Wetland assessment 2022 / 08 / 04 ECO

AQUATIC BIODIVERSITY ASSESSMENT, WETLAND DELINEATION AND ASSESSMENT FOR THE PROPOSED NAOS SOLAR PV PROJECT TWO ON PORTION 2 OF THE FARM WATERFORD NO. 573, NEAR VILJOENSKROON IN THE FREE STATE PROVINCE.

January 2023

Prepared for: SOLA Group
Document version 2.0 – Final
Compiled by: M Van der Westhuizen

AQUATIC BIODIVERSITY ASSESSMENT, WETLAND DELINEATION AND ASSESSMENT FOR THE PROPOSED NAOS SOLAR PV PROJECT TWO ON PORTION 2 OF THE FARM WATERFORD NO. 573, NEAR VILJOENSKROON IN THE FREE STATE PROVINCE.

January 2023

Conducted for:

SOLA Group

Compiled by:

M van der Westhuizen *(Pri.Sci.Nat.)*, MSc Environmental Sciences

An associate of Touching Africa

REPORT DISTRIBUTION LIST

Name	Institution
Ms. Abigail Forbes	SOLA Group
Ms. Lisa de Lange	Environamics
Relevant official	Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs
	Interested and affected parties

DOCUMENT HISTORY

Report no	Date	Version	Status
2022 / 08 / 04 ECO	August 2022	1.0	Draft
2022 / 08 / 04 ECO	January 2023	2.0	Final

CURRICULUM VITAE

Mari van der Westhuizen

(M.Sc. Environmental Sciences, Professional Natural Scientist: Ecological Science)

PERSONAL DETAILS

Name:	Mari van der Westhuizen
Maiden name:	La Grange
Nationality:	South African
Date of birth:	26 October 1985
E-mail address:	mariwesthuizen@gmail.com
Cell phone number:	+27 82 257 1715
Identity number:	851026 0045 083

KEY QUALIFICATION

M. Sc. Environmental Sciences (2010)

B.Sc. Honours in Ecological Remediation and Sustainable Usage (2007)

B. Sc. with Microbiology and Botany at the North West University, Potchefstroom Campus (2006)

AWARDS AND PRIZES

Best Second year Microbiology student (2005)

Best M.Sc. in Botany (2010)

SHORT COURSES COMPLETED

Tools for Wetland Assessment (2015) Rhodes University

Multivariate Statistics course (CANOCO) (2009) University of Kwazulu-Natal

MEMBERSHIP WITH PROFESSIONAL BODIES AND ASSOCIATIONS

Registered as a Professional Natural Scientist in Ecological Science at the South African Council for Natural Scientific Professions (SACNASP), with registration number 400166/15.

South African Association of Botanists (SAAB)

KEY RELEVANT EXPERIENCE

10 years' experience:

- Terrestrial ecology and biodiversity specialist surveys for Environmental Authorisations (Environmental Impact Assessments).
- Protected tree counts.
- Declared invader surveys.
- Wetland specialist assessments for EIA's.
- GIS mapping and data processing (ArcGIS and QGIS).
- Writing and reviewing scientific reports.
- Desktop studies for a variety of projects (environmental, geology, hydrogeology).
- Teaching (science, botany, and geography).

DECLARATION OF INDEPENDENCE

I, Mari van der Westhuizen, hereby confirm my independence as a specialist and declare that I do not have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which I was appointed as ecologist in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the aquatic biodiversity impact assessment, wetland delineation and wetland risk matrix assessment for the proposed Naos Solar PV Project Two development on Portion 2 of the farm Waterford No. 573, near Viljoenskroon in the Free State Province.

Full Name: Mari van der Westhuizen

Title / Position: Ecologist

Qualification(s): B.Sc. in Botany and Microbiology (2006) North West University;

B.Sc. Honours in Ecological Remediation and Sustainable Usage (2007) North West University;

M.Sc in Environmental Sciences (2010) North West University

Experience (years): 10

Registration(s): SACNASP (Pri.Sci.Nat. # 400166/15 – Ecological Science)

Phone no: +27 82 257 1715 **Email**: mariwesthuizen@gmail.com

List of abbreviations	
BAR	Basic Assessment Report
CBA	Critical Biodiversity Areas
DFFE	Department of Forestry, Fisheries and the Environment
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
ESO	Environmental Site Officer
EIA	Ecological Impact Assessment
EIS	Ecological Sensitivity and Importance
EMPr	Environmental Management Programme
ENPAT	Environmental Potential Atlas
ESA	Ecological Support Areas
GA	General Authorisation
HGM type	Hydrogeomorphic type
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWM5	National Wetland Map version 5
MW	Megawatt
PA	Protected Areas
PES	Present Ecological State
PESC	Present Ecological Status Class
PV	Photovoltaic
SAAB	South African Association of Botanists
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
UVB	Unchannelled Valley Bottom
WUL	Water Use License

Table of Contents

List of Figures

List of Tables

List of Photographs

1 BACKGROUND

1.1 Assignment

Mari van der Westhuizen was requested by SOLA Group to complete an aquatic biodiversity impact assessment, wetland delineation and wetland risk matrix assessment for the proposed Naos Solar PV Project Two development on Portion 2 of the farm Waterford No. 573, near Viljoenskroon in the Free State Province (Figure 2).

The proposed solar PV project will produce 300 MW of energy and have a footprint up to 600 Ha. The term photovoltaic describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun through a process known as the Photovoltaic Effect. This refers to light energy placing electrons into a higher state of energy to create electricity. Each PV cell is made of silicon (i.e. semiconductors), which is positively and negatively charged on either side, with electrical conductors attached to both sides to form a circuit. This circuit captures the released electrons in the form of an electric current (direct current).

The infrastructure will consist of multiple PV panels, a Battery Energy Storage System (BESS), Inverters and other supporting infrastructure. The power will be evacuated into the national grid via the new proposed power line from the proposed collector substation to the 400kV Mercury Main Transmission Substation.

This report includes a detailed impact assessment of the proposed development on the watercourses or wetlands of the site. One of the main purposes was to compile a specialist report on the abovementioned aspects that will form part of the Water Use License (WUL) application, especially where the development will impede on wetlands, watercourses or other hydrological features. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in conjunction with Regulation 982 of December 2014, promulgated in terms of Section 24 (5) of NEMA and Chapter 4 of the National Water Act, Act 36 of 1998. The assignment is interpreted as follows:

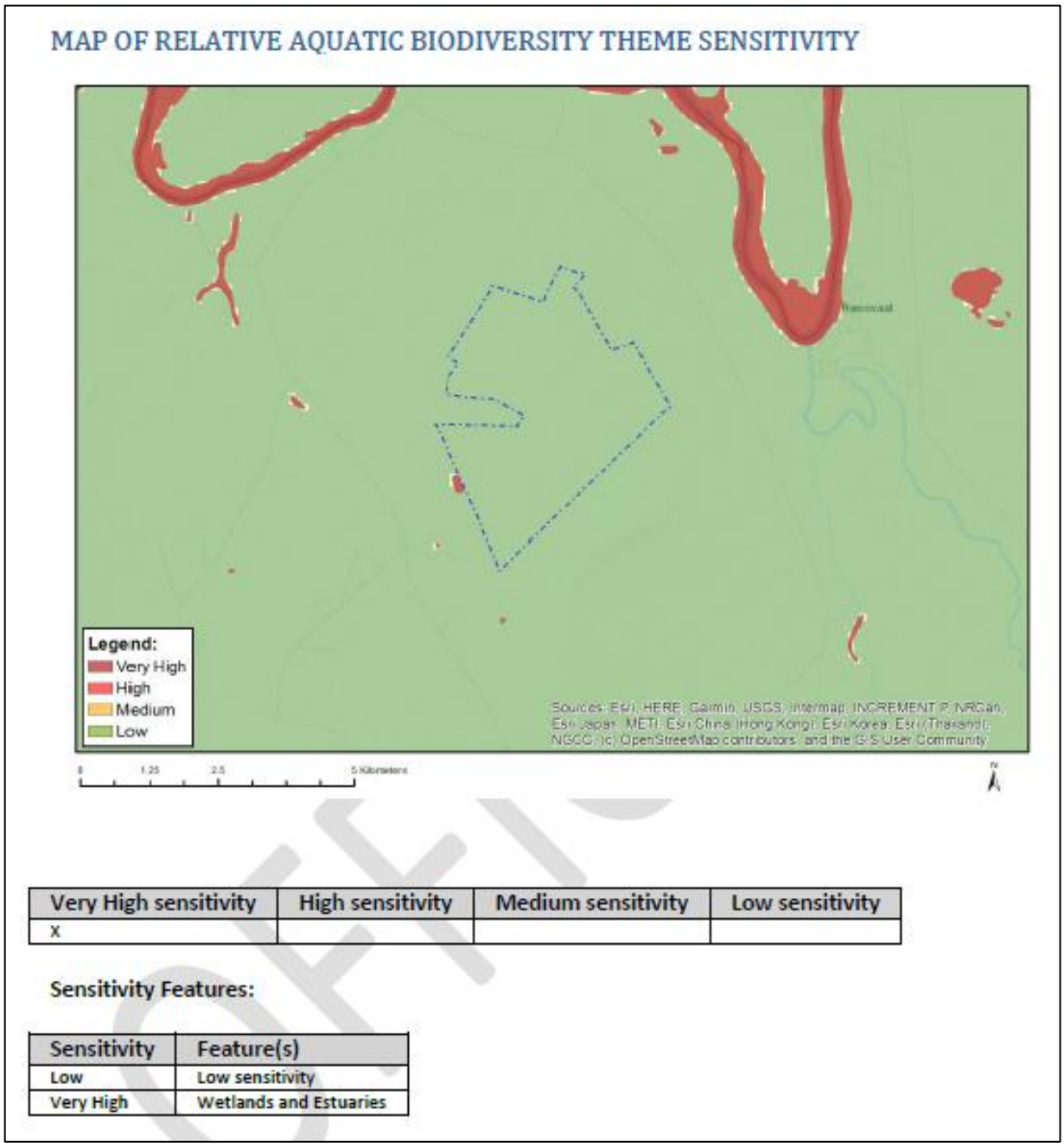
Compile a study on the wetlands of the site as per the guidelines and criteria set by the Department of Water and Sanitation. The study includes a wetland / riparian delineation and functionality assessment (Present Ecological State Ecological Importance and Sensitivity and Wet-EcoServices), with descriptions of the anticipated impacts (risks) associated with the proposed development activities and mitigation to

reduce impacts.

1.2 EIA Screening Tool

According to the national web-based environmental screening tool in terms of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), the site has the following sensitivities:

- Aquatic Biodiversity: Low Sensitivity for the project area (solar PV park) and Very high sensitivity for the grid connection corridors (Figure 1).



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands and Estuaries

Figure 1: Aquatic biodiversity theme sensitivity according to the Screening Tool

A site sensitivity verification was therefore conducted to determine if the assessment was accurate and if the studies recommended must be conducted. After the site visit the following was concluded:

- The site has a Medium sensitivity from an Aquatic biodiversity perspective. Although there are only two artificial wetlands in the project area where the solar farm will be constructed, there are two Unchannelled Valley Bottom Wetlands in the proposed grid connection corridors. These wetlands are both disturbed by roads, fences, dams and other infrastructure.

1.3 Information sources

The following information sources were obtained for the study:

1) All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to wetlands and watercourses in the study area;
2) Requirements regarding the wetland survey as stipulated in the following guidelines:
3) Practical field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2005);
4) National Wetland Classification System for South Africa (SANBI, 2009);
5) WET-Health (Version 2.0): A refined suite of tools for assessing the present ecological state of wetland ecosystems (Macfarlane *et al*., 2020).
6) Ecological Importance & Sensitivity assessment (DWAF, 1999)
7) A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas (Kotze *et al*., 2020)
8) Guidelines regarding development in and around wetlands as stipulated by the Department of Water Affairs (DWA) and the Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs;

1.4 REGULATIONS GOVERNING THIS REPORT

1.4.1 National Environmental Management Act, 1998 (Act No. 107 of 1998)

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity, gazetted 20 March 2020 (Government Notice number 320).

The compliance statement (for a site with a low sensitivity in terms of the aquatic biodiversity) must contain, as a minimum, the following information:

1) contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;
2) a signed statement of independence by the specialist;
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;
4) a baseline profile description of biodiversity and ecosystems of the site;
5) the methodology used to verify the sensitivities of the aquatic biodiversity features on the site including the equipment and modelling used where relevant;
6) in the case of a linear activity, confirmation from the aquatic biodiversity specialist that, in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase;
7) where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr;
8) a description of the assumptions made as well as any uncertainties or gaps in knowledge or data; and
9) any conditions to which this statement is subjected.

1.4.2 The National Water Act (Act No. 36 of 1998)

Chapter 4 of the National Water Act, Act 36 of 1998 specifies that:

> *"In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence. The Minister may limit the amount of water which a responsible authority may allocate. In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas."*

In section 21 of the NWA water uses are listed as:

1) Taking water from a water resource;
2) Storing water;
3) Impeding or diverting the flow of water in a watercourse;
4) Engaging in a stream flow reduction activity contemplated in section 36;

5) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
6) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
7) Disposing of waste in a manner which may detrimentally impact on a water resource;
8) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
9) Altering the bed, banks, course or characteristics of a watercourse;
10) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
11) Using water for recreational purposes.

1.4.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

This Act controls the utilisation and protection of wetlands, soil conservation and all matters relating thereto including prevention of veld fires, control of weeds and invader plants, prevention of water pollution resulting from farming practices and losses in biodiversity.

1.4.4 The National Environmental Management Act (NEMA) (Act No. 107 of 1998)

This Act embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

1.4.5 National Environmental Management: Biodiversity Act (10 of 2004)

The National Environmental Management: Biodiversity Act (10 of 2004), (NEMBA) was signed into law in mid-2004 and entered into effect on 1 September 2004. The Act provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management

authorities.

Certain activities, known as Restricted Activities, are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling.

1.5 Limitations and assumptions

The survey was conducted on the 15th of March, the 2nd of June and 14 to 15 July 2022. The depression wetlands were surveyed in March and June and the valley bottom wetlands were surveyed in July. The assessment of wetlands in winter is possible as one considers both the soil and vegetation. Although vegetation dies back in the winter, the soil remains the same. More plant species will be identifiable in summer than in winter. It is likely that not all plant species were identifiable and therefore recorded in July, but this is not essential for a successful wetland survey.

Due to the scale of the remote imagery used (Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetland areas in the field, the delineated boundaries cannot be guaranteed beyond an accuracy of about 10m on the ground. Should greater accuracy of the riparian boundary mapping be required, the boundaries will need to be pegged in the field and mapped using conventional survey techniques.

2 INTRODUCTION

Wetlands provide a wide range of ecosystem services, such as water purification, flood attenuation and streamflow regulation, carbon storage, biodiversity maintenance, recreation and many others (Kotze *et al*., 2021). Wetlands are therefore important ecosystems and are protected by law.

2.1 Definitions

The National Water Act (no. 36 of 1998) (NWA) 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."*

Wetlands are also included in the definition of a watercourse within the NWA, which implies that whatever legislation refers to a watercourse, will also be applicable to wetlands. The National Water Act (36 of 1998), Section 1(1)(xxiv), defines a '**watercourse'** as:

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

The NWA defines **riparian areas** as

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

General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998) states the following:

> In accordance with GN 509 of 2016, a **regulated area of a watercourse** for Section 21(c) and 21(i) of the NWA, 1998 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.
- In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench: or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

3 BACKGROUND TO THE STUDY AREA

3.1 Location and description of activity

The project area is on Portion 2 of the Farm Waterford No. 573, near Viljoenskroon in the Free State Province (Figure 2). The proposed grid connection corridors traverse the following farms:

Power Line Alternatives 1A, 1B and 1C (1B is the technically preferred alternative)

- Portion 1 of the Farm Waterford No. 573
- Portion 1 La Reys Kraal Zuid No. 165
- Portion 2 of the Farm Kleinfontein No. 369
- Remaining Extent of the Farm Kleinfontein No. 369
- Portion 2 of the Farm Zaaiplaats No. 190
- Portion 3 of the Farm Zaaiplaats No. 190
- Portion 2 of the Farm Biesiefontein No. 173
- Farm Doornplaats 599

Power Line Alternative 2

- Portion 1 of the Farm Waterford No. 573
- Portion 1 La Reys Kraal Zuid No. 165
- Portion 2 of the Farm Kleinfontein No. 369
- Remaining Extent of the Farm Kleinfontein No. 369
- Portion 2 of the Farm Zaaiplaats No. 190
- Portion 3 of the Farm Zaaiplaats No. 190
- Portion 2 of the Farm Biesiefontein No. 173

Power Line Alternative 3

- Portion 1 of the Farm Waterford No. 573
- Portion 1 La Reys Kraal Zuid No. 165
- Portion 1 of the Farm Kleinfontein No. 369
- Portion 2 of the Farm Kleinfontein No. 369
- Remaining Extent of the Farm Kleinfontein No. 369
- Portion 3 of the Farm Zaaiplaats No. 190
- Portion 2 of the Farm Biesiefontein No. 173

Power Line Alternative 4

- Portion 1 of the Farm Waterford No. 573
- Portion 2 of the Farm Waterford No. 573
- Portion 2 of the Farm Biesiefontein No. 173
- Portion 4 of the Farm Biesiefontein No. 173
- Remaining Extent of the Farm Biesiefontein No. 173
- Portion 1 of the Farm Kleinfontein No. 369
- Portion 3 of the Farm Zaaiplaats No. 190

3.2 Climate

The climate for Klerksdorp is given, as it is the closest town with weather data available. Klerksdorp is 1308m above sea level. Klerksdorp's climate is a local steppe climate. The climate here is classified as BSh by the Köppen-Geiger system. The average annual temperature for the region is 18.1 °C. The annual rainfall is around 610 mm (Climate-data.org, 2022).

3.3 Geology and soil types

Geology is directly related to soil types and plant communities that may occur in a specific area. A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area is mostly the Bd 13 land type, with a small section falling into the Bc25 land type (Land Type Survey Staff, 1987) (ENPAT, 2000). The land type, geology and associated soil types is presented in **Error! Reference source not found.** below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 1: Land types, geology, and dominant soil types of the proposed development site

Landtype	Soils	Geology
Bc25	Plinthic catena: eutrophic; red soils widespread, upland duplex and margalitic soils rare	Diabase and Hekpoort lava predominantly. Shale, slate and quartzite of the Pretoria Group. Ecca shale and sandstone in the south. Quartzite usually forms

Landtype	Soils	Geology
		crests and scarps. Footslopes usually on diabase, lava, shale and slate.
Bd13	Plinthic catena: eutrophic; red soils not widespread, upland duplex and margalitic soils rare	Mainly Ecca sandstone; Ecca shale and mudstone may occur in places. Sporadic occurrence of dolerite and diabase. Pretoria Group quartzite and shale in the north-east. Aeolian sand overlies most rocks. Pans occupy 2% of land type.

3.4 Topography, land uses and drainage

The area slopes gently towards the Vaal River in the North. Drainage occurs towards the to the North, into the Vaal River. The site is located within the C24B quaternary catchment and is situated in the Middle Vaal Water Management Area.

3.5 Vegetation

The project area is situated in the Grassland biome (Mucina & Rutherford, 2006), which is characterised by herbaceous vegetation of relatively short and simple structure that is dominated by graminoids, usually of the family Poaceae. Woody plants are rare (usually low to medium-sized shrubs) or absent or are confined to specific habitats, such as smaller escarpments or koppies. Core grassland areas usually have deep, fertile soils although a wide spectrum of soil types occur. Precipitation is strongly seasonal, and the growing season lasts approximately half the year (Mucina & Rutherford, 2006).

The project area overlaps the **Vaal-Vet Sandy Grassland and Rand Highland Grassland** vegetation units (Mucina *et al*., 2018). The Vaal-Vet Sandy Grassland vegetation unit is described as plains-dominated landscape with some scattered slightly irregular undulating plains and hills. Mainly low tussock grasslands with an abundant karroid element. *Themeda triandra* is dominant in this vegetation unit. The conservation status of this vegetation unit is **Endangered**. The National Biodiversity Assessment lists it as Endangered, and the protection level is **Not protected** (SANBI,

2018).

The Rand Highland Grassland vegetation unit is described as a highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the family Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp*. caffra, P. welwitschii, Senegalia caffra and Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Searsia* (especially *S. magalismonata*) is most prominent. The conservation status of this vegetation unit is **Vulnerable**. The National Biodiversity Assessment lists it as Vulnerable and the protection level is **Poorly protected** (SANBI, 2018).

3.6 National Freshwater Ecosystem Priority Areas (NFEPAs)

South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters and estuaries. Consistent with global trends, high levels of threat have been reported for freshwater ecosystems. According to the National Biodiversity Assessment 2018 nearly 80% of inland wetland ecosystem types in South Africa are threatened and approximately 75% of inland wetland ecosystem types are both threatened and under-protected (SANBI, 2019). South Africa's freshwater fauna also displays high levels of threat: at least one third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs, dragonflies, crabs and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region.

Urgent attention is needed to ensure that we conserve some representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations. NFEPA responds to this need, providing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources (Driver et al., 2011)

There are no NFEPA wetlands or rivers inside the project area, there is a NFEPA wetland and river (the Vaal River) north of the project area (Figure 3) (Nel *et al*., 2011).

3.7 National Wetland Map 5

The National Wetland Map version 5 (NWM5) shows the distribution of inland wetland ecosystem types across South Africa and includes estuaries and the extent of some rivers (CSIR, 2018).

There are no NWM5 wetlands in the project area where the solar park is proposed to be developed, the proposed grid connection corridors however traverse two NWM5 wetlands. There is another NWM5 wetland south-east of the grid connection corridor (south-west of the project area) (Figure 3). This area south-east of the grid connection corridor was surveyed, and no signs of a wetland were encountered.

3.8 Critical Biodiversity Areas and Ecological Support Areas

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic.

The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. It should inform land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity. It is the biodiversity sector's input into multi-sectoral planning and decision-making processes (SANBI Biodiversity Advisor, 2017).

Most of the project area is degraded by agriculture. There is a section that falls into CBA 1, CBA 2 and ESA2 (see Figure 4) (Collins, 2015; Collins, 2016), which is mostly disturbed as well.

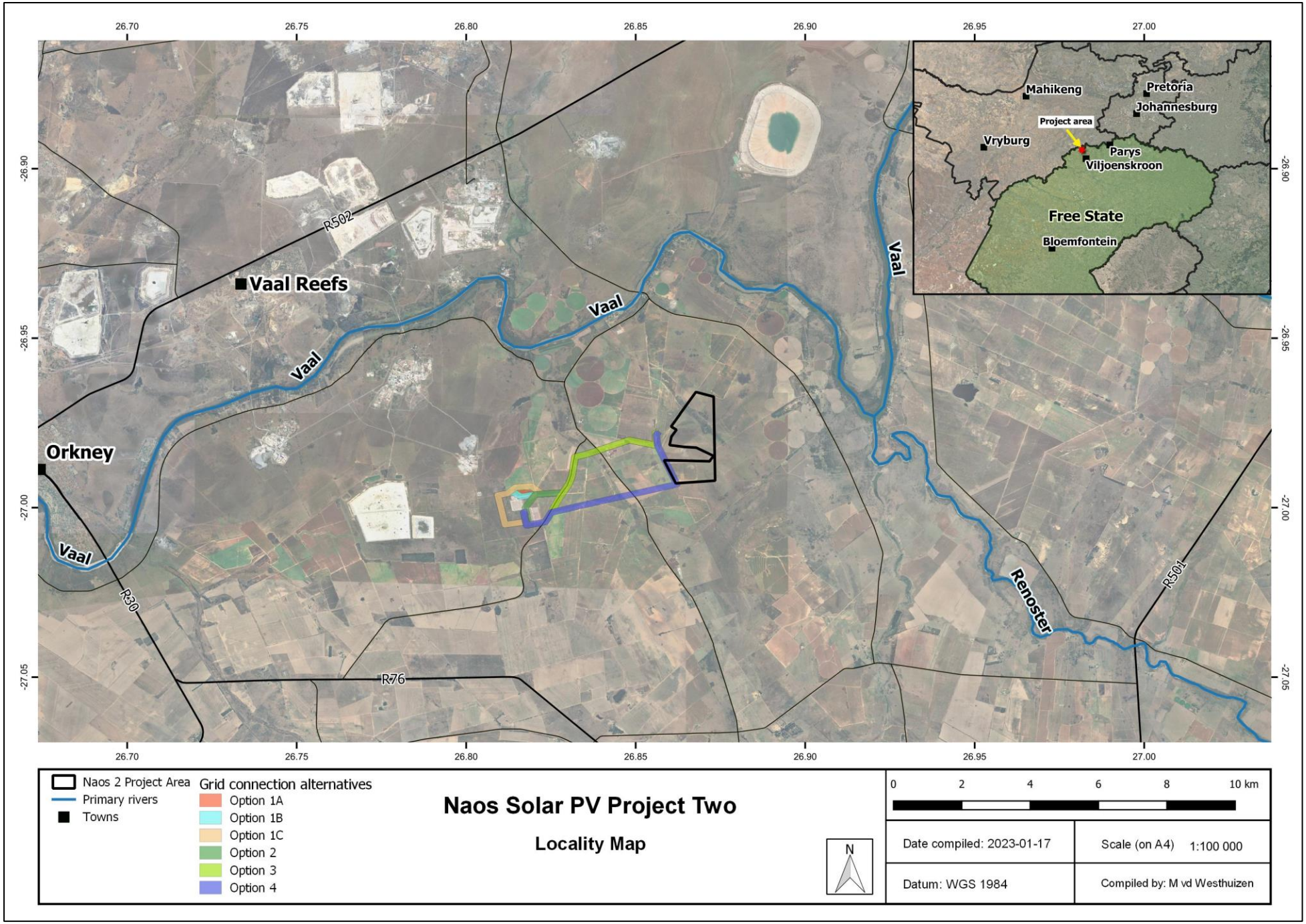


Figure 2: Locality Map

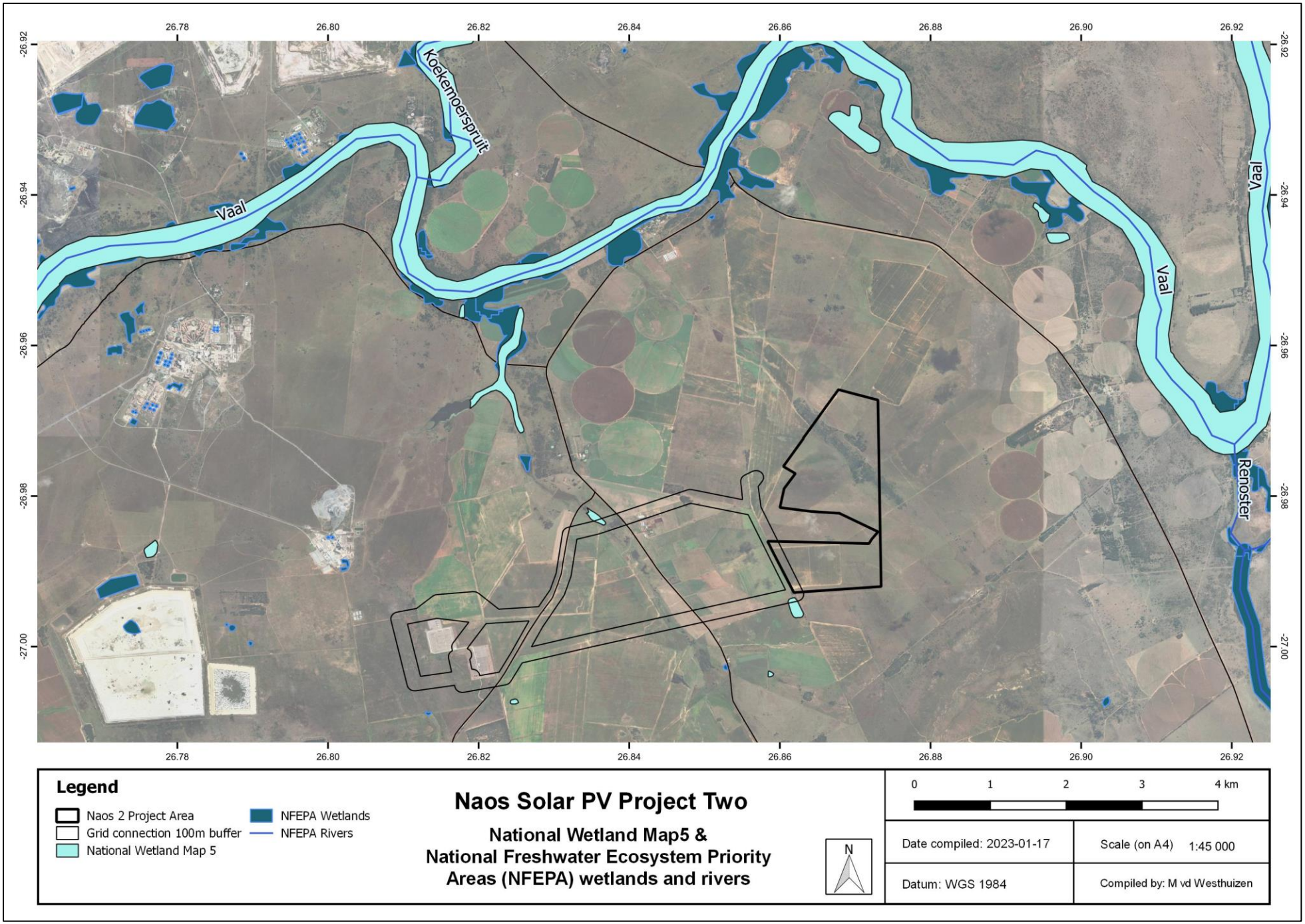


Figure 3: National Freshwater Ecosystem Priority Areas (NFEPA) wetlands and rivers

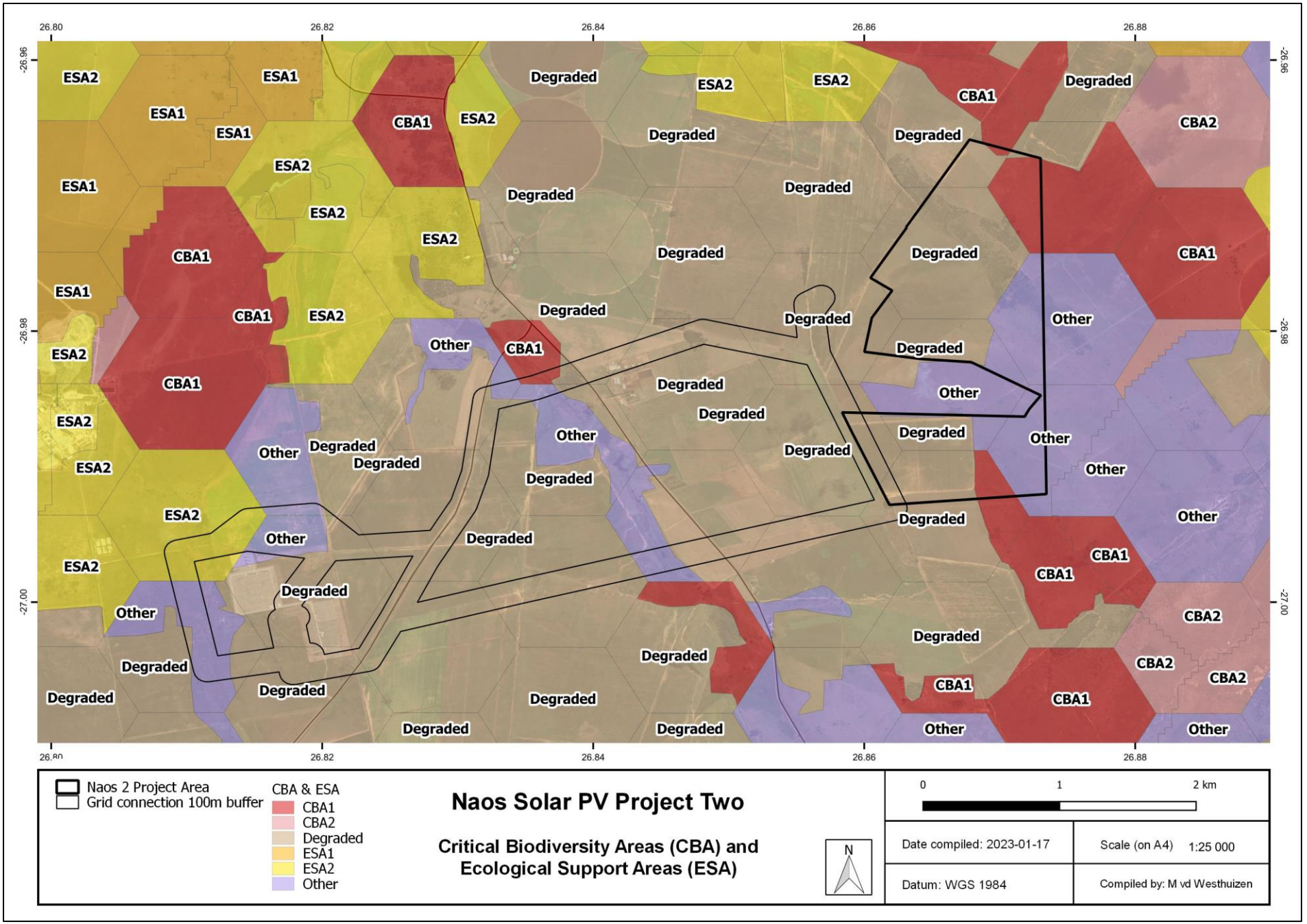


Figure 4: Critical Biodiversity Areas and Ecological Support Areas (Collins, 2015)

4 METHODS

4.1 Wetland classification

Wetlands can be classified into different hydrogeomorphic (HGM) types based on the geomorphic setting of the wetland in the landscape (e.g. valley bottom, floodplain, whether the wetland is open or closed), water source (surface water or groundwater), how water flows through the wetland (diffusely or channelled) and how water exits the wetland (Macfarlane *et al*., 2009). The HGM type of a wetland gives an indication of the structure and processes of the wetland.

4.2 Wetland delineation

Wetland delineation is essential to define the extent of a wetland. Wetland delineation procedures also determine the different zones of the wetland. Wetlands typically have three zones: the temporary, seasonal and permanent zones (Department of Water Affairs and Forestry, 2005). The wetland delineation approach developed by the Department of Water and Sanitation (previously known as the Department of Water Affairs and Forestry) is the accepted approach used by practitioners in South Africa and was therefore used for this report.

In order to identify the different wetland zones, two indicators are used namely vegetation and soil. Wetland soils (hydromorphic soils) have certain characteristics. When soil is saturated with water, anaerobic conditions persist, which leads to iron being dissolved and leached out of the soil. If the soil dries out (in the dry season for example) iron will accumulate, forming mottles. The level to which a soil is gleyed (have a grey colour due to the iron having been leached out) and the presence of mottles, indicates duration of the year that the soil is saturated with water. The permanent zone is mostly found in the centre of the wetland and is almost always saturated with water. Soils that are permanently waterlogged will be gleyed with no or little mottles, because it does not dry out and mottles are not formed. The permanent zone is surrounded by the seasonal zone, which is saturated with water for a significant duration of the rainy season. Seasonally waterlogged soils will also be gleyed, but to a lesser extent, with many mottles. The temporary zone surrounds the seasonal zone and is only saturated for short periods of the year, which is sufficient for soil to become gleyed to some extent. Few or no mottles form in the temporary zone (Department of Water Affairs and Forestry, 2005). Only the outer boundary of the wetland (temporary zone) was identified and delineated for this study.

Soil was augured to confirm the boundaries of the wetland. The wetland was mapped with a combination of the field data and satellite images. Vegetation is also an important indicator of wetlands, as most terrestrial plants are not adapted to live in waterlogged conditions. Wetland soils are low in oxygen, and plant roots needs oxygen to respire. Plants that do not have certain adaptations cannot live in wetland conditions. In anaerobic conditions (no or little oxygen) some nutrients become unavailable to plants and the concentration of certain elements can reach toxic levels. Plants adapted to these conditions are called hydrophytes and they can be used to indicate the presence and boundaries of a wetland (Department of Water Affairs and Forestry, 2005).

For the wetland delineation in this study more emphasis was placed on the vegetation. Findings were confirmed by means of soil auguring and then extrapolated with the help of satellite images.

4.3 WETLAND INTEGRITY ASSESSMENTS

4.3.1 Present Ecological Status (PES) of wetlands

WET-Health (Macfarlane *et al*., 2020) is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider ‘deviation’ from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition (Macfarlane *et al*., 2020).

Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components is illustrated schematically in Figure 5 below and forms the basis of the modular-based approach adopted in WET-Health Version 2 (Macfarlane *et al*., 2020).

Figure 5: Diagram representing the four key components of Wetland PES considered in WET-Health Version 2 (Macfarlane *et al*., 2020).

The impact categories, scores, and associated present state categories are summarised in Table 2.

Table 2: Impact scores and categories of Present Ecological State used by WET-Health for describing the integrity of the wetland.

Impact Category	Description	Impact Score Range	Present Ecological State Category
None	Unmodified, or approximates natural condition	0 – 0.9	A
Small	Largely natural with few modifications, but with some loss of natural habitats	1 – 1.9	B
Moderate	Moderately modified, but with some loss of natural habitats	2 – 3.9	C
Large	Largely modified. A large loss of natural habitat and basic ecosystem function has occurred	4 – 5.9	D
Serious	Seriously modified. The losses of natural habitat and ecosystem functions are extensive	6 – 7.9	E
Critical	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat	8 – 10.0	F

4.3.2 Ecological Importance and Sensitivity (EIS)

The EIS was determined using the methodology developed by Rountree *et al*. (2013). It is a rapid scoring system to evaluate:

- Ecological Importance and Sensitivity
- Hydrological Functions; and
- Direct human benefits.

The highest score of the three derived scores (each with range 0 – 4) was then used to indicate the overall importance category of the wetland (Table 3).

Table 3: Description of the EIS 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

4.3.3 Risk assessment matrix

A Risk Assessment, as required in terms of the General Authorisation Notice 509 of 2016 (Gazette No.40229), for any development proposed within the 1:100-year floodline. The risk assessment should be based on the following ratings (Table 4).

Table 4. Risk rating tables and methodology for the risk assessment

SEVERITY

How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, and habitat)?

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

SPATIAL SCALE

How big is the area that the aspect is impacting on?

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

DURATION

How long does the aspect impact on the resource quality?

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

FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

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

FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the resource quality?

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

LEGAL ISSUES

How is the activity governed by legislation?

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

DETECTION

How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property?

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Risk scores, classes, and the appropriate authorization process (Extract from DWS, 2016)

Rating	Class	Management Description	Authorisation	Delegation
1 - 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands are excluded.	GA	Regional Head
56 - 169	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.	WUL	Regional Head
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.	WUL	Director General

Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood
RISK ASSESSMENT MUST BE CONDUCTED BY A SACNASP REGISTERED PROFESSIONAL MEMBER AND THE ASSESSOR MUST: **1)CONSIDER BOTH CONSTRUCTION AND OPERATIONAL PHASES OF PROPOSED ACTIVITIES;** **2) CONSIDER RISKS TO RESOURCE QUALITY POST MITIGATION CONSIDERING MITIGATION MEASURES LISTED IN TABLES PROVIDED;** **3) CONSIDER THE SENSITIVITY (ECOLOGICAL IMPORTANCE AND SENSITIVITY – EIS) AND STATUS (PRESENT ECOLOGICAL STATUS - PES) OF THE WATERCOURSE AS RECEPTOR OF RISKS POSED;** **4) CONSIDER POSITIVE IMPACTS/RISKS REDUCTION AS A VERY LOW RISK IN THIS ASSESSMENT;** **5) INDICATE CONFIDENCE LEVEL OF SCORES PROVIDED IN THE LAST COLUMN AS A PERCENTAGE FROM 0 - 100%.**

5 RESULTS

5.1 WETLAND DELINEATION AND CLASSIFICATION

Figure 6 indicates the wetland delineation.

The wetlands in the project area are classified as:

1) Exorheic depression (artificial dams);
2) Unchannelled valley bottom wetland.

5.1.1 Exorheic depression (artificial dams)

The man-made dams in the project area represent depressions that are classified as exorheic depressions (Photograph 3). As the definition of an Inland System includes all inland aquatic ecosystems (i.e., not just wetlands), lakes and other open waterbodies are types of Inland Systems in terms of the Classification System, even if they are artificial such as dams. Man-made dams are therefore classified as aquatic systems since the landform characteristics of such systems fit the definition of a depression in that they typically have closed (or near closed) elevation contours and increase in depth from the perimeter to a central area of greatest depth. Lakes and other open waterbodies that have a maximum depth greater than two metres are called limnetic systems. The vegetation associated with the dams is mostly sedges and bulrushes depending on the depth of the water and the substrate. Species such as *Cynodon dactylon*, *Schoenoplectus brachyceras*, *Cyperus congestus, Cyperus Eragrostis* and *Persicaria decipiens* mostly grow in the wetlands.

5.1.2 Unchannelled valley bottom wetland

A valley-bottom wetland is a mostly flat wetland area located along a valley floor, often connected to an upstream or adjoining river channel (Ollis *et al*., 2013). Although valley-bottom wetlands are generally sites of sediment accumulation or temporary storage, as in the case of floodplain wetlands, the process of river-derived deposition is not nearly as important in these systems as it is in floodplain wetlands. As such, there tends to be few (if any) depositional features present within a valley-bottom wetland that can be ascribed to current riverine processes, although erosional features relating to riverine processes may be present. Valley-bottom wetlands are not formed by the process of flooding and large-scale sediment movement. Valley-bottom wetlands are either channelled or unchannelled (Ollis *et al*., 2013).

The valley-bottom wetland at the site is unchannelled. Unchannelled valley-bottom wetlands are characterised by their location on valley floors, an absence of distinct channel banks, and the prevalence of diffuse flows. These wetlands are generally formed when a river channel loses confinement and spreads out over a wider area, causing the concentrated flow associated with the river channel to change to diffuse flow (i.e. the river becomes an unchannelled valley-bottom wetland).

The vegetation associated with these wetlands is dominated by grasses and reeds. *Phragmites australis* and *Typha capensis* are the dominant reed species present and grass species include *Cynodon dactylon*, *Panicum schinzii*, *Aristida junciformis*, *Cymbopogon caesius* and *Setaria sphacelata* var. *sericea*. See Photograph 1 and Photograph 2.

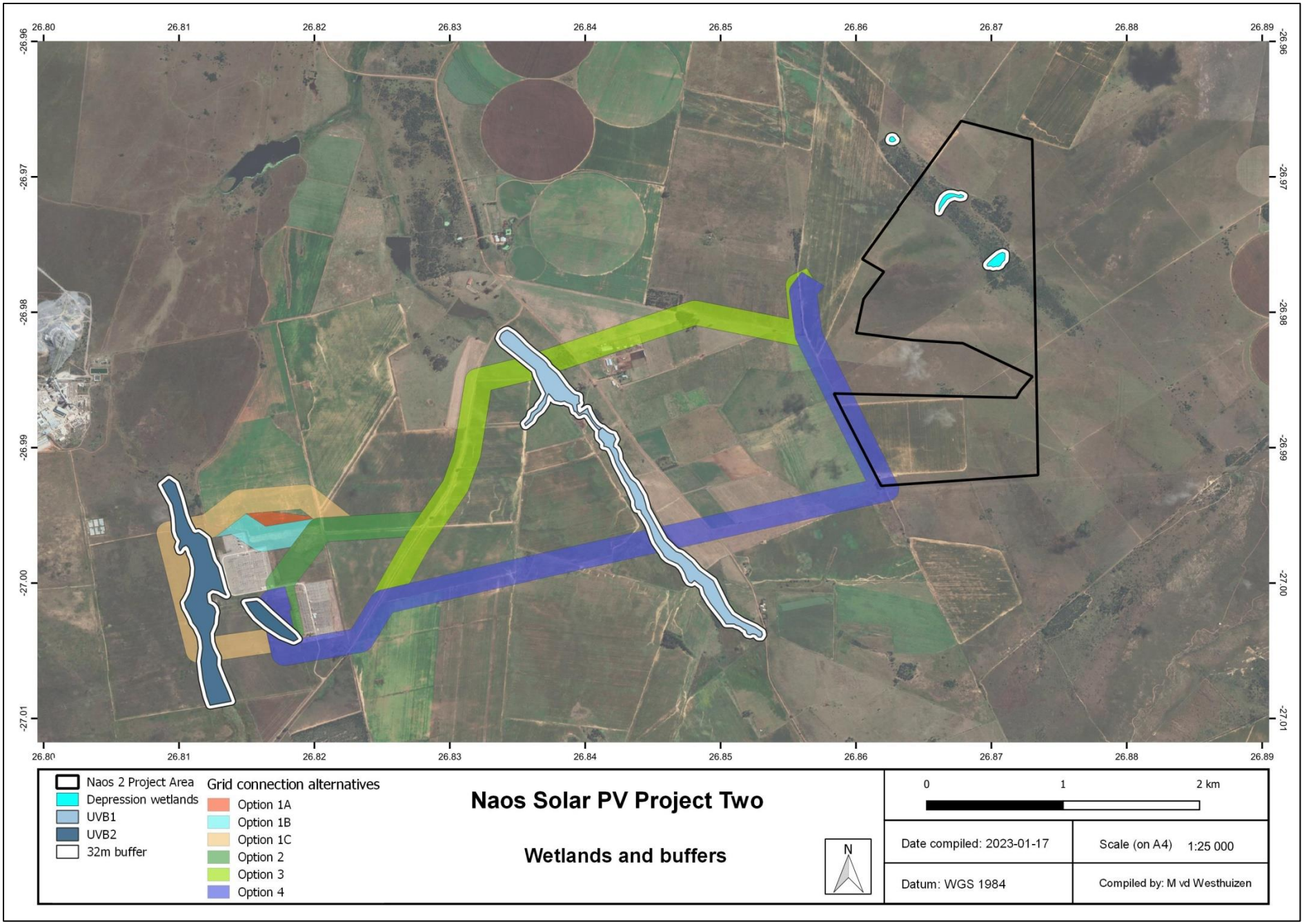


Figure 6: Wetland delineation map

Photograph 1: Unchannelled valley bottom wetland 1

Photograph 2: Unchannelled valley bottom wetland 2

Photograph 3: Depression wetland

Photograph 4: Wetland soil showing gleying and mottling

5.2 WETLAND INTEGRITY ASSESSMENTS

In determining the integrity of the drainage system, the condition of the site and the indirect and direct disturbances are considered. The impoundments, roads, alien invasive vegetation species, pollution, sedimentation and density roughness elements was taken into account in determining the PES and EIS of the wetland units on site.

5.2.1 WET-Health Assessment

Three modules, namely hydrology, geomorphology and vegetation, were assessed as a single unit for the HGM Units and subsequently an area weighted score was obtained for the HGM Units. The potential impacts of activities such as agriculture, drought and altered hydrological functions within the greater catchment were taken into consideration during the assessment. The results are summarised in Table 5 below.

Table 5: Summary of results of the WET-Health assessments conducted for the wetlands.

Summary of WET-Health assessment									
Wetland	**Hydrology**		**Geomorphology**		**Water Quality**		**Vegetation**		**Combined Ecological Category**
	Ecological Category	Trajectory of change	Ecological Category	Trajectory of change	Ecological Category	Trajectory of change	Ecological Category	Trajectory of change	Ecological Category
Depression	C	→	C	→	A	→	D	→	C
UVB1	C	→	B	→	A	→	D	→	C
UVB2	C	→	C	→	A	→	D	→	C

The PES Category for all three wetlands is a C, meaning that the functionality of the wetland is Moderately modified but with some loss of natural habitats. Based on the Trajectory of change, the wetlands PES is likely to remain stable over the next 5 years.

5.2.2 Ecosystem Services

Physical and hydrological features allow hydro-geomorphic units to perform specific ecosystems services. A Wet-EcoService evaluation was conducted for the hydro-geomorphic type found on site to determine the services as described in the methodology. The degree of disturbance and modification of wetlands results in a decrease in the ability to which they can perform these ecosystem services. The findings of the Wet-Ecoservice evaluation conducted is provided in Table 6 to 8 and Figure 7 below.

Table 6: Ecosystem Services for Depressions

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,3	0,0	0,0	Very Low
	Stream flow regulation	1,7	0,0	0,2	Very Low
	Sediment trapping	No scores	0,8	No scores	No scores
	Erosion control	0,6	0,0	0,0	Very Low
	Phosphate assimilation	No scores	1,5	No scores	No scores
	Nitrate assimilation	1,2	1,5	0,4	Very Low
	Toxicant assimilation	No scores	0,8	No scores	No scores
	Carbon storage	0,8	0,0	0,0	Very Low
	Biodiversity maintenance	1,6	0,0	0,0	Very Low
PROVISIONING SERVICES	Water for human use	0,6	0,0	0,0	Very Low
	Harvestable resources	1,5	0,0	0,0	Very Low
	Food for livestock	4,0	0,0	2,5	Moderately High
	Cultivated foods	3,0	0,0	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0,6	0,0	0,0	Very Low
	Education and Research	0,8	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

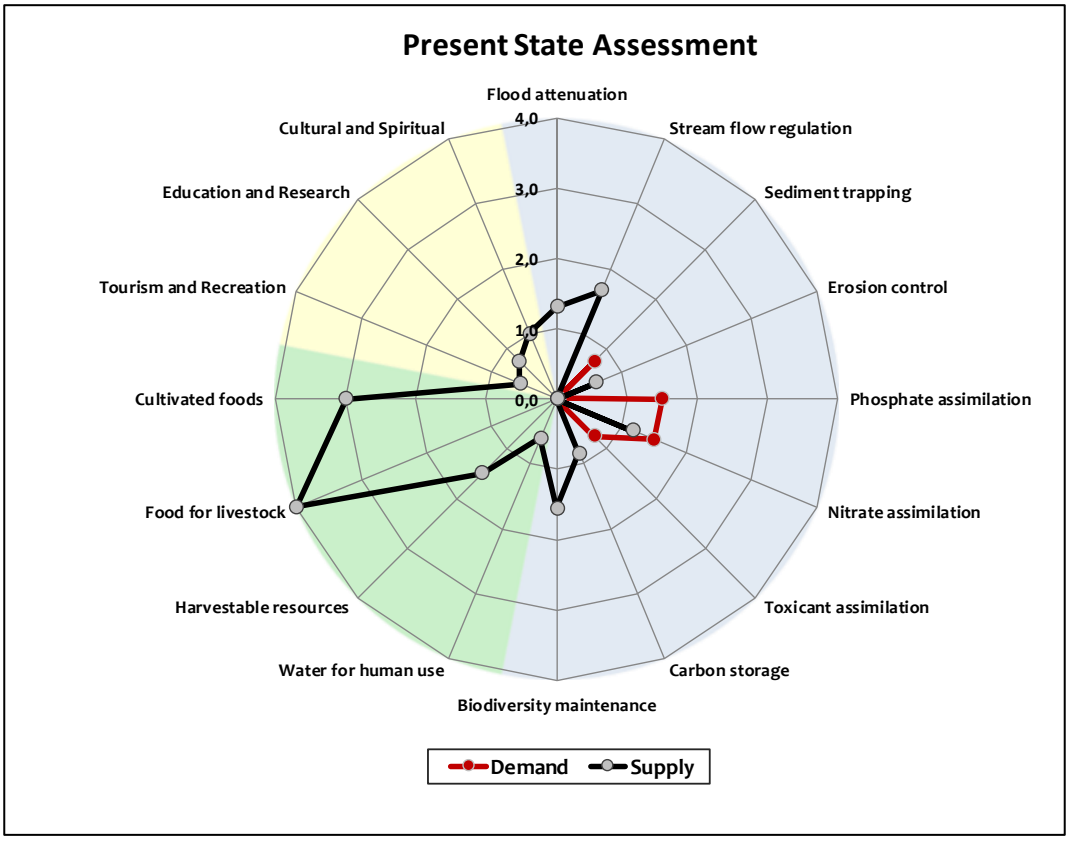
Table 7: Ecosystem services for Unchannelled valley bottom 1 (UVB1)

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,3	0,0	1,3	Low
	Stream flow regulation	3,0	0,0	1,5	Moderately Low
	Sediment trapping	2,3	1,0	1,3	Low
	Erosion control	1,7	0,3	0,4	Very Low
	Phosphate assimilation	1,4	1,0	0,4	Very Low
	Nitrate assimilation	2,0	1,0	1,0	Low
	Toxicant assimilation	2,1	1,0	1,1	Low
	Carbon storage	1,0	0,0	0,0	Very Low
	Biodiversity maintenance	1,4	1,5	0,7	Very Low
PROVISIONING SERVICES	Water for human use	2,4	0,0	0,9	Low
	Harvestable resources	1,0	0,0	0,0	Very Low
	Food for livestock	3,0	0,0	1,5	Moderately Low
	Cultivated foods	2,5	0,0	1,0	Low
CULTURAL SERVICES	Tourism and Recreation	0,9	0,0	0,0	Very Low
	Education and Research	1,3	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

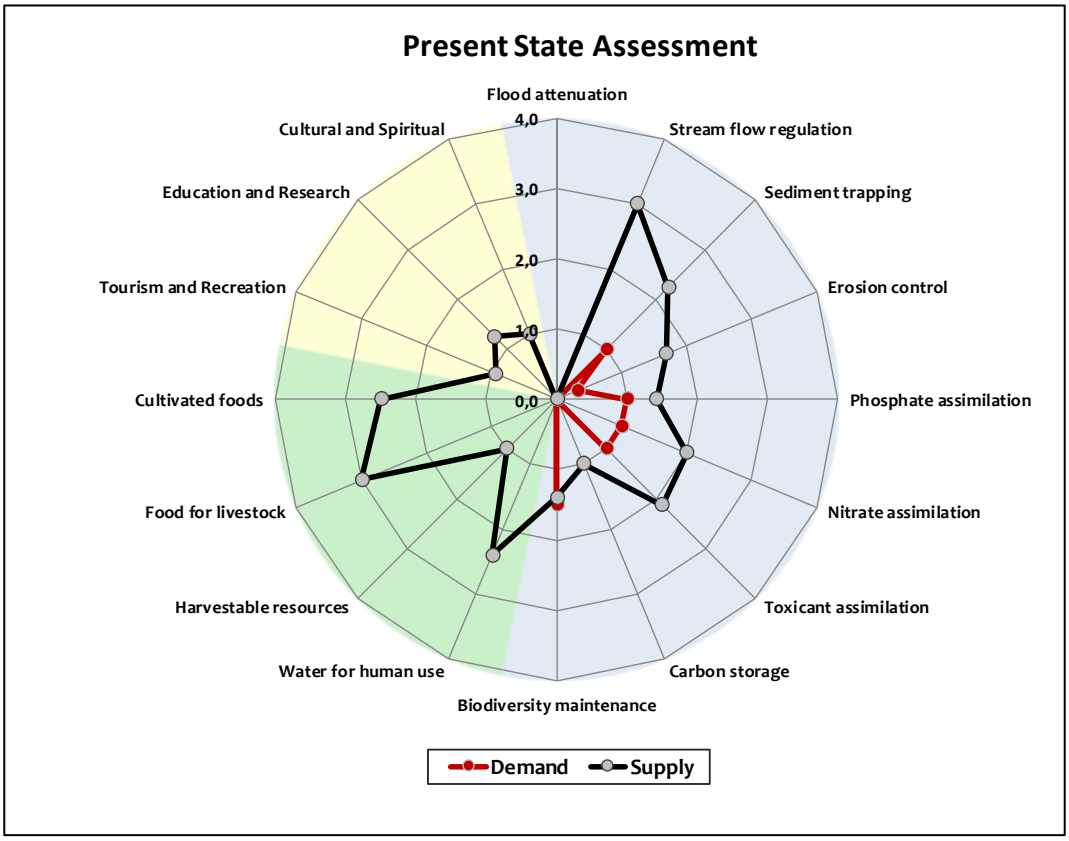
Table 8: Ecosystem Services Unchannelled valley bottom 2 (UVB2)

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,3	0,0	1,3	Low
	Stream flow regulation	3,0	0,0	1,5	Moderately Low
	Sediment trapping	2,8	1,0	1,8	Moderate
	Erosion control	2,1	0,5	0,8	Low
	Phosphate assimilation	2,3	1,0	1,3	Low
	Nitrate assimilation	2,3	1,0	1,3	Moderately Low
	Toxicant assimilation	2,5	1,0	1,5	Moderately Low
	Carbon storage	1,3	0,0	0,0	Very Low
	Biodiversity maintenance	1,7	1,5	1,0	Low
PROVISIONING SERVICES	Water for human use	1,6	0,0	0,1	Very Low
	Harvestable resources	1,5	0,0	0,0	Very Low
	Food for livestock	2,0	0,0	0,5	Very Low
	Cultivated foods	2,5	0,0	1,0	Low
CULTURAL SERVICES	Tourism and Recreation	0,8	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Depressions



Unchannelled valley bottom 1 (UVB1)



Unchannelled valley bottom 2 (UVB2)

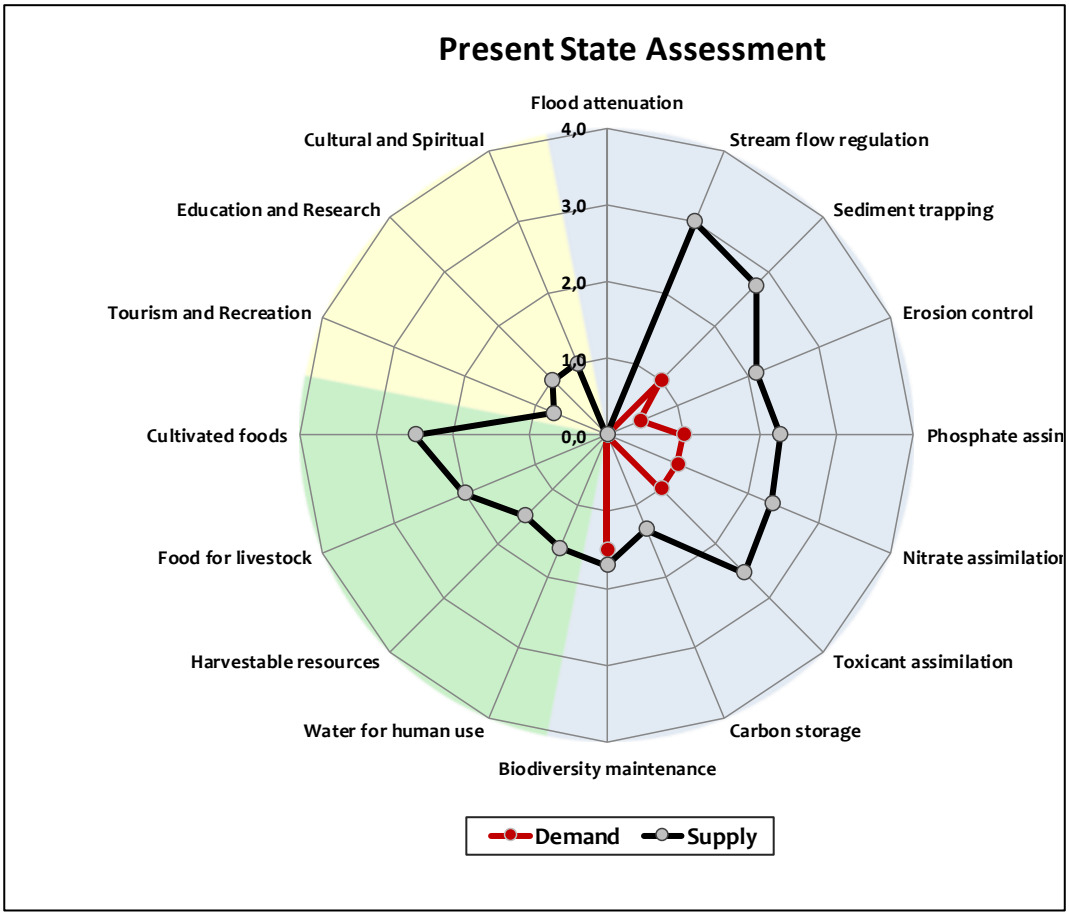


Figure 7: Results of the Ecosystem Services provided in graph format.

5.2.3 Ecological Importance and Sensitivity

The EIS assessment was applied to all wetland features within the study area in order to ascertain the levels of sensitivity and ecological importance of the features. The results of these assessments are summarised in Table 9 below.

Table 9: EIS scores obtained for the Wetlands (DWAF, 1999).

Ecological Importance and Sensitivity						
	Depressions		**UVB1**		**UVB2**	
Determinant	**Score**	**Confidence**	**Score**	**Confidence**	**Score**	**Confidence**
Biotic determinants						
Rare and endangered biota	0	4	0	3	0	3
Unique biota	0	4	0	3	0	3
Intolerant biota	0	4	1	3	1	3
Species/taxon richness	1	3	2	3	2	3
Habitat (instream and riparian) determinants						
Diversity of aquatic habitat types or features	2	4	2	4	2	4
Refuge value of habitat types	1	4	2	4	2	4
Sensitivity of habitat to flow changes	1	3	1	3	1	3
Sensitivity to flow related water quality changes	1	3	2	3	2	3
Migration route/corridor for instream and riparian biota	0	4	1	4	1	4
National parks, Wilderness areas, Nature reserves Natural Heritage sites Natural areas	0	4	2	3	1	4
Total	6		13		12	
Average score	**0,6**		**1,3**		**1,2**	
Category	**Low / marginal**		**Moderate**		**Moderate**	

The Ecological importance and sensitivity are respectively low / marginal (depressions), and moderate (UVB1 and UVB2).

6 CUMULATIVE IMPACTS

The EIA Regulations (as amended in 2017) determine that cumulative impacts, “in relation to an activity, means 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.” Cumulative impacts can be incremental, interactive, sequential or synergistic.

The term "Cumulative Effect" has for the purpose of this project been defined as: the summation of effects over time which can be attributed to the operation of the Project itself, and the overall effects on the ecosystem of the Project Area that can be attributed to the Project and other existing and planned future projects.

6.1 GEOGRAPHIC AREA OF EVALUATION

The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in this cumulative effects analysis generally includes an area of a 30km radius surrounding the proposed development – refer to Figure 8 below.

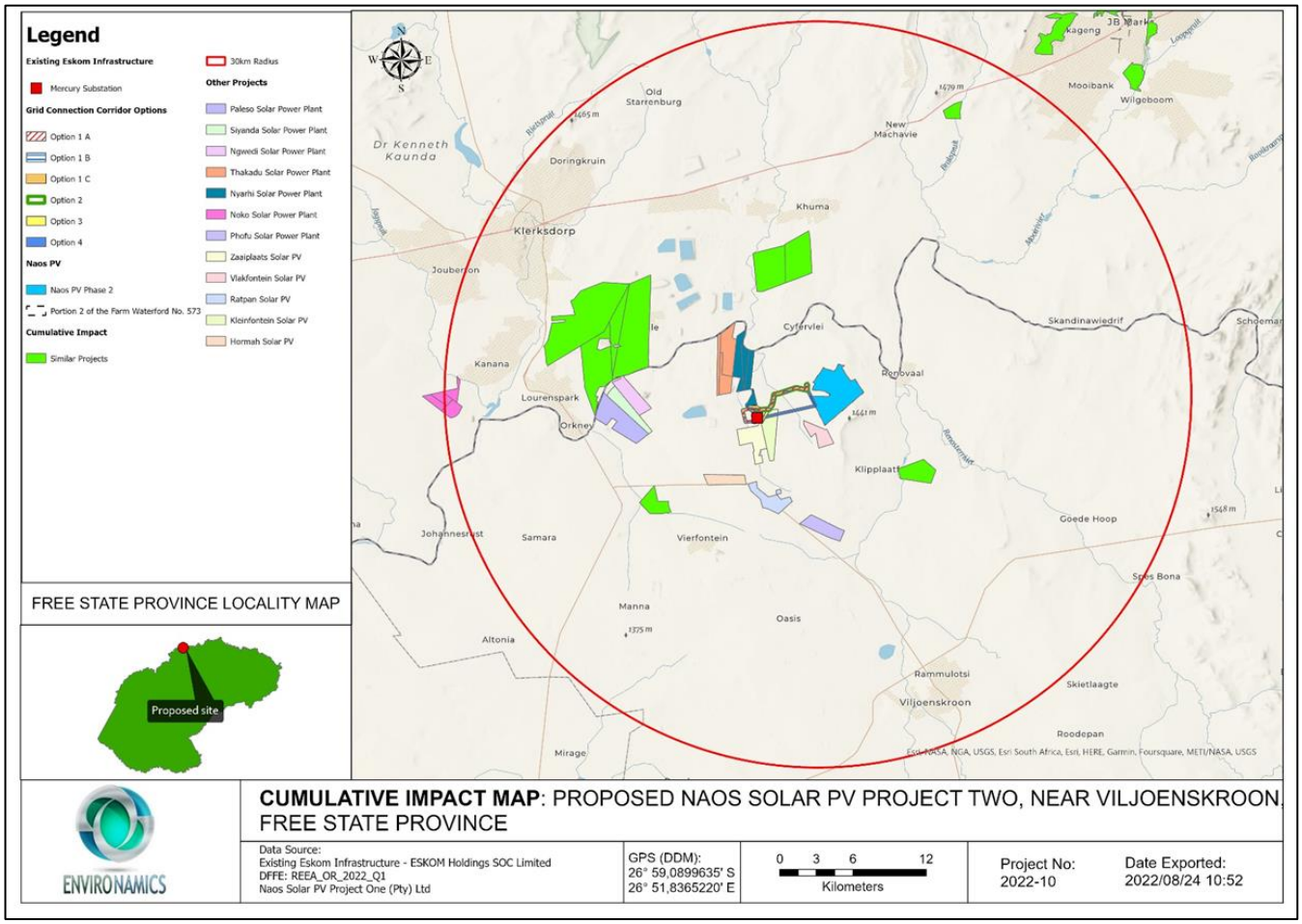


Figure 8: Cumulative impact map

The geographic spread of PV solar projects, administrative boundaries and any environmental features (the nature of the landscape) were considered when determining the geographic area of investigation. It was argued that a radius of 30km would generally confine the potential for cumulative effects within this particular environmental landscape.

6.2 OTHER PROJECTS IN THE AREA

The following section provides details on existing projects and project being proposed in the geographical area of evaluation.

Table 10: A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the solar energy facility.

Site name	Distance from study area	Proposed generating capacity	DEFF reference	EIA process	Project status
Paleso SPP	11km	150MW	14/12/16/3/3/1/2365	Basic Assessment	Approved
Siyanda SPP	10km	150MW	14/12/16/3/3/1/2369	Basic Assessment	Approved
Thakadu SPP	4km	150MW	14/1216/3/3/1/2476	Basic Assessment	Approved
Ngwedi SPP	9km	150MW	14/12/16/3/3/1/2535	Basic Assessment	In process
Nyarhi SPP	3km	150MW	14/12/16/3/3/1/2533	Basic Assessment	In process
Kabi Vaalkop PV 3	13km	75 MW	12/12/20/2513/3	Scoping and EIA	Approved
Kabi Vaalkop PV 2	12km	75 MW	12/12/20/2513/2	Scoping and EIA	Approved
Kabi Vaalkop PV	11km	75 MW	12/12/20/2513/4	Scoping and EIA	Approved
Kabi Vaalkop PV 1	11km	75 MW	12/12/20/2513/1	Scoping and EIA	Approved
Buffels Solar PV 1	8km	100MW	14/12/16/3/3/2/777	Scoping and EIA	Approved
Buffels Solar PV 2	8km	100 MW	14/12/16/3/3/2/778	Amendment	Approved
Rietvlei solar	16 km	-	14/12/16/3/3/2/450	Scoping and EIA	Withdrawn/Lapsed
Genesis Orkney Solar (Pty) Ltd	24 km	100MW	14/12/16/3/3/2/954	Scoping and EIA	Approved
Afropulse 538 Pty Ltd	7 km	50MW	12/12/20/2280	BAR	Withdrawn/Lapsed
Mulilo Renewable Project Developments (Pty) Ltd (Cluster Development): Vlakfontein Solar	2.78	75 – 100MW	Projects only in commencement phase with no Applications for EA submitted as yet	BAR	In process (commencement Phase)

Site name	Distance from study area	Proposed generating capacity	DEFF reference	EIA process	Project status
PV1 (Pty) Ltd Biesiefontein Solar PV1 (Pty) Ltd Kleinfontein Solar PV1 (Pty) Ltd Zaaiplaats Solar PV1 (Pty) Ltd Hormah Solar PV1 (Pty) Ltd Ratpan Solar PV1 (Pty) Ltd Ratpan Solar PV2 (Pty) Ltd					

It is unclear whether other projects not related to renewable energy is or has been constructed in this area, and whether other projects are proposed. In general, development activity in the area is focused on agriculture and mining. It is quite possible that future solar farm development may take place within the general area.

6.3 Cumulative impact on wetlands

The cumulative impact of solar power park developments in the area on wetlands is not foreseen to be significant, as most of the development is proposed outside of major wetlands.

7 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE WETLANDS

The two Valley Bottom Wetlands are located in the proposed grid connection corridors. The impacts of the power line are not expected to be serious, as vegetation will not be cleared. It will be disturbed to some extent as power lines are constructed during the construction phase and also during maintenance in the operational phase.

The depression wetlands will be impacted more. As vegetation surrounding the wetlands are removed, runoff and sediment load to the depression wetland will increase.

See Table 11 and Table 12 for risk matrix assessment.

7.1 Compaction, Soil Erosion and Sedimentation

7.1.1 Description of impact:

This impact will be mostly on the depression wetlands and to a lesser extent on the unchannelled valley bottom wetlands. The use of heavy machinery during the construction process of the development will result in the compaction of soil, resulting in decreased infiltration of rainwater and increased surface run-off volumes and velocities leading to a greater erosion risk. The hardened surfaces of the road and compacted soils of the proposed development area will also lead to an increase in surface run-off during storms. This can lead to erosion in the cleared areas and sedimentation in the wetlands.

Soil erosion also promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora.

7.1.2 Mitigation measures

- Compaction of soils must be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in increased runoff and erosion. Where any disturbance of the soil takes place (have taken place in the past), these areas must be stabilised and any alien plants which establish must be cleared and follow-up undertaken for the duration of the construction and decommissioning phases. It is to be undertaken by the Internal Environmental Officer or the Environmental Control Officer. Where compaction becomes apparent, remedial measures must be taken (e.g., “ripping” the affected area).

- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion.
- Erosion control mechanisms must be established as soon as possible.
- A stormwater plan must be developed with the aid of an engineer to ensure that water runoff is diverted off the site without pooling and stagnation causing erosion. Financial provision for closure will include the estimated costs for erosion control post-construction and post-decommissioning.
- Where the power line connection crosses the wetlands, disturbance must be kept to a minimum. Care must be taken not to change the hydrology of the wetlands and rehabilitation of vegetation might be required.
- If compaction occurs, rectification can be done by application and mixing of manure, vegetation mulch or any other organic material into the area. Use of well cured manure is preferable as it will not be associated with the nitrogen negative period associated with organic material that is not composted.
- Vehicle traffic must not be allowed on the rehabilitated areas, except on allocated roads, due to adverse impacts of dispersive/compaction characteristics of soils and its implications on the long term.
- Appropriate design and mitigation measures must be developed and implemented to minimise impacts on the natural flow regime of the watercourse i.e., through placement of structures/supports and to minimise turbulent flow in the watercourse.
- The indiscriminate use of machinery within the wetland area will lead to compaction of soils and destruction of vegetation and must therefore be strictly controlled.
- Solar panels may be placed in the depression wetlands, as they are artificial. The power line connection and service roads will cross two wetlands. This can be supported if disturbance is kept to a minimum.
- Perform scheduled maintenance to be prepared for storm events. Ensure that culverts have their maximum capacity, ditches are cleaned, and that channels are free of debris and brush than can block structures.

7.2 Disturbance of watercourse habitat and fringe vegetation

7.2.1 Description of impact:

Disturbance to the unchannelled valley bottom wetlands during construction and maintenance of

the power line is inevitable as heavy vehicles will operate in the area. As habitat is disturbed, fauna and flora will be negatively impacted. Vegetation structure may change, affecting wetland properties and fauna. The unchannelled valley bottom wetland 1 (UVB1) is already disturbed by agricultural activities and UVB2 was disturbed by the development of Mercury Substation, power lines and roads that traverse it. The wetlands are however still functional.

7.2.2 Mitigation measures

- As far as possible, disturbance must be kept outside of the wetlands and their buffer zones.
- Existing access roads must be used where possible.

7.3 Soil and water pollution

7.3.1 Description of impact:

Construction work will also carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface- or groundwater, leading to potential medium/long-term impacts on fauna and flora.

7.3.2 Mitigation measures

- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- No dumping of waste must take place within the wetlands or their buffer zones. If any spills occur, they must be cleaned up immediately.
- Contain all dirty water in the dirty water system and contain all dirty stormwater up to a 1:50 year flood line as a minimum. Ensure that all activities impacting on groundwater resources of the subject property are managed according to the relevant DWS Licensing regulations and groundwater monitoring and management requirements.
- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility.
- Excess waste or chemicals must be removed from site and discarded in an environmentally friendly way. The Environmental Control Officer (ECO) must enforce

this rule rigorously.

- Hazardous chemicals to be stored on an impervious surface protected from rainfall and stormwater run-off.
- Spill kits must be on-hand to deal with spills immediately.
- All vehicles must be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site must make provision for drip trays to capture spills. Drip trays must be emptied into a holding tank and returned to the supplier.
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) and chemical dust suppressants of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.
- A speed limit (preferably 40 km/hour) must be enforced on dirt roads.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with the label and application permit directions and stipulations for terrestrial and aquatic applications.

7.4 Spread and establishment of alien invasive species

7.4.1 Description of impact:

The construction almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

Furthermore, the spread of the alien invasive species through the area will be accelerated when seeds are carried by stormwater into the drainage features on the site that will

cause environmental degradation and indigenous species to be displaced.

7.4.2 Mitigation measures

- Alien and invader vegetation must not be allowed to colonise the area. Control involves killing alien invasive plants present, seedlings and establishing an alternative plant cover to limit re-growth. The use of indigenous plants must be encouraged in the rehabilitated areas (stormwater canals). Control must begin prior to construction phase considering that small populations of invader plant species occur around the project area.
- Institute strict control over materials brought onto site, which must be inspected for seeds and steps taken to eradicate these before transport to the site. The contractor is responsible for the control of weeds and invader plants.
- Rehabilitate disturbed areas outside the development footprint as quickly as possible.
- Institute a monitoring programme during construction, undertaken by the IEO or the ECO, to detect alien invasive species early. Monitoring must be done periodically by the ECO.
- Institute an eradication/control programme for early intervention if invasive species are detected. The use of indigenous plants must be encouraged in the rehabilitated areas.

Table 11: Risk Matrix Assessment: Unchannelled Valley Bottom 1 and 2 (UVB1 & 2)

RISK MATRIX (BasedA1:W28 on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)
NAME and REGISTRATION No of SACNASP Professional member: Mari van der Westhuizen..... Reg no. 400166/15
Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph +	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures Mitigation Measures	PES AND EIS OF WATERCOURSE
1	Construction Phase	Exposure of soils to rainfall and wind	Earth works for power pylons will lead to the exposure of bare soil	Soil Erosion Alteration of the amount of sediment entering the water resource and associated change in turbidity	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**5**	**1**	**1**	**5**	**2**	**9**	**45**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
	Operational Phase		If not rehabilitated properly, erosion and sedimentation will continue	Soil Erosion Sedimentation Alteration of the amount of sediment entering the water resource and associated change in turbidity	2	2	2	2	2	1	2	5	1	1	5	2	**9**	**45**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
2	Construction Phase	Construction of power line	Disturbance by heavy vehicles	Disturbance of watercourse habitat and fringe vegetation	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**5**	**1**	**1**	**5**	**2**	**9**	**45**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
	Operational Phase	Maintenance of power line	Disturbance by maintenance vehicles	Disturbance of watercourse habitat and fringe vegetation	1	1	1	1	1	1	2	4	2	2	5	2	**11**	**44**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
3	Construction Phase	Movement of vehicles on site	Spillage of harmful substances Leakages by vehicles	Soil and Water pollution	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**6**	**1**	**2**	**5**	**1**	**9**	**54**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
	Operational Phase		Leakages by maintenance vehicles		1	2	2	2	1,75	1	2	4,75	1	2	5	1	**9**	**42,75**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
4	Construction Phase	Movement of people and vehicles to and from the development site	Delivery of construction material and other vehicles to the development site	Import and spread of alien invasive vegetation	**2**	**1**	**2**	**3**	**2**	**1**	**2**	**5**	**1**	**2**	**5**	**1**	**9**	**45**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**
	Operational Phase		Movement of maintenance vehicles and peopole on site		2	1	1	2	1,5	1	2	4,5	2	2	5	1	**10**	**45**	Low Risk	**80%**	Please refer to wetland assessment report	**PES - Class C: Moderately Modified; EIS - Moderate**

Table 12: Risk Matrix Assessment: Depression wetlands

RISK MATRIX (BasedA1:W28 on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)
NAME and REGISTRATION No of SACNASP Professional member: Mari van der Westhuizen…….. Reg no. 400166/15
Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph +	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures Mitigation Measures	PES AND EIS OF WATERCOURSE
1	Construction Phase	Exposure of soils to rainfall and wind	Earth works for power pylons will lead to the exposure of bare soil	Soil Erosion Alteration of the amount of sediment entering the water resource and associated change in turbidity	2	2	2	2	2	1	2	5	1	3	5	1	10	50	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
	Operational Phase		If not rehabilitated properly, erosion and sedimentation will continue	Soil Erosion Sedimentation Alteration of the amount of sediment entering the water resource and associated change in turbidity	2	2	2	2	2	1	2	5	1	3	5	1	10	50	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
2	Construction Phase	Construction of solar panels	Disturbance by heavy vehicles	Disturbance of watercourse habitat and fringe vegetation	2	2	2	2	2	1	2	5	1	2	5	2	10	50	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
	Operational Phase	Maintenance of solar	Disturbance by maintenance vehicles	Disturbance of watercourse habitat and fringe vegetation	2	1	1	1	1,25	1	2	4,25	2	3	5	2	12	51	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
3	Construction Phase	Movement of vehicles on site	Spillage of harmful substances Leakages by vehicles	Soil and Water pollution	1	3	2	2	2	1	2	5	1	2	5	1	9	45	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
	Operational Phase		Leakages by maintenance vehicles		1	2	2	2	1,75	1	2	4,75	2	3	5	1	11	52,25	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
4	Construction Phase	Movement of people and vehicles to and from the development site	Delivery of construction material and other vehicles to the development site	Import and spread of alien invasive vegetation	2	1	2	3	2	1	2	5	1	2	5	1	9	45	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate
	Operational Phase		Movement of maintenance vehicles and peopole on site		2	1	2	2	1,75	1	2	4,75	2	3	5	1	11	52,25	Low Risk	80%	Please refer to wetland assessment report	PES - Class C: Moderately Modified; EIS - Moderate

8 POWER LINE CONNECTION OPTIONS

Four grid connection options are provided (Figure 9). From a wetland perspective, Alternatives 2, 3 and 4 would be better than Alternative 1, as they will cause less disturbance to Unchannelled Valley Bottom 2. All options can however be supported.

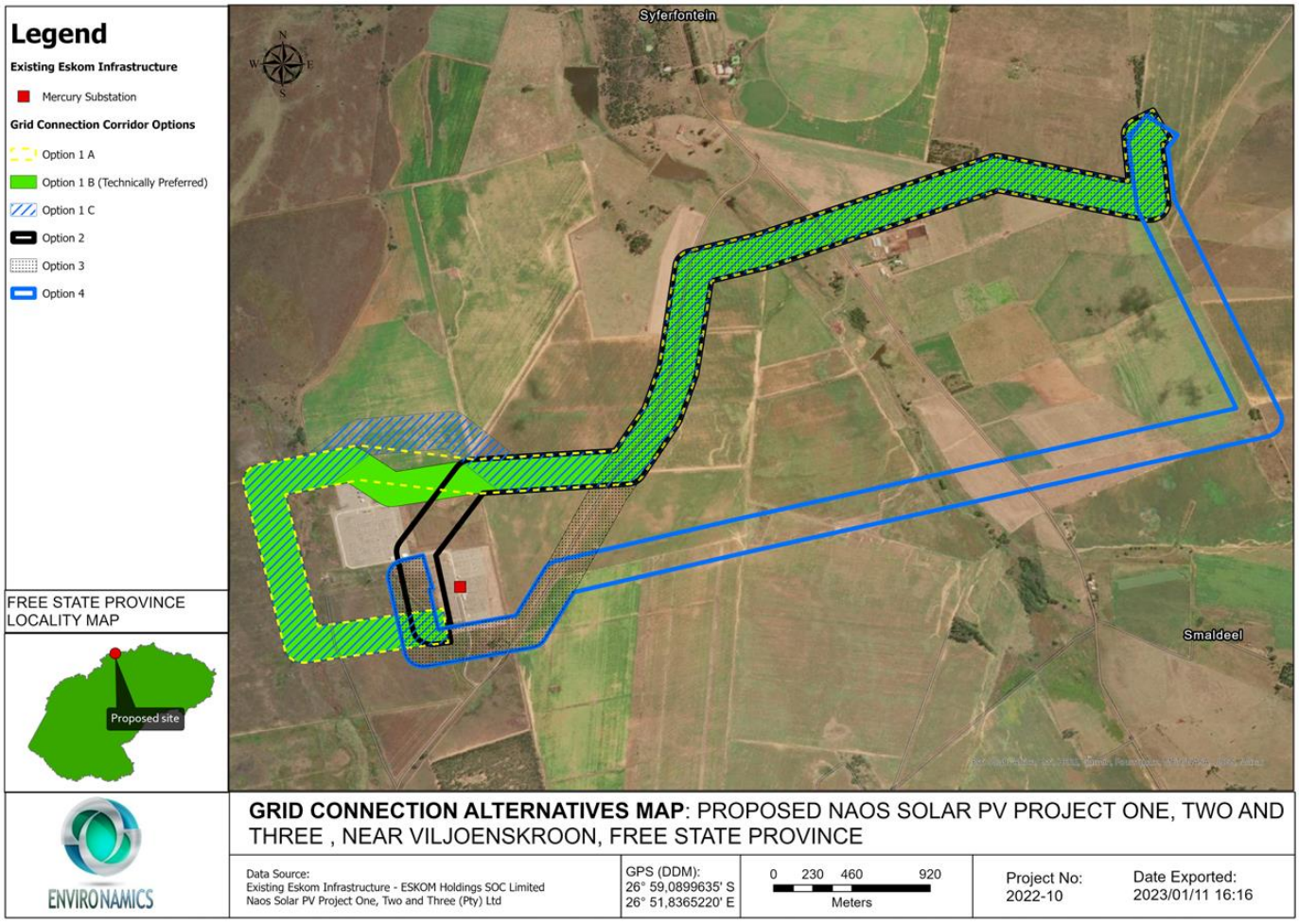


Figure 9: Four grid connection corridor alternatives proposed for the three Naos PV projects

9 DISCUSSION & CONCLUSION

Mari van der Westhuizen was requested by SOLA Group to complete an aquatic biodiversity impact assessment, wetland delineation and wetland risk matrix assessment for the proposed Naos Solar PV Project Two development on Portion 2 of the farm Waterford No. 573, near Viljoenskroon in the Free State Province. The proposed solar PV project will produce 240 MW.

According to the NEMA screening tool the site has a low sensitivity from an aquatic biodiversity perspective. A site sensitivity verification was therefore conducted to determine if the assessment was accurate. After the site visit it was concluded that the site has a Medium sensitivity from an Aquatic biodiversity perspective. Although there are only two artificial wetlands in the project area where the solar farm will be constructed, there are two Unchannelled Valley Bottom Wetlands in the proposed grid connection corridors. These wetlands are both disturbed by roads, fences, dams and other infrastructure.

The wetland delineation and classification for the project was done according to the criteria set by the Department of Water Affairs and Forestry (2005) guidelines and the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013). The soils and vegetation associated with wetlands and landscape were all used as parameters in identifying the wetlands.

Two wetland types were identified and classified as 1) Exorheic depression (manmade dam), 2) Unchannelled Valley Bottom wetland.

Baseline soil information, landscape profile and vegetation were used to confirm wetland and terrestrial properties within the study area. Present Ecological State (PES) and Ecological Importance and Sensitivity are given in the table below:

Classification	PES	EIS
Depression	C: Moderately modified	D: Low / marginal
UVB1	C: Moderately modified	C: Moderate
UVB2	C: Moderately modified	C: Moderate

A risk matrix assessment was conducted for the wetlands on site in addition to the mitigation measures recommended to ensure the protection of the wetlands. Impacts relating to the proposed development on the wetlands / riparian zones are as follows:

- Soil Erosion and Sedimentation. Alteration of the amount of sediment entering the water resource and associated change in turbidity
- Disturbance of watercourse habitat and fringe vegetation
- Soil and water pollution
- Import and spread of alien invasive vegetation.

The impacts were all low and therefore a General Authorisation will be sufficient.

The development of proposed Naos Solar PV Project Two development on Portion 2 of the farm Waterford No. 573 can be supported from a wetland perspective, as long as the mitigation measures are implemented.

10 REFERENCES

Climate-data.org. 2022. Klerksdorp climate. https://en.climate-data.org/africa/south-africa/north-west/klerksdorp-1024/ Date of access: 28 March 2022.

Council for Scientific and Industrial Research. 2011. NFEPA rivers [vector geospatial dataset] 2011. Available from the Biodiversity GIS website, downloaded on 19 April 2021

Department of Water Affairs and Forestry. 1999. Ecological Importance & Sensitivity assessment method for river ecosystems [taken from Appendix R.7 of DWAF 1999].

Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Pretoria: Department of Water Affairs and Forestry.

Department of Water and Sanitation. 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). Notice 509 of 2016.

Driver, A., Nel, J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. & Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. South African National Biodiversity Institute, CSIR, The Freshwater Consulting Group, Water Research Commission, South African National Parks & South African Institute for Aquatic Biodiversity.

ENPAT. 2000. Environmental Potential Atlas. Department of Environmental Affairs and Tourism, Pretoria.

Kotze, D., Macfarlane, D.M. and Edwards, R. 2021. WET-EcoServices (Version 2): A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas. Water Research Commission, Pretoria.

Kleynhans C.J., Louw M.D., Graham M. 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual) Joint Water Research Commission and Department of

Water Affairs and Forestry report. WRC Report No. TT 377-08

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. & Goge, M. 2009. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/08. Water Research Commission: Pretoria.

Mills, G. & Hes, L. 1997. The Complete Book of Southern African Mammals. Struik Winchester, Cape Town.

Macfarlane D.M., Ollis D.J & Kotze D.C. 2020. WET-Health (Version 2.0): A refined suite of tools for assessing the present ecological state of wetland ecosystems. Technical guide Water Research Commission, Pretoria. WRC Report TT820/20 May 2020.

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

Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds). 2005. Vegetation Map of South Africa, Lesotho and Swaziland, 1:1000000 scale sheet maps. Pretoria: South African National Biodiversity Institute.

Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. 2011. Atlas Of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission Report No. TT 500/11.

Ollis, D., Snaddon, K., Job, N. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. USER MANUAL: Inland Systems. Pretoria: SANBI Biodiversity Series 22.

Rountree M.W., Malan H.L. and Weston BC. 2013. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). WRC Report 1788/1/13. Water Research Commission, Pretoria

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. 2018. National Biodiversity Assessment: Terrestrial ecosystem threat status and protection level layer [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 13 January 2023.

South African National Biodiversity Institute (SANBI). 2019. National Biodiversity Assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis Report. South African National Biodiversity Institute, an entity of the Department of Environment, Forestry and Fisheries, Pretoria

South Africa. 1983. Conservation of Agricultural Resources Act 43 of 1983.

South Africa. 1998. National Environmental Management Act 107 of 1998.

South Africa. 1998. National Forest Act 84 of 1998.

South Africa. 1998. National Water Act 36 of 1998.

South Africa. 2009. National Environmental Management: Biodiversity Act no 10 of 2004.

South Africa. 2016. National Environmental Management: Biodiversity Act no 10 of 2004. Alien and invasive species lists, 2020.

Van Oudtshoorn, F. 2004. Gids tot grasse van Suider-Afrika. 2de uitg. Pretoria: Briza Publications.

Van Wyk, B. & Malan, S. 1998. Field guide to wild flowers of the Highveld. Second addition, second impression. Cape Town: Struik Publishers.