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Enviro INSIGHT environmental impact assessments

Appendix D4:

Aquatic Assessment

Tate Environmental
Specialist Services

Enviro-Insight CC

Freshwater Biodiversity and Watercourse Delineation

De Rust Wind Energy Facility Project

August 2022

TATE ENVIRONMENTAL SPECIALIST SERVICES

Hydrology Biodiversity Ecology

Document Reference	**Tate R. 2022 Enviro-Insight. Freshwater Biodiversity and Watercourse Delineation. De Rust Wind Energy Facility Project. August 2022. V3.**	
Front Page Image	*Stipagrostis namaquensis* from a wash in the project area (July 2022)	
Submitted to	Enviro Insight CC	
Author	Russell Tate (Pr. Sci. Nat. 400089/15)	
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Declaration

I, Russell Tate, declare that:

- I act as the independent specialist in this study;
- I will perform the work relating to the study in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the science relevant to this study, including knowledge of the Act, regulations and any guidelines that have relevance to the study;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the study;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Russell Tate

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Pr. Sci. Nat – Aquatic Science (Pr. Sci. Nat. 400089/15)

TESS

April 2023

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1 Introduction

Tate Environmental Specialist Services (TESS) was appointed by Enviro-Insight CC to assess the watercourses associated with the proposed De Rust Wind Energy Facility (WEF) and Solar Energy Facility (SEF) Projects located south of Pofadder, Northern Cape Province, South Africa.

The aim of this study was to derive the extent and condition of the watercourses associated with the project and investigate the nature of the anticipated impacts of the proposed activities. In line with the aims of the study the following Scope of Work (SoW) was established:

1. Assess the nature and extent of the watercourses associated with the proposed development;
2. Establish the Present Ecological Status (PES) of the associated watercourses;
3. Establish the Ecological Importance and Sensitivity (EIS) of the associated watercourses
4. Establish scientific effective buffer zones to reduce anticipated impacts;
5. Provide shapefiles and maps which visualise sensitive habitats;
6. Provide a risk assessment for the completed activities; and
7. Provide recommendations for mitigation and avoidance actions.

This report addresses the WEF component of the proposed project.

1.1 Definitions

According to the National Water Act (NWA) Act Number 36 of 1998 the definition of wetland and riparian areas are provided as:

- **Wetland**: 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
- **Riparian:** The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to and extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

Further definitions provided in the NWA defines a watercourse as:

- A river or spring
- A natural channel in which water flows regularly or intermittently
- A wetland, lake or dam into which, or from which water flows
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse.

- The watercourse includes, where relevant its bed and banks.

The definition of the extent of a watercourse is further defined in the amendment of the General Authorisation for section 21 (c) and (i) water uses (RSA Government, 2016). The extent of the watercourse is defined as:

- The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; and
- Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.

The definition of wetland areas are further explained by the Department of Water and Forestry (DWAF) 2005 guidelines (DWAF, 2005) where the following is considered pertinent to their classification:

- The presence, either permanently, seasonally or temporarily, of water at or near the surface
- Distinctive redoximorphic features in the soils, and
- Vegetation which is adapted to or tolerant of saturated soils.

2 Description of the Study Area

The study area is 14 km south of Pofadder, Northern Cape Province, South Africa. The hydrological setting of the project is within the D81G and D82B quaternary catchments of the Orange River water management area (Figure 2-2). The specific Area of Interest (AoI) for this project was drainage within the D81G-03996, D81G-03813 and D82B-04162 Sub Quaternary Reaches (SQR). The watercourses do not reach the Orange River and typically terminate before reaching the river. Only under significant rainfall is the D81G-03996 SQR expected to reach the Orange River via the Goob se Laagte non-perennial watercourse.

Mean Annual Precipitation (MAP) was calculated using WaPOR (2022) for the defined project area. The results indicated a MAP ranging from 103 mm in 2019 to 175 mm in 2021 whilst the MAP for the period between 2009 and 2021 was calculated to be 135 mm (Figure 2-1). Monthly precipitation trends show peak rainfall periods between October and March. In the 2021/2022 hydrological period a significant rainfall event was noted to have occurred in March 2022 where 61 mm was recorded in the AoI (Figure 2-1).

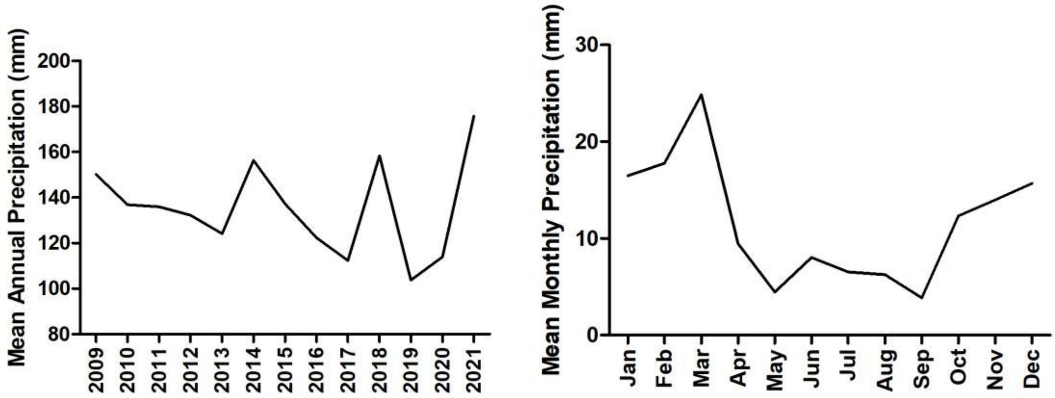

Figure 2-1: Annual (left) and mean monthly (right) precipitation in the watershed between 2009 and 2022 (WaPOR, 2022)

In order to initiate the effective delineation of the watercourses the National Freshwater Ecosystem Priority Area (NFEPA) maps and National Biodiversity Assessment (2018) spatial datasets were unlisted as presented in Figure 2-3 and Figure 2-4. The assessment revealed the presence of multiple depression systems as well as the identified river systems as defined by the SQR database. In addition, the NBA (2018) dataset indicated the presence of a Channelled Valley Bottom (CVB) wetland unit which was associated with the D81G-03996 SQR.

The landcover of the project is presented in Figure 2-5 where the primary activities in the AoI include livestock agricultural activities. Grassland landcover was closely associated with valley bottom landforms.

2.1 Notes on Spatial Framework

This project was initially completed for a much larger area which was subsequently reduced and refined. The work presented in this study provides the comprehensive assessment and therefore includes portions of the farm Houmoed.

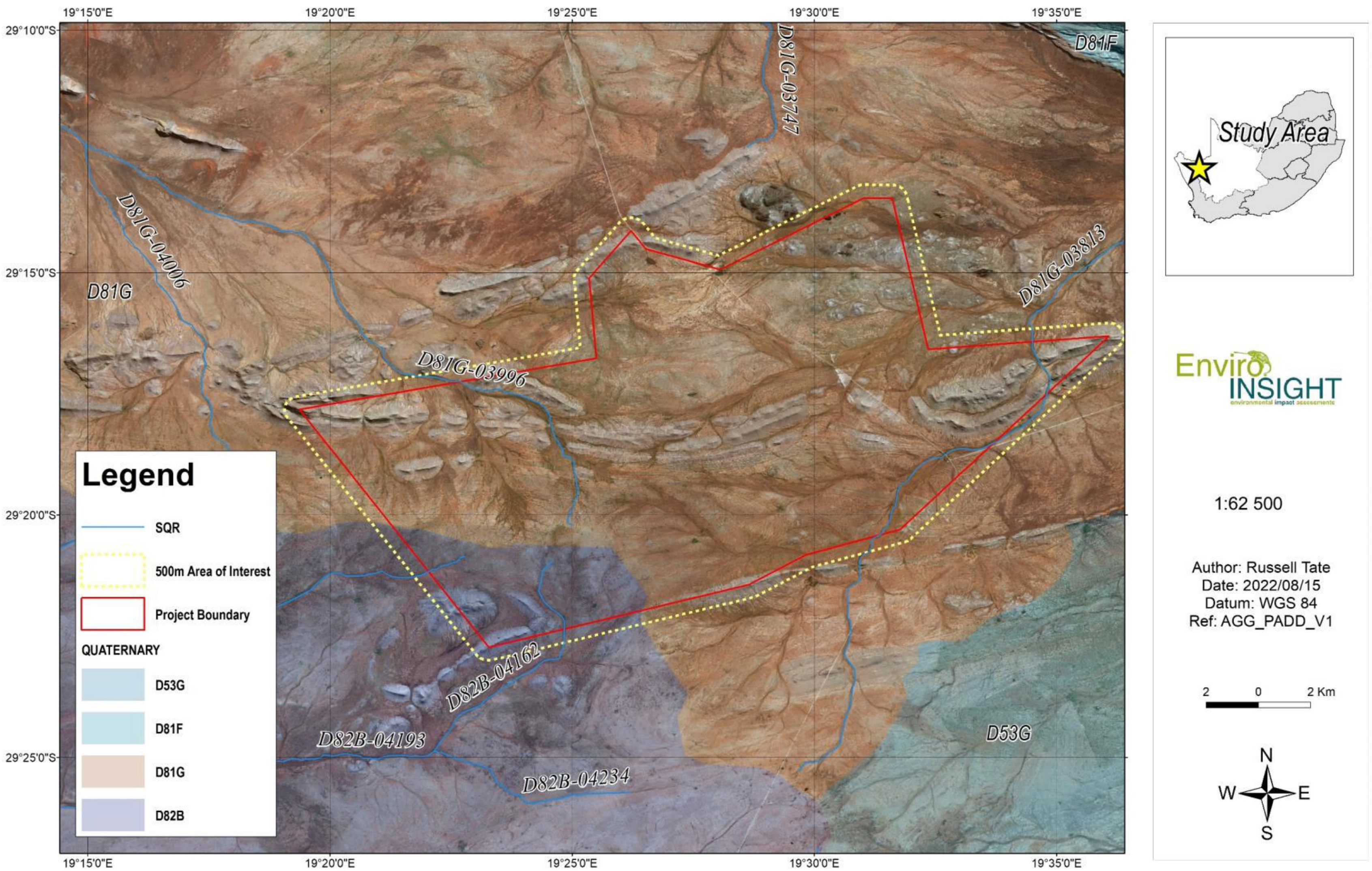

Figure 2-2: Hydrological setting of the Study Area

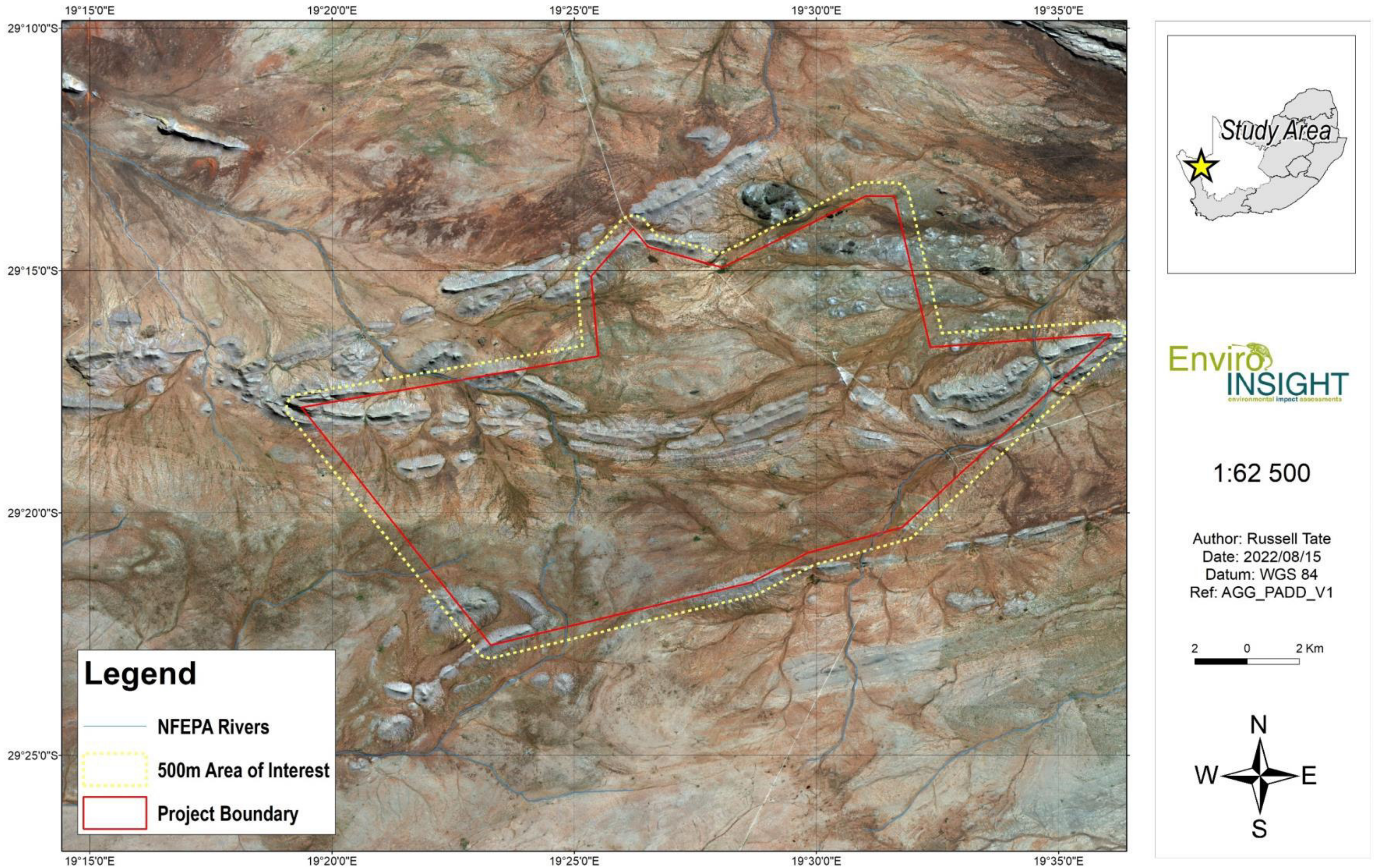

Figure 2-3: Desktop Wetlands (NFEPA, 2011)

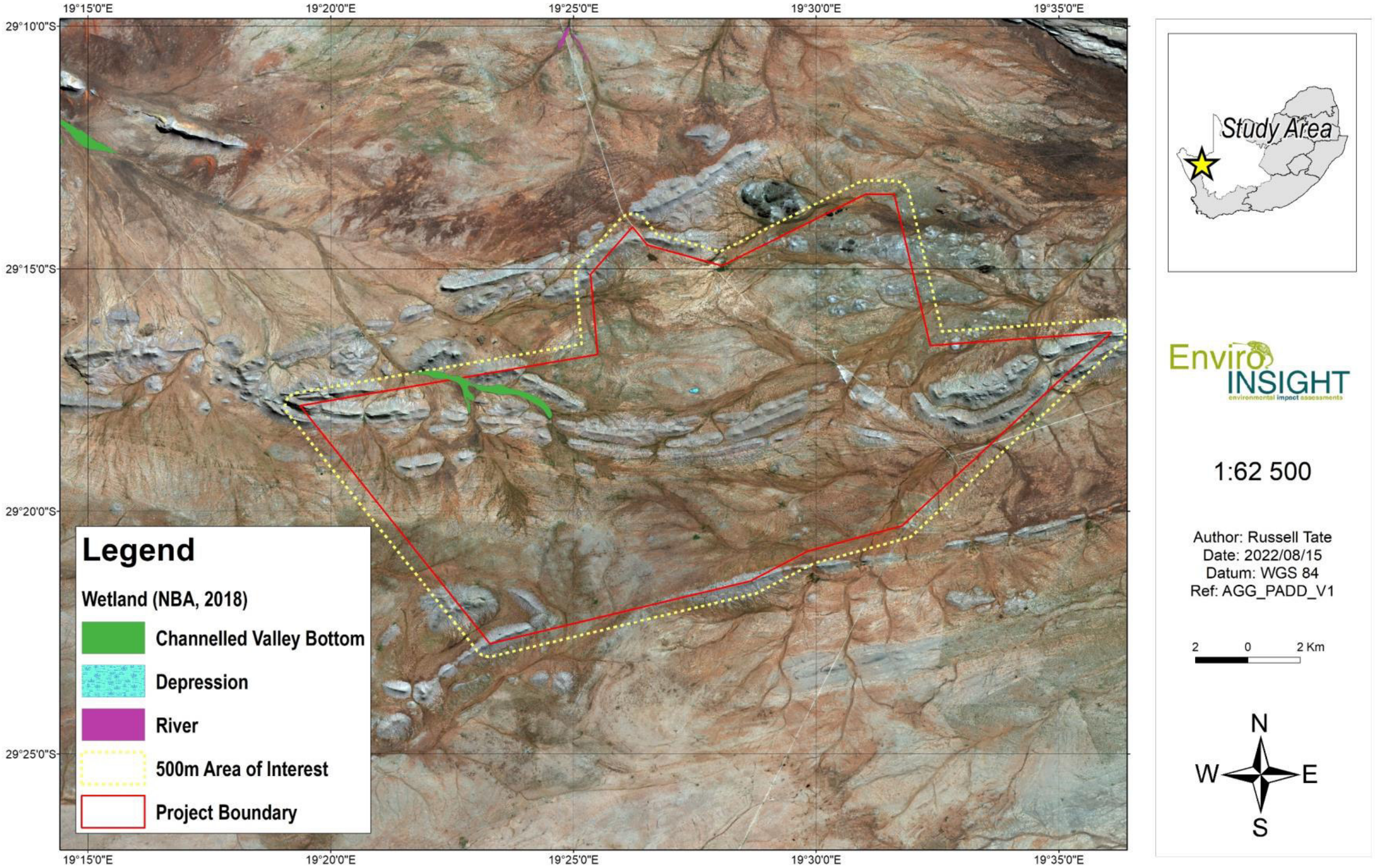

Figure 2-4: Desktop Wetlands (NBA, 2018)

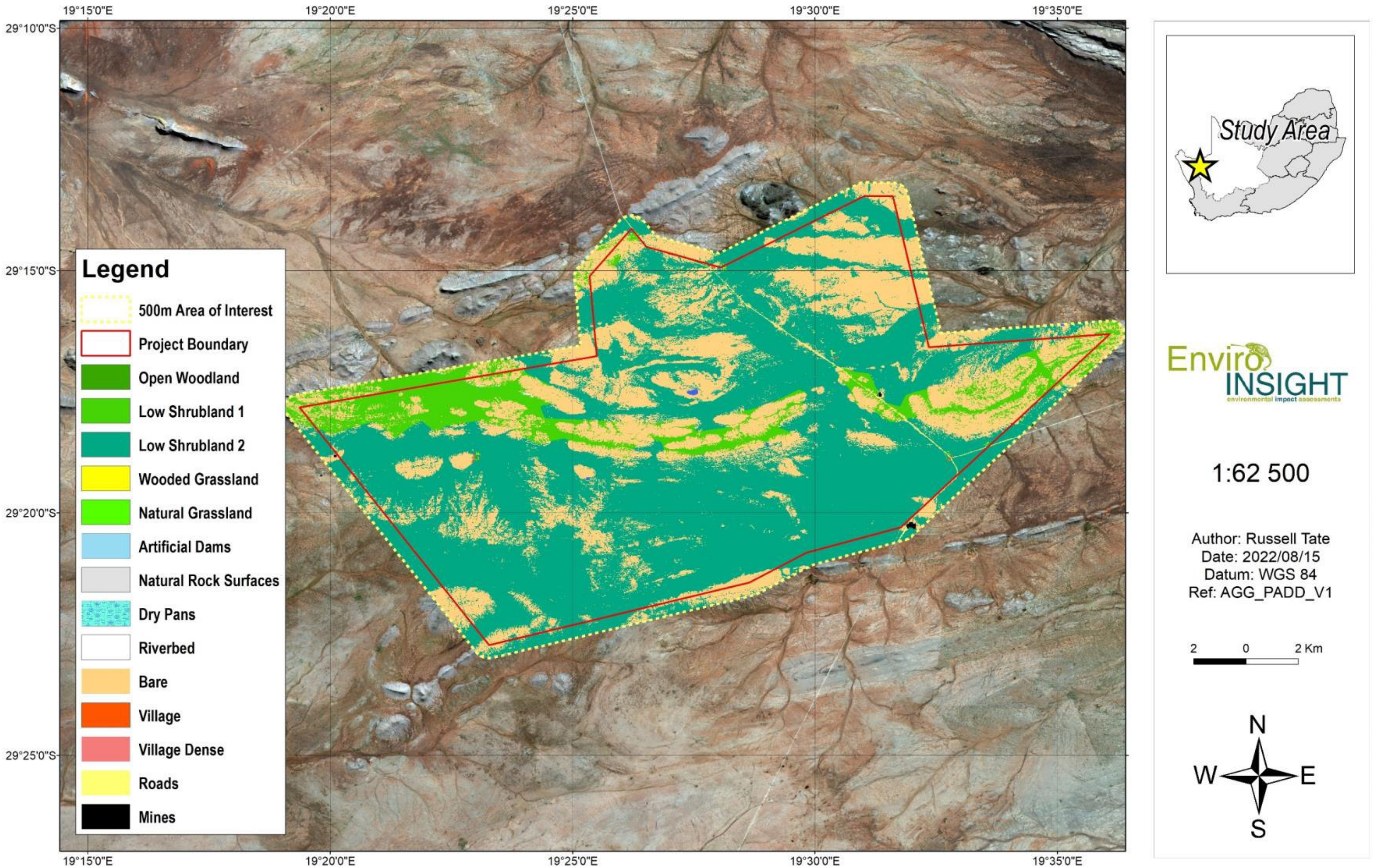

Figure 2-5: Landcover of the project area (Thompson, 2019)

3 Methods

3.1 Survey and Sample Points

A single survey was completed for this study which took place between the 20th and 22nd of July 2022.

3.2 Wetland and Riparian Ecology

To accurately define the PES, the spatial framework of the wetland PES must be characterized. To complete this, the wetland delineation protocols established by DWAF (2005) were utilised. The area considered included a 500m regulated area around the project boundary. This was then further refined to directly impacted and indirectly impacted areas. Wetlands which were not directly impacted, were assessed on a desktop scale, whilst the anticipated directly impacted wetlands were assessed using a level 2 analysis.

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section of a typical wetland is presented in Figure 3-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The terrain unit Indicator was used to identify the areas of the landscape where wetlands are likely to occur;
- The soil form indicator, utilises the soil classifications provided by the Soil Classification Working Group (1991) whereby focus is drawn to soils that are associated with prolonged and frequent saturation;
- The soil hydromorphic indicator was utilised to study the morphological signatures of the soil profiles;
- The vegetation indicator was used to identify hydrophilic vegetation associated with frequently saturated soils.

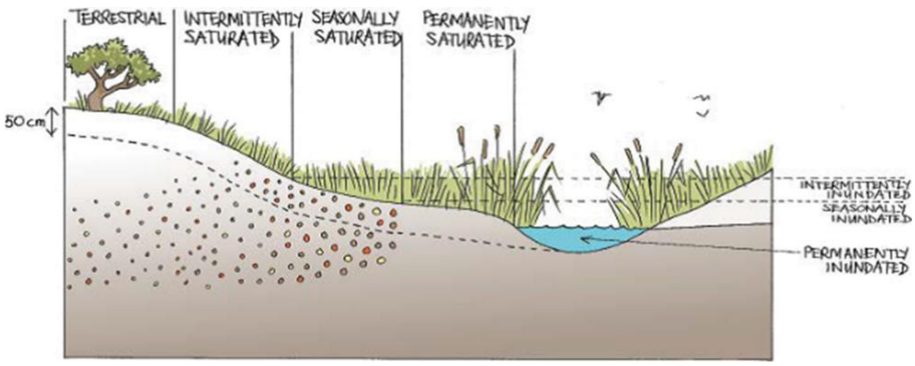

Figure 3-1: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013)

3.2.1 Ecological Classification and Description of the Wetland

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

3.2.2 Determining the Wetland Present Ecological Status

The overall approach was to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a PES score. This takes the form of assessing the spatial extent of the impact of individual activities and separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The WET-Health Version 1.0 (Macfarlane, 2008) was utilised to derive the PES. The PES categories are provided in Table 3-1.

Table 3-1: The Present Ecological Status categories, (Macfarlane, 2008)

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

3.2.3 Determining the Ecological Importance and Sensitivity of the wetland

The method used for the Ecological Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWS (1999). The method takes into consideration PES scores obtained for WET-Health as well as function and service provision of the systems to enable determination of the representative EIS category for the wetland feature. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 3-2, (Rountree et al., 2013).

Table 3-2: Description of Ecological Importance and Sensitivity categories

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

3.2.4 Wetland Functional Assessment and Ecosystem Services

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

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Version 2.0) (Kotze et al., 2020). An assessment was undertaken that examined and rated the following services according to their degree of importance and the degree to which the services are provided (Table 3-3).

Table 3-3: Classes for determining the likely extent to which a benefit is being supplied

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

Considering there were channelled systems associated with the project, it was deemed important to derive the condition of the instream habitat.

3.2.5 Habitat Condition

The Intermediate Habitat Integrity Assessment (IHIA) as described by Kleynhans (1996) was used to define the ecological condition of the riparian/wash habitats of the considered areas. The IHIA was informed by the results of the land cover assessments and direct observations of changes to the washes. The IHIA considers both the riparian and instream habitat condition but for this report only the riparian habitat was considered. The method relies on the study of reference condition or natural watercourses within a similar setting. The spatial framework of the assessment was applicable to the HGM delineations as provided in Figure 4-4. The integrity categories of the method are provided in Table 3-4.

Table 3-4: Intermediate habitat integrity categories (Kleynhans, 1996)

Category	Description	Score
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

3.3 Limitations and Assumptions

The following limitations and assumptions form part of this study:

- Watercourses are defined by dynamic processes. Temporal variation of the extent and condition of the watercourses is a naturally occurring process. Therefore, the spatial extent of the watercourses provided in this study should be reconsidered within at least 5-10 years from the publishing of this study.
- The results of this study were derived from rapid ecological assessments.
- The area was extensive, and depression pan systems very small. It is therefore probable that minor pan systems would have been missed during the survey.
- Areas directly affected by the project were surveyed, whilst within the 500m screening area, desktop information was also utilised.
- No closure or decommissioning phases were considered.
- The layout of the proposed transmission and grid connection infrastructure was not considered in this study.

4 Results

4.1 Watercourse Type and Classification

It is important to state that the watercourses classified in this study do not conform to standard wetland definitions and classifications provided in Ollis et al. (2013) where typical indicators such as redoximorphic and hydrophytic vegetation indicators were largely absent (See 4.3). Despite this, active inundation, landform indicators and at times hydrophytic vegetation indicators provided sufficient evidence to support the classification and delineation of the watercourses.

The watercourse types observed in the study area and their respective classifications are provided in Table 4-1 and Figure 4-4. A total of 11 hydrogeomorphic (HGM) units were delineated in this study consisting of two watercourse types including depressions (Figure 4-1) and non-perennial wash systems (Figure 4-2).

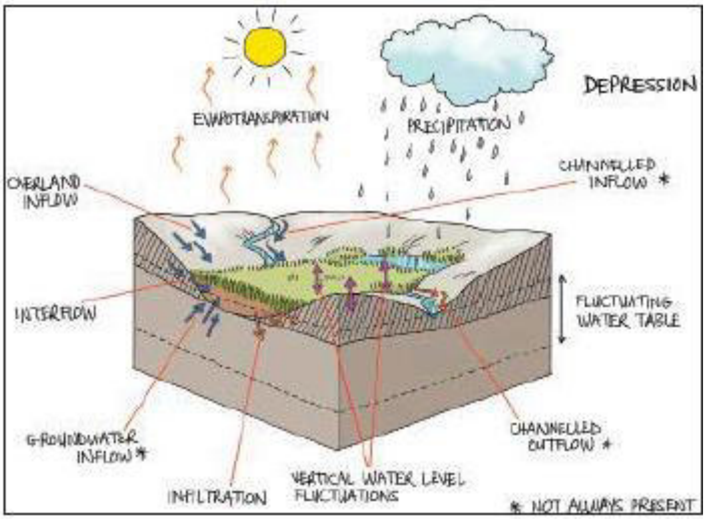

Figure 4-1: Depression HGM unit as indicated in the study area (Ollis et al., 2013)

Figure 4-2: A non-perennial wash HGM type (July 2022). Note large *Rhigozum obvatum*, *Stipagrostis* grasses and *Salsola aphylla*

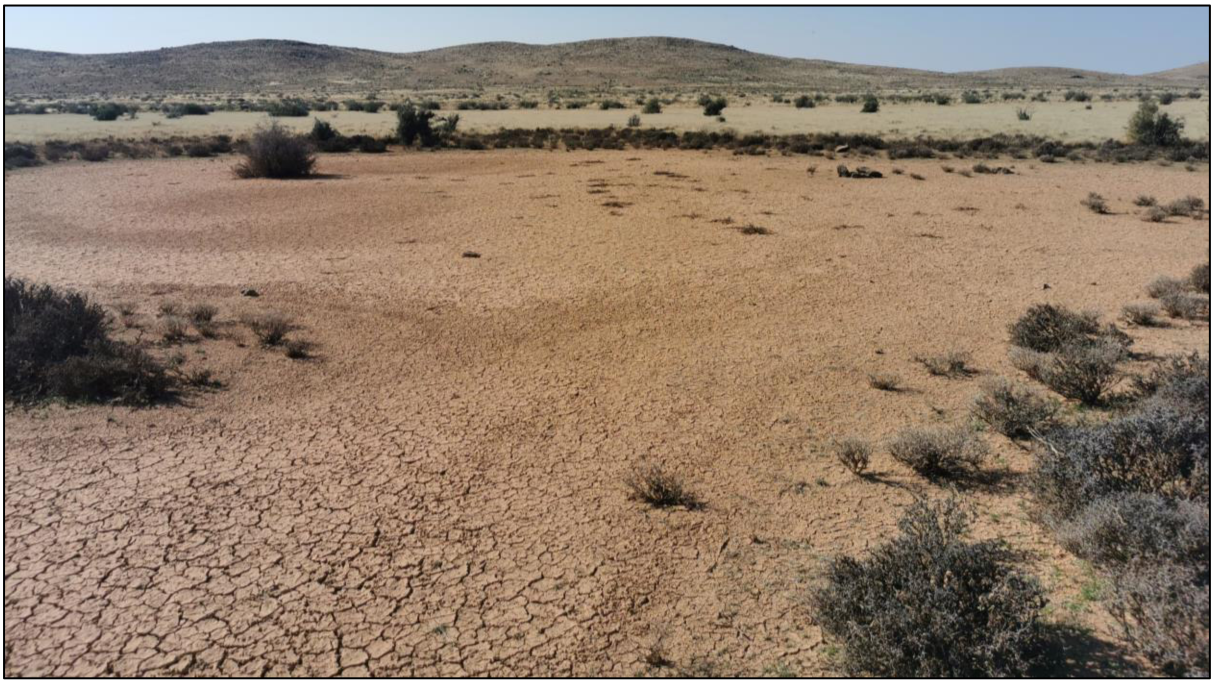

Figure 4-3: Depression system in the Pofadder AoI (July 2022)

Table 4-1: Wetland classification within 500m screening zone

Wetland System Unit	Hectares	Level 1	Level 2		Level 3	Level 4		
		System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM1	205	Inland	Nama Karoo	Gariep Desert Bioregion	Plain	Wash	Not applicable	Not applicable
HGM2	45	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Wash	Not applicable	Not applicable
HGM3	110	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Wash	Not applicable	Not applicable
HGM4	209	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Wash	Not applicable	Not applicable
HGM5	33	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Wash	Not applicable	Not applicable
HGM6	52	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Wash	Not applicable	Not applicable
HGM7	78	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Wash	Not applicable	Not applicable
HGM8	0.4	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Depression	Endorheic	Without channel inflow
HGM9	0.2	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Depression	Endorheic	Without channel inflow
HGM10	0.1	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Depression	Endorheic	Without channel inflow
HGM11	8.7	Inland	Nama Karoo	Richtersveld Bioregion	Plain	Depression	Endorheic	Without channel inflow

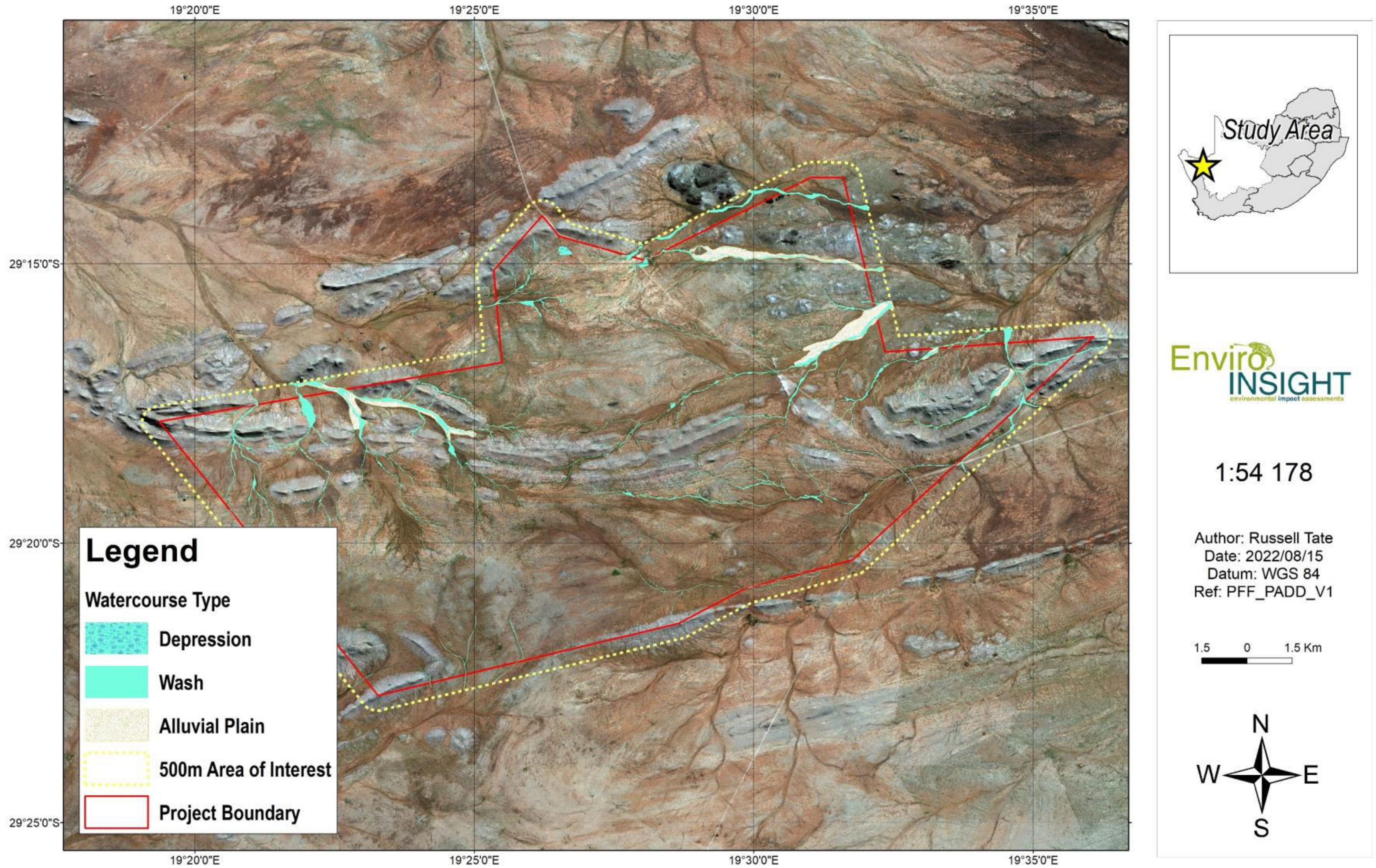

Figure 4-4: Delineation of the watercourses

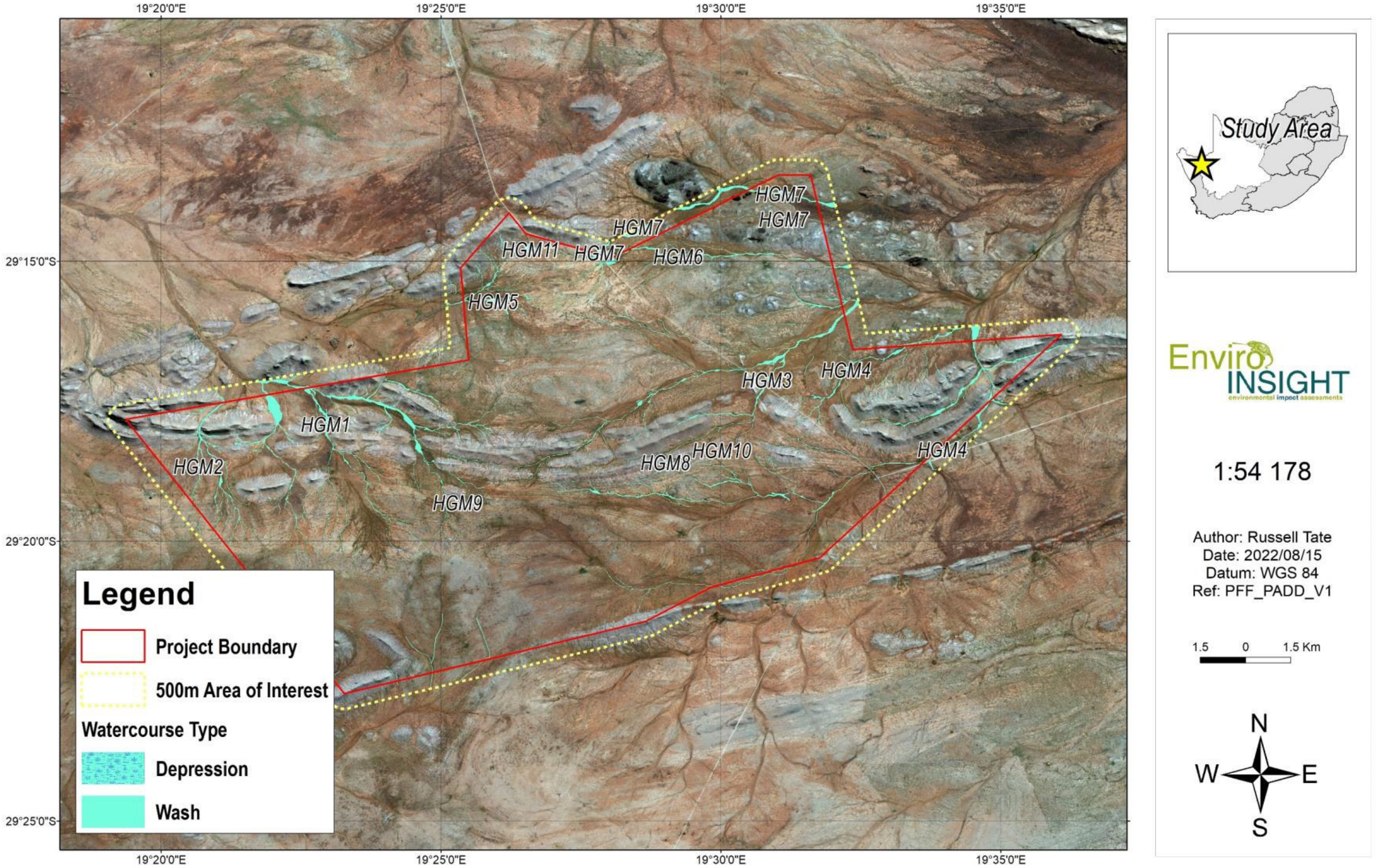

Figure 4-5: HGM Layout of the watercourses

4.2 Geomorphology

The AoI was located on the watershed between three separate catchments feeding each respective SQR to the north, east and south. There is an extensive flat plain in the south-west of the project area which is dissimilar to the rest of the study site which consisted of undulating plains with tall rocky outcrops. (Figure 4-6). Valley bottom landforms were present and were typically located between steep rocky outcrops. The wash systems typically flowed from a height proximate to 1150 metres above mean sea level (mamsl) down to 1014 mamsl where alluvial plains were observed.

The landforms associated with the project were such that alluvial processes have deposited substrates in valley bottom plains where anastomosed and multiple thread features are located. These features are dynamic and change according to rainfall patterns and the presence of obstructions. Many of the channels terminate in alluvial plains where infiltration rates reduce surface runoff.

It is anticipated that the channels within the alluvial plains change periodically. It was therefore deemed necessary to delineate these alluvial plain areas. It is however important to note that these alluvial plains are not considered to be watercourses or floodplains as active channels, vegetation and soil indicators were absent.

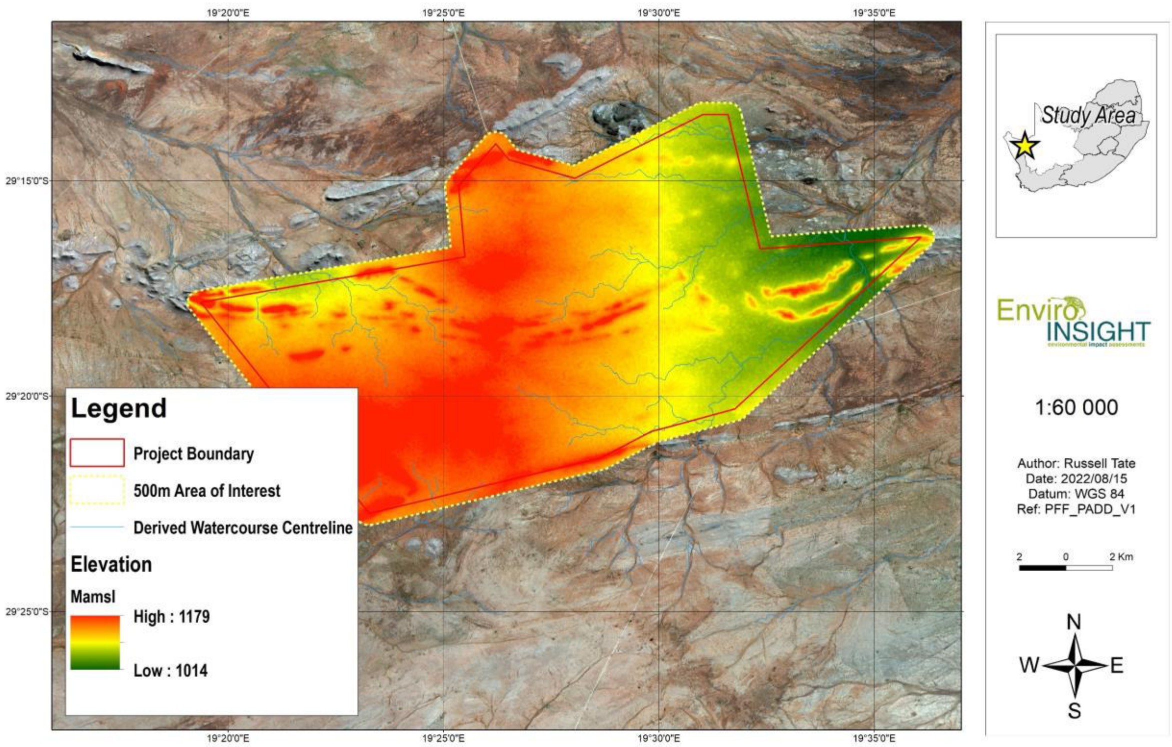

Figure 4-6: The elevation of the project area

Figure 4-7: A channelled wash system in the project area (July 2022)

4.3 Soils

Two land types were associated with the project area and included the Ag25 and Ib131 land types. Typical soil forms present in the landscape of these land types is presented in Figure 4-8 and Figure 4-9 whilst the spatial layout of the land types are provided in Figure 4-10. The Ag25 land type was the dominant form where watercourses are expected to be present in the valleys (terrain unit 5). The watercourse soil forms which would be represented are the Dundee soil forms. It is noted that out of the expected soils, only the expected Dundee soil form was likely harbour wetland/riparian characteristics.

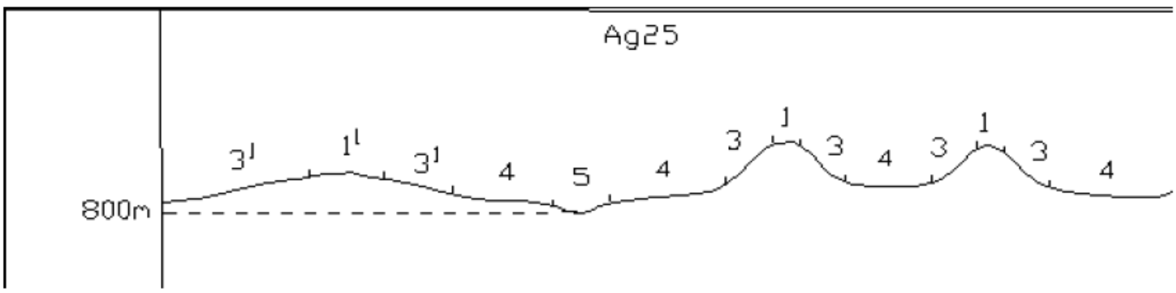

Figure 4-8: Terrain/Soil Forms commonly found in the Ag25 Land type

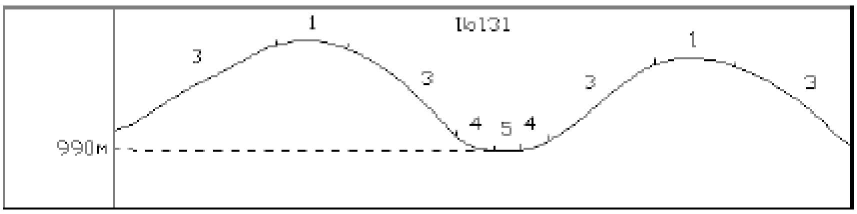

Figure 4-9: Terrain/Soil Forms commonly found in the Ib131 Land type

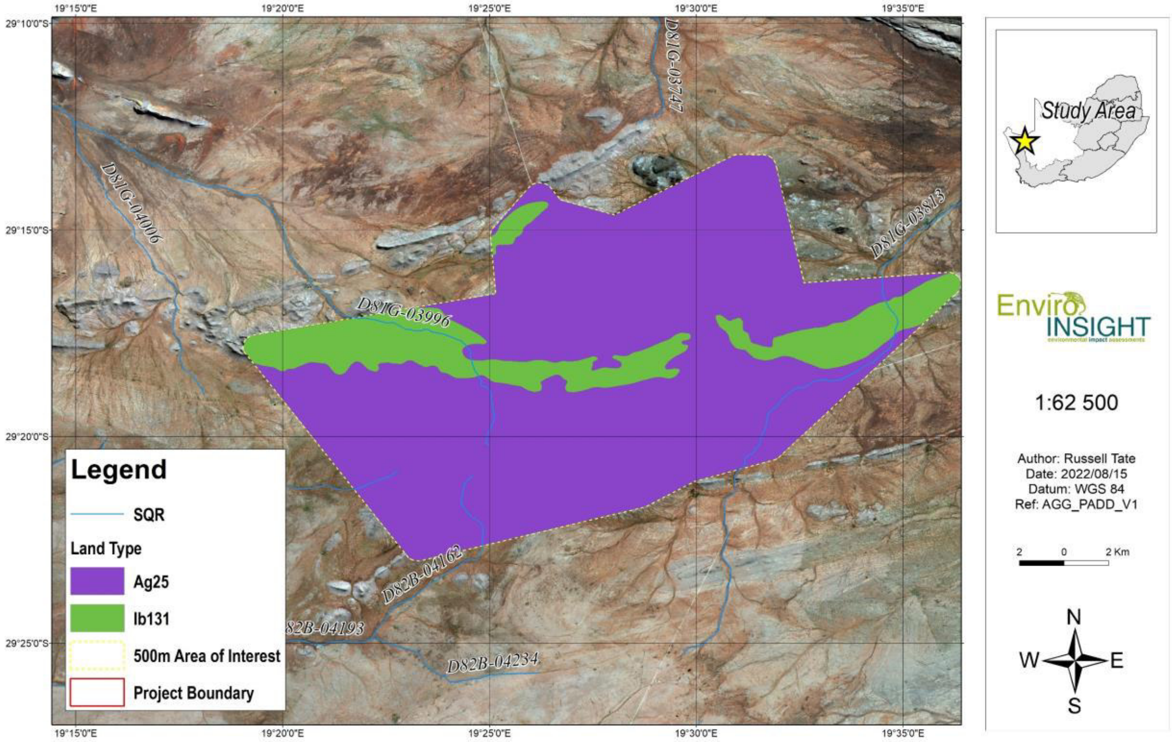

Figure 4-10: Landtype of the Project

The SCS soil classification of the soils is provided in Figure 4-11. Based on the classifications the indicate SCS classes of A/B for the Ag25 and class B for the Ib131 land types respectively. These SCS classifications indicate that the soil types have low runoff potential and high infiltration rates even when thoroughly wetted (Table 4-2).

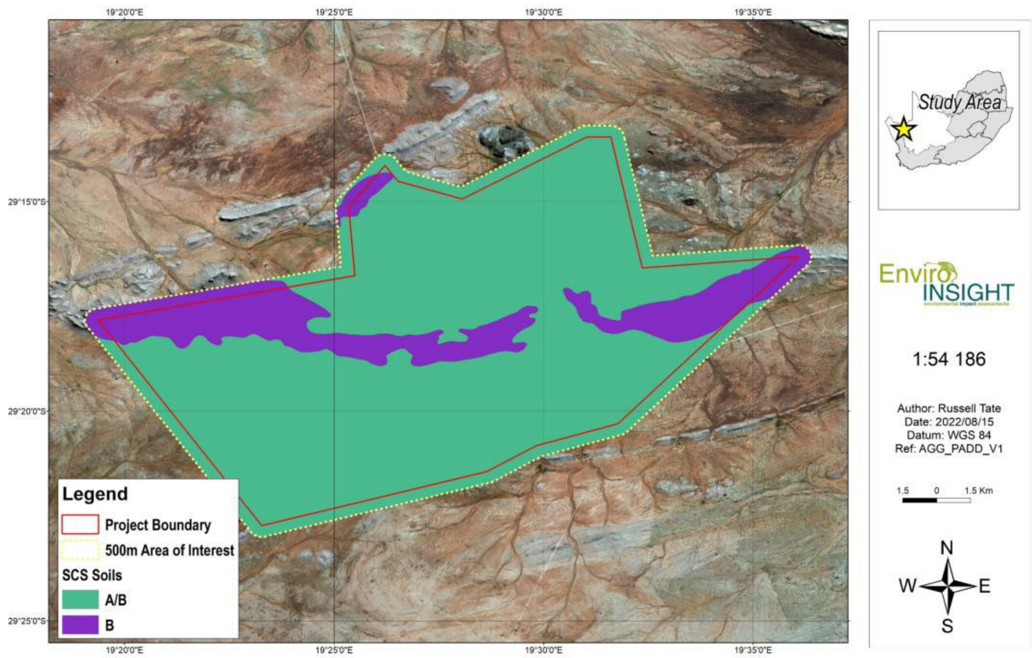

Figure 4-11: SCS Soil Classification

Table 4-2: Soil Conservation Services Hydrologic Soil Class Interpretation (SANRAL. 2013)

Class	Description
Class A	Sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.
Class B	Silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
Class C	Soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
Class D	Soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

Soil forms observed during the survey were consistent with the desktop information where typical hydromorphic soil forms as indicated in DWAF (2005) were absent from the AoI. Soil forms observed included deep freely draining soils.

There were indications of the Dundee soil forms which were present in the lower reaches of the larger watercourses in the AoI. In terms of soil indicators, alluvial plains were lacking typical features and in the case of this project it is presented that the use of the valley bottom and watercourse centreline would suffice as the watercourse primary defining feature.

Within the depression systems, surface deposits of silts were noted to occur, however the soil forms present were not indicated to be Rensburg or Arcadia soils but rather Clovelly and Mispah soil forms. Despite this, the presence of the silts in the depressions indicates that the systems are temporarily inundated and would serve an important ecological function. This further supported the classification of the depression systems.

Figure 4-12: Soil types observed in non-perennial washes showing horizons typical in the Dundee soil form (July 2022)

Figure 4-13: Surface silt deposits which occur over an orthic sandy horizon and bedrock indicative of a Clovelly soil form typical in the depression systems (July 2022)

4.4 Vegetation

The vegetation types present in the AoI is provided in Figure 4-14 and showed a diverse vegetation types. It is noted that the watercourses were largely associated with the Bushmanland Arid Grassland vegetation type. Common species in the vegetation types include grass typical of *Stripagrostis* and *Schmidtia* species (Mucina and Rutherford, 2006).

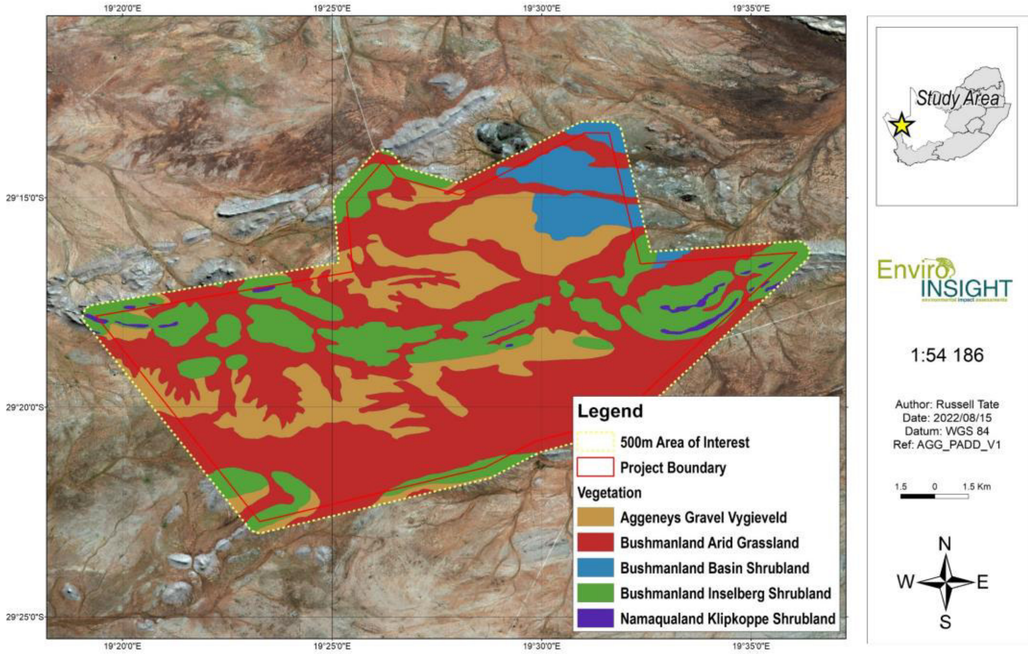

Figure 4-14: Vegetation type of the project area

The active channels of watercourses showed typical watercourse zonation whereby active instream areas were denuded of vegetation, but channel edge and banktop vegetation included stands of *Stripagrostis* grasses including stands of *Stipagrostis namaquensis* (Figure 4-16). Larger specimens of *Rhigozum obvatum* were also noted to occur in denser stands within the valley bottom and within depression landforms. The riparian zone indicator species, *Salsola aphylla* was also found to be present in the valley bottom landforms within the AoI which supports classification of these watercourses. These species are considered to be obligate riparian taxa and are typically confined to alluvial soils such as the Dundee soil form (DWAF, 2005).

The conclusions drawn from the study indicates that soil and vegetation indicators were effective to inform watercourse extent. However, owing to a high degree of variability a greater confidence was placed on landform indicators such as direct inundation observations, silt deposits, and topography.

Figure 4-15: Large *Rhigozum obvatum (left)* and *Salsola aphylla* (July 2022)

Figure 4-16: *Stipagrostis namaquensis* present in the watercourses of the AoI (July 2022)

4.5 Watercourse Condition

The results of the IHIA are presented in Table 4-3 and Table 4-4. The results of the PES analysis for depression systems are presented Table 4-5.

Table 4-3: IHIA for Instream Habitat

Criterion	Water loss	Flow mod	Bed mod	Channel mod	Water quality	Inundation	Exotic veg	Exotic fauna	Solid waste disposal	Condition
HGM1	10	10	10	10	0	0	0	0	5	77
HGM2	5	5	5	5	0	0	0	0	0	89
HGM3	10	8	8	8	0	0	0	0	5	80
HGM4	5	5	5	5	0	0	0	0	5	88
HGM5	0	5	5	5	0	0	0	0	5	91
HGM6	10	10	10	10	0	10	0	0	5	73
HGM7	10	10	10	10	0	5	0	0	5	75

Table 4-4: IHIA for Riparian Habitat

Criterion	Indigenous vegetation removal	Exotic vegetation encroachment	Bank erosio n	Channel mod	Water loss	Inundation	Flow mod	Water quality	Conditio n
HGM1	10	0	8	8	0	0	5	0	84
HGM2	5	0	0	5	0	0	0	0	95
HGM3	5	0	0	5	0	0	0	0	95
HGM4	5	0	0	5	0	0	0	0	95
HGM5	5	0	0	5	0	0	0	0	95
HGM6	10	0	0	5	5	5	10	0	82
HGM7	5	0	0	5	0	5	8	0	88

Table 4-5: Depression Present Ecological Status (July 2022)

	Hydrology		Geomorphology		Vegetation		PES	PES
	Rating	Score	Rating	Score	Rating	Score	Rating	Class
HGM8	2	Moderate	1	Small	1	Small	1.4	Class B
HGM9	2	Small	1.5	None	1.9	Small	1.9	Class B
HGM10	2	Moderate	1.5	Small	1.8	Small	1.8	Class B
HGM11	1.5	Moderate	1.5	Small	1.8	Small	1.6	Class B

The ecological condition of the watercourses were not impacted to a significant degree. Where modifications were observed they were related to impoundments or crossings via linear infrastructure. It is noted that watercourse and roadway crossings across the alluvial plains have a significant impact on channel morphology which follows that of the road path.

4.6 Ecosystem Services

The depression and wash HGM units provided primarily biodiversity and grazing related eco-services. The results of the ecological function assessment are provided in Table 4-6. The results indicated a moderately high importance for biodiversity maintenance for both depression and wash systems. The results also indicted a moderate importance rating for provisioning services, particularly relating to the use of the systems for grazing.

Table 4-6: Ecological Function Assessment Results (July 2022)

ECOSYSTEM SERVICE		Washes	Depressions
REGULATING AND SUPPORTING SERVICES	Flood attenuation	Very Low	Very Low
	Sediment trapping	Very Low	Very Low
	Erosion control	Very Low	Very Low
	Phosphate assimilation	Very Low	Very Low
	Nitrate assimilation	Very Low	Very Low
	Toxicant assimilation	Very Low	Very Low
	Carbon storage	Very Low	Very Low
	Biodiversity maintenance	Moderately High	Moderately High
PROVISIONING SERVICES	Water for human use	Very Low	Moderate
	Harvestable resources	Very Low	Very Low
	Food for livestock	Moderately Low	Moderately Low
	Cultivated foods	Very Low	Very Low
CULTURAL SERVICES	Tourism and Recreation	Very Low	Moderately Low
	Education and Research	Very Low	Very Low
	Cultural and Spiritual	Moderately Low	Very Low

4.7 Ecological Importance and Sensitivity

Previous studies have indicated that the depression systems, such as those observed in this study provide crucial services to organisms such as endemic invertebrates, migratory birds and mammals. The Northern Cape conservation plan is provided in Figure 4-17. The plan indicates that the wash and depression habitats are located in Critical Biodiversity Areas one and two. Ecological Support Areas were also noted to be present. The results of the EIS assessment for the watercourses are presented in Table 4-7. The depression pan systems were derived to have very high EIS, whilst the non-perennial washes were derived to be of moderate EIS.

Pans are classified as shallow, usually oval or round, depressions that typically undergo phases of complete desiccation, though some may be continuously inundated (Allan et al. 1995). Most often, pans are defined as endorheic wetlands, though some may seep via diffuse flow paths found below the surface into adjacent valley bottoms. Their endorheic state results in fluctuations in water quality ranging from very low conductivity, due to rainfall, to high conductivity due to evaporation (de Klerk et al., 2012). Due to the endorheic nature of the pans, they are more vulnerable to development.

Invertebrates surviving in these variable conditions therefore are required to be able to survive periods of high temperatures and conductivity and often even desiccation (Liefferink et al. 2014). Due to the fluctuating nature of the water quality dynamics in pan environments, the assessment of aquatic biota, which is adapted to life in the environment, can often provide more accurate data for the determination of the overall ecological state of the considered environments.

The presence of the invertebrates within the depression pan systems further supports their classification as important and sensitive landscape features which corroborates their assessment and classification as watercourses. No listed aquatic macroinvertebrates are associated with the proposed project.

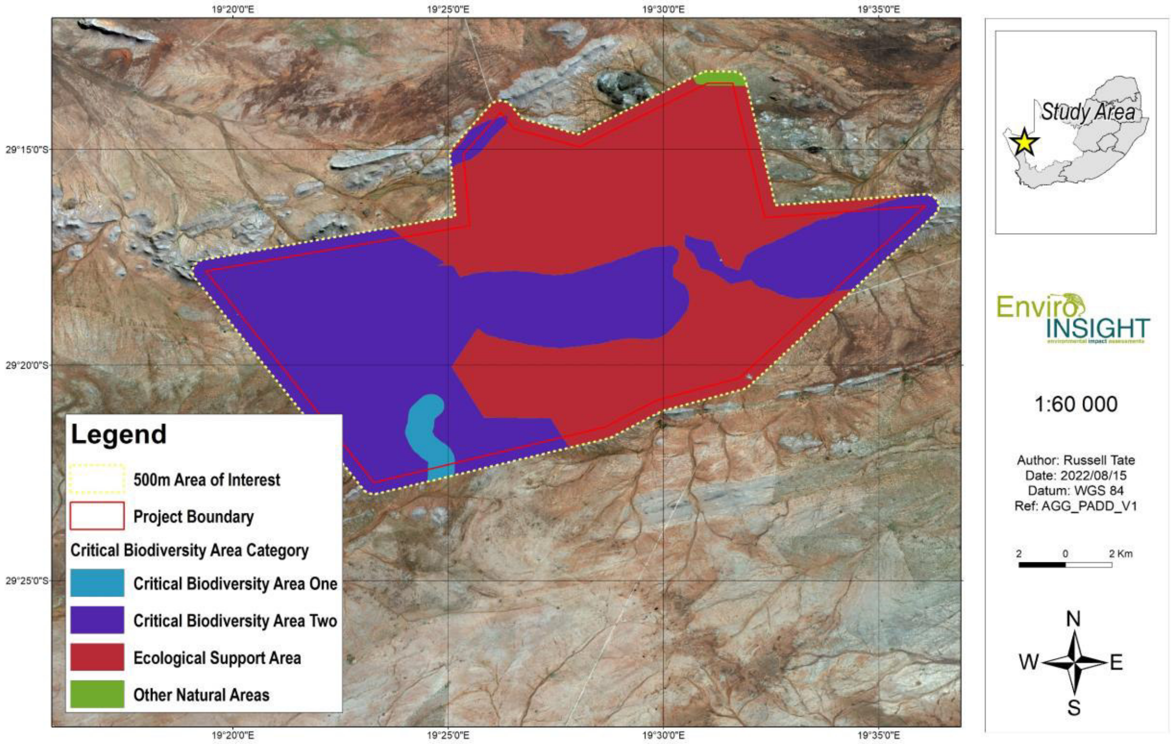

Figure 4-17: Northern Cape Conservation Plan

Table 4-7: Ecological Importance and Sensitivity

Wetland Importance and Sensitivity	Depression Systems Isolated	Non-Perennial Washes
Ecological Importance and Sensitivity	3.3	2.4
Hydrological/functional importance	2.4	1.2
Direct human benefits	1.1	1.0

Wetland Importance and Sensitivity	Depression Systems Isolated	Non-Perennial Washes
Highest Value	**3.3**	**1.7**
EIS Category	**Very High**	**Moderate**

4.8 Buffers and Regulated Areas

According to the National Environmental Management Act (Act no. 107 of 1998), Amendment of the Environmental Impact Assessment Regulations listing notice 1 of 2014, should no existing setback be defined, an area of 32 metres from the edge of the watercourse must not be developed (buffered).

In the case of this study, the buffer zones were defined based on the river and wetland ecosystems buffer tool as presented in Macfarlane et al. 2017 and Macfarlane et al. (2009). The results of the buffer tool are provided in Table 4-8, whilst the buffers are visualised in Figure 4-18.

The buffer zone indicated a need of 15m from the washes, whilst a buffer zone of 20m was provided for depressions. It is however important to consider the dynamic nature of the washes as well as the ecological importance of the depression systems. For this reason it is proposed that buffer zones are increased from 15m to 25m for the wash systems. Whilst depression systems were provided with a buffer zone of 50m to protect the expected catchment of the systems. The provision of the wider buffers aligns with the precautionary approach particularly where indicators for the delineations were limited.

Table 4-8: Buffer requirements before and after mitigation Washes

Phase	Before mitigation	After mitigation	Recommended Buffer
Construction	15	15	25
Operation	15	15	25

Table 4-9: Buffer requirements before and after mitigation Depressions

Phase	Before mitigation	After mitigation	Recommended Buffer
Construction	20	20	50
Operation	20	20	50

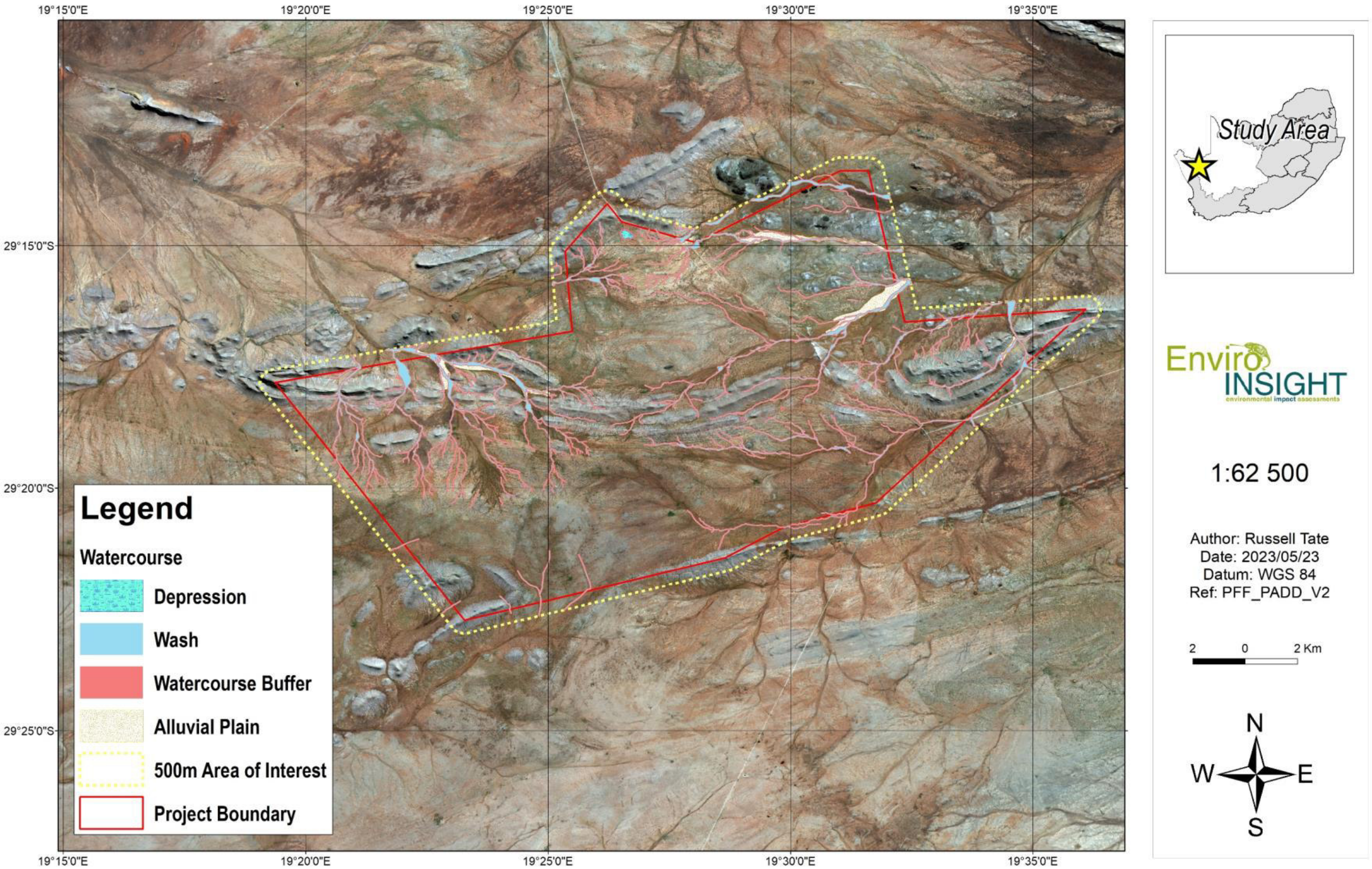

Figure 4-18: 40m and 100m buffer zone for the watercourse

5 Risk Assessment

5.1 Risk Assessment Methodology

The risk assessment was conducted in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016). The significance of the impact is calculated according to Table 5-1.

Table 5-1: Risk Assessment Matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
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. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

Once a potential impact has been determined it is necessary to identify which project activity will cause the impact, the probability of occurrence of the impact, and its magnitude and extent (spatial and temporal). This information is important for evaluating the significance of the impact, and for defining mitigation and monitoring strategies. Direct and indirect impacts of the impacts identified during the specialist investigations were assessed in terms of five standard rating scales to determine their significance.

The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on six criteria, namely:

- Status of impacts (Table 5-2) – determines whether the potential impact is positive (positive gain to the environment), negative (negative impact on the environment), or neutral (i.e. no perceived cost or benefit to the environment). Take note that a positive impact will have a low score value as the impact is considered favourable to the environment;
- Spatial extent of impacts (Table 5-3) – determines the spatial scale of the impact on a scale of localised to global effect. Many impacts are significant only within the immediate vicinity of the site or within the surrounding community, whilst others may be significant at a local or regional level. Potential impact is expressed numerically on a scale of 1 (site-specific) to 5 (global);
- Duration of impacts (Table 5-4) – refers to the length of time that the aspect may cause a change either positively or negatively on the environment. Potential impact is expressed numerically on a scale of 1 (project duration) to 5 (permanent);
- Frequency of the activity (Table 5-5)– The frequency of the activity refers to how regularly the activity takes place. The more frequent an activity, the more potential there is for a related impact to occur.

- Severity of impacts (Table 5-6) – quantifies the impact in terms of the magnitude of the effect on the baseline environment, and includes consideration of the following factors:
    - The reversibility of the impact;
    - The sensitivity of the receptor to the stressor;
    - The impact duration, its permanency and whether it increases or decreases with time;
    - Whether the aspect is controversial or would set a precedent;
    - The threat to environmental and health standards and objectives;
- Probability of impacts (Table 5-7) –quantifies the impact in terms of the likelihood of the impact occurring on a percentage scale of <5% (improbable) to >95% (definite).
- Confidence – The degree of confidence in predictions based on available information and specialist knowledge:
    - Low;
    - Medium; or
    - High.

In addition, each impact needs to be assessed in terms of reversibility and irreplaceability as indicated below:

- Reversibility of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
    - High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);
    - Moderate reversibility of impacts;
    - Low reversibility of impacts; or
    - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).
- Irreplaceability of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):
    - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);
    - Moderate irreplaceability of resources;
    - Low irreplaceability of resources; or
    - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

Table 5-2: Status of Impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment (positive impact)	+
Neutral	No determined cost or benefit to the receiving environment	N
Negative	At cost to the receiving environment (negative impact)	-

Table 5-3: Extent of Impacts

Rating	Description	Quantitative Rating
Very Low	**Site Specific** – impacts confined within the project site boundary	1
Low	**Proximal** – impacts extend to within 1 km of the project site boundary	2
Medium	**Local** – impacts extend beyond to within 5 km of the project site boundary	3
High	**Regional** – impacts extend beyond the site boundary and have a widespread effect - i.e. > 5 km from project site boundary	4
Very High	**Global** – impacts extend beyond the site boundary and have a national or global effect	5

Table 5-4: Duration of Impacts

Rating	Description	Quantitative Rating
Very Low	**Project duration** – impacts expected for the duration of the project or not greater than 1 year	1
Low	**Short term** – impacts expected on a duration timescale of 1 to 2 years	2
Medium	**Medium term** – impacts expected on a duration timescale of 2-5 years	3
High	**Long term** – impacts expected on a duration timescale of 5-15 years	4
Very High	**Permanent** – impacts expected on a duration timescale exceeding 15 years	5

Table 5-5: Frequency of impacts

Rating	Frequency	Quantitative Rating
Very Low	Annually or less	
Low	6 monthly	
Medium	Monthly	
High	Weekly	
Very High	Daily / Permanent	

Table 5-6: Severity of Impacts

Rating	Description	Quantitative Rating
Very Low	Negligible – zero or very low impact	1
Low	Small / potentially harmful	2
Medium	Significant / slightly harmful	3
High	Great / harmful	4
Very High	Disastrous / extremely harmful	5

Table 5-7: Probability of Impacts

Rating	Description	Quantitative Rating
Highly Improbable	Likelihood of the impact arising is estimated to be negligible; <5%.	1
Improbable	Likelihood of the impact arising is estimated to be 5-35%.	2
Possible	Likelihood of the impact arising is estimated to be 35-65%	3
Probable	Likelihood of the impact arising is estimated to be 65-95%.	4
Highly Probable	Likelihood of the impact arising is estimated to be > 95%.	5

5.2 Determination of Impact Significance

The information presented above in terms of identifying and describing the aspects and impacts is summarised in below in Table 5-8 and significance is assigned with supporting rational.

Table 5-8: Consolidated Table of Aspects and Impacts Scoring

Spatial Scale	**Rating**	**Duration**	**Rating**	**Severity**	**Rating**
Activity specific	1	One day to one month	1	Insignificant/non-harmful	1
Area specific	2	One month to one year	2	Small/potentially harmful	2
Whole site/plant/mine	3	One year to ten years	3	Significant/slightly harmful	3
Regional/neighbouring areas	4	Life of operation	4	Great/harmful	4
National	5	Post closure	5	Disastrous/extremely harmful	5

Frequency of Activity	Rating	Probability of Impact	Rating
Annually / Once-off	1	Almost never/almost impossible (<5%)	1
6 monthly	2	Very seldom/highly unlikely (5-35%)	2
Monthly	3	Infrequent/unlikely/seldom (35-65%)	3
Weekly	4	Often/regularly/likely/possible (65-95%)	4
Daily / Regularly	5	Daily/highly likely/definitely (> 95%)	5

Significance Rating of Impacts	Timing
Very Low (1-25) Low (26-50) Low – Medium (51-75) Medium – High (76-100) High (101-125) Very High (126-150)	Pre-construction Construction Operation Decommissioning

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which is assessed by the relevant specialist. The description and assessment of the aspects and impacts is presented in a consolidated table with the significance of the impact assigned using the process and matrix detailed below.

The sum of the first three criteria (spatial scope, duration and severity) provides a collective score for the consequence of each impact. The sum of the last two criteria (frequency of activity and frequency of impact) determines the likelihood of the impact occurring. The product of consequence and likelihood leads to the assessment of the significance of the impact (Significance = Consequence X Likelihood), shown in the significance matrix below in Table 5-9.

Table 5-9: Significance Assessment Matrix

	Consequence (Severity + Spatial Scope + Duration)														
Likelihood (Frequency of Activity + Probability of Impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	08	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 5-10: Positive and Negative Impact Mitigation Ratings

Colour Code	**Significance Rating**	**Value**	**Negative Impact Management Recommendation**	**Positive Impact Management Recommendation**
	Very High	126-150	Avoidance – consider alternatives	Optimal contribution from Project

	High	101-125	Avoidance as far as possible; implement strict mitigation measures to account for residual impacts	Positive contribution from Project with scope to improve
	Medium-High	76-100	Where avoidance is not possible, consider strict mitigation measures	Moderate contribution from Project with scope to improve
	Low-Medium	51-75	Mitigation measures to lower impacts and manage the project impacts appropriately	Improve on mitigation measures
	Low	26-50	Appropriate mitigation measures to manage the project impacts	Improve on mitigation measures; consider alternatives to improve on
	Very Low	1-25	Ensure impacts remain very low	Consider alternatives to improve on

The model outcome is then assessed in terms of impact certainty and consideration of available information. Where a particular variable rationally requires weighting or an additional variable requires consideration the model outcome is adjusted accordingly.

5.3 Risk Assessment Results

5.3.1 Existing Activities – No Go Situation

Existing activities within the project area include livestock agriculture, road infrastructure and minor impoundments. These activities have had a limited impact on the status of the watercourses and these systems are still considered to be sensitive. The no-go situation indicates the long term maintenance of the assessed watercourses.

5.3.2 Proposed Activities

No specific project activities were provided for this assessment. The expected activities that will be completed for the proposed turbine and grid connection projects are summarised below:

- Site access and clearing of vegetation in working areas;
- Establishment of laydown yard/construction camps;
- Excavations and earthworks for infrastructure setting;
- Excavations and earthworks for turbine foundation;
- Stockpiling and movement of soils and construction materials;
- Storage and use of chemicals, fuels and oils;
- Diversion and crossing of watercourses;
- Storm-water management.

5.3.3 Linear Infrastructure

The existing road infrastructure on the site will be utilised for all ongoing and proposed activities. Additional roads are however going to be required, these will be used to access and service the turbine and grid connection structures. The roadways will require the implementation of wash crossings.

5.3.3.1 Avoidance

5.3.3.1.1 Roads

It is recommended that this study is updated following the finalisation layout of the proposed road network. The proposed road networks must avoid creating excessive crossings of the wash habitats and must avoid the established depression systems.

5.3.3.1.2 Grid Connections

The proposed grid connection pylons must not be placed within the buffer zones stipulated in this study.

5.3.3.1.3 Culverts - Crossings

Drifts are recommended to be utilised as opposed to culverts. It is recommended that rocky drifts are utilised as solid concrete drifts.

5.3.3.2 Construction Phase

The construction phase of linear infrastructure will involve the active clearing of vegetation, altering of valley bottom landforms as well as general catchment drainage modification. Direct unavoidable impacts are anticipated at wash crossing points.

The clearing of vegetation and exposure and movement of top and sub-soils present risk to altering chemical and physical conditions in local watercourses. The presence of roadways will further decrease surface roughness in the watersheds. The expected impacts are sedimentation and erosion of downstream reaches as a resultant impact of increased surface flow velocity and substrate erodibility. The crossing points will directly modify instream conditions and may result in direct instream habitat loss.

5.3.3.2.1 Mitigation Actions

- All contractors and staff are to be familiarised with the method statement and have undergone an induction / training on the location of sensitive No-Go areas and basic environmental awareness using the mitigation provided in this report.
- Access routes into or adjacent to the wash must make use of existing road ways and crossings where possible;
- Areas where construction is to take place must be clearly demarcated. Any areas not demarcated must be avoided;
- Storm-water generated from roadways must be captured and buffered, where flow velocities are to be significantly reduced before discharge into the environment.
- Storm-water verges as well as other denuded areas must be grassed (re-vegetated) with local indigenous grasses to protect against erosion;

- Any materials excavated must not be deposited in the river channel or valley slopes where it is prone to being washed downstream or impeding natural flow;
- The installation of sedimentation/erosion protection measures must be implemented before the start of construction, e.g., several rows of silt traps and fences (this is particularly important in the access roads leading or adjacent to the watercourse);
- Stockpiling or storage of materials and/or waste must be placed beyond the defined buffers in this report for each respective activity;
- No vehicles shall enter watercourse buffer zones outside of construction footprints;
- No vehicles shall be serviced on site; a suitable workshop with appropriate pollution control facilities should be utilised offsite;
- Hydrocarbons for refuelling purposes must be stored in a suitable storage device on an impermeable surface outside of the delineated wetland buffer zone;
- Disturbed areas must be re-vegetated after completion of the phase;
    - A one-month timeframe for the initiation of this action;
    - Ripping of the soils should occur in two directions; and
    - Removed vegetation and topsoil can be harvested and applied here.
- Drainage channels constructed for the access roads must be constructed so as not to result in erosion;
- An inspection of the drainage channels must be completed within 1 month following the end of activities and within a month after the first rainfall event which exceeds 5mm. Should excessive sediment be transported down the channels it is recommended that sediment screens are implemented;
- Sediment screens must be inspected, maintained and cleared every month or after significant rainfall (>30mm/24hrs);
- An alien vegetation removal and management plan must be implemented along the verges of the roads and crossing points;
- General storm-water management practices should be included in the design phase and implemented during the construction phase of this project; and
- Following the completion of the phase, all construction materials and debris should be removed and disposed of in a suitable off-site area. An inspection should be completed within a week after the phase is completed.

5.3.3.3 Operation Phase

Drainage off the hardened surfaces created by the roadways and pylon structures are anticipated to be silt laden and of a higher runoff velocity during rainfall events when compared to existing conditions. This can result in the erosion, bank destabilisation and sedimentation of downstream watercourses. Similarly, to the construction phase, the operation phase of the crossing points are likely to concentrate flows downstream. The above process is likely to result in erosion and sedimentation. The subsequent effect of this would be water and habitat quality deterioration leading to a decreased ecological status of associated watercourses.

5.3.3.3.1 Mitigation Actions

The following mitigation is recommended for the operational phase

- The implementation of a suitable storm-water management plan for the disturbance footprint must be in place and implemented by this phase;
- The access road and silt traps (if installed) must be inspected monthly for signs of erosion. When erosion is observed, the area should be rehabilitated within 7 days. In addition, inspections following a >80mm/24 hr rainfall event must occur within 7 days of the event;
- An annual audit of the roads for signs of environmental disturbance outside of the footprint area must be conducted; and
- Alien invasive management programmes should continue throughout the duration of the activity.
- Watercourse monitoring should take place annually as part of the environmental management plan.

5.3.4 Turbines

5.3.4.1 Avoidance

Turbines must be located outside of the delineated watercourse buffer zones.

5.3.4.2 Construction Phase

The clearing of vegetation and placement of hardened surfaces increases rainfall runoff velocities which can result in the increase in flood-peaks, sedimentation and erosion of downstream watercourses. Furthermore, the reduced infiltration because of the hardened surfaces will negatively affect the catchment water balance.

Workshops and laydown yards are often sources for contaminants such as hydrocarbons. Thus, runoff or seepage from these areas can negatively affect local watercourses. Offices, including domestic waste facilities are sources for contaminants to local watercourses and therefore mitigation must ensure these aspects are contained.

5.3.4.2.1 Mitigation Actions

The mitigation actions for the construction phase for associated ancillary infrastructure are provided below:

- The implementation of the buffer zone stipulated in this report;
- Clean and dirty surface water separation and a storm-water management plan must be put into place via standard best practice methods;

- A clear storm-water management plan for hardened surfaces must be implemented;
- The revegetation of disturbed non-active cleared areas must take place within the first growing season between September and March following completion of the activity;
- The above must be audited within 3 months of completing the phase;
- No discharge of domestic water must occur if possible. Domestic water must be reused for dust suppression.

5.3.4.3 Operation Phase

The operation of the structures will impact the surrounding watercourses via direct runoff from hardened surfaces and materials from stockpiles and workshops. This runoff will likely contain contaminants and occur at elevated velocities. Impacts to be expected in this phase can largely be related to water quality and quantity impacts.

5.3.4.3.1 Mitigation Actions

- The implementation of the buffer zones provided in this report;
- Clean and dirty surface water separation and storm-water management plan must be put into place via standard best practice methods;
- An effective storm-water management plan for the solar farm must be implemented;
- The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase;
- The above must be audited within 3 months of completing the phase;
- No discharge of domestic water must occur if possible. Domestic water must be reused for dust suppression. Should domestic water be required to be discharge, the management of nitrogen concentrations is imperative.
- All stockpiles and hazardous waste storage areas must be bunded by either a cut-off trench directed to a Pollution Control Dam or via a berm.

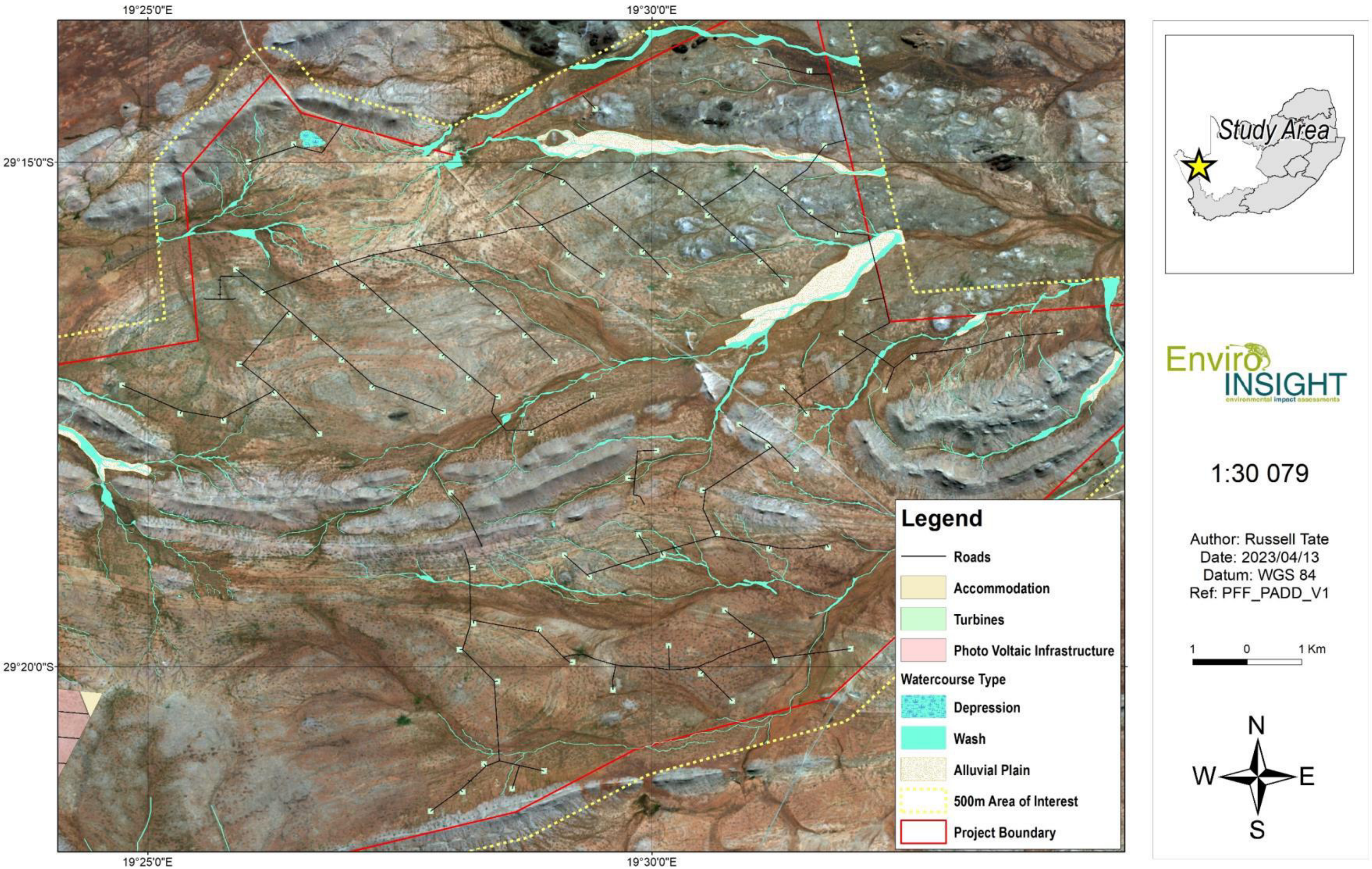

Figure 5-1: Proposed Project Layout

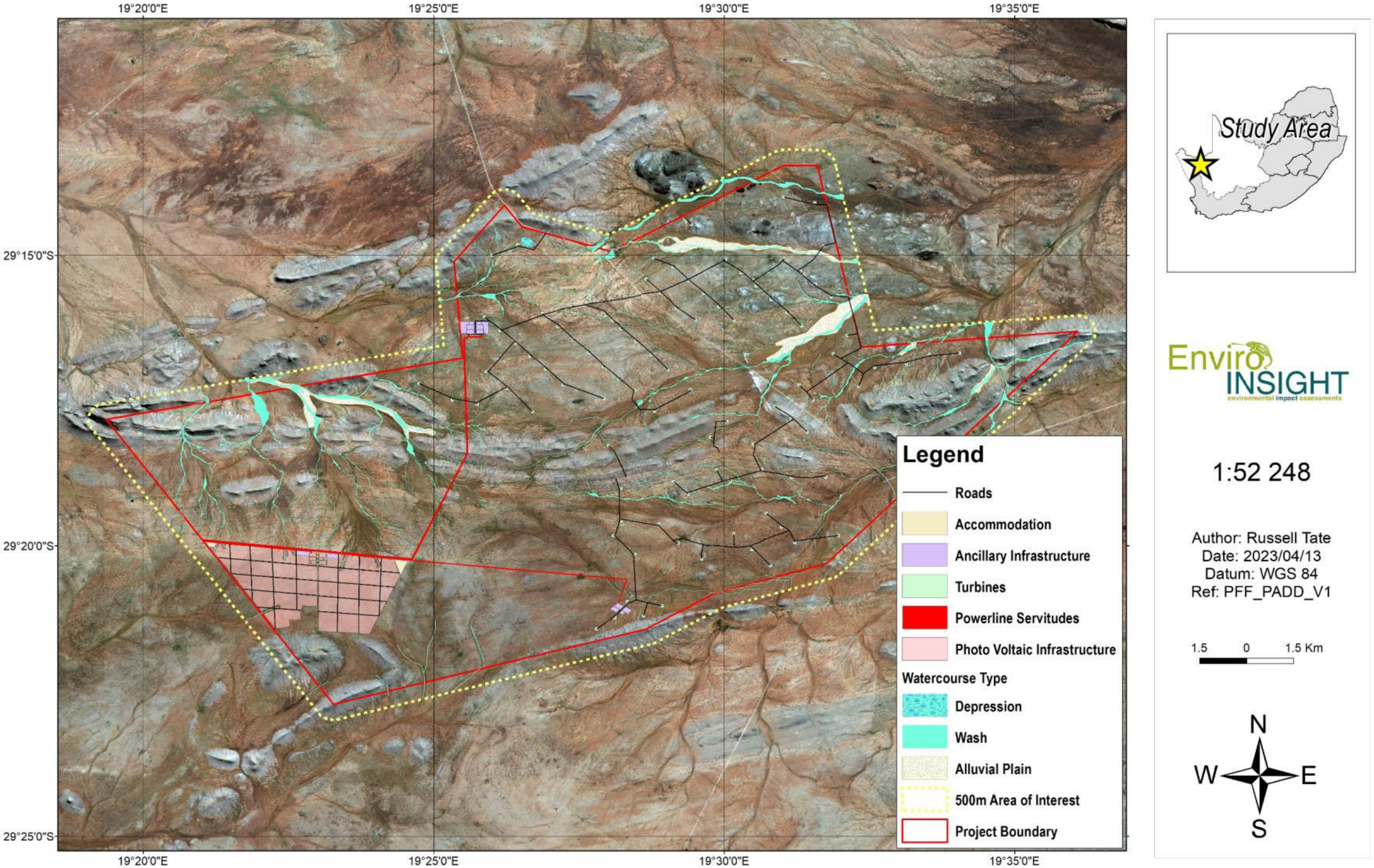

Figure 5-2: Cumulative project layout

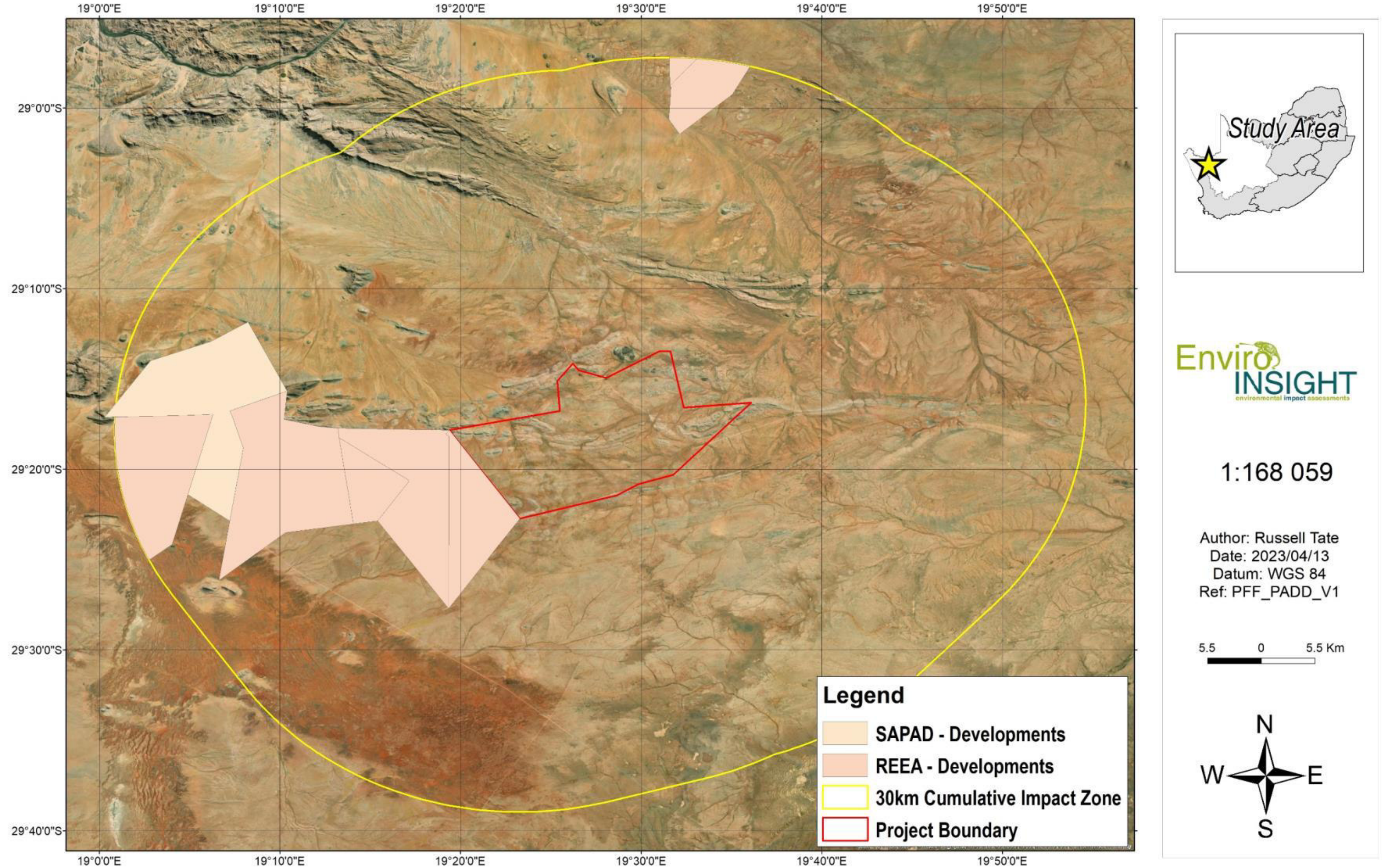

Figure 5-3: Cumulative Project Layout – Including Regional Applications

5.3.5 Risk Assessment Tables

Table 5-11: Department of Water and Sanitation Risk Assessment Compiled by Russell Tate (Pr. Sci. Nat.) – Linear, Turbine and Solar Activities

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Operation of equipment and machinery	1	1	2	1	1.25	1	3	5.25
Clearing vegetation	1	1	2	1	1.25	1	3	5.25
Stockpiling of and placement construction materials	1	1	2	1	1.25	1	3	5.25
Excavating/shaping landscape	2	1	2	2	1.75	1	1	3.75
Final landscaping, backfilling and postconstruction rehabilitation	2	1	2	2	1.75	1	1	3.75
Operational Phase								
Alteration of drainage	1	1	1	1	1	1	1	3
Alteration of surface water flow dynamics	1	1	1	1	1	1	1	3
Establishment of alien plants on disturbed areas	1	1	1	1	1	1	1	3

Table 5-12: Department of Water and Sanitation Risk Assessment Compiled by Russell Tate (Pr. Sci. Nat.) – Linear, Turbine and Solar Activities

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Operation of equipment and machinery	2	2	0	3	7	36.75	Low	Low
Clearing vegetation	2	2	0	3	7	36.75	Low	Low
Stockpiling of and placement construction materials	2	2	0	3	7	36.75	Low	Low
Excavating/shaping landscape	2	2	0	3	7	36.75	Low	Low
Final landscaping, backfilling and postconstruction rehabilitation	2	2	0	3	7	36.75	Low	Low
Operation Phase								
Alteration of drainage	3	2	0	3	8	24	Low	Low
Alteration of surface water flow dynamics	3	2	0	3	8	24	Low	Low
Establishment of alien plants on disturbed areas	3	2	0	3	8	24	Low	Low
In accordance with General Notice 509 "Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below								

Table 5-13: NEMA Impact Assessment – Pre-mitigation

Phase	Construction					Operation		
Activity	Operation of equipment and machinery	Clearing vegetation	Stockpiling of and placement construction materials	Excavating/shaping landscape	Final landscaping, backfilling and postconstruction rehabilitation	Alteration of drainage	Alteration of surface water flow dynamics	Establishment of alien plants on disturbed areas
Spatial Scale	1	1	1	1	1	1	1	1
Duration	3	3	3	3	3	4	4	4
Severity	2	3	2	3	2	3	3	3
Frequency	1	1	1	1	1	5	5	5

Probability	4	4	4	4	4	4	4	4
Significance Rating	30	35	30	35	30	72	72	72
Significance interpretation	Low	Low	Low	Low	Low	Low-medium	Low-medium	Low-medium

Table 5-14: NEMA Impact Assessment – Post Avoidance and Mitigation

Phase	**Construction**				**Operation**			
Activity	**Operation of equipment and machinery**	**Clearing vegetation**	**Stockpiling of and placement construction materials**	**Excavating/shaping landscape**	**Final landscaping, backfilling and postconstruction rehabilitation**	**Alteration of drainage**	**Alteration of surface water flow dynamics**	**Establishment of alien plants on disturbed areas**
Spatial Scale	1	1	1	1	1	1	1	1
Duration	3	3	3	3	3	4	4	4
Severity	2	3	2	3	2	3	3	3
Frequency	1	1	1	1	1	5	5	5
Probability	1	1	1	1	1	1	1	1
Significance Rating	12	14	12	14	12	48	48	48
Significance interpretation	Low	Low	Low	Low	Low	Low	Low	Low

5.4 Unplanned Events

The planned activities of the development will have known impacts which were discussed; however, there is potential for unanticipated impacts on a watercourse which result from accidents or equipment failure. As a result, these risks are undefined as the size, volume, toxicity etc. are unknown making assessing the risk unfeasible; however, their potential for modification of a system should still be noted. Due to the unanticipated nature of these risks, capturing them all is impossible. Hydrocarbon spillages into riverine habitat has the potential to contaminate both sediments and water resources. As a result, spill kits must be always available on site with all incidents reported to the onsite Environmental Control Officer (ECO). During construction, unplanned erosion may occur from, for example bank collapse during construction which will result in the sedimentation of the watercourse downstream. Erosion control measures must therefore be considered.

Table 5-15 is a summary of the findings from a riverine ecology perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases.

Table 5-15: Unplanned Events and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spill	Contamination of sediments and water resources associated with the spillage.	A spill response kit must be always available. The incident must be reported on and if necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of downstream river reach.	Erosion control measures must be put in place. Monitoring and active engagement with local land users is recommended to monitor for erosion in the long term.

5.5 Cumulative Impact Statement

The expected cumulative impacts for the proposed project on aquatic biodiversity are minimal should the avoidance and mitigation measures be implemented (Figure 5-2 and Figure 5-3). The nature of the soils, gentle topography and aridity of the region has significant effects on the runoff potential during storm events whereby anticipated impacts are minimal.

5.6 Irreplaceable Loss

Should the mitigation and avoidance actions as recommended in this study be implemented, no irreplaceable loss of aquatic biodiversity can be expected.

6 Aquatic Ecology Minimum Requirements Statements

The National Environmental Management Act (NEMA) has established minimum criteria that must be considered in aquatic biodiversity studies (RSA Government, 2020).

Although these aspects were largely covered in this report, specific aspects relating to the anticipated impacts remain. The following table was compiled to directly address the remaining aspects not already covered by the impact and risk assessment (Table 6-1).

Table 6-1: Additional aspects required by the minimum report requirement notice

Condition	Response
2.5.1: Is the proposed development consistent with maintaining the priority aquatic ecosystems in its current state and according to the stated goal.	No NFEPA areas to be significantly effected.
2.5.2: Is the proposed development consistent with maintaining the resource quality objectives.	No applicable Resource Quality Objectives anticipated to be impacted.
2.5.3a: How will the project impact on the hydrological functioning at a landscape level.	The project will likely reduce infiltration rates and increase the catchment hardness.
2.5.3a: Will the proposed development change the sediment regime of the aquatic ecosystem.	A minor increase in sediment yields can be expected from the project.
2.5.3c: What will the extent of the modification in relation to the overall aquatic ecosystem be.	Should avoidance be implemented limited impacts to watercourse extents can be expected.
2.5.3d: To what extent will the risks associated with water uses and related activities change.	There will be a minimal impact to water users associated with the project.
2.5.4a: How will the proposed development effect base flows.	Baseflows are likely to be reduced via the activities.
2.5.4b: How will the proposed development effect the quantity of water.	It is expected that an increase peak flow will occur in the associated watercourses.
2.5.4b: How will the proposed development effect the hydrogeomorphic characteristics of the watercourse.	There are no likely impacts to the hydrogeomorphic features.
2.5.4b: How will the proposed development effect the quality of water.	No to minor effects on water quality are expected.
2.5.4b: How will the proposed development effect habitat fragmentation.	There is unlikely to be habitat fragmentation in the watercourses considered.
2.5.4f: How will the proposed development effect unique or important aquatic features.	No unique or important features are likely to be impacted.
2.5.5a: How will the proposed development impact on flood attenuation.	No impact to flood attenuation can be expected given the aridity of the region.
2.5.5b: How will the proposed development impact on streamflow regulation.	Limited impacts to streamflow are anticipated.
2.5.5c: How will the proposed development impact on sediment trapping.	Sediment trapping of natural vegetation will be reduced by the project. Sediment trapping in watercourses was already regarded as limited and therefore the project will have a limited impact on sediment trapping.
2.5.5d: How will the proposed development impact on phosphate assimilation.	Phosphate assimilation is expected to be retained where limited impacts to assimilation processes can be expected.
2.5.5e: How will the proposed development impact on nitrate assimilation.	Nitrate assimilation is expected to be retained where limited impacts to assimilation processes can be expected.
2.5.5f: How will the proposed development impact on toxicant assimilation.	Toxicant assimilation is expected to be retained where limited impacts to assimilation processes can be expected.
2.5.5g: How will the proposed development impact on erosion control.	The proposed project will implement erosion/surface water controls and will therefore minimise erosion risk.
2.5.5h: How will the proposed development impact on carbon storage	Carbon storage in watercourses is unlikely to be impacted.
2.5.6: How will the proposed development impact on freshwater ecology with regards to the community composition	The proposed project is unlikely to effect freshwater ecology.

7 Recommendations and Monitoring

The following monitoring plan is provided Table 7-1.

Table 7-1: Monitoring plan for the project

Location	Monitoring objectives	Frequency of monitoring	Parameters to be monitored
Crossing points associated with linear infrastructure	Determine if erosion is occurring	Once every 2 years	Habitat condition
Depression systems	Determine if avoidance has been implemented	Once every 2 years	It is proposed that live sampling take place and water quality measured. Should no water be present, substrate zooplankton sampling and hatching must take place

The following are recommendations made in support of this study:

- Several areas associated with the proposed grid connection were not surveyed during the study, it is recommended that access to the farms is obtained and the study updated.
- It is recommended that the avoidance actions proposed in this study are implemented where-after final road and turbine layouts must be re-assessed.
- It is recommended that floodlines are determined for the project.
- General authorisations are recommended for the proposed wash crossings where required.

8 Conclusion

The outcome of this assessment delineated 11 watercourse units within the AoI. These watercourses were considered to be minimally modified and in a largely natural PES. The watercourses were classified as having Very High and Moderate EIS ratings. A scientific buffer was calculated for the watercourses, however inline with the precautionary principle, and given the highly variable nature of the washes, it was proposed that a 100m buffer for depressions and a 40m wash buffer was utilised to protect these sensitive environments.

8.1 Impact Statement

The outcomes of the risk assessment indicate minor impacts from the proposed activities. The minor impacts can be attributed to low runoff potential, gentle topography and arid conditions. Should avoidance and basic mitigation actions be implemented, limited impacts to aquatic biodiversity can be expected.

In the view of the proposed new activities, should the proposed mitigation actions be implemented, no fatal flaw was identified. In line with the recommendations, avoidance must be implemented.

9 References

Allan DG, Seaman MT and Keletja B. 1995. The endorheic pans of South Africa. In: Cowan GI (ed.), Wetlands of South Africa. Department of Environmental Affairs and Tourism, Pretoria, South Africa.

Department of Water and Forestry (DWAF). 2005. A practical filed procedure for identification and delineation of wetlands and riparian areas. Pretoria, Republic of South Africa.

Ferreira M, Wepener V and van Vuren JHJ. 2012. Aquatic invertebrate communities of perennial pans in Mpumalanga, South Africa: a diversity and functional approach. African Invertebrates 53 (2): 751-68.

Hamer M Rayne NA. 1996. A note on the unusual crustacean community of a temporary pool in the Northern Cape. South African Journal of Aquatic Science 22:100-104.

Kleynhans CJ. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. Journal of Aquatic Ecosystem Health 5: 41–54.

Kotze D, Macfarlane D, Edwards R. June 2020. Wet-EcoServices (Version 2). A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas. WRC Project K5/2737.

Kotze DC, Marneweck GC, Batchelor AL, Lindley DC, Collins NB. 2009. A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.

Land Type Survey Staff. (1972 - 2006). Land Types of South Africa: Digital Map (1:250 000 Scale) and Soil Inventory Databases. Pretoria: ARC-Institute for Soil, Climate, and Water.

Liefferink SL, Tate RB, van Vuren JHJ, Ferreira M and Malherbe W. 2014. A comparison of methods for incubating zooplankton diapausing eggs from sediment of endorheic pans in Free State, South Africa.

Macfarlane DM, Dickens J, Von Hase F. 2009. Development of a methodology to determine the appropriate buffer zone width and type for developments associated with wetlands, watercourses and estuaries.

Macfarlane DM, Kotze DC, Ellery WN, Walters D, Koopman V, Goodman P, Coge C. 2008. WET-Health, a technique for rapidly assessing wetland health. WRC Report TT 340/08. Water Research Commission.

Mucina L, Rutherford MC. 2006. The vegetation of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria, South Africa.

National Biodiversity Assessment (NBA). 2018. National Wetland Map 5 dataset. South African National Biodiversity Institute (SANBI).

Ollis DJ, Snaddon CD, Job NM, Mbona N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

RSA Government. 2016. General Authorisation in Terms of Section 39 of the National Water Act, 1998 (Act no. 36 of 1998) For Water Uses as Defined in Section 21 (c) or Section 21 (i). Department of Water and Sanitation. Notice 509 of 2016.

RSA Government. 2020. Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24 (5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation. Government Gazette Number 43110. Number 320 of 2020.

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), Online, http://bgis.sanbi.org/Projects/Detail/186, Version 2018.

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

Thompson M. 2019. South African National Land-Cover 2018 Report and Accuracy Assessment. GeoTerraImage SA Pty Ltd.

WaPOR. 2022. https://wapor.apps.fao.org/home/WAPOR_2/1. Accessed 2022/08/10.