.5 MH); • and • Sediment trapping (2.0 M).	High	C/D: Improve
A03						4.3 (D)			
A07						4.1 (D)			
A08						4.7 (D)			
A09						4.1 (D)			
A12						4.2 (D)			
A13						4.8 (D)			
A05						4.3 (D)	• Food for livestock (2.5 MH); • Biodiversity maintenance (2.2 H); • and • Sediment trapping (1.8 M).	Mod-high	C/D: Improve
A06						4.5 (D)			
A10						4.3 (D)			
A11						4.3 (D)			
A15						6.3 (E)	• Biodiversity maintenance (2.7 H); • Stream flow regulation (1.5 ML); and • Sediment trapping (1.3 ML).	High	C/D: Improve
A16						6.1 (E)			
A01	829-831 (3)	Active wash, with localised brackish flats and a dam upstream in the catchment.	• Wash with uniform red silty loam, becoming redder with depth.	• Wash vegetation comprised of *A. congesta, Chloris virgata, Chrysocoma. ciliata, Cyperus usitatus, Eriocephalus. ericoides, Lycium cinereum* and *Ruschia intricata.*	• Historical and ongoing overgrazing; • Historical widespread cultivation; • Historical flooding; and • Dams upstream.	4.5 (D)	• Biodiversity maintenance (2.7 H); • Food for livestock (2.5 MH); • and • Sediment trapping (2.0 M).	High	C/D: Improve
A04	935-940, 947-948 (9)	Active wash, with a dam in the downstream section and a localized degraded area (A14) in the upstream section of the catchment. Evidence of overland wash.	• Wash with uniform red-brown fine sandy silty loam (0-50 cm). • Dam with brown silty loam (0-30 cm), with brown-grey and orange, low contrast mottles (30-50 cm).	• Wash with *A. congesta, Caroxylon glabrescens, Lycium. horidum, R. intricata* and *Zygophyllum incrustatum.* • Dam and downstream seepage area with *Cotula* sp., *Eragrostis* sp., *Rumex* sp., *Tragus berteronianus* and *Xanthium spinosum.*	• Historical and ongoing overgrazing; • Historical widespread cultivation and; • Historical flooding; • Dam and shallow impoundments; and • Existing road network.	4.9 (D)	• Biodiversity maintenance (3.1 H); • Food for livestock (2.5 MH); and • Sediment trapping (2.3 M).	High	C/D: Improve

UNIT	WAYPOINTS	FEATURES	SOILS	VEGETATION	KEY EXISING UNIT AND CATCHMENT IMPACTS	PES	KEY ECOSYSTEM SERVICES	EIS	REC
A14	941-946 (6)	Localised section of degraded active wash (Badland) within A04, with localized brackish flat (C01) series of gullies, concrete and earthen berm weirs and erosion control dams. Evidence of historical cultivation. Break in earthen dam berm, with downstream erosion gully. Risk of headward erosion.	• Soils include red to red-brown, somewhat silty, fine sandy loam with very few bark-brown and black mottles and soft nodules (0-30 cm), and red to orange-brown silty sandy loam with coarse sand, fine gravel, few brown-grey mottles and/or dark brown crumbly nodules (30-50 cm).	• Flat wash areas include *A. congesta, Eragrostis lehmanniana, Eragrostis* sp., *E. ericoides, L. cinereum, Melolobium candicans, Moraea polystachya, Pteronia glauca* and *Rhigozum obovatum*. • Gully bed with *A. congesta* and *Bidens pilosa.* Banks dominated by *Melianthus comosus*, with *Mesembryanthenum coriarum*	• Historical and ongoing overgrazing; • Historical widespread cultivation and; • Historical flooding; Series of erosion gullies, concrete weirs and erosion control dams.	6.3 (E)	• Biodiversity maintenance (2.2 M); and • Sediment trapping (1.3 ML).	Moderate	D: Maintain
A17	923-929, 934 (8)	Degraded active wash (Badlands), with series of gullies, concrete and earth berm weirs, and erosion control dams. Evidence of overgrazing. Downstream section, near western boundary of WEF cluster, includes a large seepage area and network of gullies. Further downstream impacted by large dam, with concrete dam wall.	• Upstream section soil comprised of hard, red-brown sandy loam. • Downstream seepage areas comprised of reddish (5 YR 5/6), powdery, sandy silty loam within the 0-25 cm horizon, with or without gravel at 25-30 cm, and becoming an orange (5 YR 6/6) very fine, sandy loam within the 30-50 cm horizon.	• Upstream section comprised of sparse *A. congesta, C. glabrescens* and *L. cinereum*. • Downstream seepage area vegetated by *Aizoon namaense*, *A. congesta, Asclepia* sp., *Atriplex semibaccata*, *B. pinnatifida*. *E. lehmanniana, Eragrostis* sp., *Lycium* sp., *Pentzia incana, P. glauca, Scirpoides dioecus, Stipagrostis namaquensis* and *T. berteronianus.*	• Historical and ongoing overgrazing; • Historical widespread cultivation and current localized cultivation; • Historical flooding; • Shallow impoundments; • Existing road network; and • Series of erosion gullies, concrete weirs and erosion control dams.	6.1 (E)	• Biodiversity maintenance (2.7 H); • Stream flow regulation (1.5 ML); and • Sediment trapping (1.3 ML).	High	C/D: Improve
A18	921-922 (2)	Based on vantage point observations, the unit is a degraded active wash (Badland), with series of gullies, concrete weirs and erosion control dams. High erosion risk from dam overflows. Areas of active deposition. Localised, slightly wetter areas.	Not sampled.	Not sampled.	• Historical and ongoing overgrazing; • Historical widespread cultivation; • Historical flooding; • Existing road network; and • Series of erosion gullies, concrete weirs and erosion control dams.	6.1 (E)	• Biodiversity maintenance (2.2 M); and • Sediment trapping (1.3 ML).	Moderate	D: Maintain
LATERAL WASHES (NWA CLASSIFCATION: TERRESTRIAL)									
B01	Desktop delineated	Assessment units were delineated at the desktop level using topographic data and Google Earth imagery. The topographic, soil and vegetation characteristics of these units are assumed to resemble those in the field-verified conditions found within the sampled lateral washes within the broader WEF cluster study area. The WET-Health, WET-Ecoservices and EIS assessments, as well as the REC determination, were based on Google Earth imagery, land cover maps and similar conditions at the sampled units within the broader study area. Please refer to the general description provided in Table 3.3.				4.7 (D)	• Food for livestock (2.2 M); and • Sediment trapping (1.8 M).	Moderate	D: Maintain
B02						4.2 (D)			
B03						4.2 (D)			
B04						4.0 (D)			
LOWLAND FLATS AND PANS (NWA CLASSIFCATION: TERRESTRIAL)									
C02	Desktop delineated	Assessment units were delineated at the desktop level using topographic data and Google Earth imagery. The topographic, soil and vegetation characteristics of these units are assumed to resemble those in the field-verified conditions found within the sampled lowland flat described below. The WET-Health, WET-Ecoservices and EIS assessments, as well as the REC determination, were based on Google Earth imagery, land cover maps and similar conditions at the sampled units.				4.3 (D)	• Flood attenuation (1.4 ML); Sediment trapping (1.3 L); and • Food for livestock (1.2 L).	Mod-low	D: Maintain
C03						4.1 (D)			
C04						4.1 (D)			
C01	941-946 (6)	Brackish flat, within Badland (A14).	• Red brown silty loams.	• Vegetation comprised of *Aizoon namaense*, *A. congesta*, *Asparagus laricinus, C. glabrescens, C. virgata, E. ericoides, Lycium horidum, P.*	• Historical and ongoing overgrazing; • Historical widespread cultivation; and	5.0 (D)			

UNIT	WAYPOINTS	FEATURES	SOILS	VEGETATION	KEY EXISING UNIT AND CATCHMENT IMPACTS	PES	KEY ECOSYSTEM SERVICES	EIS	REC
				glauca, Tragus berteronianus and *Z. incrustatum.*	• Historical flooding.				
MESA-TOP FLATS (NWA CLASSIFCATION: TERRESTRIAL)									
D01	Desktop delineated	Assessment units were delineated at the desktop level using topographic data and Google Earth imagery. The topographic, soil and vegetation characteristics of these units are assumed to resemble those in the field-verified conditions found within the sampled mesa-top flats within the broader WEF cluster study area. The WET-Health, WET-Ecoservices and EIS assessments, as well as the REC determination, were based on Google Earth imagery, land cover maps and similar conditions at the sampled units within the broader study area. Please refer to the general description provided in Table 3.3.				3.2 (C)	• Food for livestock (1.2 L); and • Biodiversity maintenance (1.0 L).	Low	C: Maintain
D02						3.2 (C)			
D03						3.2 (C)			
D04						3.2 (C)			
UNCHANNELLED LOW ORDER DRAINAGE LINES (NWA CLASSIFCATION: TERRESTRIAL)									
E01	Desktop delineated	Assessment units were delineated at the desktop level using topographic data and Google Earth imagery. The topographic, soil and vegetation characteristics of these units are assumed to resemble those in the field-verified conditions found within the sampled unchanneled low order drainage line described below and within the broader WEF cluster study area. The WET-Health, WET-Ecoservices and EIS assessments, as well as the REC determination, were based on Google Earth imagery, land cover maps and similar conditions at the sampled units within the broader study area. Please refer to the general description provided in Table 3.3.				1.77 (B)	• Food for livestock (2.2 M); • Biodiversity maintenance (2.0 M); and • Erosion control (1.5 ML).	Moderate	B: Maintain
E04						1.77 (B)			
E05						1.77 (B)			
E06						1.77 (B)			
E02						1.77 (B)	• Food for livestock (2.2 M); • Biodiversity maintenance (1.5 ML); and • Erosion control (1.1 L).	Mod-low	B: Maintain
E09						1.77 (B)			
E03						1.90 (C)	• Food for livestock (2.2 M); • Biodiversity maintenance (1.3 ML); and • Erosion control (1.1 L).	Mod-low	C: Maintain
E10						1.90 (C)			
E07	930-933 (4)	Gently-sloped, topographically-defined area of ephemeral flow accumulation, lacking any hydric conditions and a well-defined channel.	• Yellowish red-brown silty loam with fine sand (0-15 cm) and red-brown silty loam with fine sand and few dark red concretions (15-50 cm).	• Moderately well vegetated, with some bare areas. Species includes *A. congesta, A. laricinus*, *A. semibaccata*, *C. glabrescens, Hermannia desertorum* and *L. horidum.*	• Historical and ongoing overgrazing; and • Historical widespread cultivation.	1.77 (B)	• Food for livestock (2.2 M); • Biodiversity maintenance (2.0 M); and • Erosion control (1.1 L).	Mod-low	B: Maintain
E08	914-918 (5)	Rocky, gently concave basin of flow accumulation (E08), with a knick point drop-off into a narrowing and steepening well-defined rocky drainage channel (F09).	• Basin soils include shallow (<10 cm), yellow-brown fine sandy loam.	• Vegetation comprised of *A. congesta, D. lycoides, Eragrostis* sp., *R. intricata, T. berteronianus* and *Z. incrustatum.*	• Historical and ongoing overgrazing.	1.77 (B)	• Food for livestock (2.2 M); • Biodiversity maintenance (1.5 ML); and • Erosion control (1.1 L).	Mod-low	B: Maintain
CHANNELLED LOW ORDER DRAINAGE LINES (NWA CLASSIFCATION: WATERCOURSE)									
F01	Desktop delineated	Assessment units were delineated at the desktop level using topographic data and Google Earth imagery. The topographic, soil and vegetation characteristics of these units are assumed to resemble those in the field-verified conditions found within the sampled channeled low order drainage line units and within the broader WEF cluster study area. The WET-Health, WET-Ecoservices and EIS assessments, as well as the REC determination, were based on Google Earth imagery, land cover maps and similar conditions at the sampled unit described below and within the broader study area. Please refer to the general description provided in Table 3.3.				1.26 (B)	• Food for livestock (2.2 ML); and • Biodiversity maintenance (2.2 M).	Moderate	B: Maintain
F02						1.26 (B)			
F03						1.26 (B)			
F04						1.26 (B)			
F05						1.26 (B)			
F06						1.26 (B)			
F10						1.26 (B)			
F11						1.26 (B)			
F12						1.26 (B)			
F13						1.26 (B)			
F14						1.26 (B)			

UNIT	WAYPOINTS	FEATURES	SOILS	VEGETATION	KEY EXISING UNIT AND CATCHMENT IMPACTS	PES	KEY ECOSYSTEM SERVICES	EIS	REC
F07						1.26 (B)	• Food for livestock (2.2 ML); and • Biodiversity maintenance (1.7 M).	Moderate	B: Maintain
F08						1.26 (B)			
						1.26 (B)			
						1.26 (B)			
						1.26 (B)			
F09	914-918 (5)	Rocky, gently concave basin of flow accumulation (E08), with a knick point drop-off into a narrowing and steepening well-defined rocky drainage channel (F09). Note: It is recommended that the proposed access road be realigned outside of the drainage line. Recommended shift from waypoint 914 to 918. Access road should be designed to prevent concentrated flow.	• Channel soils, immediately downstream of the knick point, are comprised of brown sandy loam (0-25 cm) and dark grey-brown silty loam with white flecks (25-45 cm), overlaying bedrock at about 45 cm.	• Vegetation comprised of *A. congesta, D. lycoides, Eragrostis* sp., *R. intricata, T. berteronianus* and *Z. incrustatum.*	• Historical and ongoing overgrazing.	1.26 (B)	• Food for livestock (2.2 ML); and • Biodiversity maintenance (1.7 M).	Moderate	B: Maintain
ARTIFICIAL WETLANDS – DAMS (NWA CLASSIFCATION: WETLAND)									
Desktop delineated		Characterised by an earthen, typically vegetated, or concrete dam wall. Evidence of impounded water, including generally bare or sparsely vegetated areas, with either open water or cracked, moist or dry, clayey surfaces. Often accompanied by windmills, pumps and/or livestock water troughs. All units are dams into which, or from which, water flows and are at least periodically covered with shallow water. The dams generally support at least some hydric soils and a few aquatic or wetland species. However, these hydric conditions are often highly localised to the areas of the dams subject to the most prolonged saturation, with most of the full supply areas lacking these conditions. Although artificial, the dams are generally considered wetlands under NWA.				N/A	• Sediment trapping (1.5 ML); and • Water for human use (1.3).	Mod-low	N/A