AGGENEYS 2 SOLAR PHOTOVOLTAIC PV FACILITY

Northern Cape Province

Freshwater Delineation and Impact Assessment Report
Final report

April 2019

savannah environmental

t +27 (0)11 656 3237
f +27 (0)86 684 0547
e info@savannahsa.com
w www.savannahsa.com

Prepared for:

ABO Wind Aggeneys 2 PV (Pty) Limited
Unit B1, Mayfair Square
Century Way, Century City
7441

savannah environmental

t +27 (0)11 656 3237 f +27 (0)86 684 0547 e info@savannahsa.com w www.savannahsa.com
First Floor, Block 2, 5 Woodlands Drive Office Park, Cnr Woodlands Drive & Western Service Road, Woodmead, 2191

EXECUTIVE SUMMARY

ABO Wind Aggeneys 2 PV (Pty) Ltd (ABO Wind) is proposing to develop a 100 MW solar photo-voltaic (PV) facility including associated infrastructure on the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province. The proposed solar PV facility project site is ~250 hectares, comprised of ~233 hectares of fixed-tilt PV, single-axis tracking PV or double-axis tracking PV panel arrays (approximately 3.5m height), and the remaining 17 hectares composed of the associated infrastructure, including the storage area, O&M block and internal roads. The project falls within the Springbok Renewable Energy Development Zone No. 8. ABO Wind has commissioned Savannah Environmental to undertake a freshwater delineation and impact assessment to determine whether the proposed development will affect any freshwater resources on the project site.

This freshwater report focused on providing information on the freshwater resources baseline environment for the proposed SEF and associated infrastructure on the project site within the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province. The freshwater study was established using the collection of available secondary information (available databases, satellite imagery and relevant scientific literature) in order to provide a freshwater baseline environmental before undertaking a site visit to verify desktop findings and confirm or refute the presence of freshwater resources on the project site.

From a desktop perspective, it was observed from Google Earth™ satellite imagery that **several ephemeral watercourses** could be observed on the project site. **No other freshwater resources were identified at a desktop level consulting database information.** However, it must be noted that the project site was found to be mainly located **within an Ecological Support Area (ESA), with a small portion within a Critical Biodiversity Area 2 (CBA2)**, however field results indicated no ephemeral watercourses occurred on or near (>250m) the CBA 2 areas and as such only the ESA areas are applicable to the ephemeral watercourses discussed in this report.

The in-field investigation and assessment confirmed the presence of the **five (05) ephemeral watercourse reaches** within the project site, which can be classified as Lower Foothill Rivers in terms of the inland classification system. These freshwater resources were delineated using the indicators as stipulated in the national guidelines, and were assessed further accordingly.

The ecological condition of the riparian habitat for the ephemeral watercourses were assessed to gain an understanding of the condition of the habitat. This was assessed using the VEGRAI methodology. The Ecological Condition (EC) of the riparian habitat of the watercourses were assessed to be **76.7% unmodified** and therefore, a **Class C moderately modified system**.

A qualitative assessment of the potential ecosystem services that could be provided by the ephemeral watercourses followed the ecological condition assessment. It was found that the primary potential ecosystem services assessed included **sediment trapping, bank stabilisation and maintenance, flood attenuation, ecological corridor for migration of species and erosion control**. The watercourses drain the southern part of the Gamsberg inselberg local catchment of quaternary catchment D82C. With this in mind, the function of the watercourses to provide the ecosystem services mentioned above is relatively important for the local area. The riparian habitat of the watercourses is not dense, but offers some resistance to flows and provides a degree of sediment trapping, flood attenuation, bank stabilisation and erosion control function for the immediate area. The vegetation condition and composition of the riparian habitat also

means that the watercourses are likely to act as a migration corridor for faunal and avifaunal species utilising the watercourses.

The ecological importance and sensitivity (EIS) of the watercourses were assessed taking into account the various determinants of each freshwater resource. The most prominent determinants of the wetland, which scored moderately, was in terms of being i**mportant from a migration route/breeding and feeding site for amphibians and waterfowl despite being ephemeral in nature**. In addition to this, the watercourses were identified to serve an important role in performing **sediment trapping, attenuation of storm water and energy dissipation for the local catchment**. Lastly, the results of the desktop assessment and VEGRAI assessment informed the ecological integrity component of the EIS assessment, also scoring moderately due to the fact that the watercourses are in an ESA area, and were assessed to be a Class C moderately modified system in terms of the vegetation ecological condition. **Overall, the EIS of the watercourses was classed as a Class C system which is considered to be moderately ecologically important and sensitive on a local scale.**

A **buffer zone of 15m** for the ephemeral watercourses was determined which is to be implemented in accordance with the explanation which follows. With regard to the buffer zone, the PV panels can span over the ephemeral watercourses given the ephemerality of the watercourses and limited vegetation cover. The mounting structures of the PV panels must not however be placed directly inside the watercourses, but are permissible in the buffer zone of the watercourses. The mounting structures should also be limited to the bare minimum within the buffer zone where required. Internal roads and underground cables are also permissible through the watercourses provided that the necessary water use license or general authorisation is obtained from the Department of Water and Sanitation. No other buildings or infrastructure are allowed in the watercourses and the associated buffer zone.

A comparative assessment of the two (02) Operation and Maintenance Block 1 and 2 alternatives was undertaken in which it was determined that **Alternative Operation and Maintenance Block 2 is viewed as most favourable** given the slightly less indirect impact to one watercourse when compared with **Alternative Operation and Maintenance Block 1**. It was noted that **Alternative Operation and Maintenance Block 1 is also viewed as favourable (but less so than alternative Operation and Maintenance Block 2 mentioned above) given the limited expected indirect impact on two of the nearby (<100m) watercourses.**

The impact assessment identified potential impacts during the construction, operation and decommissioning phases. These included **potential impacts to the vegetation, geomorphology and water quality of the watercourses during the construction and decommissioning phases**. The significance ratings of the potential impacts ranged from **Medium to Low (including without and with mitigation measures)**. With regard to the **operation phase**, potential impacts as a result of **vehicle movement were identified, of which the significance rating was Medium without and Low with mitigation measures**. A cumulative impact assessment was also undertaken. The results showed that the **significance rating of the cumulative impacts** as a **result of surrounding similar solar energy developments**, including the proposed development, would be **Medium without and with implementation of mitigation measures**. Suitable **mitigation measures were proposed to minimise potential impacts** as far as possible.

With consideration of the condition and functionality of the watercourses identified, and the potential impacts anticipated, the following recommendations are made from a freshwater perspective:

» A construction and operation stormwater management plan must be compiled by a suitable engineer to address general drainage and run-off management;

- An alien invasive and control management plan is to be compiled for the construction and post-construction phases by a suitably qualified ecological specialist, and implemented accordingly;
- Prior to construction, a risk assessment is to be undertaken for the road crossings through the ephemeral water courses and for the development of the PV arrays over the ephemeral watercourses. This is to be undertaken to determine the need for appropriate water use licensing with the Department of Water and Sanitation.

Ultimately, the proposed development was assessed to have a **moderate to low** negative potential impact on the affected watercourses. With the implementation of the mitigation measures and recommendations stipulated, the potential impacts can be minimised. **The proposed construction of the solar PV facility and associated infrastructure as per the layout proposed is therefore supported, and should be allowed to proceed on condition that the mitigation measures proposed are implemented, in addition to obtaining the necessary water use license or general authorisation from the Department of Water and Sanitation prior to any construction activities commencing.**

PROJECT DETAILS

Title	:	Freshwater Delineation and Impact Assessment Report for the proposed Aggeneys 2 Solar Photovoltaic Facility and associated infrastructure near Aggeneys, Northern Cape Province
Authors	:	Savannah Environmental (Pty) Ltd Shaun Taylor
External Reviewer	:	Stephen Burton *Pr. Sci. Nat.* (Registration Number: 117474) – SiVEST Environmental (Pty) Ltd
Client	:	ABO Wind Aggeneys 2 PV (Pty) Ltd
Report Revision	:	Revision 4 – Final
Date	:	May 2019

When used as a reference this report should be cited as: Savannah Environmental (2019). Freshwater Delineation and Impact Assessment Report for the Aggeneys 2 Solar Photovoltaic Facility and associated infrastructure near Aggeneys, Northern Cape Province.

SPECIALISTS DECLARATION OF INTEREST

I, Shaun Taylor, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the Act.

Shaun Taylor
Name

Signature

May 2019
Date

SHORT SUMMARY OF SPECIALIST AND EXPERTISE

Shaun's highest qualification is a Master of Science Degree in Aquatic Health. Shaun has an in-depth understanding of environmental and water related South African legislation. Applicable legislation includes the National Environmental Management Act, 1998 (Act No. 107 of 1998), the Environmental Impact Assessment (EIA) Regulations (2006, 2010 and 2014, as amended) and the National Water Act, 1998 (Act No. 36 of 1998). Within the water field, Shaun has undertaken and completed numerous Water Use License Applications (WULAs), General Authorisations (GAs), Risk Assessments and Water Use License (WUL) compliance monitoring for various developments. Shaun also specialises in wetland ecology and operates as a wetland specialist, having also undertaken and completed numerous wetland and riparian assessments for renewable energy developments, linear projects as well as site specific projects. Lastly, Shaun has undertaken several wetland rehabilitation plans for various developments and a wetland offset plan.

A selection of recent specialist studies undertaken, include the following:

» Proposed construction of a 140MW Wind Farm and Associated Infrastructure near Hutchison, Northern Cape Province: Surface Water Assessment;
» Proposed construction of the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province: Surface Water Assessment;
» Proposed construction of the Xha! Boom Wind Farm, Northern Cape Province: Surface Water Assessment;
» Proposed construction of the Gras Koppies Wind Farm, Northern Cape Province: Surface Water Assessment;
» Proposed construction of the Ithemba Wind Farm, Northern Cape Province: Surface Water Assessment;
» Proposed construction of the Harte Beeste Leegte Wind Farm, Northern Cape Province;
» Proposed construction 132kV Power Lines and a Substation for Tsakane Ext 10 and 22, Gauteng Province: Surface Water Assessment;
» Proposed construction of a Linking Station, Power Lines and Substations for the Mainstream Wind Energy Facilities near Beaufort West, Western Cape Province; and
» Proposed expansion of the Mountain Valley "A" Grade Chicken Abattoir on the Remainder of Subdivision of Portion 17 (of 16) of the Farm Leeuw Poort 1120 FT, KwaZulu-Natal Province: Surface Water Assessment;
» Proposed Wilmar Oil Processing Facility in Phase 1A Richards Bay Industrial Development Zone in Richards Bay, Kwa-Zulu Natal Province: Wetland Delineation Assessment.
» Proposed construction of the De Wildt Solar Photovoltaic Power Plant, Gauteng Province: Surface Water Assessment;
» Proposed construction of up to a 5MW Solar Photovoltaic (PV) Energy Facility on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad, North West Province: Surface Water Assessment;
» Proposed construction of the Rietkuil Coal Railway Siding near Bronkhorstspruit, Gauteng Province: Surface Water Assessment;
» Proposed maintenance of the Water Pipeline in Parys, Ngwathe Local Municipality, Free State Province: Surface Water Assessment.

Curriculum vitae (CV) of the above specialist is attached as **Appendix A**.

TABLE OF CONTENTS

ACRONYMS

AC	Alternating Current
CBA	Critical Biodiversity Areas
CMA	Catchment Management Agency
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DC	Direct Current
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ESA	Ecological Support Area
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
FEPAs	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GPS	Global Positioning System
GN. R	Government Notice Regulation
HGM	Hydrogeomorphic
I&AP	Interested and Affected Party
km	Kilometre
kV	Kilovolt
LC	Least Concern
LM	Local Municipality
MW	MegaWatt
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NEMA	National Environmental Management Act (No. 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Area
PES	Present Ecological State
PV	Photovoltaic
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SCA	Systematic Conservation Assessment
WRC	Water Research Commission
WUL	Water Use License
WWF	Worldwide Fund for Nature

1. INTRODUCTION

ABO Wind Aggeneys 2 PV (Pty) Ltd (ABO Wind) is proposing to develop a 100 MW solar photo-voltaic (PV) facility including associated infrastructure on the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province. The proposed solar PV facility project site is ~250 hectares, comprised of ~233 hectares of fixed-tilt PV, single-axis tracking PV or double-axis tracking PV panel arrays (approximately 3.5m height), and the remaining 17 hectares composed of the associated infrastructure, including the storage area, O&M block and internal roads. The proposed development is located in the Khai-Ma Local Municipality, located in the greater Namakwa District Municipality. The project falls within the Springbok Renewable Energy Development Zone No. 8.

ABO Wind has commissioned Savannah Environmental to undertake a freshwater delineation and impact assessment to determine whether the proposed development will affect any freshwater resources on the project site. The watercourse delineation and impact assessment for the proposed development has been undertaken by Shaun Taylor, with external peer review by Stephen Burton of SiVEST Environmental (Pty) Ltd.

This report has been finalised following comments received by the Department of Water and Sanitation (DWS) on the Basic Assessment reports released to the public for review and comment. DWS made three (3) comments of relevance for this report, and the section within the report where these comments are addressed is detailed in the table below.

Comment received from DWS (Ms V Ramugondo – 23/05/2019)	**Section in this report where comment is addressed**
a) Please note that the Department rates all perennial and non-perennial rivers together with all dry river beds and natural drainage and associated riparian areas extremely sensitive to development. An option of developing (developing of solar PV) further away from the all water courses would be the preferred option;	Section 5.4
b) No development or construction should be done or may occur within 100m; 1:100 year flood line of a river/drainage lines (whichever is furthest) and 500m of a pan/wetland without authorisation from this department. The water courses should be delineated in order to provide an appropriate buffer to maintain such water courses;	Section 5.5
i) The final Basic Assessment Report must clearly show all water courses as defined in the National Water Act, 1998 (Act 36 of 1998) as well as the delineated 1:100 year flood lines or 100 meters of a river/drainage line (whichever is the furthest) and 500m metres.	Section 5.1.3

1.1. Project Description

The proposed development is for a 100 MW solar PV facility, including associated infrastructure. The components of the solar PV facility and the associated infrastructure will include the following:

- Arrays of PV panels up to 3.5 m high (fixed-tilt PV, single-axis tracking PV or double-axis tracking PV) on 233 ha;
- Mounting structures to support the PV panels;
- Cabling between the project components (to be lain underground where applicable);
- On-site substation (~0.625 ha);
- On-site inverters to convert the power from direct current (DC) to alternating current (AC);
- On-site step-up transformers;
- Site offices and maintenance buildings (~1 ha), including workshop areas for maintenance and storage, canteen, visitor's centre;
- Gatehouse and security office;
- Laydown area (~5 ha);
- Main site access road (~200 m long and 6 m wide, to be tarred if necessary);
- Internal access roads (~18-20 km total length and 4-5 m wide); and
- Fencing.

1.2. Project Location

The solar PV facility will be located on the Remaining Extent of the Farm Bloemhoek 61 approximately 10km east of the town of Aggeneys in the Northern Cape Province (**Figure 1.1**). The project site can be accessed via a gravel road known as Loop 10 off the N14 national highway. The project site is situated within Ward 04 of the Khai-Ma Local Municipality (Category B municipality), which is located within the greater Namakwa District Municipality.

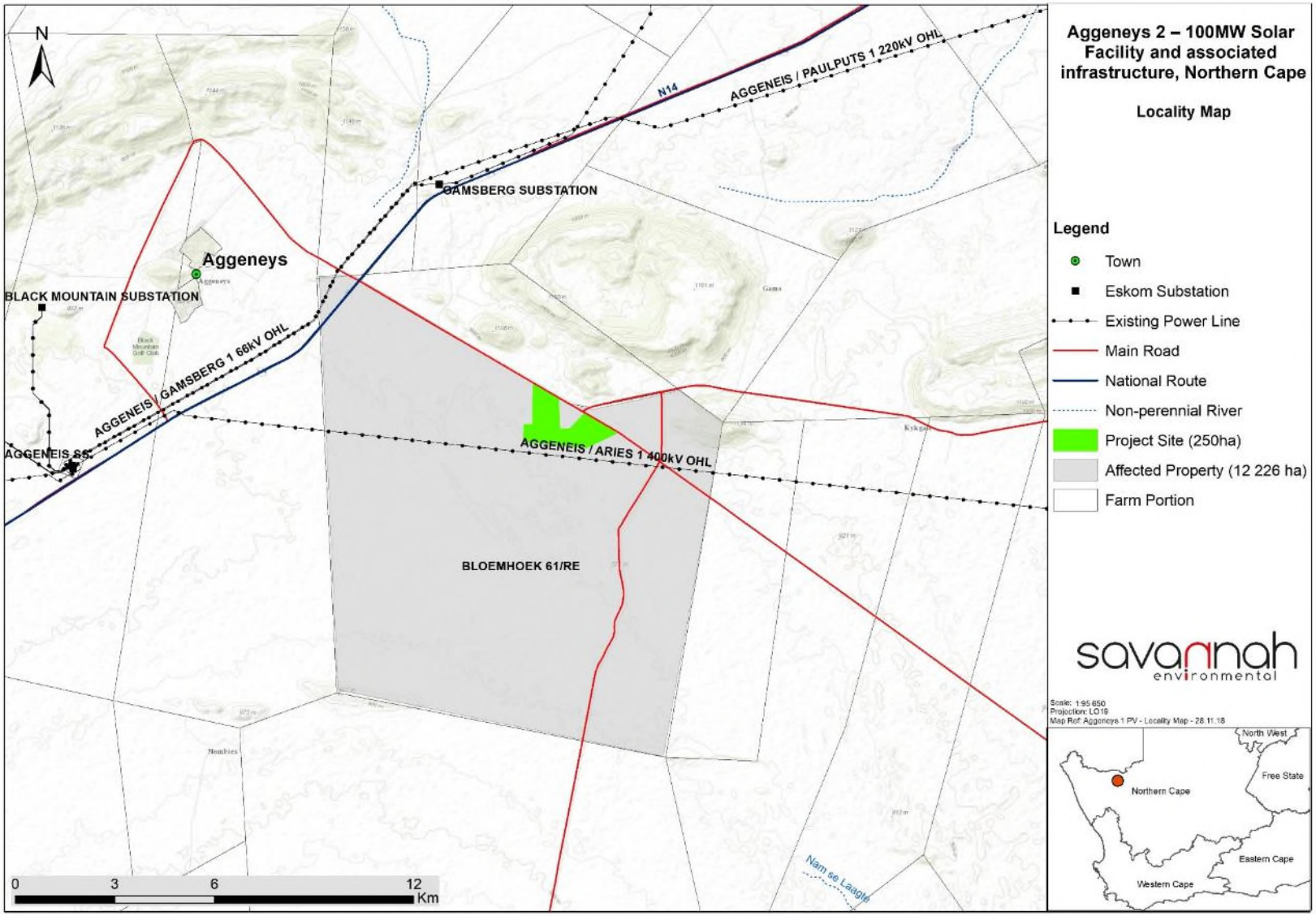

Figure 1.1: Locality map

1.3. Structure of this Freshwater Report

This freshwater delineation and impact assessment report has been structured as follows:

- **Chapter 2** provides an overview of the legislative framework applicable to the proposed development from a freshwater perspective.
- **Chapter 3** provides an overview of the methodology and approach utilised in preparing this freshwater delineation and impact assessment report.
- **Chapter 4** provides the findings of the desktop assessment using the available database information.
- **Chapter 5** provides the findings of the site visit and freshwater delineation results, including the various ecological condition, importance and sensitivity assessments related to the identified freshwater resources.
- **Chapter 6** provides the legislative implications of the proposed development from a freshwater perspective.
- **Chapter 7** provides the results of the comparative alternatives assessment.
- **Chapter 8** provides the results of the impact assessment.
- **Chapter 9** provides the conclusion and recommendations of the freshwater delineation and impact assessment report.

2. LEGISLATIVE FRAMEWORK

The applicable legislative framework plays an important role in contextualising the proposed development from a freshwater perspective. In this regard, a key component of the freshwater legislative context is to assess the proposed development in terms of the suitability of the project in terms of the key legislation.

The following key pieces of legislation were reviewed as part of this review process:

National Legislative Context:

- Constitution of the Republic of South Africa (1996);
- National Environmental Management Act (No. 107 of 1998) (NEMA);
- Environmental Impact Assessment Regulations (2014), as amended; and
- National Water Act, 1998 (Act No. 36 of 1998) (NWA).

2.1. Constitution of the Republic of South Africa (1996)

The Constitution of the Republic of South Africa, 1996 is the supreme law of South Africa, and forms the foundations for a democratic society in which fundamental human rights are protected. The Bill of Rights contained in Chapter 2 of the Constitution enshrines the rights of all people in South Africa, and affirms the democratic values of human dignity, equality and freedom. Section 24 of the Constitution pertains specifically to the environment. It states that:

24. Everyone has the right –

(a) To an environment that is not harmful to their health or well-being; and

(b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

(i) Prevent pollution and ecological degradation.

(ii) Promote conservation.

(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The Constitution also however outlines the need to promote social and economic development. Section 24 of the Constitution therefore requires that development be conducted in such a manner that it does not infringe on an individual's environmental rights, health, or well-being and to have the environment protected. This is relevant with regards to freshwater environments, which are protected under national legislation in South Africa (see section below).

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

The National Environmental Management Act (No. 107 of 1998) (NEMA) is South Africa's key piece of environmental legislation, and sets the framework for environmental management in South Africa. It provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. NEMA is founded on the principle that everyone has the right to an environment that is not harmful to their health or well-being as contained within the Bill of Rights. In accordance with this, it states that:

- *The State must respect, protect, promote and fulfil the social, economic and environmental rights of everyone and strive to meet the basic needs of previously disadvantaged communities.*
- *Sustainable development requires the integration of social, economic and environmental factors in the planning, implementation and evaluation of decisions to ensure that development serves present and future generations.*
- *Everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*

In addition, the National environmental management principles contained within NEMA state that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Wetlands and similar systems (such as watercourses) are specifically mentioned with regards to requiring specific attention in management and planning procedures, and therefore need to be identified when planning developments, such that adequate management procedures can be put in place to ensure negative impacts are avoided, minimised or remedied appropriately.

2.3. Environmental Impact Assessment Regulations (2014), as amended

The Environmental Impact Assessment Regulations (2014), as amended, were promulgated *inter alia* with the purpose of regulating the procedure and criteria relating to the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations for the commencement of activities subjected to environmental impact assessment, in order to avoid or mitigate detrimental impacts on the environment, and to optimise positive environmental impacts. The activities identified for which environmental authorisation is required, are included in Government Notice Regulation (GN. R) 327 Listing Notice 1, GN. R 325 Listing Notice 2 and GN. R 324 Listing Notice 3. Included in these listing notices, are activities related specifically to freshwater resources where affected. The specific listed activities that may be triggered as a result of the proposed development are assessed in **Section 6** below.

2.4. National Water Act, 1998 (Act No. 36 of 1998) (NWA)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) was developed in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. In accordance with the provisions of the National Water Act (No. 36 of 1998) (NWA), all "water uses" must be licensed with the Competent Authority (i.e. the Regional Department of Water and Sanitation (DWS) or the relevant Catchment Management Agency (CMA) where applicable). At a general level, the DWS is ultimately responsible for the effective and efficient water resources management to ensure sustainable economic and social development in line with the NWA. DWS is also responsible for evaluating and issuing licenses pertaining to water use (i.e. Water Use Licenses (WULs) and / or registration of General Authorisations (GAs) where this is applicable to developments.

A "water use" is defined in Section 21 of the NWA, and includes the following:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38(1) of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

With the above in mind, should any water resource be affected by any proposed development, the necessary WUL application and / or registration of GA will become relevant, where applicable.

Note that a WUL application is generally applied for where the above water uses are required as a result of direct impact to watercourses. However, it must be noted indirect impacts are also taken into consideration through the applicable Government Notices. In particular, Government Notice (GN) 509 of 2016, becomes relevant where a watercourse is affected by a proposed development and is within the "regulated area of a watercourse". The regulated area of a watercourse is defined as:

"a) 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;
b) In the absence of a determined 1 in 100-year flood line or riparian area, the area within 100m from the edge of a watercourse where the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to Section 144 of the Act); or
c) A 500m radius from the delineated boundary (extent) of any wetland or pan".

In light of the above, an assessment of any direct and indirect impacts to water resources must be undertaken in terms of the Risk Assessment Protocol, where a proposed development affects a watercourse within the above-mentioned proximities, and when applying for authorisation from the DWS.

The relevant activities are assessed and stipulated in **Section 6** where any watercourses are to be affected by the proposed development.

3. METHOD AND APPROACH OF THE STUDY

3.1. Purpose and Objective of the Freshwater Assessment

This freshwater report has been prepared for the purposes of establishing whether the proposed development will affect any freshwater resources.

The objectives of the freshwater report include:

- Desktop identification of freshwater sensitivities within the project site through the review of existing desktop and database information;
- Site visit, including delineation of any freshwater resources within the project site; and
- Mapping of the identified freshwater resources (from the site visit and existing data).

3.2. Approach to the Study

This freshwater report provides a snapshot of the setting within which the proposed development is located. It provides an overview of the freshwater environment and the extent that the current status quo is likely to change as a result of the proposed development. Available information was therefore consulted to determine the status quo of the freshwater environment, which was based on desktop sources as well as field investigation and verification.

The desktop freshwater baseline was established using available database information, which comprised the following:

- Collection and review of existing database information, including:
  - South African Vegetation Types (Mucina & Rutherford, 2006/2012);
  - National Freshwater Ecosystems Priority Areas (NFEPA) database, 2011; and
  - Northern Cape Conservation Plan, 2017.
- Use of satellite imagery to identify any potential wetland areas (Google Earth™).

A site visit was then undertaken to investigate and verify the available desktop information. The site visit was undertaken in accordance with the DWAF (2005) guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". The draft DWAF (2008) guidelines, "Update Manual for the Identification and Delineation of Wetlands and Riparian Areas" was also consulted as a supplementary guideline. In terms of the guidelines, the assessment for riparian habitats requires the following aspects to be taken into account:

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

The topography associated with a watercourse/s can comprise (but, is not always limited to) the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat.

The delineation of the riparian habitat relies primarily on vegetation indicators. The outer edge of the riparian habitat can be delineated where there is a distinctive change in the vegetation species composition to the adjacent terrestrial area or where there is a difference in the physical structure (robustness or growth forms – size, structure, health, compactness, crowding, number of individual plants) of the plant species from the adjacent terrestrial area (DWAF, 2005).

Riparian habitats are usually associated with alluvial soils (relatively recent deposits of sand, mud or any type of soil sediment) (DWAF, 2005). This indicator is not commonly viewed as the primary indicator, but rather as a supplementary indicator to confirm either topographical indicators, vegetation indicators, or both.

Where riparian habitats occur, the above-mentioned indicators were used to identify the outer edge. A Global Positioning System (GPS) device was used to record the points taken in the field to inform the delineation process.

For watercourses, it is possible to determine the hydrological regime which provides information on the functionality of the systems. Ollis *et al*., (2013) states that the hydrological regime can be characterised by the frequency and duration of flow (i.e. perenniality), classified as follows:

- Perennial – flows continuously throughout the year in most years;
- Non-perennial – does not flow continuously throughout the year, although pools may persist. Can be sub-divided as follows:
    - Seasonal – with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year;
    - Intermittent – water flows for a relatively short time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years;
    - Unknown – for rivers where it is not known whether a non-perennial system is seasonal or intermittent.; and
- Unknown – for rivers where the flow type is not known.

Once identified, it is possible to classify rivers into three channel types. The channel types are based on the changing saturation frequency of soils in the riparian zone which can be classified inter alia as follows (DWAF, 2005):

- **A Section** – Least sensitive watercourses in terms of impact on water yield from the catchment. They are situated in the unsaturated zone and do not have riparian habitats or wetlands. Not as hydrologically sensitive as the B and C Sections of a watercourse;
- **B Section** – In the zone of the fluctuating water table, and only has base flow at any point in the channel when the saturated zone is in contact with the channel bed. Base flow is intermittent in this section of the watercourse, with flow at any point in the channel dependent on the current height of the water table. The gradient of the channel bed is flat enough for deposition of material to take place, and initial signs of flood plain development may be observed; and
- **C Section** – Always in contact with the zone of saturation and therefore, always has base flow. These are perennial streams with flow all year round, except perhaps in times of extreme droughts. Channel gradients in these sections are very flat, and a flood plain is usually present.

3.3. Freshwater Definition and Classification

For the purposes of this assessment, the classification of freshwater resources was undertaken applying the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013). This classification system applies to inland freshwater resources or systems, which are defined as, "an aquatic ecosystem with no existing connection to the ocean". Three broad types of inland systems exist that are dealt with by the classification system including the following:

- Rivers, which are 'lotic' aquatic ecosystems with flowing water concentrated within a distinct channel, either permanently or periodically;
- Open waterbodies, which are permanently inundated 'lentic' aquatic ecosystems where standing water is the principal medium within which the dominant biota live. In the Classification System, open waterbodies with a maximum depth greater than 2 m are called limnetic (lake-like) systems; and
- Wetlands, which are transitional between aquatic and terrestrial systems, and are generally characterised by (permanently to temporarily) saturated soils and hydrophytic vegetation. These areas are, in some cases, periodically covered by shallow water and/or may lack vegetation.

The inland system classification works on a six-tiered structure (**Table 3.1**). The tiered structure progresses from Systems at the broadest spatial scale (Level 1), through Regional Setting (Level 2) and Landscape Units (Level 3), to Hydrogeomorphic (HGM) Units at the finest spatial scale (Level 4). At Level 5, Inland Systems are distinguished from each other based on the hydrological regime and, in the case of open waterbodies, the inundation depth class. At Level 6, six 'descriptors' have been incorporated into the Classification System. These descriptors allow for distinguishing between aquatic ecosystems with different structural, chemical, and/or biological characteristics. For the purposes of this assessment only a Level 4 classification was undertaken as this is deemed to be sufficient for the purposed of an environmental impact assessment study. The Level 4 classification is shown in **Table 3.2** below.

Table 3.1: Inland System Classification (adapted from Ollis *et al*., 2013).

Distinguishing between Marine, Estuarine and Inland Systems	**Wetland/Aquatic Ecosystem Context**		**Functional Unit**		**Wetland/Aquatic Ecosystem Characteristics**
Level 1: Type of System	**Level 2: Regional Setting**	**Level 3: Landscape Unit**	**Level 4: Hydrogeomorphic (HGM) Unit**	**Level 5: Hydrological Regime**	**Level 6: Descriptors**
» Marine » Estuarine » Inland System	» Department of Water Affairs (DWA) Ecoregions » NFEPA WetVeg Groups » Other Spatial Framework	» Valley Floor » Slope » Plain » Bench	River Floodplain Wetland Channelled Valley Bottom Wetland Depression Seep Wetland Flat	Perenniality » Period and Depth of Inundation » » Period of Saturation	» Natural vs Artificial » Salinity » pH » Substratum Type » Vegetation Cover Type » Geology

Table 3.2: Hydrogeomorphic Units for Inland Systems (taken from Ollis *et al*., 2013)

Level 4: Hydrogeomorphic (HGM) Unit		
HGM Type	**Longitudinal Zonation/ Landform/Outflow Drainage**	**Landform/Inflow Drainage**
A	**B**	**C**
River	Mountain Headwater Stream	Active Channel
		Riparian Zone
	Mountain Stream	Active Channel
		Riparian Zone
	Transitional	Active Channel
		Riparian Zone
	Upper Foothills	Active Channel
		Riparian Zone
	Lower Foothills	Active Channel
		Riparian Zone
	Lowland River	Active Channel
		Riparian Zone
	Rejuvenated Bedrock Fall	Active Channel
		Riparian Zone
	Rejuvenated Foothills	Active Channel
		Riparian Zone
	Upland Floodplain	Active Channel
		Riparian Zone
Channelled Valley Bottom Wetland	Not Applicable	Not Applicable
	Not Applicable	Not Applicable
Unchannelled Valley Bottom Wetland	Not Applicable	Not Applicable
	Not Applicable	Not Applicable
Floodplain Wetland	Floodplain Depression	Not Applicable
	Floodplain Flat	Not Applicable
Depression	Exorheic	With Channelled Flow
		Without Channelled Flow
	Endorheic	With Channelled Flow
		Without Channelled Flow
	Dammed	With Channelled Flow
		Without Channelled Flow
Seep	With Channelled Flow	Not Applicable
	Without Channelled Flow	Not Applicable
Wetland Flat	Not Applicable	Not Applicable

3.4. Riparian Habitat Ecological Condition

The riparian Vegetation Response Assessment Index (VEGRAI) is designed for a qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleyhans *et al*., 2007). As Kleynhans *et al* (2007) explains, the VEGRAI model firstly describes the status of riparian vegetation in both the current and reference states and secondly, compares differences between the two states as a measure of vegetation response to an impact regime. When assessing the state of the riparian habitat, the habitat can be broken down into two components including, the marginal zone and non-marginal zone (**Figure 3.1**). The marginal zone includes the area from the water level at low flow, if present, to those features that are hydrologically activated for the greater part of the

year (Kleynhans *et al*., 2007). The non-marginal zone collectively includes the lower and upper zone. The lower zone extends from the marginal zone and usually ends where a marked increase occurs in lateral elevation, whilst the upper zone extends from the end of the lower zone to the end of the riparian corridor which is usually characterised by steeper slopes and the presence of both riparian and terrestrial vegetation species (Kleynhans *et al*., 2007). It must be noted that not all zones are necessarily present in all watercourses. The identified riparian vegetation zones (Marginal, Non-marginal (Lower and Upper zones)) are used as the metric groups which are then rated, weighted and an Ecological Category (A-F) can then be determined (see **Table 3.3** below).

Table 3.3: Ecological Categories for VEGRAI Index (Kleyhans *et al*., 2007).

Ecological Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

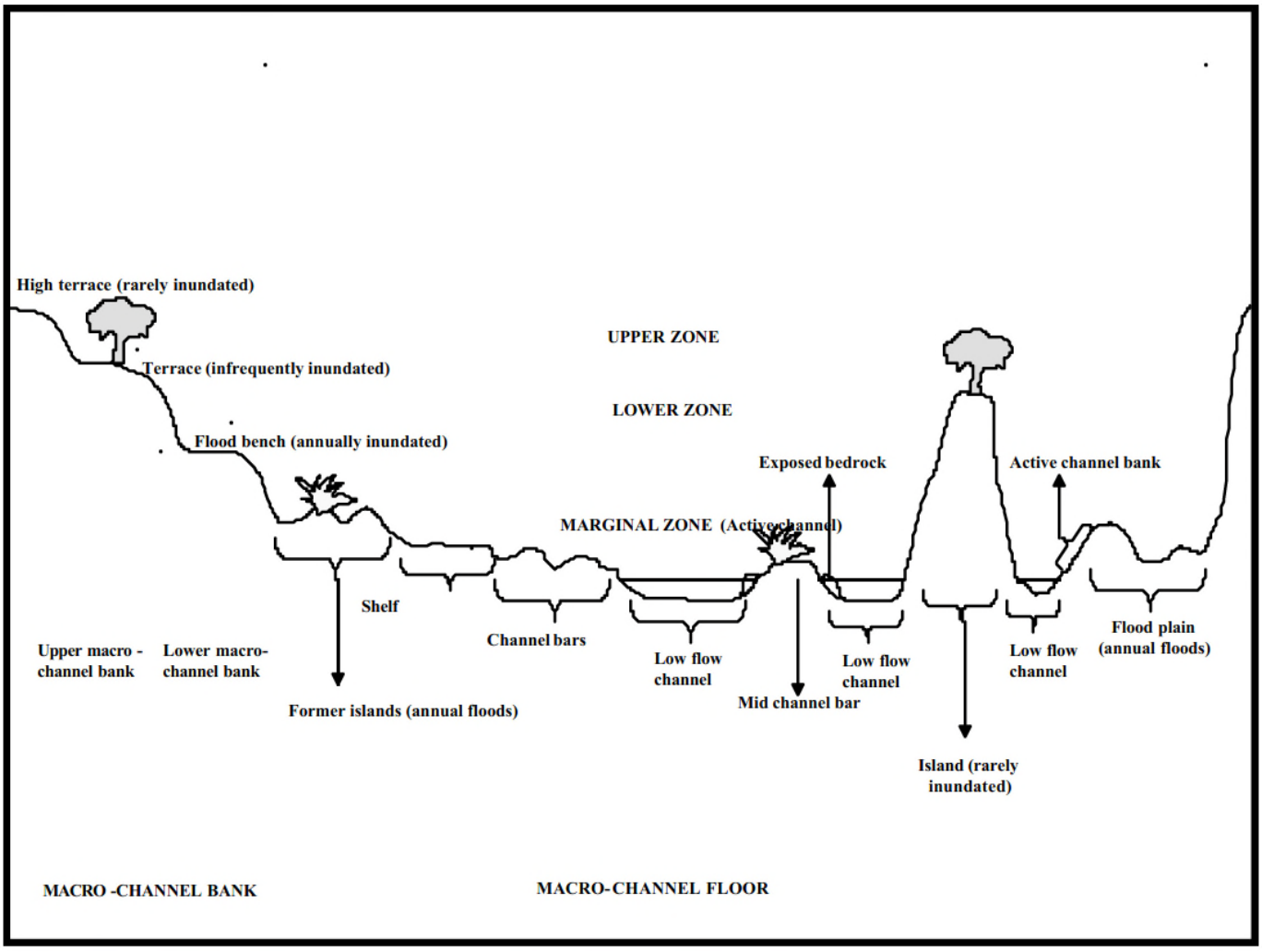

Figure 3.1: Illustration of the Marginal and Non-marginal Zones (taken from Kleynhans et al., 2007).

There are two levels that can be applied to the index assessment including a Level 3 and Level 4 assessment. The Level 3 index is aimed at general aquatic ecologists, whilst a Level 4 assessment is aimed at specialist riparian vegetation ecologists. A Level 3 assessment was applied to this study. The metric groups for a Level 3 assessment includes the following:

- Woody:
  - Cover;
  - Abundance; and
  - Species Composition.
- Non-woody:
  - Cover;
  - Abundance; and
  - Species Composition.

Through application of the above VEGRAI index assessment, the ecological condition (state) of the riparian habitat of the freshwater resources were determined.

3.5. Riparian Habitat Ecosystem Services

To assess the importance of the riparian habitat and the ecosystem services supplied to society, the following functions of the riparian habitat were considered:

- Sediment Trapping;
- Nutrient Trapping;
- Bank Stabilisation and Bank Maintenance;
- Flood Attenuation;
- Maintenance of Biotic Diversity;
- Primary Production;
- Erosion Control; and
- Ecological Corridor for Migration.

As no currently applicable methodology is available for the assessment of riparian zone ecosystem services, a qualitative assessment was therefore undertaken based on the above functionality of the identified freshwater resources.

3.6. Riparian Habitat Ecological Importance and Sensitivity

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (DWAF, 1999). The ecological sensitivity refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (DWAF, 1999). The ecological importance and sensitivity (EIS) can be calculated according to the determinants listed in **Table 3.4** below, by attributing a suitable score[1] to each determinant.

Information, where relevant, was taken from the Riparian Ecosystem Services assessment (i.e. biodiversity maintenance information) and applied to this assessment. Rivers are important in contributing to biodiversity targets which can be informed by the ecosystem threat status and protection level, the level of priority as assessed through the National Freshwater Ecosystem Priority Areas project (Nel *et al*., 2011), fine-scale biodiversity plans and in bioregional plans (Macfarlane *et al*., 2016). This information, was therefore, also used to inform the assessment. Once calculated the EIS category (EISC) was determined (**Table 3.5**). The category can range from an A to D with A being Very High and D being Low/Marginal.

Table 3.4: Example table showing the Environmental Importance and Sensitivity Biotic and Habitat Determinants (DWAF, 1999).

Determinant	Score	Confidence
Primary Determinants		
1. Rare & Endangered Species		
2. Populations of Unique Species		
3. Species/taxon Richness		
4. Diversity of Habitat Types or Features		

[1] Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

5. Migration route/breeding and feeding site for wetland and riparian species		
6. Sensitivity to Changes in the Natural Hydrological Regime		
7. Sensitivity to Water Quality Changes		
8. Flood Storage, Energy Dissipation & Particulate/Element Removal		
Modifying Determinants		
9. Protected Status		
10. Ecological Integrity		
TOTAL		
MEDIAN		
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE		

Table 3.5: Environmental Importance and Sensitivity Categories for Biotic and Habitat Determinants (DWAF, 1999).

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

3.7. Riparian Habitat Buffer Zones

An ecological resource buffer zone is typically an area of vegetated, un-developed land surrounding a resource that is maintained to protect, support and screen flora and fauna associated with a resource from the disturbances associated with neighbouring land uses and / or a proposed development. As freshwater resources (including riparian habitats) are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of these habitat units that could potentially emanate from terrestrial-based anthropogenic activities. Buffer zones are therefore, typically required to protect and minimise the edge impacts on the identified freshwater resources.

The compilation of preliminary guidelines for the determination of wetland and watercourse buffer zones was developed by Macfarlane *et al* (2014). The current method according to Macfarlane *et al* (2014) proposes highly conservative buffer widths based on generic relationships for broad-scale assessments, but also allows buffers to be modified based on more detailed site-level information. This method of buffer determination was used at a site-specific level for this assessment.

3.8. Impact Assessment Method

The potential impacts were identified based on the proposed project and the potential impacts that may result from the proposed development. Direct, indirect and cumulative impacts of the potential impacts identified were assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5.
- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high.
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

$$S=(E+D+M)P$$

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area).

» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated).
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

3.9. Limitations and Assumptions

The following assumptions and limitations are applicable:

» Freshwater resources were initially identified and delineated at a desktop level using either database information or satellite imagery (Google Earth™). This information was then ground-truthed using a GPS device and verified in the field work phase. The GPS used is expected to be accurate from 5m up to 15m depending on meteorological conditions. Where initial delineations were undertaken at a desktop level, these were refined based on findings made in the field and the relevant GPS points recorded.
» The site visit was undertaken on 21-22 November 2018. Due to seasonal vegetation growth preferences, vegetation species can grow at different times / seasons of the year. As such, some hydrophytic (water-loving) vegetation species may not have been present at the time of the assessment. Seasonal variation of vegetation and associated identification limitations therefore apply to this assessment given the short term once-off nature of the fieldwork component. Therefore, the assessment is not considered a fully comprehensive study on hydrophytic vegetation species occurrence within the freshwater resources delineated. Rather, this study provides a snapshot of the vegetation occurrence at the time of the assessment.
» This study has focused on the delineation of freshwater resources that are likely to be affected by the proposed development and which fall within the regulated area of a watercourse (i.e. 100m from the edge of a watercourse or within 500m of the radius of a wetland affected by the proposed development). Identification and delineation of freshwater resources in the wider area was not undertaken.
» The delineation of the freshwater resources (riparian habitat of the watercourse), was limited to the reach of the watercourse that was affected by the proposed development. A delineation of the riparian habitat of the entire watercourse was therefore not undertaken.
» This study is limited to providing a freshwater delineation, riparian vegetation response assessment index, riparian ecosystem services assessment and environmental importance and sensitivity assessment. No other assessments were undertaken or formed part of this study. Aquatic assessments (including fish, invertebrates, amphibians, water quality, hydrological, floodline or groundwater studies) have not been included.
» Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas (NFEPA, 2011) database. This database is a national scale database. Some smaller freshwater resources may therefore not be contained in the database. Furthermore, mainly permanently saturated wetlands and perennial rivers are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles as well as ephemeral watercourses may not be included in the database. The fieldwork component was included in the assessment to verify the desktop database information and to address the potential shortcomings where wetlands and watercourses may have been overlooked in the database information but are present in the field.

4. FRESHWATER DESKTOP ASSESSMENT

The results of the freshwater desktop baseline assessment are shown in **Figure 4.1** below. The findings are provided in the sections below.

4.1. National Level Database Information

4.1.1 National Freshwater Ecosystems Priority Areas (2011) Database

The National Freshwater Ecosystems Priority Areas (NFEPA) (2011) database is an outcome of a three-year partnership project between South African National Biodiversity Institute (SANBI), Council for Scientific and Industrial Research (CSIR), Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks) (Nel *et al*. 2011). The NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supports sustainable use of water resources. The spatial priority areas are known as Freshwater Ecosystem Priority Areas (FEPAs).

FEPAs were identified based on:
- Representation of ecosystem types and flagship free-flowing rivers.
- Maintenance of water supply areas in areas with high water yield.
- Identification of connected ecosystems.
- Representation of threatened and near-threatened fish species and associated migration corridors.
- Preferential identification of FEPAs that overlapped with:
    - Any free-flowing river
    - Priority estuaries identified in the National Biodiversity Assessment 2011
    - Existing protected areas and focus areas for protected area expansion identified in the National Protected Area Expansion Strategy.

According to the NFEPA (2011) database, there are **no wetlands or rivers (perennial or otherwise) on the project site nor are there any wetlands within 500m of the project site**.

4.1.2 Vegetation Types (Mucina & Rutherford, 2006)

In terms of the vegetation characteristics, the proposed site is within the Nama-Karoo Biome according to Mucina and Rutherford (2012). The specific vegetation type within this Biome is the Bushmanland Sandy Grassland – Nkb 4, according to the Mucina and Rutherford (2012) classification, however Simon Todd found during his Ecological specialist fieldwork that the site is comprised of Bushmanland Arid Grassland rather, based on as-yet unpublished Mucina and Rutherford 2016 data. The Bushmanland Arid Grassland vegetation type is thus detailed below, as adapted from Mucina and Rutherford (2012). **Please note:** at present no distribution maps are available for the 2016 classification and delineation.

The distribution of Bushmanland Arid Grassland approximately spans from the town of Prieska in the east, to Upington in the north, and surrounds much of Aggeneys, and is often intermingled with other vegetation units such as Kalahari Karrois Shrubland, Lower Gariep Broken Veld and Gordonia Duneveld (Mucina and Rutherford, 2012). Bushmanland Arid Grassland is commonly found at altitudes of between 600 – 1200m.

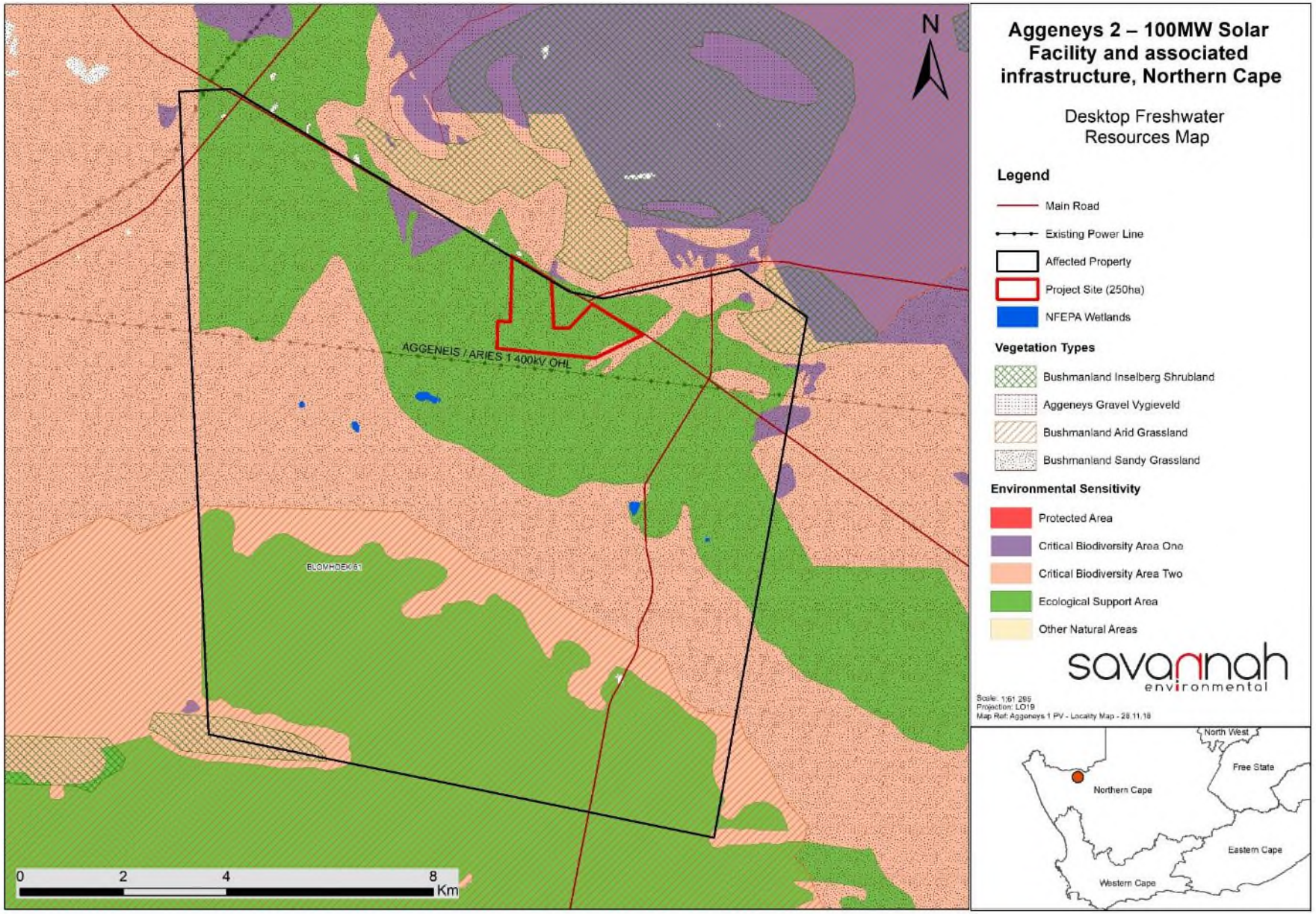

Figure 4.1: Freshwater Desktop Occurrence Map

The landscape associated with Bushmanland Arid Grassland can be described as extensive to irregular plains or on gently sloping plateau, generally sparsely vegetated by grassland comprised mainly of white grass species (*Stipagrostis* spp.). In certain places low Salsola shrubs alter the vegetation structure Mucina and Rutherford (2012). Bushmanland Arid Grassland responds to rainfall by producing a rich layer of annual herbs.

The geology commonly found associated with Bushmanland Arid Grassland is that of quaternary alluvium and calcrete, with superficial deposits of the Kalahari Group (towards the eastern boundary of this vegetation type). Soils are mostly red-yellow apedal soils, freely drained with a high base status and typically less than 300mm deep (over the majority of the area associated with Bushmanland Arid Grassland). For the remainder of the area associated with Bushmanland Arid Grassland, the soils go deeper than 300mm.

In terms of the conservation status of the Bushmanland Arid Grassland, it is Nationally listed as 'Least Threatened' (LC), with a conservation target of 21%, with none statutorily conserved (Mucina and Rutherford, 2012).

4.1.3 National Biodiversity Assessment Database (2012)

No wetlands or rivers were identified in terms of the National Biodiversity Assessment (2012) database or within 500m of the project site.

4.1.4 Google Earth Satellite Imagery (2017)

Google Earth™ satellite imagery was used to inspect the project site to visually identify any possibly affected freshwater features that were not contained in the consulted databases. From the imagery dated 2017, it was identified that a few **ephemeral watercourses** could be observed which diagonally traverse the project site in a north east to south west direction along the northern border of the project site. The watercourses would therefore require field verification in the fieldwork phase to ground-truth and delineate the watercourses.

4.2. Provincial Level Database Information

4.2.1 Northern Cape Conservation Plan (2017)

The Northern Cape Conservation Plan (NCCP) (2017) (yet to be released to the public, but was considered herein) is a Provincial level environmental database. The NCCP (2017) has replaced the Namakwa Biodiversity Sector Plan of 2008. At a regional level, the NCCP (2017) identifies Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) within the Northern Cape Province, based on a systematic biodiversity sector plan.

Spatial data of the Northern Cape Conservation Plan (2017) is available on SANBI and has been used for the desktop assessment. A Critical Biodiversity Areas of the Northern Cape: Technical Report has been released; however, no definitions or limits of acceptable loss has been included in the technical report. Therefore, considering the current lack of information regarding the CBAs in the Northern Cape, specifically related to the Northern Cape Conservation Plan of 2017, the previous definitions as per the Namakwa District Biodiversity Sector Plan, 2008 are used in this report. The Namakwa District Biodiversity Sector Plan, 2008, defines a Critical Biodiversity Area (CBA) as "areas of the landscape that need to be maintained in a natural

or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses". CBAs are also categorised into CBA 1 and CBA 2, where CBA 1 is a natural landscape where ecosystems and species are fully intact and undisturbed. These areas are considered to have high irreplaceability or low flexibility in terms of meeting the biodiversity pattern targets – if the biodiversity features are lost then the targets will not be met. CBA 1 landscapes are at or past their limits for acceptable change. CBA 2 areas are considered to be near-natural landscapes where the ecosystem and species are largely intact and undisturbed. These areas have an intermediate irreplaceability or some flexibility in terms of the extent of the area required to meet the biodiversity targets – there are options for loss of some biodiversity components without compromising the ability to achieve the targets. CBA 2 landscapes are approaching but have not passed their limits of acceptable change.

In terms of Ecological Support Areas (ESA), these are defined as "areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas". In general terms, an ESA is usually a corridor or buffer area linked to a CBA which provides support in terms of the conservation and protection of the CBA. Therefore, ESAs are not considered to be as sensitive as CBAs, but are still required to be considered as areas where development is required to be minimised in order to achieve conservation targets.

Other Natural Areas (ONA) also form part of the Namakwa District Biodiversity Sector Plan, 2008. These areas are considered to be in a natural state, however the condition of the area does not qualify it to form part of either an ESA or a CBA.

Consultation with the Northern Cape Department of Environmental and Nature Conservation was undertaken in order to obtain a better understanding of the CBAs associated with the Northern Cape Conservation Plan of 2017. The Department indicated that the Conservation Plan considers a CBA 1 area as a no-go area for development. Areas classified as CBA 2 have some options for development (through negotiation, depending on the nature of the area), and ESA areas are less restrictive in terms of development. However, formal definitions of the CBAs included in the Northern Cape Conservation Plan were not provided by the Department at this time.

According to the NCCP (2017), **a CBA 2 area falls over a small portion of the south eastern corner of the project site and an ESA area falls over the remaining area of the project site**. No ONAs were evident in terms of the database information. As described above, CBA 2 areas have some options for development (through negotiation, depending on the nature of the area), and ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development. These management principles need to be kept in mind by decision-makers when making decisions regarding developments in these areas.

5. FRESHWATER SITE VISIT FINDINGS

The field investigation was undertaken on 21-22 November 2018. November is considered to be one of the wet seasons, however drought conditions had continued from previous seasons and no rain had fallen before the assessment was undertaken. Conditions were hot and sunny, with very minimal cloud cover and little wind. No surface water was visible on the project site at the time of the assessment. The project site was vegetated mainly by sparse and scattered scrub and grass species.

The results of the freshwater field investigation are shown in **Figure 5.1**. The findings are discussed in the sub-sections below.

5.1. Riparian Habitat Delineation Results

The freshwater resources identified from a desktop level on the project site included several ephemeral watercourses in the north eastern areas of the project site. The watercourses are located in the Orange Primary Catchment, and in Quaternary Catchment D82C. The watercourses are within the greater Orange Water Management Area (WMA).

These freshwater features were investigated further and verified in the field. The findings of the watercourse delineation assessment are provided below.

5.1.1 Topography Associated with the Watercourses

The general topography in the project site is relatively flat, with the exception of isolated inselbergs in the areas beyond the project site. The inselbergs are not directly affected by the proposed development. **Five (05) ephemeral watercourse reaches[2]** were identified on the project site which can be classified as Lower Foothill Rivers in terms of the national classification system. The ephemeral watercourses emanated from culverts under the Loop 10 road north of the project site boundary, which allows water run-off from the inselbergs north of the project site to drain through onto the project site (**Photograph 5.1**). As a consequence of the flat terrain, the ephemeral watercourses become very diffuse before disappearing into the landscape altogether along the length of the watercourses. Minor topographical incisions as a result of water erosion create the channel form for the ephemeral watercourses, which are relatively shallow (<0.5m) and narrow (~1-5m).

[2] These features are very typical for the Northern Cape and the site is not considered to be unique considering the presence of these systems.

Photograph 5.1: Photo of an ephemeral watercourse emanating from the Loop 10 road culvert leading to the project site's relatively flat landscape.

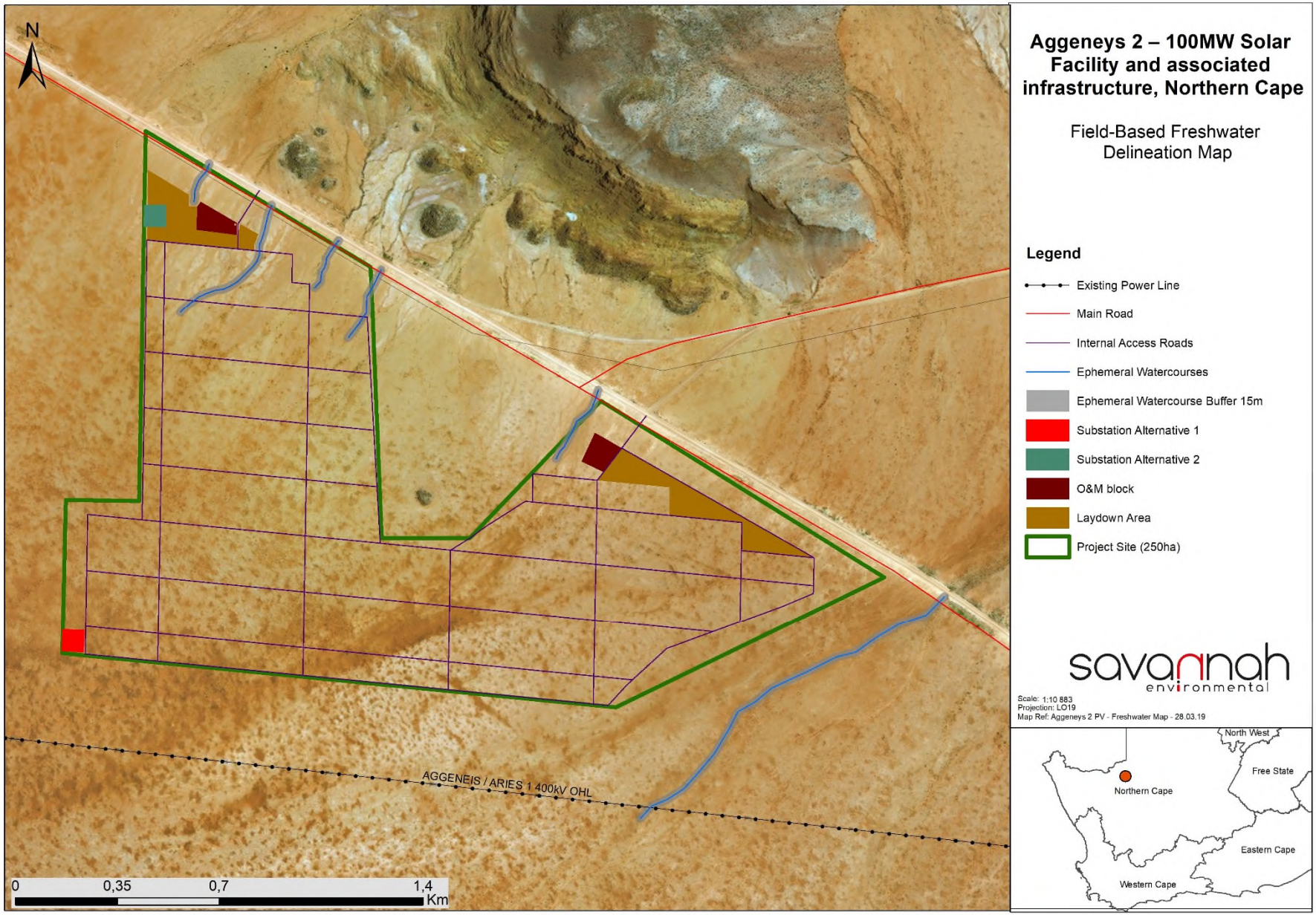

Figure 5.1: Freshwater Delineation Map

5.1.2 Alluvial Soils and Deposited Materials

Given the arid nature of the climate in the region, the hydrological regime (frequency and duration of flow) of the watercourses are typically ephemeral, flowing only after rainfall events for very short-lived periods (hours to a few days). The limited vegetation cover and exposed nature of the soils means that sediment is transported from the surrounding catchment into the watercourses, making flows relatively turbid (thick sediment laden). As a result, alluvial deposits (**Photograph 5.2**) are apparent in the dry watercourse beds when not in flow. The identified watercourses are no different to those described above, showing the same characteristics described above. The alluvial deposits included fine to sandy grain sediments, as well as coarse grained calcareous materials.

Photograph 5.2: Photo showing alluvial deposits on the dry bed of an ephemeral watercourse.

These watercourses can be described as a Section B channel type, given that the section of the particular reach of the watercourse is in a zone of the fluctuating water table and will only have base flow at any point in the channel when the saturated zone is in contact with the channel bed. The base flow is however intermittent as mentioned earlier, with flow at any point in the channel dependent on the current height of the water table. The gradient of the channel bed is however flat enough for deposition of material to take place.

5.1.3 Riparian Vegetation

General vegetation cover was observed as part of the delineation assessment. The basal cover could be described as predominantly grassland vegetation (**Photograph 5.3**), with some scrubland vegetation species also present. The grassland appeared to consist of a mix of graminoid species consisting mainly of *Stipagrostis sp.* and *Schmidtia sp*. The scrubland vegetation species observed was mainly *Boscia foetida*

subsp. *Foetida*, *Lycium cinereum*, *Pappea capensis, Phaeoptilum spinosum* and *Rhigozum* sp. Overall, the vegetation condition appeared to be disturbed as a result of grazing impacts from livestock on the property.

Photograph 5.3: *Rhigozum* sp. observed in the watercourse.

A comment received from the Department of Water and Sanitation (DWS) during the public disclosure of this report read as follows:

> *"i) The final Basic Assessment Report must clearly show all water courses as defined in the National Water Act, 1998 (Act 36 of 1998) as well as the delineated 1:100 year flood lines or 100 meters of a river/drainage line (whichever is the furthest) and 500m metres."*

This section contained a description of the delineation of the water features observed on site. These have been mapped in the associated Basic Assessment report showing both the water courses as defined in the National Water Act, and the 100m and 500m boundaries required by the comment above. No 1:100 year floodline investigation was conducted.

5.2 Riparian Habitat Vegetation Response Assessment Index (VEGRAI) Results

In order to apply the VEGRAI index it is essential to qualify the reference conditions (Kleynhans *et al*., 2007). The reference conditions are a determination of the state of the riparian habitat that is completely natural and unmodified / affected by existing impacts.

The reference state of the vegetation within the identified watercourses (marginal and non-marginal zone) would typically include scrub (*Boscia foetida* subsp. *Foetida*, *Lycium cinereum*, *Pappea capensis, Phaeoptilum spinosum* and *Rhigozum* sp.) and graminoid species consisting of *Stipagrostis* sp. dominated substrate within the active channel and along the fringes in the non-marginal zone. Cover would remain

fairly low given the very dry climate and free draining alluvial soils. Water flow would be intermittent only after rainfall events and for short lived periods, as previously mentioned.

The present state of the vegetation within the watercourses resemble close to the natural state as described above, with the exception of grazing disturbance, vehicle tracks through the watercourses along the farm boundary and the containment of flow on Loop 10 road just north of the boundary of the farm. No exotic vegetation was noted however, despite the disturbance factors described above. Water flow will also remain intermittent and turbid as per the reference state mentioned above. Other disturbances include the existing farm boundary fence line and farm tracks through the watercourses.

Taking the above into consideration, the results shown in **Table 5.1** below were obtained for the VEGRAI assessment.

Table 5.1: Result of the VEGRAI assessment of the watercourses.

LEVEL 3 ASSESSMENT						
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**	**NOTES: (give reasons for each assessment)**
MARGINAL	76,7	63,9	4,2	1,0	100,0	Larger proportion of the vegetation component and channel structure.
NON-MARGINAL	76,7	12,8	4,2	2,0	20,0	Smaller fringe component of the vegetation component and channel structure.
	2,0				120,0	
LEVEL 3 VEGRAI (%)				76,7		
VEGRAI EC				**C**		
AVERAGE CONFIDENCE				4,2		

Based on the result above, the Ecological Condition (EC) of the riparian habitat of the watercourses were assessed to be **76.7% unmodified** and therefore, a **Class C moderately modified system**.

5.3 Riparian Habitat Ecosystem Services Results

The primary potential ecosystem services provided by the identified watercourses include sediment trapping, bank stabilisation and maintenance, flood attenuation, ecological corridor for migration of species and erosion control. The watercourses drain the southern part of the Gamsberg inselberg local catchment of quaternary catchment D82C. With this in mind, the function of the watercourses to provide the ecosystem services mentioned above is relatively important for the local area. The riparian habitat of the watercourses is not dense, but offers some resistance to flows and provides a degree of sediment trapping, flood attenuation, bank stabilisation and erosion control function for the immediate area. The vegetation condition and composition of the riparian habitat also means that the watercourses are likely to act as a migration corridor for faunal and avi-faunal species utilising the watercourses when in flow, albeit for a short-lived period.

Other potential ecosystem services provided, but deemed to be to a lesser extent, include nutrient trapping, maintenance of biotic diversity and primary production.

5.4 Riparian Habitat Ecological Importance and Sensitivity (EIS) Results

The ecological importance and sensitivity (EIS) of the watercourses were assessed taking into account the various determinants of the watercourses. The results of the assessment are provided in **Table 5.2** below.

Table 5.2: Riparian Habitat Ecological Importance and Sensitivity Results

Freshwater Resource Name	**Ephemeral Watercourses**		**Reason**
Determinant	**Score**	**Confidence**	
Primary Determinants			
1. Rare & Endangered Species	0	2	No specific aquatic fauna and flora species of conservation importance associated with these watercourses were identified during the field assessment.
2. Populations of Unique Species	0	2	No specific populations of unique fauna and flora species were identified with These watercourses during the field assessment.
3. Species/taxon Richness	1	3	Species and taxon richness are relatively low in terms of hydrophytic floral species.
4. Diversity of Habitat Types or Features	1	3	The diversity of habitat types is limited to communities of graminoid and shrubland vegetation in and near the in-stream habitat of the watercourses.
5. Migration route/breeding and feeding site for wetland species	3	3	As the watercourses are ephemeral, during times of flow it is likely to serve as an important migration route/breeding and feeding site for amphibians and waterfowl despite no species being identified on the day of the watercourse assessment.
6. Sensitivity to Changes in the Natural Hydrological Regime	2	3	The ephemeral nature of the hydrological regime of the watercourses means that they will be fairly sensitive to reductions and changes in the natural hydrological regime. The graminoid species that make up the in-stream habitat is likely to transition to more terrestrial and drought resistant species with any further reduction of water supply.
7. Sensitivity to Water Quality Changes	2	3	The watercourses are associated with high sediment loads given the harsh arid climate and exposed nature of the soils generally. This is evidenced in the alluvial deposits in-stream of the watercourses. Furthermore, the watercourses consist of fairly hardy graminoid species and as such, would be fairly tolerant to water quality changes.
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	One of the main potential functions of the watercourses are the ability to perform a functional role in terms of sediment trapping, attenuation of storm water and energy dissipation for the local catchment. In this regard, the watercourses are significant in terms of the role they perform in the greater landscape.
Modifying Determinants			
9. Protected Status	2	0	None.
10. Ecological Integrity	3	4	The overall EC of the watercourses were assessed to be a Class C moderately modified system. The watercourses are also within an Ecological Support Area which raises

			the significance of the ecological integrity, which needs to be maintained as far as possible.
TOTAL	17	26	
MEDIAN	1,7	2,6	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**C**		**The watercourses are considered to be moderately ecologically important and sensitive on a local scale**

In light of the above, the most prominent determinants in which the watercourses scored moderately was in terms of being important from a migration route/breeding and feeding site for amphibians and waterfowl despite being ephemeral in nature. In addition to this, the watercourses were identified to serve an important role in performing sediment trapping, attenuation of storm water and energy dissipation for the local catchment as identified in **Section 5.2** above. Lastly, the results of the desktop assessment and VEGRAI assessment informed the ecological integrity component of the EIS assessment, also scoring moderately due to the fact that the watercourses are in an ESA area, and was assessed to be a Class C moderately modified system in terms of the vegetation ecological condition. Overall, the EIS of the watercourses were classed as a **Class C system which is considered to be moderately ecologically important and sensitive on a local scale**.

A comment received from DWS during the public disclosure of this report read as follows:

> *"a) Please note that the Department rates all perennial and non-perennial rivers together with all dry river beds and natural drainage and associated riparian areas extremely sensitive to development. An option of developing (developing of solar PV) further away from the all water course would be the preferred option;"*

The abovementioned sensitivity assessment was concluded on the basis of a field assessment and subsequent EIS scoring, and as such may be regarded as a ground-truthed assessment of the sensitivity of these features. In addition, all reasonable efforts were made in determining the exact layout of the facility - taking into account the ground-truthed freshwater sensitivities of the site, possible layout optimisations and any possible alternatives, the restrictive measured applied to the buffer zone (detailed below), as well as the mitigation measures contained in this report. In doing so, the proponent has demonstrated optimisation and minimisation of impacts on sensitive features towards presenting a suitable development proposal to the authority.

5.5 Riparian Habitat Buffer Zones

A **buffer zone of 15m** for the ephemeral watercourses is to be implemented. With regards to the buffer zone, the PV panels can span over the ephemeral watercourses given the ephemerality of the watercourses and limited vegetation cover. The mounting structures of the PV panels must not however be placed directly inside the watercourses, but are permissible in the buffer zone of the watercourses. The mounting structures should also be limited to the bare minimum within the buffer zone where required. Internal roads and underground cables are also permissible through the watercourses provided that the necessary water use license or general authorisation is obtained from the Department of Water and Sanitation. No other buildings or infrastructure are allowed in the watercourses and the associated buffer zone. The buffer zone calculation can be found in **Appendix B**.

A comment received from the Department of Water and Sanitation (DWS) during the public disclosure of this report read as follows:

> "b) No development or construction should be done or may occur within 100m; 1:100 year flood line of a river/drainage lines (whichever is furthest) and 500m of a pan/wetland without authorisation from this department. The water courses should be delineated in order to provide an appropriate buffer to maintain such water courses;"

No development or construction should will commence within 100m of a water course on the site and 500m of a pan/wetland without the relevant authorisation from the Department. Delineations of the water features as identified through this study can be found in Section 5.1 of this report, with an appropriate buffer zone determination included in Section 5.5. in order to maintain such water courses. Furthermore, the mapping of these delineations is contained in the associated Basic Assessment report.

6. LEGISLATIVE IMPLICATIONS OF THE PROPOSED DEVELOPMENT

The relevant legislative implications of the proposed development within the context of freshwater resources is provided in the sub-sections below.

6.1. Legislative Implications in terms of NEMA read with the EIA Regulations (2014), as amended

The specific activities in terms of NEMA read with the EIA Regulations (2014), as amended, that will be triggered as a result of the proposed development in the context of freshwater resources are provided in **Table 6.1** below. The reasons that these activities are triggered, are also included in the table below.

Table 6.1: Activities triggered in terms of the EIA Regulations (2014), as amended, in terms of freshwater resources affected by the proposed development

Activity No(s):	Potentially applicable Basic Assessment Activity(ies) as set out in Listing Notice 1 (GN R327)	Reason why the listed activity is applicable
12(ii)(a)(c)	The development of – (ii) Infrastructure or structures with a physical footprint of 100 square metres or more; Where such development occurs- (a) within a watercourse; (c) within 32 metres of a watercourse.	The proposed solar PV facility will directly affect ephemeral watercourses on the project site, which will include the development of PV panels of 100 square metres or more within the watercourses, and the development of buildings, lay-down areas, PV panels and mountings structures within 32m of the watercourses on the project site.
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, san, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	The proposed solar PV facility will require road crossings through the watercourses for internal roads which will require infilling of soils/rock of more than 10 cubic metres into the watercourses where required.

No impacts related to freshwater resources fall within the ambit of GN. R 325 Listing Notice 2. Therefore, these activities are not applicable. From the above, an application for environmental authorisation by means of a Basic Assessment (BA) process will be required for impacts to watercourses due to the proposed development.

6.2. Legislative Implications in terms of the NWA and Government Notices 509 of 2016

As the proposed development will involve the development of PV panels over the ephemeral watercourses and internal roads through the ephemeral watercourses identified, water uses c) and i) in terms of Section 21 of the NWA are relevant. However, since no mounting structures will impose on the physical channel structure of the watercourses, and the PV panels will merely go over the watercourses, as well as the establishment of internal roads will involve physical alteration at the crossing points through the watercourses, the proposed development will not result in the significant physical alteration of the channel of the watercourses. As such, it is possible that a General Authorisation (GA) may be applicable to the proposed development in terms of Government Notice 509 of 2016 as the proposed development will be within the regulated area of the ephemeral watercourses (i.e. the area within 100m from the edge of a watercourse). However, a risk assessment in terms of the Risk Assessment Protocol will need to be undertaken

prior to construction to assess the level of risk associated with the proposed development, and the need to register for a GA or WULA. This has been recommended in **Section 9** below.

7. COMPARATIVE ALTERNATIVES ASSESSMENT

Two alternatives have been proposed for the operation and maintenance block: Operation and Maintenance Block 1 and Operation and Maintenance Block 2. A comparative assessment of each alternative is provided in **Table 7.1** below, providing reasons for the selection of the preferred.

Table 7.1: Comparative Alternatives Assessment

Preferred Alternatives from a Freshwater Perspective	
Alternative Operation and Maintenance Block 1	**Alternative Operation and Maintenance Block 2**
The construction of the proposed operation and maintenance block 1 will not directly affect any ephemeral watercourses. However, the operation and maintenance block 1 is within 100m of two ephemeral watercourses, and indirect impacts such as sedimentation and increased run-off may affect these watercourses. Given that only indirect impacts can be expected, which can be mitigated (see **Section 8** below), this alternative is viewed as favourable.	The construction of the proposed operation and maintenance block 2 will not directly affect any ephemeral watercourses. However, the operation and maintenance block 2 is within 100m of one ephemeral watercourse, and indirect impacts such as sedimentation and increased run-off may affect this watercourse. Given that only indirect impacts can be expected, which can be mitigated (see **Section 8** below), this alternative is viewed as most favourable.

Based on the information in the comparative assessment above, **Alternative Operation and Maintenance Block 2 is viewed as most favourable** given the slightly less indirect impact to one watercourse when compared with **Alternative Operation and Maintenance Block 1**. It must be noted that **Alternative Operation and Maintenance Block 1 is also viewed as favourable (but less so than alternative Operation and Maintenance Block 2 mentioned above) given the limited expected indirect impact on two of the nearby (<100m) watercourses.**

8. IMPACT ASSESSMENT

The potential impacts of the proposed development on freshwater resources are provided in this section below. It must be noted that the overall impact of both alternatives (where relevant) is provided below in the same impact rating tables. Even though there is a slightly reduced indirect impact is expected, this has no significance on the scoring of the parameters measured as the difference in impact is fairly similar, and so the potential impact is therefore the same for both alternatives where applicable.

8.1. Potential Impacts on the Vegetation of the Ephemeral Watercourses (Construction Phase)

Based on the proposed layout, the PV arrays are planned over the watercourses and buffer zones identified, and as a result, some vegetation may need to be cleared from the watercourses where the PV array is planned.

The impact rating is shown in **Table 8.1** below.

Table 8.1: Potential impacts associated with vegetation clearance in the watercourses.

Nature: Clearance of vegetation associated with the ephemeral watercourses.		
	Without mitigation	**With mitigation**
Extent	Project site (1)	Project site (1)
Duration	Very short-term (1)	Very short-term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**32 (Medium)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Limited	Limited
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » No lay-down areas, operation and maintenance buildings are allowed in the watercourse areas and associated buffer zones. » No in-stream vegetation is to be removed unnecessarily. » Where in-stream vegetation is to be cleared, vegetation is not to be completely removed. Rather, vegetation should be trimmed to 300mm height above ground level to ensure surface roughness is maintained » The Environmental Officer (EO) must be present when vegetation is trimmed to supervise this process and ensure compliance with this control measure. » Alien invasive and control management plan is to be formulated and implemented. » No construction in the watercourse is to take place over the two rain peak periods associated with the watercourses (i.e. during November & between February - March). This will avoid impacts to flow, as construction will be limited to periods when the watercourses are likely to be dry.		
Residual Impacts: No residual impacts after implementation of mitigation measures.		

8.2. Potential Impacts on the Water Quality of the Ephemeral Watercourses (Construction Phase)

The mounting structures of the PV panel arrays may be required within the stipulated 15m buffer zones of the watercourses, but are not to be placed directly in the watercourses. With the construction of the mounting structures, the impacted area is understood to be limited to the immediate area of the mounting structure in which piling may take place. There will be some disturbance of the soils and associated clearance which will expose soils leaving the areas vulnerable to sedimentation and erosion around the mounting structures but more importantly in the areas designated for the lay-down areas, on-site substations and operation and maintenance buildings. Sedimentation can result directly or indirectly via stormwater run-off from the aforementioned areas.

In addition to the above, with the presence and movement of construction vehicles and associated machinery, there is a potential for compaction, as well as fuels and oils to spill or leak either directly into the watercourses or indirectly via storm water run-off.

Lastly, sanitation will be required for workers during the construction phase. Temporary sanitation facilities are likely to be utilised. Spillages or leaks from temporary sanitation facilities may result during the construction phase, which can enter into the ephemeral watercourses directly or via stormwater run-off within the local catchment area.

The impact rating is shown in **Table 8.2** below.

Table 8.2: Potential impacts associated with water quality in the watercourses.

Nature: Sedimentation of watercourses and associated erosion due to increased run-off and clearance of vegetation in the immediate catchment area. Oil and fuel leaks and spills directly in the watercourses or indirectly via stormwater run-off. Temporary sanitation facilities may pollute the ephemeral watercourses.		
	Without mitigation	**With mitigation**
Extent	Project site (1)	Project site (1)
Duration	Very short-term (1)	Very short-term (1)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Medium)**	**12 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Limited	Limited
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation: » Where mounting structures are within the buffer zone of the ephemeral watercourses, these areas need to be temporarily bunded using an appropriate structure (i.e. silt nets, sand bags, pegged wooden planks) until construction is complete at each point. » The outer areas of the cleared lay-down, operation and maintenance building, and on-site substation areas that are within 100m of the watercourse must have make use of sedimentation preventative measures such as use of silts nets, sand bags or any other suitable sedimentation preventative technique to prevent sedimentation entering the watercourses via surface water run-off during construction. » All soil stockpiles on the project site that are within 100m of a watercourse must be bunded using an appropriate structure (i.e. silt nets, sand bags, pegged wooden planks). » All vehicles and machinery must be checked for leaks before being allowed to operate on the project site. Should leaks be detected, the relevant vehicles and machinery must be repaired before being allowed to operate on the project site. » No storage of fuels, oils or any other hazardous substance are allowed directly in the watercourses or within 100m from any watercourse. » General storage of fuels, oils and any other hazardous substances must be contained in bunded areas. » No construction in the watercourses is to take place over the two rain peak periods associated with the watercourses (i.e. during November & between February - March). This will avoid impacts to flow, as construction will be limited to periods when the watercourses are likely to be dry. » Temporary sanitation may not be placed directly or within 100m of any ephemeral watercourse. » Temporary sanitation facilities must be regularly checked for leaks and spillages, and repaired where any leakages are detected before being allowed for use on the project site.
Residual Impacts: No residual impacts after implementation of mitigation measures.

8.3. Potential Impacts on Geomorphology of the Ephemeral Watercourses (Construction Phase)

Internal roads will be required for the PV arrays areas through the watercourses. Compaction of the bed and channels of the ephemeral watercourses due to movement of vehicles is likely to take place.

The impact rating is shown in **Table 8.3** below.

Table 8.3: Potential impacts associated with movement of vehicles in the watercourses.

Nature: Soil compaction of the bed of the ephemeral watercourses or associated erosion are expected with the movement of vehicles through the ephemeral watercourses.		
	Without mitigation	**With mitigation**
Extent	Project site (1)	Project site (1)
Duration	Very Short-term (1)	Very Short-term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Highly probable (4)
Significance	**40 (Medium)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- » Suitable crossings through the watercourses are to be implemented where required. In general, it is not expected that hard structures (road culverts) will be required in the watercourses, and that the establishment of vehicle tracks will be sufficient. However, it is recommended that gravel be used through the watercourses to assist with stabilization and to prevent erosion within the watercourses.
- » Necessary water use license or general authorisation must be obtained from the Department of Water and Sanitation prior to commencing with construction activities.
- » Internal roads are not to be tarred.
- » Vehicle movement through the watercourses is to be limited as far as possible.
- » All internal roads through watercourses are to be monitored for erosion regularly during the construction phase.
- » Where erosion takes place, the Environmental Control Officer (ECO) must inspect the degree of erosion and propose suitable mitigation measures to prevent further erosion.
- » Construction stormwater management plan must be compiled by a suitable engineer to address general drainage and run-off issues.
- » Post-construction monitoring of the watercourses by the ECO is also required to determine the occurrence of erosion following the completion of construction.

Residual Impacts:

No residual impacts after implementation of mitigation measures.

8.4. Vehicle movement in the watercourses during monitoring (Operation Phase)

Vehicle movement through the ephemeral watercourses via internal roads is likely to be required during the operation phase. This activity will be associated with impacts to the watercourses in terms of compaction and possible erosion soils.

The impact rating is shown in **Table 8.4** below.

Table 8.4: Potential Impacts associated with vehicle movement in the watercourses.

Nature: Soil compaction of the bed of the ephemeral watercourses or associated erosion are expected with the movement of vehicles through the ephemeral watercourses.		
	Without mitigation	**With mitigation**
Extent	Project site (1)	Project site (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	**55 (Medium)**	**28 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- » Necessary water use license or general authorisation must be obtained from the Department of Water and Sanitation for impacts to a watercourse.
- » Vehicle movement through the watercourses is to be limited as far as possible.
- » Internal roads are not to be tarred.
- » Crossing through watercourses must be catered for in the design of the SEF, and must include for appropriate gravel beds through the watercourses to prevent erosion and to stabilize the bed of the watercourses.
- » All internal roads through watercourses are to be monitored for erosion annually during the operation phase.
- » Where erosion takes place, the managing agent must inspect the degree of erosion and propose suitable mitigation measures to prevent further erosion.

Residual Impacts:
Residual impacts after implementation of mitigation measures will be minimal.

8.5. Decommissioning of the solar PV facility (Decommissioning Phase)

The same potential impact identified in the construction phase can be associated with the decommissioning of the proposed solar PV facility but in reverse order. The same impacts, significance ratings and mitigation measures are applicable.

8.6. Cumulative Impacts

The assessment of cumulative impacts was undertaken with consideration of similar solar energy developments, and for which cumulative impacts can be identified that are anticipated to affect freshwater resources in the region. This mainly relates to the trend of renewable energy projects arising in the region around Aggeneys (see **Figure 8.1** below), which is located in a REDZ and is therefore considered preferable for such facilities. Known developments that can be expected to have a cumulative impact on the affected quaternary drainage catchment include the twelve (12) 75MW Solar Capital solar PV facilities authorised on the same farm (Remaining Extent of the Farm Bloemhoek 61) as the proposed development, as well as the Orlight Biotherm 75MW solar PV development (currently under construction) located higher in the catchment of the proposed development. Other proposed renewable energy developments in the region are either located outside of the quaternary drainage catchment or are located downstream outside of the drainage network of the project site, and will therefore not affected the freshwater resources assessed.

Of relevance from a freshwater perspective, the potential impacts to watercourses as a result of similar renewable energy developments in the catchment include direct physical alteration and degradation of watercourses; indirectly, from a catchment level, transformation of land use and associated change in surface roughness resulting in consequent hydrological alterations in catchment drainage are also of concern; and finally, consequent increased sedimentation and erosion may also result.

The rating and significance related to possible cumulative impacts is shown in **Table 8.5** below.

Table 8.5: Potential cumulative impacts to the freshwater resources.

Nature: Indirect impacts due to catchment level changes to surface roughness, alteration of hydrology, as well as direct impacts related to physical alteration and degradation of freshwater resources in general.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Regional (3)	Regional (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**33 (Medium)**	**39 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation[3]:

- Necessary precautions undertaken to minimise direct impacts to watercourses and avoid impacting watercourses directly as far as possible.
- Prevent complete clearance of vegetation on the project sites, to maintain some level of surface roughness to assist with control of increased run-off in the catchment.
- Sedimentation preventative measures to be implemented to prevent sedimentation via run-off at a catchment level.
- Erosion protection measures to be implemented to watercourses, where required.
- Ensure that all fuels, oils and hazardous substances are kept out of all watercourses at a safe distance (i.e. 100m from any watercourse) and that storage areas are sufficiently bunded to prevent run-off containing substances entering watercourses.

Cumulative impacts:

Described above.

Residual Impacts:

No residual impacts after implementation of mitigation measures.

[3] Mitigation is assumed to be implemented by renewable energy projects in the surrounding area by default.

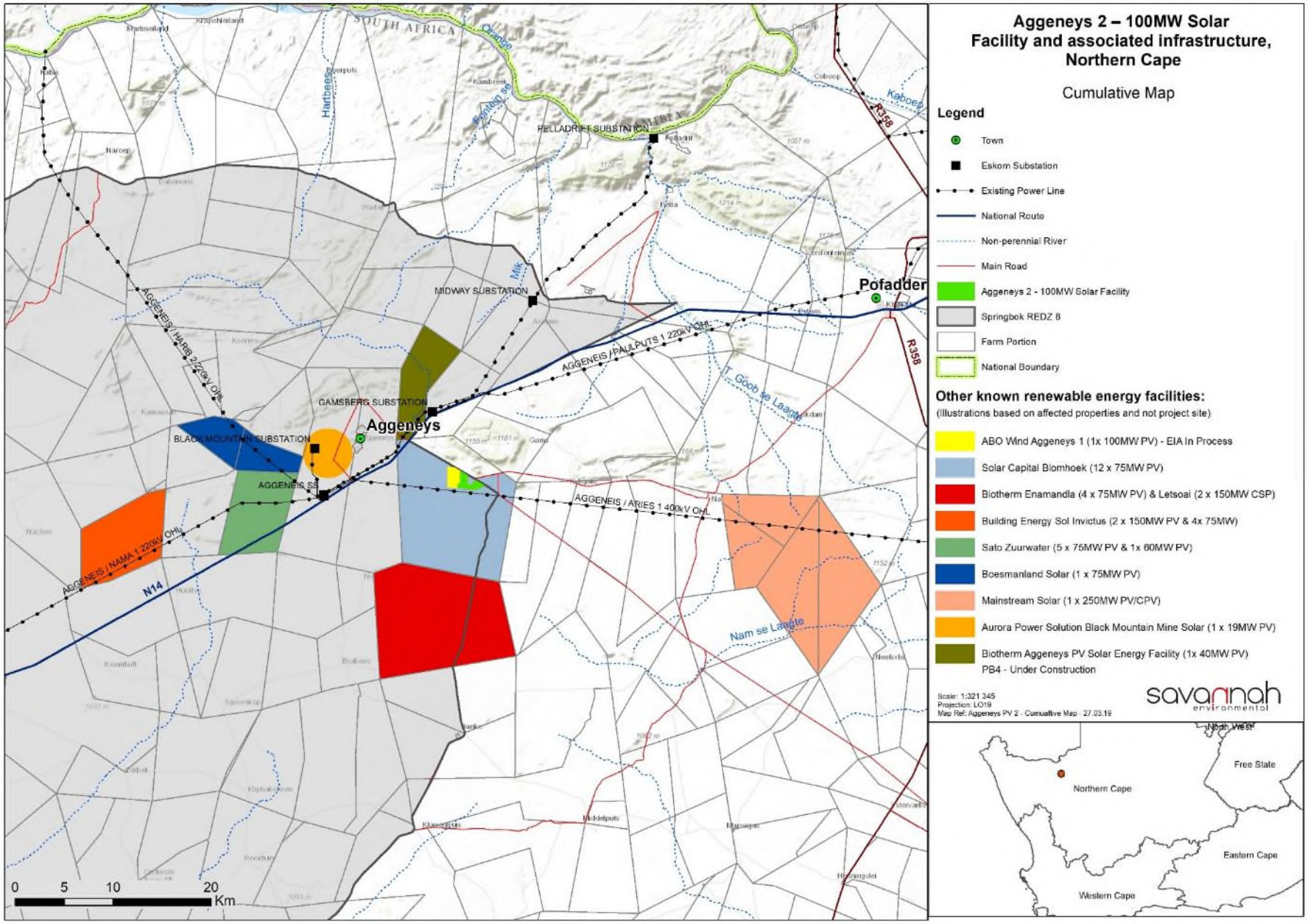

Figure 8.1: Cumulative Map

9. CONCLUSION AND RECOMMENDATIONS

This freshwater report focused on providing information on the freshwater resources baseline environment for the proposed solar PV facility and associated infrastructure on the project site within the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province. The freshwater study was established using the collection of available secondary information (available databases, satellite imagery and relevant scientific literature) in order to provide a freshwater baseline environmental before undertaking a site visit to verify desktop findings and confirm or refute the presence of freshwater resources on the project site.

From a desktop perspective, it was observed from Google Earth™ satellite imagery that **several ephemeral watercourses** could be observed on the project site. **No other freshwater resources were identified at a desktop level consulting database information.** However, it must be noted that the project site was found to be mainly located **within an Ecological Support Area, with a small portion within a Critical Biodiversity Area 2**, however field results indicated no ephemeral watercourses occurred on or near (>250m) the CBA 2 areas and as such only the ESA areas are applicable to the ephemeral watercourses discussed in this report.

The in-field investigation and assessment confirmed the presence of the **five (05) ephemeral watercourse reaches** within the project site, which can be classified as Lower Foothill Rivers in terms of the inland classification system. These freshwater resources were delineated using the indicators as stipulated in the national guidelines, and were assessed further accordingly.

The ecological condition of the riparian habitat for the ephemeral watercourses were assessed to gain an understanding of the condition of the habitat. This was assessed using the VEGRAI methodology. The Ecological Condition (EC) of the riparian habitat of the watercourse was assessed to be **76.7% unmodified** and therefore, a **Class C moderately modified system**.

A qualitative assessment of the potential ecosystem services that could be provided by the ephemeral watercourses followed the ecological condition assessment. It was found that the primary potential ecosystem services assessed included **sediment trapping, bank stabilisation and maintenance, flood attenuation, ecological corridor for migration of species and erosion control**. The watercourses drain the southern part of the Gamsberg inselberg local catchment of quaternary catchment D82C. With this in mind, the function of the watercourses to provide the ecosystem services mentioned above is relatively important for the local area. The riparian habitat of the watercourses is not dense, but offers some resistance to flows and provides a degree of sediment trapping, flood attenuation, bank stabilisation and erosion control function for the immediate area. The vegetation condition and composition of the riparian habitat also means that the watercourses are likely to act as a migration corridor for faunal and avi-faunal species utilising the watercourses.

The ecological importance and sensitivity (EIS) watercourses were assessed taking into account the various determinants of each freshwater resource. The most prominent determinants of the watercourses, which scored moderately, was in terms of being i**mportant from a migration route/breeding and feeding site for amphibians and waterfowl despite being ephemeral in nature**. In addition to this, the watercourse was identified to serve an important role in performing **sediment trapping, attenuation of storm water and energy dissipation for the local catchment**. Lastly, the results of the desktop assessment and VEGRAI assessment informed the ecological integrity component of the EIS assessment, also scoring moderately due to the fact

that the watercourses are in an ESA area, and were assessed to be a Class C moderately modified system in terms of the vegetation ecological condition. **Overall, the EIS of the watercourses were classed as a Class C system which is considered to be moderately ecologically important and sensitive on a local scale.**

A **buffer zone of 15m** for the ephemeral watercourses was determined which is to be implemented in accordance with the explanation which follows. With regards to the buffer zone, the PV panels can span over the ephemeral watercourses given the ephemerality of the watercourses and limited vegetation cover. The mounting structures of the PV panels must not however be placed directly inside the watercourses, but are permissible in the buffer zone of the watercourses. The mounting structures should also be limited to the bare minimum within the buffer zone where required. Internal roads and underground cables are also permissible through the watercourses provided that the necessary water use license or general authorisation is obtained from the Department of Water and Sanitation. No other buildings or infrastructure are allowed in the watercourses and the associated buffer zone.
A comparative assessment of the two (02) operation and maintenance block alternatives was undertaken in which it was determined that **Alternative Operation and Maintenance Block 2 is viewed as most favourable** given the slightly less indirect impact to one less watercourse when compared with **Alternative Operation and Maintenance Block 1**. It was noted that **Alternative Operation and Maintenance Block 1 is also viewed as favourable (but less so than alternative Operation and Maintenance Block 2 mentioned above) given the limited expected indirect impact on two of the nearby (<100m) watercourses.**

The two on-site substation locations proposed as part of the development footprint are both located within areas where no ephemeral watercourses or other freshwater features are located and, therefore, no infringement on these features is expected to occur. Therefore both proposed locations are considered to be acceptable in terms of infringement on freshwater features.

The impact assessment identified potential impacts during the construction, operation and decommissioning phases. These included **potential impacts to the vegetation, geomorphology and water quality of the watercourses during the construction and decommissioning phases**. The significance ratings of the potential impacts ranged from **Medium to Low (including without and with mitigation measures)**. With regard to the **operation phase**, potential impacts as a result of **vehicle movement were identified, of which the significance rating was Medium without and with mitigation measures**. A cumulative impact assessment was also undertaken. The results showed that the **significance rating of the cumulative impacts** as a **result of surrounding similar renewable energy developments**, including the proposed development, would be **Medium without and with implementation of mitigation measures**. Suitable **mitigation measures were proposed to minimise potential impacts** as far as possible.

With consideration of the condition and functionality of the watercourses identified, and the potential impacts anticipated, the following recommendations are made from a freshwater perspective:

- A construction and operation stormwater management plan must be compiled by a suitable engineer to address general drainage and run-off management;
- An alien invasive and control management plan is to be compiled for the construction and post-construction phases by a suitably qualified ecological specialist, and implemented accordingly; and
- Prior to construction, a risk assessment is to be undertaken for the road crossings through the ephemeral watercourses and for the development of the PV arrays over the ephemeral watercourses Where such risk assessment determines the overall risk level to be 'Low', a General Authorisation process will be required. Conversely, where 'Moderate' or 'High' risk ratings are determined, a full Water Use Licence

(WUL) application must be submitted for water use authorisation to the Department of Water and Sanitation for such activities.

Ultimately, the proposed development was assessed to have a moderate to low negative potential impact on the affected watercourses. With the implementation of the mitigation measures and recommendations stipulated, the potential impacts can be minimised. **The proposed construction of the solar PV facility and associated infrastructure as per the layout proposed is therefore supported, and should be allowed to proceed on condition that the mitigation measures proposed are implemented, in addition to obtaining the necessary water use license or general authorisation from the Department of Water and Sanitation prior to any construction activities commencing.**

10. REFERENCES

Collins, N. B. 2005. Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.

Department of Water Affairs and Forestry, 1999. Resource Directed Measures for Protection of Water Resources. Volume 4: Wetland Ecosystems, Version 1.0, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2005. A practical field procedure for identification and delineation of wetlands and riparian areas (edition 1). DWAF, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M., Rountree, A. L. Batchelor, J. Mackenzie and D. Hoare. Streamflow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

De Wit., M. C. J. 1993. Cainozoic evolution of drainage systems of the north-west Cape. Unpublished PhD thesis, University of Cape Town. 371 pp.

Dollar, E. S. J., 1998. Palaeofluvial geomorphology in southern Africa: a review. Progress in Physical Geography 22: 3 325–349.

Kleynhans, C. J., Mackenzie, J., Louw, M. D., 2007. Module F: Riparian Vegetation Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No.

MacFarlane, D. M., Bredin, I. P., Adams, J. B., Zungu, M. M., Bate, G. C & Dickens, C. W. S., 2015: Preliminary guideline for the determination of buffer zones for rivers, wetlands and estuaries. Final Consolidated Report. WRC Report No. TT 610/14, Water Research Commission, Pretoria.

Mucina, L & Rutherford, M. C., 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19, South African National Biodiversity Institute, Pretoria.

Nel, J. L., Murray, K. M., Maherry, A. M., Peterson, C. P., Roux, D. J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E. R., Smith-Adao, L. B., Mbona, N., Downsborough, L & Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. Water Research Commission Report No. 1801/2/11. Water Research Commission.

Ollis, D. J., Snaddon, C. D., Job, N. M & Mbona, M. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa, User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

APPENDIX A
SPECIALIST CV

APPENDIX B
BUFFER ZONE CALCULATION

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

BUFFER ZONE TOOL FOR THE DETERMINATION OF AQUATIC IMPACT BUFFERS AND ADDITIONAL SETBACK REQUIREMENTS FOR RIVER ECOSYSTEMS

WATER RESEARCH COMMISSION

Note: For further guidance on the application of this tool, users should refer to the preliminary guideline for the determination of buffer zones. It is also important to note that buffer widths calculated by the model only cater for impacts associated with diffuse-source surface runoff. Additional mitigation measures should therefore be defined to cater for other potential impacts. Finally, the buffer zone tool has been designed to be used one case study at a time.

Name of Assessor	Shaun Taylor	Project Details	Aggeneys PV and Powerline Assessment	Date of Assessment	22-Nov-18

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

Level of assessment	Site-based

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

Approach used to delineate the riparian zone & active channel?	Site-based delineation	River type	Lowland river

Step 3: Refer to the DWA management objectives for mapped water resources or develop surrogate objectives

Present Ecological State	C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
Ecological importance & sensitivity	High	Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They typically play an important role in providing ecological services at the local scale.
Management Objective	Maintain	

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

Assess threats of planned activities on water resources and determine desktop buffer requirements

Proposed development / activity			
Sector	Industry	Includes a range of industrial activities from light industrial with limited impacts on surrounding land use, to hazardous or noxious industry with high impact on surrounding land use. Includes activities such as the processing of resources and storage of manufactured materials and products.	
Sub-Sector	Electricity generation works	Facilities that supply electrical power from energy sources (including coal, gas, bio-material or hydro-electric stations), but not including solar powered generators.	

Climatic factors	MAP Class	0 - 400mm	Rainfall Intensity	Zone 1

	Threat Posed by the proposed land use / activity	Desktop Threat Rating	Specialist Threat Rating	Justification for changes in threat ratings
Construction Phase	1. Alteration to flow volumes	VL	VL	
	2. Alteration of patterns of flows (increased flood peaks)	L	M	Clearing of land for PV arrays to create alteration of flows in the immediate catchment.
	3. Increase in sediment inputs & turbidity	VH	H	Ephemeral watercourses typically high in sedimenation due to the natural climate. A level of increased sedimentation can be expected due to clearance of land around mounting structures of the PV array.
	4. Increased nutrient inputs	VL	VL	
	5. Inputs of toxic organic contaminants	VL	VL	
	6. Inputs of toxic heavy metal contaminants	L	VL	No heavy metal contamination assocaited with the PV develoment.
	7. Alteration of acidity (pH)	N/A		
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	
Operational Phase	1. Alteration to flow volumes	H	VL	No contribution or reduction to flow volumes expected in terms of the PV and power line developments.
	2. Alteration of patterns of flows (increased flood peaks)	H	M	Alteration of patterns of flows expected to be moderate give that the catchment already exhibits little surface roughness. Hence, limited clearing requried for the mounting structures for the PV arrays.
	3. Increase in sediment inputs & turbidity	M	M	
	4. Increased nutrient inputs	VL	VL	
	5. Inputs of toxic organic contaminants	M	M	
	6. Inputs of toxic heavy metal contaminants	L	VL	Clearing of land for PV arrays to create alteration of flows in the immediate catchment.
	7. Alteration of acidity (pH)	H	L	Alteration of acidity expected to be low in terms of the PV and power line developments.
	8. Increased inputs of salts (salinization)	H	VL	Increased inputs of salts expected to be negiligible for the PV and power line developments.

	9. Change (elevation) of water temperature	VH	VL	No change in water temparature expected for the PV and power line developments.
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	

Desktop buffer requirement (m)	55

Note: This buffer does not cater for any important biodiversity features. It is also not designed to cater for a range of impacts other than those associated with lateral inputs. As such, this desktop buffer requirement should only be used to provide a course-level indication of potential setback requirements for the land use under consideration.

Assess the sensitivity of water resources to threats posed by lateral land-use impacts

Stream order	Channel width	Perenniality	Average catchment slope	Inherent runoff potential of catchment soils
> 5th order	1 – 5m	Ephemeral systems	<3%	Moderate (B/C)
Longitudinal river zonation	**Inherent erosion potential (K factor) of catchment soils**	**Retention time**	**Inherent level of nutrients in the landscape: Is the river/stream and its catchment underlain by sandstone?**	**Inherent buffering capacity**
Lowland river	0.50 - 0.70	Generally free-flowing (lotic)	Yes	"Hard" water rich in bicarbonate and carbonate ions or naturally acid waters high in organic acids
Underlying geographical formations	**River depth to width ratio**	**Mean Annual Temperature**	**Level of domestic use**	Note: See the guideline document for further information on the rationale for indicator selection and how these attributes affect the sensitivity of Rivers to lateral inputs.
Primarily Palaeozoic and Mesozoic sedimentary rock formations	> 0.25	Zone 5 (19.5 - 24.2 Deg C)	Low	

Assess the sensitivity of important biodiversity elements to threats posed by lateral land-use impacts

	Threat Posed by the proposed land use / activity	Sensitivity: Water Resource	Sensitivity: Biodiversity	Site-Based Risk Class	Justification for increasing the sensitivity to cater for any important biodiversity elements including special habitats and species of conservation concern.
Construction Phase	1. Alteration to flow volumes	M		VL	
	2. Alteration of patterns of flows (increased flood peaks)	M		M	
	3. Increase in sediment inputs & turbidity	M		H	
	4. Increased nutrient inputs	M		VL	
	5. Inputs of toxic organic contaminants	M		VL	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	L		N/A	
	8. Increased inputs of salts (salinization)	L		N/A	
	9. Change (elevation) of water temperature	L		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	M		VL	
Operational Phase	1. Alteration to flow volumes	M		VL	
	2. Alteration of patterns of flows (increased flood peaks)	M		M	
	3. Increase in sediment inputs & turbidity	M		M	
	4. Increased nutrient inputs	M		VL	
	5. Inputs of toxic organic contaminants	M		L	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	L		VL	
	8. Increased inputs of salts (salinization)	L		VL	
	9. Change (elevation) of water temperature	L		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	M		VL	

Refine desktop buffer requirements based on site-based investigations

Buffer attributes	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Slope of the buffer	Gentle (2.1 - 10%)			
Vegetation characteristics (Construction phase)	Low: Sparse vegetation cover with large areas of bare soil			
Vegetation characteristics (Operational phase)	Low: Sparse vegetation cover with large areas of bare soil			
Soil permeability	High: Deep well-drained soils (e.g. sand and loamy sand).			
Topography of the buffer zone	Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception.			
Site-based aquatic impact buffer requirements (without additional mitigation measures)				
Construction Phase	**25**	**Not Assessed**	**Not Assessed**	**Not Assessed**
Operational Phase	**15**	**Not Assessed**	**Not Assessed**	**Not Assessed**

Where appropriate, identify additional mitigation measures and refine aquatic impact buffer width accordingly

	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class	Specialist justification for refined threat ratings with clear reference to supporting documentation.
Construction Phase	1. Alteration to flow volumes	VL			
	2. Alteration of patterns of flows (increased flood peaks)	M			
	3. Increase in sediment inputs & turbidity	H	Excavation to take place oustide of the rainy season (between Feburary and April). Use of bunding for stockpiles. Limited vegetatino clearance	M	Limiting sedimentation potential from the surrounding landscape during construction somewhat
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)				
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			
Operational Phase	1. Alteration to flow volumes	VL			
	2. Alteration of patterns of flows (increased flood peaks)	M			
	3. Increase in sediment inputs & turbidity	M			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	M			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)	L			
	8. Increased inputs of salts (salinization)	VL			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Revised aquatic impact buffer requirements (including additional mitigation measures)				
Construction Phase	**15**	**Not Assessed**	**Not Assessed**	**Not Assessed**
Operational Phase	**Not Assessed**	**Not Assessed**	**Not Assessed**	**Not Assessed**

Additional mitigation measures to consider	Y/N	Comments
Have additional mitigation measures been identified to cater for any point-source discharges?	N/A	
Have additional mitigation measures been identified to cater for potential groundwater impacts?	N/A	

Where necessary review and refine aquatic impact buffer requirements to cater for practical management considerations

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Final aquatic impact buffer requirements (including practical management considerations)				
Construction Phase	15	Not Assessed	Not Assessed	Not Assessed
Operational Phase	15	Not Assessed	Not Assessed	Not Assessed
Final aquatic impact buffer requirement	15	Not Assessed	Not Assessed	Not Assessed
Rationale for any increases in final buffer requirements				

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

Key aspects to be considered	Y/N	Comments
Have important biodiversity elements been flagged for specific consideration?	N	
Has a survey been undertaken to verify occurrence and to establish the need to cater for these in development planning?	N	
Have core areas required to protect any species of conservation concern been identified and mapped?	Y	
Have additional biodiversity buffers been defined to protect core areas & important habitat from outside disturbances?	N/A	
Could the planned development / activity impact on an important local or regional ecological corridor?	Y	
If connectivity is important, have corridor design guidelines been considered when defining corridor requirements?	N/A	
Has consideration been given to terrestrial habitat protection and management?	N	

Step 6: Delineate and demarcate recommended setback requirements

Key mapping requirements	Y/N	Comments
If present, has the boundary of the riparian zone been delineated?	Y	
Has the edge of the active channel been delineated?	Y	
Have final aquatic impact buffer zones been mapped?	Y	
Have setback requirements for water resource protection been delineated based on the maximum of the above?	N/A	
Have core areas, biodiversity buffers and biodiversity corridors been mapped?	N	
Other considerations		
Is there a need for hydrological buffers to cater for potential groundwater impacts?	N	
Have additional restrictions relating to flood lines and flood control been considered and been accounted for?	N	
Have aesthetic considerations been considered and been accounted for?	N	
Has recreational use values been considered and been accounted for?	N/A	

Step 7: Document management measures necessary to maintain the effectiveness of set-back areas

Relevant management measures should feed into the licencing recommendations and conditions in the WULA and Environmental Management Programme.

Key management considerations	Y/N	Comments
Has consideration been given to the demarcation of setback areas?	N/A	
Have management measures necessary to maintain the functioning of setback areas been defined?	N/A	
Have activities that should not be permitted in the aquatic impact buffer zone been stipulated?	Y	No mounting structures fro PV panels and pylons for the power lines permitted in the watercourses.
Have management measures to ensure the continued functioning of additional mitigation measures been defined?	N/A	

Step 8: Monitor implementation and review effectiveness

Successful implementation will require regular monitoring of implementation to ensure that mitigation measures are effective. As such, it is important that monitoring requirements are clearly defined.

Monitoring requirements	Y/N	Comments
Have construction-phase monitoring requirements been defined?	Y	Excavations are to be monitoried by the ECO weekly during construction.
Have operational-phase monitoring requirements been defined?	Y	Poles are to be regularly monitored annually for strucutural integrity in the watercourse.