GRID CONNECTION INFRASTRUCTURE FOR THE AGGENEYS 2 SOLAR PHOTOVOLTAIC FACILITY

Northern Cape Province

Freshwater Feature Delineation and Impact Assessment Report

April 2019

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EXECUTIVE SUMMARY

ABO Wind Aggeneys 2 PV (Pty) Ltd (ABO Wind) is proposing to develop up to a 220kV single circuit, or double circuit 132kV overhead power line and collector substation for the Aggeneys 2 – 100MW solar photovoltaic (PV) facility on the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province. The proposed power line will route from the collector substation on the solar PV facility project site and connect to the national grid via the Aggeneis Main Transmission Substation (MTS). 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 feature delineation and impact assessment to be undertaken to determine whether the proposed development will affect any freshwater resources at the collector substation and within the proposed power line alternative corridors. The freshwater feature delineation and impact assessment for the proposed development has been undertaken by Shaun Taylor of Savannah Environmental (Pty) Ltd, with external peer review by Stephen Burton of SiVEST Environmental (Pty) Ltd.

This freshwater features report focused on providing information on the freshwater resources baseline environment for the proposed power line and collector substation within the proposed power line corridors for the Aggeneys 2 solar PV facility near Aggeneys, Northern Cape Province. The freshwater study was established using the collection of available secondary information (available databases and satellite imagery) 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 within the proposed power line corridors.

Two alternative power line corridors and associated collector substations have been proposed including Alternative power line Corridor **1** (**southern alignment – preferred alternative**) and Alternative power line Corridor **2** (**northern alignment**), and their associated Alternative Collector Substations 1 and 2. Each Collector Substation logically connects with its associated power line alternative, and are thus assessed as inextricably linked infrastructure (i.e. Collector Substation Alternative 1 and Alternative Power Line Corridor 1 may not be separated as they service each other and would not make sense if treated separately). A comparative assessment was conducted and is addressed further on in this executive summary and report.

From a desktop perspective, it was observed from Google Earth™ satellite imagery that **several ephemeral watercourses and wetlands** could be observed within the power line corridors and within the regulated area of a watercourse or wetland. **No other freshwater resources were identified at a desktop level consulting database information.** However, the only relevant desktop information of relevance was that the proposed power line corridors were found to be located within:

<u>Alternative Power Line Corridor 1 (southern alignment)</u>

- Critical Biodiversity Area 2 (**CBA2**); and
- Ecological Support Areas (**ESA**).

<u>Alternative Power Line Corridor 2 (northern alignment)</u>

- Critical Biodiversity Area 1 (**CBA1**);
- Critical Biodiversity Area 2 (**CBA2**); and
- Ecological Support Areas (**ESA**).

The in-field investigation and assessment confirmed the presence of **Seven (07) ephemeral depression wetlands in total**, of which three (03) ephemeral wetlands were identified directly within, and four (04) ephemeral wetlands outside of the proposed power line corridor Alternative 1 but within 500m within the regulated area of a watercourse (according to the NWA definition). The wetlands shared similar geomorphological characteristics and ranged in size from 0,1 to 6,6 hectares. The shapes of the wetlands also varied from circular/oval-shaped to kidney-shaped wetlands. In addition, **twenty-three (23) ephemeral watercourses and two (2) large ephemeral watercourses** were identified. These freshwater resources were delineated using the indicators as stipulated in the national guidelines.

The present ecological state of the ephemeral wetlands was assessed to be **Class B (largely natural) ephemeral depression wetland systems**. However, the Class B rating is expected to slowly deteriorate over time with further overgrazing and consequent change in surface roughness.

The wetland ecosystem services were determined for all wetlands (collectively scored). The wetland ecosystem services **that scored highest included maintenance of biodiversity, sediment trapping and erosion control**. The wetlands therefore offered good potential for sediment and erosion control in the area. The wetlands were also identified to be important from a maintenance of biodiversity function due to the potential for red data species to occur in the area. This refers to the regionally endemic Red Lark species. In addition to this, invertebrates like *branchiopods* and *dipterans* hatch out, and algae can be reactivated when wetlands fill up sufficiently. Wildlife, especially water birds, are also known to gather to feed in such resurrected systems. As such, unique populations can be expected to be present after sufficient rainfall.

The ecological importance and sensitivity (EIS) of the ephemeral depression wetlands was assessed taking into account the various determinants of the wetland systems. The EIS of the ephemeral depression wetlands were assessed to be **Class B systems** due to relatively high scores for ecological integrity, protected status, hydrological and geomorphological functional role and importance from a biodiversity perspective. The wetlands were therefore considered to be highly ecologically important and sensitive at a regional scale.

For the watercourses, the present state of the vegetation was found to closely resemble the natural state, with the exception of grazing disturbance and vehicle tracks. No exotic vegetation was noticed however, despite the disturbance factors described above. Other disturbances include the existing farm boundary fence line and farm tracks through the watercourses. Taking existing impacts into consideration, the Ecological Condition (EC) of the riparian habitat of the ephemeral watercourses were collectively assessed to be **Class C moderately modified systems**.

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 collectively provided included sediment trapping, bank stabilisation and maintenance, flood attenuation, ecological corridor for migration of species and erosion control. The function of the watercourses to provide these ecosystem services was assessed to be relatively significant for the local area. **The EIS of all the watercourses (including large ephemeral watercourse no. 1 and no. 2) were assessed to be Class C systems,** which are considered to be moderately ecologically important and sensitive on a regional scale.

A **buffer zone of 15m** for all the freshwater resources was determined to offer adequate protection, and which is to be implemented in accordance with the explanation which follows. Given the nature and type of the development, the footprint of the power lines was deemed to be relatively minimal. In addition, the

power lines are able to easily span any of the freshwater resources (wetlands and watercourses). Importantly, no pylons for the power lines are to be positioned in the freshwater resources to avoid any direct impacts. Issues of sedimentation and erosion are the main concern as a result of indirect impacts and which can be easily mitigated. In addition to this, the collector substation is not near (<100m) of any surface water resources. Therefore, no direct or indirect impacts can be expected that would require special mitigation measures for this component.

A comparative assessment of the two (02) alternative power line corridors and collector substations was undertaken in which it was determined that **Alternative Power Line Corridors 1 and 2, and the associated collector substation alternatives, are both viewed as acceptable, with Alternative 1 being more favourable.**

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 wetlands and watercourses during the construction and decommissioning phases**. The significance ratings of the potential impacts ranged from **Medium to Low without mitigation, and Low with mitigation measures**. With regard to the **operation phase**, potential impacts as a result of **vehicle movement through wetlands and watercourses 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 grid connection infrastructure developments**, including the proposed development, would be **Medium cumulatively and Low rated in isolation**. Suitable mitigation measures were proposed to avoid impacts where possible and to minimise potential impacts as far as possible.

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

- No pylon towers are to be placed directly within the wetlands and watercourses or the associated buffer zones, and are rather to be spanned across watercourses and the associated buffer zones;
- Existing service roads and tracks are to be used where reasonable and feasible;
- 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 so as not to affect the present ecological state of the wetlands and the ecological condition of the riparian habitat of the freshwater resources assessed; and
- Prior to construction, a risk assessment is to be undertaken for the construction of a power line through the wetlands and watercourses where required. This is to be undertaken to determine the need for appropriate water use licensing with 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 freshwater resources affected. With the implementation of the mitigation measures and recommendations stipulated, the potential impacts can be minimised. **The proposed construction of the power line and associated collector substation as per the proposed corridors and layout 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, where required.**

PROJECT DETAILS

Title	:	Freshwater Features Delineation and Impact Assessment Report for the Proposed Grid Infrastructure for the Aggeneys 2 Solar Photovoltaic Facility near Aggeneys, Northern Cape Province
Authors	:	Savannah Environmental (Pty) Ltd Shaun Taylor (Revision 1) Gideon Raath (Revision 2)
External Reviewer	:	Stephen Burton *Pr. Sci. Nat.* (Registration Number: 117474) – SiVEST SA (Pty) Ltd
Client	:	ABO Wind Aggeneys 2 PV (Pty) Ltd
Report Revision	:	Revision 2
Date	:	April 2019

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

SPECIALISTS DECLARATION OF INTERESTS

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

April 2019
Date

Specialist Company Name:	Savannah Environmental Pty Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement recognition	-
Specialist name:	Gideon Raath			
Specialist Qualifications:	M.Sc. Geography and Environmental Studies (SUN), B.Sc. (Hons) Ecology, conservation and the environment (WITS), B.Sc. Environmental Management (UJ)			
Professional affiliation/registration:	Pr.Sci.Nat. (SACNASP) – Member No. 117178			
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Postal code:	2157	Cell:	Not supplied	
Telephone:	011 656 3237	Fax:	086 684 0547	
E-mail:	gideon@savannahsa.com			

I, Gideon Raath, 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.

Gideon Raath
Name

Signature

April 2019
Date

SHORT SUMMARY OF SPECIALISTS AND EXPERTISE

Shaun Taylor

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; and
» Proposed maintenance of the Water Pipeline in Parys, Ngwathe Local Municipality, Free State Province: Surface Water Assessment.

The curriculum vitae (CV) for the above specialist is attached as **Appendix A**.

Gideon Raath

Gideon holds an MSc (Geography and Environmental Management; SU), a BSc Honours (Ecology and Environmental Studies - Cum laude; Wits) and a BSc (Geography and Environmental Management; UJ). His MSc thesis focused on the hydrological impact on the spatial distribution of invasive Eucalyptus trees along the Breede River, while his honours thesis evaluated ethnobotanical relationships around the Rio Tinto copper mine in Phalaborwa. Most recently he has worked as an Environmental Consultant at EOH Coastal and Environmental Services (EOH CES), conducting environmental authorisations applications (NWA, NEMA, MPRDA), Public Participation Processes, GIS specialisation as well as Ecological and Wetland specialist studies. Previously, Gideon worked as the Monitoring & Evaluation Project Manager for the City of Cape Town's invasive species unit (Environmental Resources Management Department).

Gideon's GIS background includes the management of the City of Cape Town invasive species GIS database, involving the storage, management, recall and quality control off all sightings, clearance visits and known infestations. Further experience include mapping for various consulting projects, boundary verification through ground-truthing and the spatial mapping and delineation component of this MSc research. Gideon has further attended public participation workshops, and has been involved with IAP identification, translation, public meetings and engagement for a variety of projects, mainly within the Afrikaans speaking Northern Cape. Gideon is interested in invasion ecology, treatment of groundwater pollution through phytoremediation, botanical and wetland specialist studies, GIS application for ecology and environmental management, and the EIA processes in general. Lastly, Gideon has undertaken several ecological impact assessments for various developments.

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

Project Name & Location	Client Name	Role
Boshoek Loop Rail Upgrade BAR and Water Use Licence, Rustenburg, North-West Province	Transnet SOC Ltd	Aquatic specialist
City of Johannesburg nature reserve proclamation (Phase II), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	Botanical specialist
SANRAL Bierspruit R510 road upgrade Water Use Licence, Basic Assessment, Thabazimbi, Limpopo Province	SANRAL SOC Ltd & Royal HaskoningDHV South Africa	Ecological specialist
Kibler Park Church Development Ecological Assessment, Johannesburg, Gauteng	Riverside Community Church	Ecological specialist
Barberton IAPS Waste Water Treatment Works development BAR, water use licence and SASS 5 assessment, Barberton, Mpumalanga Province	Umjindi Local Municipality and Rhodes University	Aquatic specialist
Wijnberg Trust Dam 2 expansion Aquatic Impact Assessment, Greyton, Western Cape	Wijnberg Trust	Aquatic specialist
SANRAL Caledon N2 Section 3 road upgrade project Basic Assessment, Water Use Licence and Specialist reports, Caledon, Western Cape Province	JG Afrika Engineering	Ecological specialist
City of Johannesburg nature reserve proclamation boundary verification (Phase I), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	GIS specialist
iGas integrated biodiversity screening, Saldanha, Western Cape	Central Energy Fund - iGas (subsidiary)	Faunal specialist (assistant)

Bloekombos (Kraaifontein) botanical baseline and impact assessment, Cape Town, Western Cape	Western Cape Provincial Government (PGWC)	Aquatic specialist Botanical specialist
Masetjaba water tower development Ecological Impact Assessment, Tsakane, Gauteng	Naidoo Consulting (for City of Ekurhuleni)	Ecological specialist
Nigel gas pipeline development, Nigel, Gauteng	Energy Group Pty Ltd	Ecological specialist

A full curriculum vitae (CV) is attached as **Appendix A.**

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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
SEF	Solar Energy Facility
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 up to a 220kV single circuit, or double circuit 132kV overhead power line and collector substation for the Aggeneys 2 – 100MW solar photovoltaic (PV) facility on the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province. The proposed power line will route from the collector substation on the solar PV facility project site and connect to the national grid via the Aggeneis Main Transmission Substation (MTS). 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 feature delineation and impact assessment to be undertaken to determine whether the proposed development will affect any freshwater resources at the collector substation and within the proposed power line alternative corridors. The freshwater feature delineation and impact assessment for the proposed development has been undertaken by Shaun Taylor of Savannah Environmental (Pty) Ltd, with external peer review by Stephen Burton of SiVEST Environmental (Pty) Ltd.

1.1. Project Description

ABO Wind are proposing to develop up to a 220kV single circuit, or double circuit 132kV overhead power line and collector substation for the Aggeneys 2 – 100MW solar PV facility on the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys, Northern Cape Province.

The proposed project will consist of the following:

- A single circuit 220kV, or double circuit 132kV power line with a capacity of up to 220 kV/132kV(x2) and a maximum height of up to 40 m. The servitude width would be up to a maximum of 47 m wide and two alternative corridors have been proposed for assessment as follows:
    - Alternative 1 – follows adjacent the routing of an existing 400kV power line, and eventually meets with and follows the N14, extending for ~15 km in length; and
    - Alternative 2 – follows the Loop 10 gravel road, and eventually meets with and follows the N14, extending for ~17 km.
- A new collector substation with an area of approximately ~1.25 ha would be located at the eastern end of the power line alternative ultimately approved;
- A new switching station including new feeder bays, busbars, protection equipment etc.;
- A gravel access road (to be tarred if required) to the substation, ~6 m wide and up to ~2 km long;
- New feeder bay/s at the exiting Aggeneis Main Transmission Substation (MTS).

1.2. Project Location

The collector substation and associated infrastructure will be located on the Remaining Extent of the Farm Bloemhoek 61 approximately 9km east of the town of Aggeneys in the Northern Cape Province (Figure 1.1).

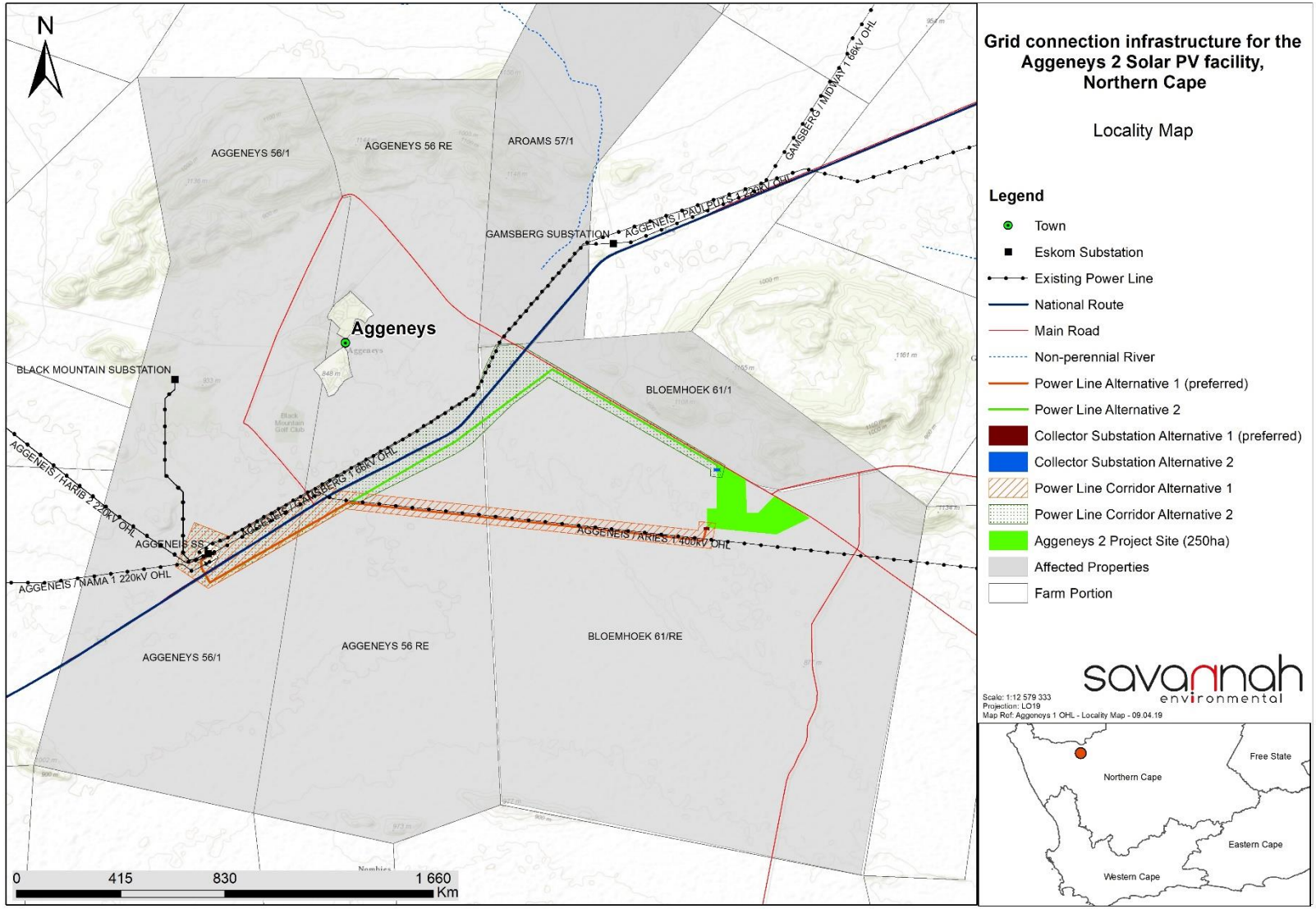

Figure 1.1: Locality map

The power line alternative corridors however will traverse the following additional properties:

- Remaining Extent of Farm Bloemhoek 61;
- Portion 1 of Bloemhoek 61;
- Portion 2 of Bloemhoek 61;
- Portion 3 of Bloemhoek 61;
- Remaining Extent of Farm Aggeneys 56;
- Portion 1 of Farm Aggeneys 56;
- Portion 2 of Farm Aggeneys 56; and
- Portion 1 of the Farm Aroams 57.

The project area is generally accessible from the N14 national highway and via a gravel road off the N14 national highway known as Loop 10. 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.

1.3. Structure of this Freshwater Report

This freshwater feature 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 feature 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 feature delineation results, including the various wetland health, wetland ecosystem services, riparian habitat ecological condition, riparian habitat ecosystem services, 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 feature 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 wetlands or watercourses. However, it must be noted that indirect impacts are also taken into consideration through the applicable Government Notices. In particular, Government Notice (GN) 509 of 2016, becomes relevant where a wetland or 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 or wetland 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 or wetlands are to be affected by the proposed development.

3. METHOD AND APPROACH OF THE STUDY

3.1. Purpose and Objective of the Freshwater Feature Assessment

This freshwater report has been prepared for the purposes of establishing whether the proposed development will affect any freshwater resources both directly and / or indirectly.

The objectives of the freshwater report include:

» Desktop identification of freshwater sensitivities within the power line corridors (including the collector substation site) through the review of existing desktop and database information;
» Site visit, including delineation of any freshwater resources within the power line corridors and collector substation site; and
» Mapping of the identified freshwater resources (from the site visit and existing data).

3.2. Approach to the Study

This report provides a snapshot of the freshwater 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:
    o South African Vegetation Types (Mucina & Rutherford, 2006/2012);
    o National Freshwater Ecosystems Priority Areas (NFEPA) database, 2011; and
    o 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.

3.3. Freshwater Definition and Classification

For the purposes of this assessment, the classification of freshwater resources was undertaken by 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:

- 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

3.3.1. Wetland Definition, Classification & Delineation

The lawfully accepted definition of a wetland, in South Africa, is that within the NWA. Accordingly, the NWA defines a wetland as:

> "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*".

However, for an area to be considered a wetland, the soil signatures (see Soil Wetness Indicator definition below) that are associated with wetlands must be present within the top 50cm of the soil profile (Collins, 2005). This understanding, and the above definition of a wetland, is applied in this report.

It must be noted that there are a number of wetland types in South Africa. Wetland types in South Africa have therefore been classified within a classification system as described in **Section 3.3** above. This classification system refers to inland wetlands which have been categorised into hydrogeomorphic (HGM) units. Ollis *et al*. (2013) defines the different wetland HGM units, as follows:

- *Channel* (river, including the banks): a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit;
- *Channelled valley-bottom wetland*: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a "river";
- *Un-channelled valley-bottom wetland*: a valley-bottom wetland without a river channel running through it;
- *Floodplain wetland*: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a "river";
- *Depression*: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates;
- *Flat*: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat; and
- *Hillslope seep*: a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

In terms of the delineation guidelines, four wetland indicators are used to determine the outer boundaries of a wetland.

These include:

- **Terrain Unit Indicator** – An important practical index for identifying those parts of the landscape where wetlands are likely to occur. Wetlands typically qualify as a valley bottom unit, occurring on the crest (i.e. in depressions) of the landscape, or the mid-slope and / or foot-slope;
- **The Soil Form Indicator** – Identifies the soil forms, as defined by the Soil Classification Working Group (1991, or latest version), which are associated with prolonged or frequent saturation;
- **The Soil Wetness Indicator** – Identifies the morphological "signatures" which have developed in the soil profile as a result of prolonged and frequent saturation. Soils which are saturated for prolonged periods can become depleted of oxygen when roots and / or microorganisms consume the oxygen present in soil between pore spaces. Once depleted, the soils are effectively anaerobic (little to no oxygen present). Under prolonged anaerobic conditions, a change in the chemical characteristics of soil minerals (such as iron and manganese) takes place, whereby the minerals become soluble and can leach out of the soils producing a leached soil matrix. Where most of the iron, being one of the most abundant minerals, is dissolved out of the soils, leaving a greyish, greenish, bluish soil matrix, the soils can be said to be "gleyed". However, under a fluctuating water table, where conditions in the soil change from anaerobic (under saturated conditions) to aerobic (where oxygen is present in soils, under dry conditions), dissolved minerals (typically, iron and manganese) return to an insoluble state forming patches or mottles which represent distinct wetland soil signatures associated with wetlands. The soil signatures can include orange, yellow or black mottles or spots that have formed through the anaerobic and aerobic conditions associated with fluctuating water tables. Soils which display these unique characteristics are termed hydromorphic soils.

» **The Vegetation Indicator** – Identifies hydrophilic (water-loving) / hydrophytic (water plant) vegetation associated with frequently saturated soils. In identifying hydrophytic vegetation, it is important to distinguish between plant species that are (DWAF, 2005):
  - Obligate wetland species (ow): always grows in wetland - >99% chance of occurrence;
  - Facultative wetland species (fw): usually grow in wetlands – 67-99% chance of occurrence;
  - Facultative species (f): are equally likely to grow in wetlands and non-wetland areas – 34-66% chance of occurrence;
  - Facultative dry-land species (fd): usually grow in non-wetland areas but sometimes grow in wetland = 1-34% chance of occurrence.

3.3.2. Watercourse Definition, Classification & Delineation

Ollis *et al*., (2013) provides a definition for rivers, as referred to in **Section 3.3** above. However, this assessment will use an adapted version of the definition of a watercourse to define hydrological flowing systems (rivers and drainage lines), as per the NWA, which *inter alia* states the following:

"*a) a river or spring;*
b) a natural channel in which water flows regularly or intermittently".

Note that the NWA definition of a "watercourse" also includes wetlands, lakes or dams into which or from which waterflows, as well as any collection of water which the Minister may, by notice in the *Gazette*, declare a watercourse. However, this has not been included here, as a more specific definition for wetlands has been provided in **Section 3.3.1** above, that is consistent with the NWA. As such, this report addresses both these components separately. In addition, no collection of water declared by the Minister is relevant for this assessment, and is not provided for herein. Note also, that although the above definition is slightly different to that provided by Ollis *et al*., (2013), the watercourses that are defined in accordance with the above can still be applied to the classification system, and which has been applied as such in this report.

For watercourses, it is possible to determine the hydrological regime of the watercourse, 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 frequency of saturation of soils in the riparian zone which can be classified inter alia as follows (DWAF, 2005):

- **A Section** – Least sensitive watercourses in terms of impacts 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.

In terms of the guidelines, the assessment for riparian habitats requires the following aspects to be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

The topography associated with a watercourse 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 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 or 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.

3.4. Wetland Present Ecological State

To determine the ecological state that a wetland is in, the WET-Health tool was designed to provide a rapid assessment on the Present Ecological State (PES). This tool examines the deviation from the natural reference ecological condition of a wetland by analysing the hydrological, geomorphological and vegetation components of a wetland in a spreadsheet designed information sheet which assesses a wetland in terms of the extent, intensity and magnitude of an impact (Macfarlane *et al*., 2008). This is done by assigning a score on a scale of 1 to 10 which is classified into one of six health classes ranging from A to F, with A representing completely unmodified (natural) and F representing modifications that have reached a critical level (Macfarlane *et al*., 2008). The health classes are provided in Table 3.3 below.

Table 3.3: WET-Health Impact Scores and Categories for the Wetland Present Ecological State (Macfarlane *et al.*, 2008).

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural.	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

The WET-Health tool includes for a Level 1 (desktop) and Level 2 (detailed field) PES assessment. This study included a Level 2 detailed assessment.

3.5. Wetland Ecosystem Services

Individual wetlands can supply different ecosystem services to society, as each system will have its own respective hydro-geomorphic characteristics. The wetland ecosystem services that were assessed in this study through the WET-EcoServices (Kotze *et al*., 2007) tool, are listed in Table 3.4 below.

Table 3.4: WET-Ecoservices (Kotze *et al.*, 2007).

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits	Flood attenuation	
			Streamflow regulation	
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
			Carbon storage	
		Biodiversity maintenance		
	Direct benefits	*Provision of water for human use*		
		Provision of harvestable resources[2]		
		Provision of cultivated foods		
		Cultural significance		
		Tourism and recreation		
		Education and research		

3.6. 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 3.5 below).

Table 3.5: 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

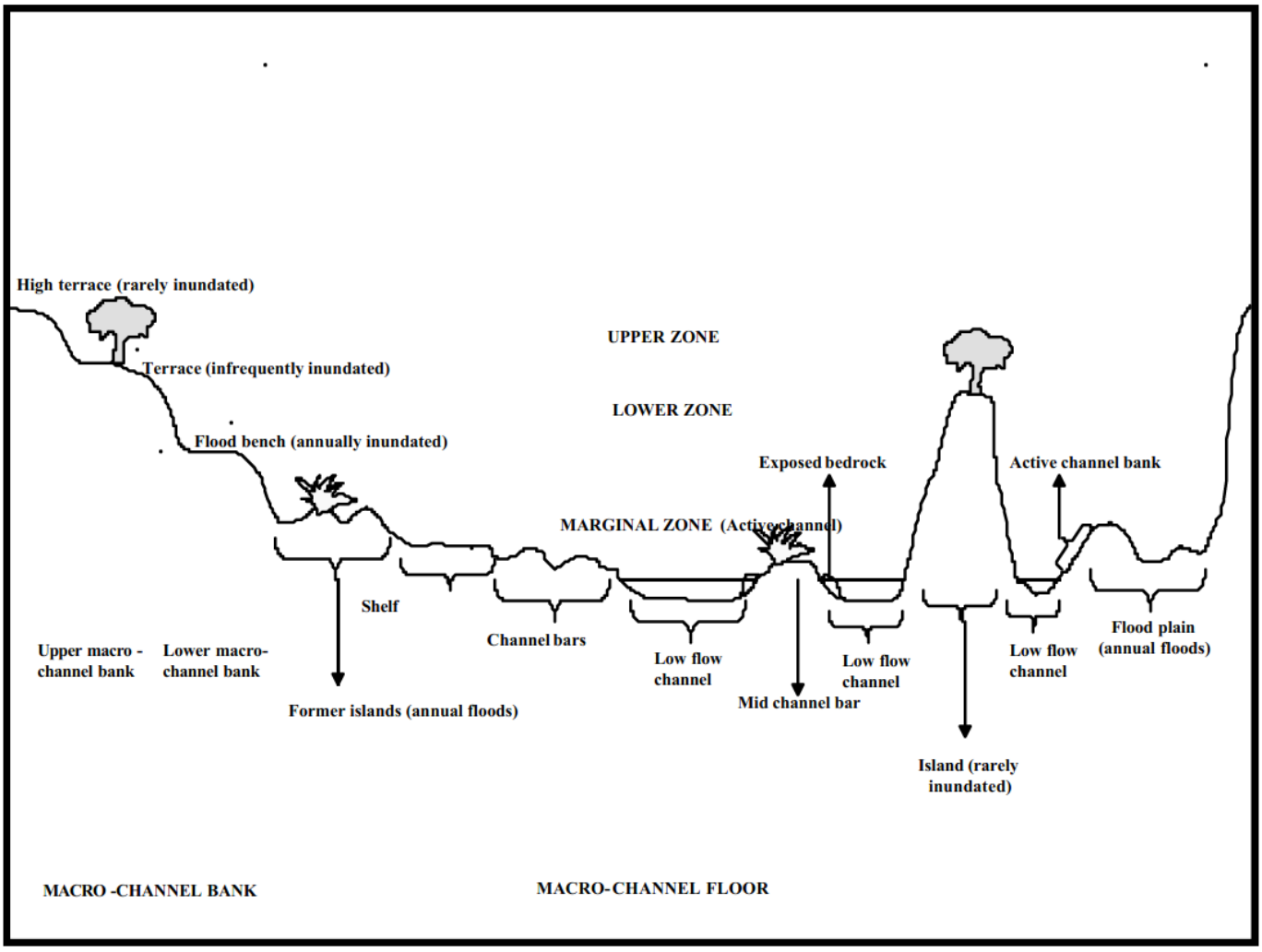

Figure 3.1: Illustration of the Marginal and Non-marginal Zones (taken from Kleynhans *et al*., 2007).

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.

3.7. 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.

3.8. Freshwater 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 3.6 below and attributing a suitable [1]score to each determinant. Information, where relevant, was taken from the Wetland and Riparian Ecosystem Services assessments (i.e. biodiversity maintenance information) and applied to this assessment. Additionally, information on the conservation planning importance of wetlands and rivers were also used. Wetlands and 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 3.7). The category can range from an A to D, with A being Very High and D being Low/Marginal.

Table 3.6: 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		

[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

4. Diversity of Habitat Types or Features		
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 3.7: 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

3.9. Freshwater Resources 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.

3.10. 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).

Assessment of impacts must be summarised in the following table format. The rating values as per the above criteria were included.

3.11. 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 feature delineation, wetland present ecological state determination, riparian vegetation response assessment index, wetland and 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.
» The WET Health methodology (Macfarlane *et al*., 2009) focuses on wetlands that are connected to the drainage network in some way, and it therefore excludes endorheic pans. The geomorphological component of any endorheic depression wetlands cannot be evaluated until a methodology exists for this purpose. The geomorphological component of the Present Ecological State for any endorheic depression wetlands was therefore excluded.
» 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.

» A minor 2-track dirt access road is currently being employed by Eskom representatives for ongoing maintenance of the 400kV line. The applicant intends to employ this alignment by developing the power line route adjacent to this existing 400kV, however will not be able to utilise the existing access road for the 400kV line in all instances. Subsequently it was assumed that access to the power line route will be provided through a minor 2-track dirt access road immediately adjacent the existing 400kV power line route - but not within that existing servitude. The existing road may in principle be used in difficult terrain or where a new road would be detrimental, e.g. at a crossing of a drainage line, however this would be subject to access being granted and the terrain being suitable on a case by case basis. Where possible however, the 400kV route will be employed for access, and will form part of the proponents' overall mitigation strategy and means of reducing impact to the environment, as included in this report.

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) in the proposed power line corridors. However, field delineation found a depression wetland within 500m of the proposed power line corridor**. The wetland is not considered a Wetland Freshwater Ecological Priority Area (FEPA) however. Wetland FEPAs are wetlands that are intended to stay in good condition to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansions identified in the National Protected Areas Expansion Strategy (NPAES). **As such, the wetland is not considered significant in terms of the above.**

4.1.2 Vegetation Types (Mucina & Rutherford, 2006)

In terms of the vegetation characteristics, the proposed power line corridors are 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 therefore 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 Karroid Shrubland, Lower Gariep Broken Veld and Gordonia Duneveld (Mucina and Rutherford, 2012). Bushmanland Arid Grassland is commonly found at altitudes of between 600 – 1200m.

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).

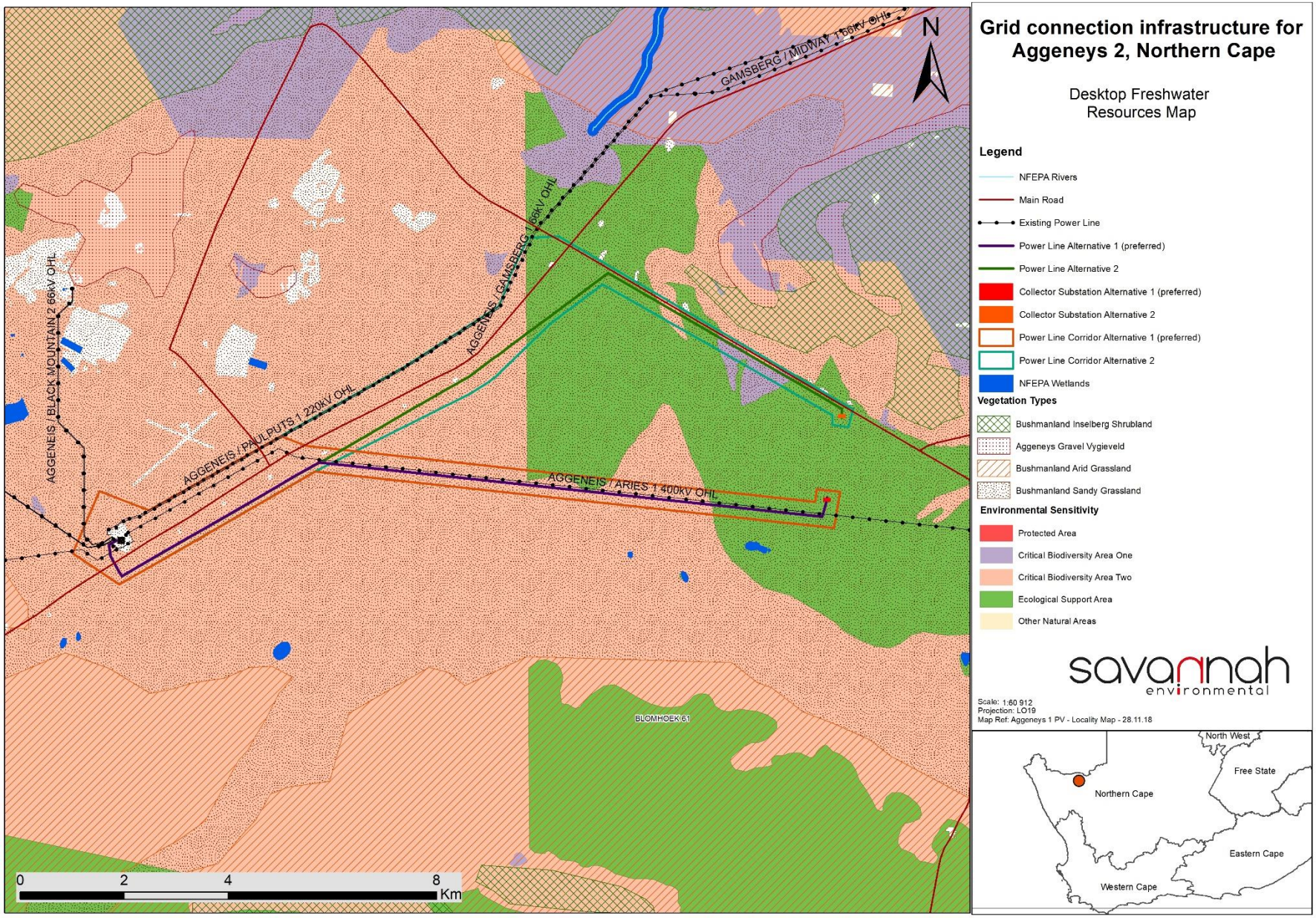

Figure 4.1: Freshwater features Desktop Occurrence Map

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 proposed corridors.

4.1.4 Google Earth Satellite Imagery (2017)

Google Earth™ satellite imagery was used to inspect the power line corridor alternatives 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 **ephemeral watercourses** could be observed which traverse the proposed power line corridors. In addition, it was apparent that some wetland areas were also visible in and within 500m of the power line corridors from the aerial imagery dated 2017. The watercourses and wetlands observed from the aerial imagery would therefore require field verification in the fieldwork phase to ground-truth and delineate the watercourses and wetlands.

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 across the majority of the western area of the proposed power line corridors, and in the case of alternative power line corridor 2 (the northern alignment), a CBA1 area is also found within the corridor. In addition, both alternative routes are occupied by ESA areas towards the eastern portion of both routes**. 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 in either of the power line corridors at the time of the assessment. The power line corridors were vegetated mainly by sparsely scattered scrub and grass species.

The freshwater resources identified from a desktop level included a number of ephemeral watercourses and wetlands in the proposed power line corridors, as well as some wetlands within 500m of the proposed power line corridors. These freshwater resources are located in the Orange Primary Catchment, and in Quaternary Catchment D82C. The freshwater resources are within the greater Orange Water Management Area (WMA).

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

5.1. Wetland Delineation Results

The wetlands identified at a desktop level from Google Earth images were investigated further and verified in the field. **Seven (07) ephemeral depression wetlands in total** were identified, ground-truthed and delineated in the field, of which three (03) ephemeral wetlands were identified directly within the power line corridor no 1 (southern alignment), and four (04) ephemeral wetlands outside of the proposed power line corridor alternative 1 (southern alignment), but within 500m within the regulated area of a watercourse (according to the NWA definition). Although vegetation and soil indicators for these wetlands were weak, they were regarded as complete wetlands fulfilling a wetland function within the landscape, and are thus considered to have an elevated sensitivity (described further below). The wetlands shared similar geomorphological characteristics and ranged in size from 0,1 to 6,6 hectares (Plate 5.1). The shapes of the wetlands also varied from circular/oval-shaped to kidney-shaped wetlands. The findings of the wetland delineation assessment are provided in the sub-sections below.

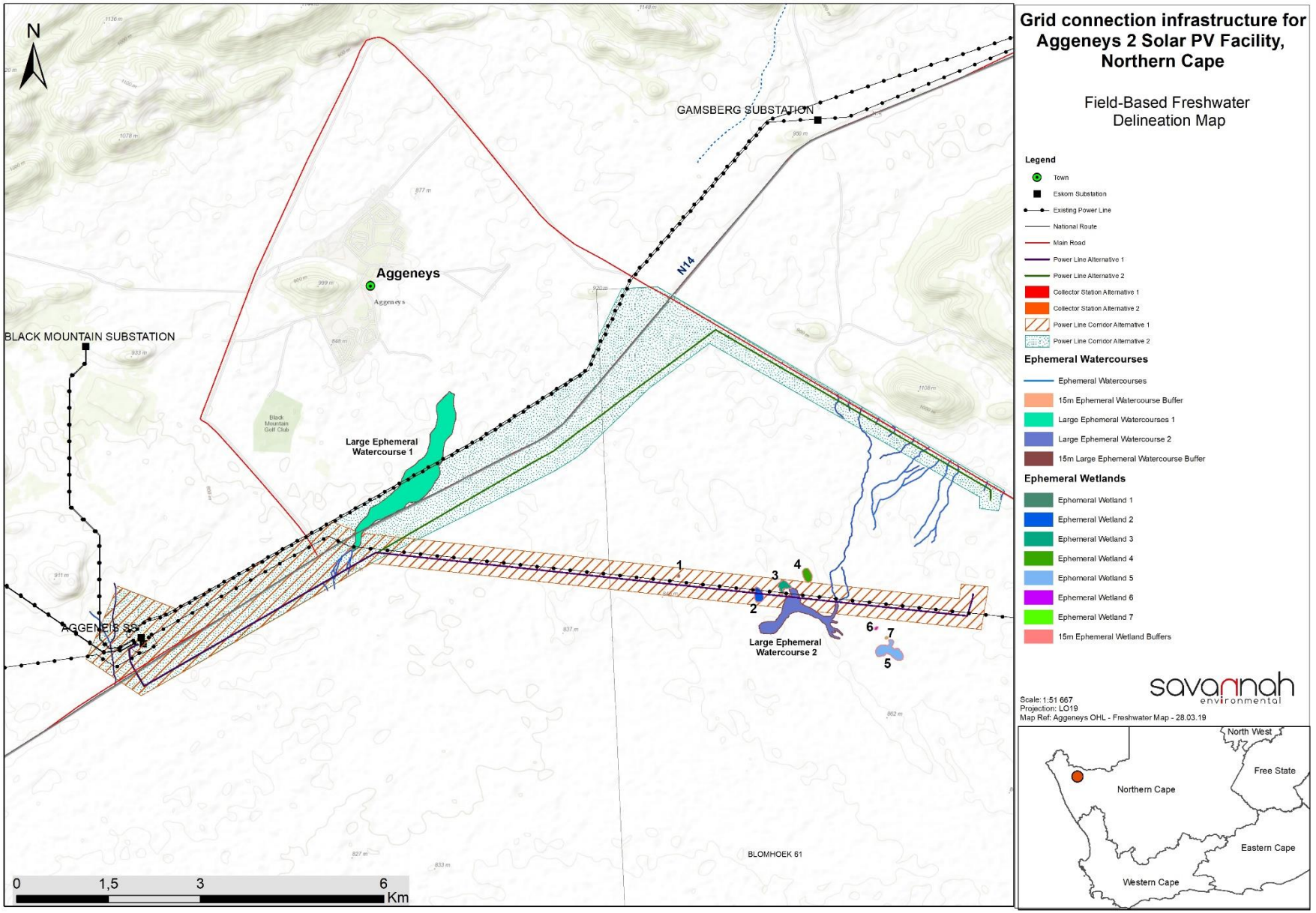

Figure 5.1: Freshwater Feature Delineation Map

Plate 5.1: Photograph of the largest ephemeral wetland (ephemeral wetland 5, which lies well outside of the assessment corridor).

5.1.1 Wetland Terrain and Soils

The wetlands were found within a cluster to the south west of the proposed Aggeneys 2 PV project site in between the red dune area associated with the power line corridor or in the flat area to the east of the dune area. The soil properties of the wetlands were highly similar in that the Orthic A horizon overlay an E horizon, in which soils were characterised by mainly fine-grained sandy sediments (Plate 5.2) in terms of grain size distribution. The soils could also be described as structureless. The combination and order of the soil layers indicate the Fernwood Soil Form. According to the Munsell Soil Chart (Munsell Soil Chart, 2009), the hue, chroma and value of the soil samples taken from the E horizon were pink (7.5YR/8/4), and paler in colour than that of the overlying Orthic A which could be described as red in colour. This is typical of E horizon soils that have undergone reduction with lateral flow through the E horizon which has resulted in the loss of colouring materials such as iron oxides producing the characteristic bleached appearance (SCWG, 1991). However, these wetland features can be described as remnants of earlier (Cretaceous) drainage systems (De Wit, 1993).

Each depression has its own endorheic drainage net and can be regarded as discontinuous groundwater windows, in which substantial excess of evaporation over precipitation under prevailing hot, dry climate leads to rapid concentration of dissolved solids within each discrete basin (Partridge *et al*., 2010). The depression wetlands are linked by now defunct palaeo-valleys which, under more humid conditions of the Miocene, contained substantial rivers within the relict Koa River valley. Historically, the Koa River valley drainage system was disrupted both by progressive aridification and by uplift along the Griqualand-Transvaal axis, causing the dismembering of the Koa River (Partridge & Maud, 2000). Currently, the wetlands do still serve a function as a 'wetland' given the reduced soil characteristics, but are deemed to be ephemeral, only becoming saturated after sporadic rainfall.

Plate 5.2: Photo of the fine sandy nature of the soils within the wetlands

5.1.2 Wetland Vegetation

The vegetation varied between the ephemeral wetlands. Ephemeral wetlands 1, 5, 6 and 7 were predominantly devoid of vegetation within the core of the wetlands, and only fringed by some scrub (*Rhigozum* sp.) vegetation and graminoid species (*Stipagrostis* sp.). This is presumably due to the highly saline geochemical properties of the soils in which less tolerant species aren't able to proliferate. The remaining wetlands were sparsely vegetated with *Hermannia* sp. (Plate 5.3- right) and *Rhigozum* species intermixed with graminoid species including *Stipagrostis* sp. and *Schmidtia* sp. Ephemeral wetland 4 had a single *Boscia foetida* subsp *foetida* species (Plate 5.3- left). These vegetation types are not considered hydrophytic (water-loving), which are typical for wetlands, although the lack of hydrophytic species can be expected as a result of the harsh dry climate, and sporadic rainfall.

Plate 5.3: Photo of the vegetation within ephemeral wetland 3 showing *Hermannia* sp. (left) and ephemeral wetland 4 showing *Boscia foetida* subsp *foetida* species (right)

5.2. Wetland Present Ecological State

The ephemeral depression wetlands were assessed on the basis of the hydrological and vegetation components of the wetlands. The combined health class for all wetlands was assessed to be **Class B (largely natural) ephemeral depression wetland systems**.

The hydrological component was found to be affected most by the change in surface roughness in the current state when compared to the reference state of vegetation expected under natural conditions. This is applicable at a catchment level and site-specific level for each of the wetlands. In general, the state of the vegetation is affected by overgrazing of cattle on the property. As such, the surface roughness is less than what could be expected under reference conditions, thereby causing increased flood peaks and alteration of flows in the catchment. At a site-specific level, some depressions are devoid of vegetation whilst others have some grass and scrub species within the wetlands. Where vegetation is present, overgrazing affects the level of cover in the wetlands, which is less than expected under reference conditions. The vegetation and hydrological condition of the wetlands are therefore inextricably linked with regards to the impacts affecting the wetlands, which have resulted in the slightly modified state of the wetlands.

Overall, an impact score of 1,32 was assessed when combining the two components, which resulted in the Class B rating. Importantly, the Class B rating is expected to slowly deteriorate over time with further overgrazing and consequent change in surface roughness.

5.3. Wetland Ecosystem Services

The potential wetland ecosystem services assessed to be provided by the ephemeral depression wetlands is collectively shown in Figure 5.2 below. The wetlands have the same essential characteristics and were collectively assessed when determining the wetland ecosystem services provided.

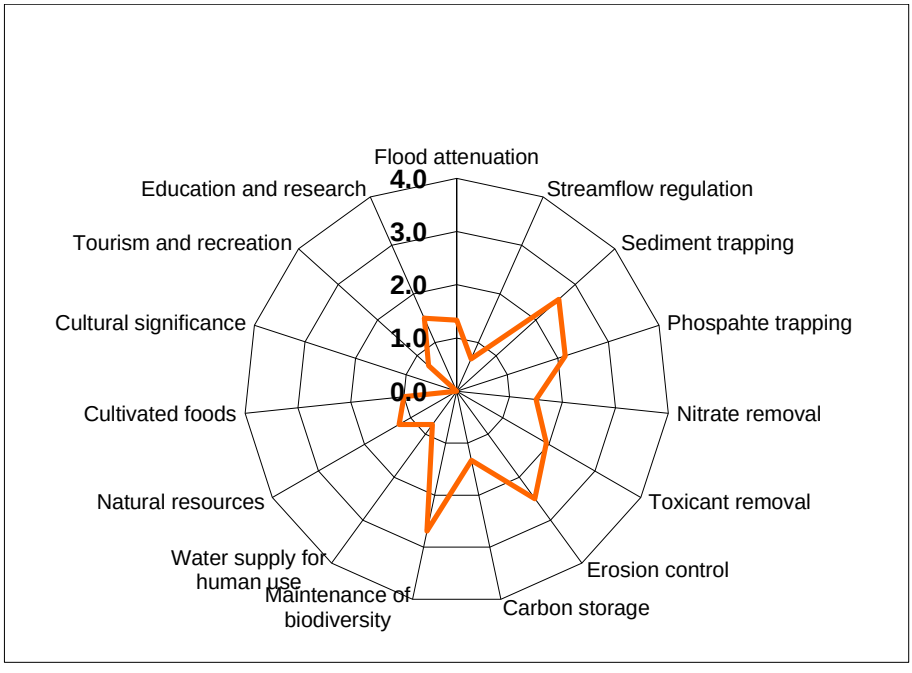

Figure 5.2: Ephemeral Depression Wetlands Ecosystem Services

The **ecosystem services which scored highest included maintenance of biodiversity, sediment trapping and erosion control**. The depression wetlands therefore offer good potential for sediment and erosion control in the area. The wetlands were also identified to be important from a maintenance of biodiversity function due to the potential for red data species to occur in the area. This refers to the regionally endemic Red Lark species. In addition to this, invertebrates like branchiopods and dipterans hatch out and algae are reactivated when pans fill up sufficiently. Wildlife, especially water birds, are known to gather to feed in such resurrected systems. As such, unique populations can be expected to be present after sufficient rainfall.

Aside from the ecosystem services, there are however a number of other potential wetland ecosystem services that the wetlands can provide, but to a lower level. These include biogeochemical cycling in the form of phosphate trapping and toxicant removal. In general, the depression wetlands were not found to offer a high number of potential ecosystem services to a significant degree, owing mainly to the harshness of the climate and the ephemerality of the systems. Nonetheless, all wetlands have an important functional (albeit to a limited extent) and ecological role in the landscape of which the ephemeral depression wetland is no different.

5.4. Wetland Ecological Importance and Sensitivity (EIS)

The ecological importance and sensitivity (EIS) of the ephemeral depression wetlands was assessed taking into account the various determinants of the wetland systems.

The results of the assessment are provided in Table 5.1 below.

Table 5.1: Ephemeral Depression Wetlands Ecological Importance and Sensitivity

Wetland Name	**Ephemeral Depression Wetlands**		**Reason**
Determinant	**Score**	**Confidence**	
Primary Determinants			
1. Rare & Endangered Species	3	3	Red lark avifaunal species of conservation importance associated with watercourses reported to occur in the nearby study area which may utilise pans during times of saturation.
2. Populations of Unique Species	3	2	*Boscia foetida* subsp *foetida* species identified in ephemeral wetland 4. No specific aquatic populations of unique fauna and flora species were identified within the watercourses during the field assessment however as wetlands were dry. However, invertebrates like branchiopods and dipterans hatch out and algae are reactivated when pans fill up sufficiently. Wildlife, especially water birds, are known to gathers to feed in such resurrected systems. As such, unique populations can be expected to be present after sufficient rainfall.
3. Species/taxon Richness	1	4	Species and taxon richness are relatively low in terms of hydrophytic floral species.

4. Diversity of Habitat Types or Features	1	4	The diversity of habitat types is limited to bare areas devoid of vegetation as well as communities of graminoid and scrubland vegetation fringing and inside some of the core of the wetlands.
5. Migration route/breeding and feeding site for wetland species	3	3	The wetlands are likely to be important migration route/breeding and feeding sites for invertebrates and waterfowl after rainfall events. The wetlands are also likely to be a potential feeding site for Red Lark.
6. Sensitivity to Changes in the Natural Hydrological Regime	2	3	The ephemeral nature of the wetlands mean that the wetlands will be fairly sensitive to further 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 over grazing and reduction of water supply.
7. Sensitivity to Water Quality Changes	2	3	The wetlands act as sediments sinks and therefore are typically associated with high sediment loads given the minimal vegetation cover and harsh dry climate. This is evidenced in the alluvial deposits in the wetlands. The wetlands are known to be sodic and will have a good buffering capacity.
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	One of the main potential functions of the wetlands is the ability to perform a functional role in terms of sediment trapping, erosion control and particulate removal. In this regard, the wetlands are significant in terms of the role the wetlands perform in the greater landscape.
Modifying Determinants			
9. Protected Status	3	4	CBA 2 According to the Northern Cape Conservation Plan 2017, with wetlands 5-7 occurring within ESA areas.
10. Ecological Integrity	3	4	The overall PES of the wetlands was assessed to be Class B (largely natural with few modifications) systems.
TOTAL	24	33	
MEDIAN	2,4	3,3	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**B**		**The wetlands are considered to be highly ecologically important and sensitive on a regional scale**

Considering the information above and the relatively high scores for ecological integrity, protected status, hydrological and geomorphological functional role and importance from a biodiversity perspective, the EIS of the ephemeral depression wetlands was assessed to be **Class B system** which is considered to be highly ecologically important and sensitive on a regional scale.

5.5. Riparian Habitat Delineation Results

The ephemeral watercourses were investigated further and verified in the field. **Twenty-three (23) ephemeral watercourses and two (2) large ephemeral watercourses** were identified and ground-truthed in the field within the proposed power line corridors. The findings of the watercourse and riparian habitat delineation assessment are provided in the sub-sections below.

5.5.1 Ephemeral Watercourses

5.5.1.1 Topography associated with the Watercourses

The general topography of the power line corridors is relatively flat, with the exception of isolated inselbergs in the areas beyond the proposed power line corridors that are not directly affected. The ephemeral watercourses can be classified as Lower Foothill Rivers in terms of the national classification system. 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 structure for the ephemeral watercourses, which are relatively shallow (<0.5m) and narrow (~1-5m).

5.5.1.2 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 (Plate 5.4) 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.

Plate 5.4: Photo showing alluvial deposits on the dry bed of an ephemeral watercourse.

The watercourses can be described as a Section B channel types, 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.

5.5.1.3 Riparian Vegetation

General vegetation cover was observed as part of the delineation assessment. The basal cover could be described as predominantly grassland vegetation (Plate 5.5), 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 were mainly *Lycium cinereum*, *Pappea capensis, Phaeoptilum spinosum* and *Rhigozum* sp. Overall, the vegetation condition appeared to be disturbed as a result of grazing impacts from game and livestock on the affected properties.

Plate 5.5: *Rhigozum* sp. observed in the watercourse.

5.5.2 Large Ephemeral Watercourses

5.5.2.1 Topography Associated with the Watercourse

The topography associated with the large ephemeral watercourse 1 can be described as a flat open plain area (Plate 5.6– left). Large ephemeral watercourse 1 opens up into a floodplain area over the landscape, with multiple shallow but braided minor and eroded channel incisions into the bed of the watercourse. As a consequence of the flat terrain, the macro-channel of the watercourse is broad, spanning some 500m at the widest point of the reach that was delineated.

Large ephemeral watercourse 2 meanders through a red dune area within the Koa River Valley (Plate 5.6 – right). The broad valley bottoms are evident between the dunes within this valley where the watercourse routes through.

Plate 5.6: Photo of the open floodplain nature of large ephemeral watercourse 1 in the otherwise flat landscape (left). Photo of the meandering nature of the drainage area associated with large ephemeral watercourse 2 in amongst the red dunes of the Koa River Valley (right).

5.5.2.2 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 large watercourses are typically ephemeral, flowing only after rainfall events for very short-lived periods (hours to a few days) much like the smaller ephemeral watercourses referred to above in **Section 5.5.1.2** above. Likewise, the limited vegetation cover and exposed nature of the soils means that sediment is transported from the surrounding catchment into the watercourses, making the watercourses flows relatively turbid (thick with sediment) with the result that alluvial deposits (Plate 5.7) are apparent in the dry watercourse beds when not in flow.

Plate 5.7: Photo showing alluvial deposits on the dry bed of the watercourse.

The large ephemeral watercourses can be also 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 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.

5.5.2.3 Riparian Vegetation

The basal cover could be described as a mix of grassland vegetation (Plate 5.8), with scrub vegetation species also present. The grassland appeared to consist of a mix of graminoid species consisting mainly of *Stipagrostis namaquensis*, *S. obtusa*, *S. uniplumis* and *Schmidtia kalahariensis*. The scrub vegetation species observed included *Hermannia* sp., *Lycium cinereum*, *Pappea capensis, Phaeoptilum spinosum* and *Rhigozum* sp. Overall, the vegetation condition appeared to be slightly disturbed as a result of grazing impacts.

Plate 5.8: *Stipagrostis namaquensis* observed in the watercourse.

5.6 Riparian Habitat Vegetation Response Assessment Index (VEGRAI) Results

In order to apply the VEGRAI index (Table 5.2) 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 (*Lycium cinereum*, *Pappea capensis, Phaeoptilum spinosum* and *Rhigozum* sp.) and graminoid species consisting of *Stipagrostis* and *Schmidtia* 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 and vehicle tracks. 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.

Table 5.2: 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	69,7	4,2	1,0	100,0	Larger proportion of the vegetation component and channel structure.
NON-MARGINAL	76,7	7,0	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		

Taking the above into consideration, the Ecological Condition (EC) of the riparian habitat of the ephemeral watercourses was collectively assessed to be **Class C moderately modified systems**.

5.7 Riparian Habitat Ecosystem Services Results

The primary potential ecosystem services collectively provided by the identified ephemeral 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 significant for the local area. The vegetation comprising the riparian habitat of the watercourses is sparsely distributed, but do offer resistance to flows and provides a 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.

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

5.8 Riparian Habitat Ecological Importance and Sensitivity (EIS) Results

The ecological importance and sensitivity (EIS) of the watercourses was assessed taking into account the various determinants of the ephemeral and large ephemeral watercourses. It was found that the scores for the determinants of the ephemeral watercourses and large ephemeral watercourse no. 1 and no. 2 were similar and were grouped accordingly. The results of the assessment are provided in Table 5.3 below.

Table 5.3: Riparian Habitat Ecological Importance and Sensitivity Results

Watercourse Names	**Ephemeral Watercourses and Large Ephemeral Watercourse 1&2 (i.e. all watercourses)**		**Reason**
Determinant	**Score**	**Confidence**	
Primary Determinants			
1.Rare & Endangered Species	3	3	Red lark avifaunal species of conservation importance associated with the watercourses are reported to occur in the study area (Large Ephemeral Watercourse no. 2 only) which may utilise the watercourses during times of flow.
2.Populations of Unique Species	1	4	No specific aquatic populations of unique fauna and flora species were identified with the watercourse during the field assessment.
3.Species/taxon Richness	0	4	Species and taxon richness were relatively very low in terms of hydrophytic floral species.
4. Diversity of Habitat Types or Features	1	4	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. Potential feeding site and migration corridor for Red Lark (Large Ephemeral Watercourse 2 only)
6.Sensitivity to Changes in the Natural Hydrological Regime	2	3	The ephemeral nature of the hydrological regime of the watercourses mean that they will be somewhat 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 over grazing and 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. This is evidenced in the alluvial deposits in-stream of the watercourse, particularly Large Ephemeral Watercourse no. 2. Furthermore, the watercourses consisted of fairly hardy scrub and graminoid species and as such, would be fairly tolerant to water quality changes.
8.Flood Storage, Energy Dissipation &	2	3	One of the main potential functions of the watercourses are the ability to perform a moderately functional role in terms of sediment

Particulate/Element Removal			trapping, attenuation of storm water and energy dissipation for the local catchment. In this regard, the watercourse is moderately important in terms of the role it performs in the greater landscape.
Modifying Determinants			
9. Protected Status	3	4	Ephemeral Watercourse no. 1&2 are both in a Critical Biodiversity Area 2 according to the Northern Cape Conservation Plan 2017
10.Ecological Integrity	2	4	The overall EC of the watercourse was assessed to be a Class C moderately modified system.
TOTAL	19	35	
MEDIAN	1,9	3,5	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**C**		**The watercourses are considered to be moderately ecologically important and sensitive on a regional scale**

In light of the above, the **EIS of all the watercourses (including large ephemeral watercourse no. 1 and no. 2) were assessed to be Class C systems, which are considered to be moderately ecologically important and sensitive on a regional scale.**

5.9 Freshwater Resources Buffer Zones

A **buffer zone of 15m** for all the freshwater resources is to be implemented. Given the nature of the type of the proposed powerline development, the footprint of the power lines is relatively minimal and can easily span any of the freshwater resources (wetlands and watercourses). Importantly, no towers for the power lines are to be positioned in the freshwater resources to avoid any direct impacts. Issues of sedimentation and erosion are the main concern as a result of indirect impacts which can be easily mitigated (see **Section 8**). In addition to this, the collector substation is not near (<100m) of any surface water resources. Therefore, no direct or indirect impacts can be expected which would require special mitigation measures. The buffer zone calculations can be found in **Appendix B**.

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 6.1 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 power lines will need to span watercourses in either of the proposed power line corridors. Therefore, development of the power lines within the watercourses are applicable.

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 wetlands and watercourses due to the proposed development.

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

The proposed development will involve the development of a collector substation and power lines of up to 220kV. The proposed development of the collector substation will not trigger any water uses. However, the proposed power lines will be required to span over the ephemeral watercourses of which water uses c) and i) are applicable under Section 21 of the NWA. However, there are existing service roads along the existing 400kV power line and along Loop 10 road and the N14. It has been assumed in this report that these existing service roads will be used to provide access where possible, but where this remains unfeasible, a separate minor 2-track dirt access road will be required along the proposed power line routes (whichever is approved) for construction activities as well as ongoing maintenance. This will incur minor impacts where access roads cross watercourses or wetlands, and will require DWS authorisation. Pending the input of a risk assessment for such activities, a General Authorisation (GA) or full Water Use Licence (WUL) will 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). This has been recommended in **Section 9** below.

7. COMPARATIVE ALTERNATIVES ASSESSMENT

Two alternative power line corridors and associated collector substations have been proposed including Alternative Power Line Corridor 1 and 2, and the associated Alternative Collector Substations 1 and 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 Assessment of Alternatives.

Preferred Alternatives from a Freshwater Features Perspective	
Alternative Power line Corridor 1	**Alternative Power line Corridor 2**
There are ten ephemeral watercourses and two large ephemeral watercourses within alternative power line corridor 1. There are also three ephemeral wetlands located within the corridor, whilst four other ephemeral wetlands are located approximately >125m from the edge of the proposed power line corridor. It is possible that all the aforementioned freshwater resources will be affected by the proposed power lines with the exception of the three other ephemeral wetlands located approximately >125m from the edge of the proposed power line corridor. However, it must be stated that all freshwater resources and direct impacts as a result of the pylon placement can be avoided when placing the pylons outside of the boundaries and associated buffer zones of the freshwater resources. The requirement for new services roads will only be likely should the existing service roads for the existing 400kV and 66kV power lines in this power line corridor not be practical. With this in mind, the potential direct impacts can be mitigated and mainly indirect impacts to the watercourses and wetlands within the proposed power line corridor are expected, both of which (direct and indirect) may be mitigated to varying degrees. Given the above - this alternative is viewed as favourable.	There are twenty ephemeral watercourses and one large ephemeral watercourse within alternative power line corridor 1. There are no wetlands within this proposed power line corridor. Only six of the ephemeral watercourses cross the entire width of the proposed power line corridors, while all other ephemeral watercourses (including the large ephemeral watercourse) partially traversing the proposed power line corridor. The proposed power line will be able to span the ephemeral watercourses that extend across the entire width of the power line corridors, and will also be able to avoid those that are partially within the power line corridor including the associated buffer zones. Direct impacts as a result of the pylon placement can also be avoided when placing the pylons outside of the boundaries and associated buffer zones of the freshwater resources. In addition, due to the existing access from Loop 10 road and the N14, the extent of new access roads may be reduced, depending on the practicality and feasibility of utilising existing access roads. With this in mind, the potential direct impacts can be mitigated and mainly indirect impacts to the watercourses and wetlands within the proposed power line corridor are expected, both of which (direct and indirect) may be mitigated to varying degrees. Given the above - this alternative is also viewed as favourable.
Alternative Collector Substation 1	**Alternative Collector Substation 2**
There are no freshwater resources in the development footprint of the collector substation, nor are there any freshwater resources within 500m of the collector substation. This collector substation is viewed as favourable.	There are no freshwater resources in the development footprint of the collector substation. However, there are three ephemeral watercourses within 500m of the development footprint. Although, the location of the collector substation is south (downstream) of the ephemeral watercourses and therefore, no indirect impacts can be expected during construction or operation as it is not located higher in the catchment to affect the flows of these watercourses. This collector substation is viewed as acceptable.

Based on the information in the comparative assessment above, **Alternative Power Line Corridors 1 and 2, and the associated collector substation alternatives, are both viewed as acceptable, with Alternative 1 being more favourable.**

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 as the difference for each are negligible. In addition, it must be noted that no indirect impacts to the ephemeral wetlands identified outside of the proposed power line corridors will take place due to the distance to the proposed development and limited area of impact associated with the power line construction process.

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

With construction of the proposed power lines, there may be degradation of vegetation in the wetlands and watercourses as a result of disturbance during construction. This may occur through the development of new access roads (minor 2-track dirt access road) or through vehicles utilising existing service roads or farm tracks through the wetlands and watercourses, both of which are likely to damage vegetation (to varying degrees). Furthermore, vehicle movement within the wetlands and watercourses during stringing can also result in vegetation disturbance. Lastly, where towers are placed within the wetlands or watercourses, vegetation is likely to be removed which will result in degradation of the freshwater resources.

The impact rating is shown in Table 8.1 below.

Table 8.1: Potential impacts associated with vegetation clearance in the wetlands and watercourses for power line infrastructure and associated access road development.

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	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- » Vehicle movement within the wetlands and watercourses must be minimized, and existing service roads utilised where practical and feasible.
- » No blading or scraping is to be employed for new access road construction. New access roads are to be created by recurring use in order to allow remnant vegetation to rehabilitate naturally following construction. Where required (i.e. where vegetation presents an obstacle), manual removal of vegetation using hand tools may be permitted;
- » Worker movement is to be limited to the servitude of the power lines being erected. Workers are not allowed outside of the servitude in the wetlands and watercourses during construction.
- » Workers are not allowed to destroy or harm wetland and riparian habitat vegetation where not absolutely required for the construction work.
- » No in-stream or riparian vegetation is to be removed where not absolutely required for the construction work.
- » The Environmental Officer (EO) must monitor vehicle movement and report any movement outside of the newly developed minor 2-track dirt access road, existing service roads or farm tracks.
- » No pylon towers are to be placed directly within the wetlands and watercourses or the associated buffer zones, and are to be spanned across watercourses and the associated buffer zones.
- » The power line is to avoid impacting on all freshwater resources as far as possible.
- » 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 vegetation when growth is stimulated by the rains and will also avoid impacts to flow, as construction will be limited to periods when the watercourses are likely to be dry. This will also limit disturbance to potential occurrence of red data avifaunal species and other charismatic species that may inhabit the freshwater resources during this time.
- » Although no alien species were noted during the assessment, it is good practice to ensure that an alien invasive and control management plan is to be formulated and implemented to prevent any encroachment of alien invasive species into the area.

Residual Impacts:

No residual impacts after implementation of mitigation measures.

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

Where pylons are placed outside of the wetlands, watercourses and the associated buffer zones, with excavation, there is a potential for sedimentation to enter the watercourses via storm water run-off. In addition to this, with the presence and potential movement of construction vehicles and associated machinery through the wetlands and watercourses on existing service roads and farm tracks during construction of the proposed power line, there is a potential for 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 storm water 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 wetlands and watercourses.

Nature: Sedimentation of wetlands and watercourses due to increased run-off and clearance of vegetation in the immediate catchment area from construction excavation. Oil and fuel leaks and spills directly in the wetlands and watercourses or indirectly entering freshwater systems via stormwater run-off. Temporary sanitation facilities may leak into the ephemeral wetlands and 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	Probable (3)	Improbable (2)
Significance	**24 (Low)**	**12 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

» Where pylons are placed in close proximity to the buffer zone of the freshwater resources, the soil stockpile 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.
» No pylon towers are to be placed directly within the wetlands and watercourses or the associated buffer zones, and are to be spanned across watercourses and the associated buffer zones.
» All vehicles and machinery must be maintained regularly and checked for leaks before being allowed to move within the service roads and farm tracks (existing or developed). Should leaks be detected, the relevant vehicles and machinery must be repaired before being allowed to operate within the power line servitude.
» No storage of fuels, oils or any other hazardous substance are allowed directly in the wetlands and watercourses or within 100m from any wetland or watercourse.
» General storage of fuels, oils and any other hazardous substances must be contained in bunded areas.
» Emergency oil spill kits must be available should a spill occur.
» Temporary sanitation may not be placed directly or within 100m of any wetland or watercourse.
» Temporary sanitation facilities must be regularly checked for leaks and spillages, and repaired where any leakages are detected before being allowed for use in the power line servitude.
» temporary sanitation facilities must be cleaned regularly to ensure they stay within capacity.

Residual Impacts:
No residual impacts after implementation of mitigation measures.

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

Use of existing service roads and farm tracks, or the development of a new minor 2-track dirt access road where access may not be readily available, are likely to be required for the construction of the power line through any wetlands or watercourses where these cannot be avoided. Compaction of the bed of the ephemeral wetlands and watercourses due to movement of vehicles is therefore likely to take place.

The impact rating is shown in Table 8.3 below.

Table 8.3: Potential impacts on geomorphology of watercourses associated with movement of vehicles in the wetlands and watercourses.

Nature: Soil compaction of the bed of the wetlands and watercourses can be expected with the movement of vehicles through the freshwater resources where required.

	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)	Probable (3)
Significance	**32 (Medium)**	**18 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation: » The necessary water use license or general authorisation must be obtained from the Department of Water and Sanitation prior to commencing with construction within 500m of delineated wetlands or 100m of watercourses (i.e. within the regulated area of a watercourse or wetland). » Vehicle movement through the wetlands and watercourses is to be limited as far as possible (i.e. deviate around watercourses where possible); » Vehicle movement within the wetlands and watercourses must utilise existing service roads where practical and feasible; » No pylon towers are to be placed directly within the wetlands and watercourses or the associated buffer zones, and are to be spanned across watercourses and the associated buffer zones. » All existing service or farm tracks through watercourses are to be monitored by the EO for erosion regularly during the construction phase. » Where erosion takes place, the EO must inspect the degree of erosion and propose suitable mitigation measures to prevent further erosion. » Post-construction monitoring of the watercourses by the EO is also required to determine the occurrence of erosion following the completion of construction, and must propose suitable mitigation measures to prevent further erosion where required.
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 wetlands and watercourses via service roads created during the construction phase (or pre-existing access roads), as well as farm tracks are likely to be required during the operation phase. This activity may be associated with impacts to the wetlands and watercourses in terms of compaction and possible soil erosion.

The impact rating is shown in Table 8.4 below.

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

Nature: Soil compaction of the bed of the ephemeral watercourses are expected with the movement of vehicles through the ephemeral wetlands and watercourses.		
	Without mitigation	**With mitigation**
Extent	Project site (1)	Project site (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	Highly probable (4)	highly probable (4)
Significance	**36 (Medium)**	**28 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- Vehicle movement through the wetlands and watercourses during monitoring and maintenance is kept to a minimum;
- Vehicle movement through the wetlands and watercourses during monitoring and maintenance is to be limited to existing tracks or project service tracks.
- All service roads and farm tracks used during monitoring and maintenance 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.
- No pylon towers are to be placed directly within the wetlands and watercourses or the associated buffer zones, and are to be spanned across watercourses and the associated buffer zones.

Residual Impacts:

No residual impacts after implementation of mitigation measures.

8.5. Decommissioning of the power line (Decommissioning Phase)

The same potential impacts identified in the construction phase can be associated with the decommissioning of the proposed power line and associated collector substation but in reverse order. The same impacts, significance ratings and mitigation measures are therefore applicable.

8.6. Cumulative Impacts

The assessment of cumulative impacts was undertaken in consideration of similar renewable energy developments requiring connection to the national grid, 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 arsing 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 that are of concern 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, the Biotherm Aggeneys 75MW solar PV development (currently under construction) located higher in the catchment of the proposed development and the Biotherm Concentrated Solar Power (CSP) and PV facility south of the proposed development, which will all require connection to the grid and may impact on the freshwater resources identified and delineated in this assessment. The remaining proposed renewable energy developments in the region are either located outside of the quaternary drainage catchment or are not likely to impact on the freshwater resources identified in this assessment. It must be noted however that the Biotherm Aggeneys 75MW solar PV development is currently under construction and is known to loop into the existing 220kV/66kV power line heading to Aggeneis Main Transmission Substation, so no cumulative impacts are expected for this development.

Of relevance from a freshwater features perspective, the potential impacts to the wetlands and watercourses as a result of grid connections for similar renewable energy developments in the catchment include direct physical alteration and degradation of watercourses with placement of grid infrastructure and associated service roads within freshwater resources. Of greater importance from a catchment level, is the transformation of land use and associated decrease in surface roughness from clearance required for general construction of the renewable energy facilities resulting in hydrological alterations in catchment drainage are also of concern. 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 in the greater area.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Regional (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**27 (Low)**	**33 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation[2]: » Necessary precautions need to be undertaken to avoid impacting wetlands and watercourses both directly and indirectly as far as possible; where this is not possible, impacts must be minimised as far as possible. » Necessary water use license or general authorisation from the Department of Water and Sanitation, as well as an environmental authorisation must be obtained from the Department of Environmental Affairs (National or Provincial where applicable) before any impact to wetlands and watercourses occur. » Prevent complete clearance of vegetation on project sites, to maintain some level of surface roughness to assist with control of increased run-off in the catchment to limit surface erosion or sheetwash. » Sedimentation preventative measures to be implemented to prevent sedimentation via run-off at a catchment level. » Erosion protection measures are to be implemented to wetlands and watercourses where required. » Ensure that all fuels, oils and hazardous substances are kept out of all wetlands and 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 wetlands and watercourses.		
Cumulative impacts: Described above.		
Residual Impacts: No residual impacts after implementation of mitigation measures.		

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

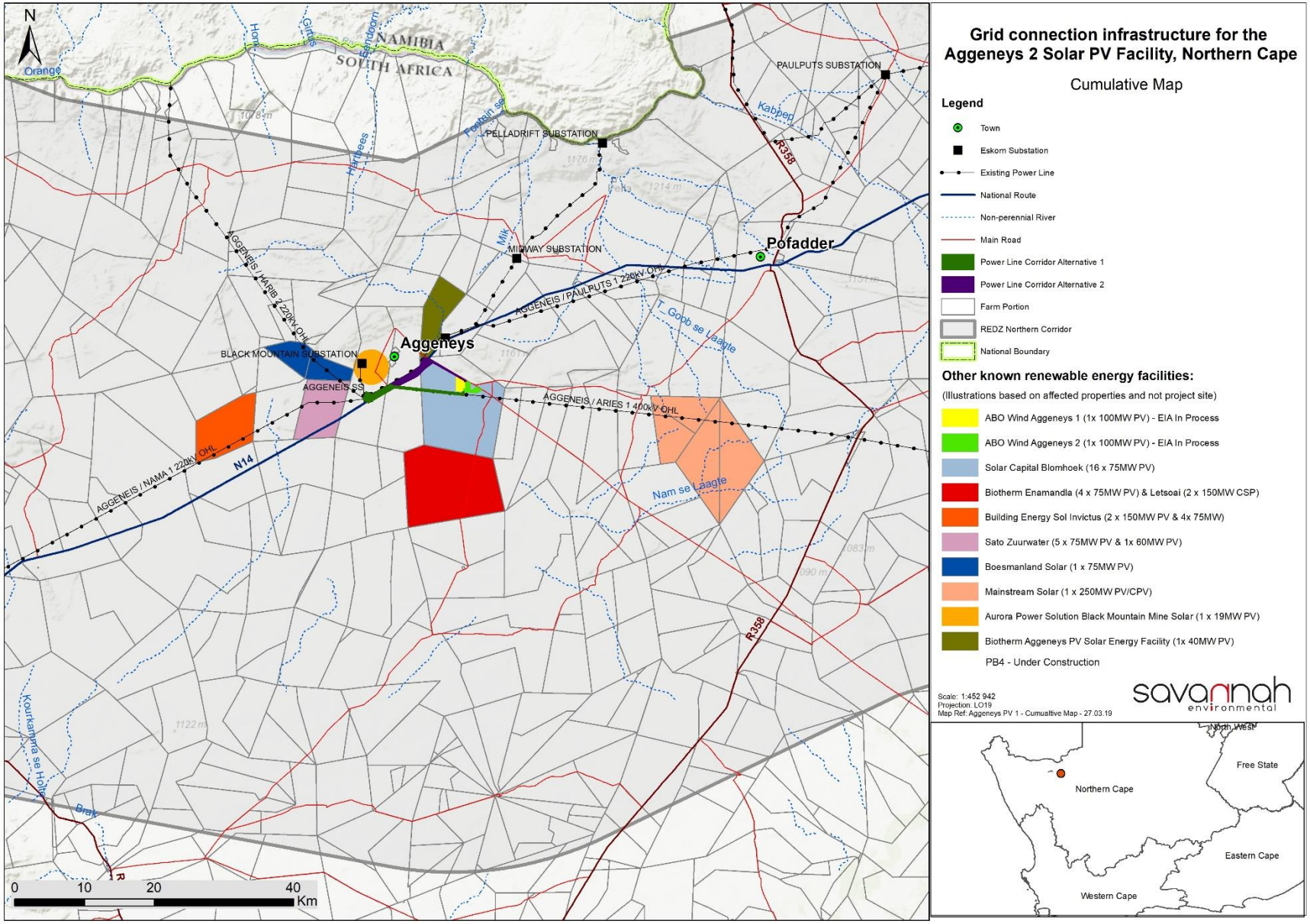

Figure 8.1: Cumulative Map which indicates other renewable energy facilities in the area, which will also require grid connection solutions to connect to the National grid.

9. CONCLUSION AND RECOMMENDATIONS

These freshwater features report focused on providing information on the freshwater resources baseline environment for the proposed power line and collector substation within the proposed power line corridors for the Aggeneys 2 solar PV facility near Aggeneys, Northern Cape Province. The freshwater study was established using the collection of available secondary information (available databases and satellite imagery) 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 within the proposed power line corridors.

From a desktop perspective, it was observed from Google Earth™ satellite imagery that **several ephemeral watercourses and wetlands** could be observed within the power line corridors and within the regulated area of a watercourse or wetland. **No other freshwater resources were identified at a desktop level consulting database information.** However, the only relevant desktop information of relevance was that the proposed power line corridors were found to be located within:

Alternative Power Line Corridor 1 (southern alignment)
- Critical Biodiversity Area 2 (**CBA2**); and
- Ecological Support Areas (**ESA**).

Alternative Power Line Corridor 2 (northern alignment)
- Critical Biodiversity Area 1 (**CBA1**);
- Critical Biodiversity Area 2 (**CBA2**); and
- Ecological Support Areas (**ESA**).

The in-field investigation and assessment confirmed the presence of **Seven (07) ephemeral depression wetlands in total**, of which three (03) ephemeral wetlands were identified directly within, and four (04) ephemeral wetlands outside of the proposed power line corridor Alternative 1 but within 500m within the regulated area of a watercourse (according to the NWA definition). The wetlands shared similar geomorphological characteristics and ranged in size from 0,1 to 6,6 hectares. The shapes of the wetlands also varied from circular/oval-shaped to kidney-shaped wetlands. In addition, **twenty-three (23) ephemeral watercourses and two (2) large ephemeral watercourses** were identified. These freshwater resources were delineated using the indicators as stipulated in the national guidelines.

The present ecological state of the ephemeral wetlands was assessed to be **Class B (largely natural) ephemeral depression wetland systems**. However, the Class B rating is expected to slowly deteriorate over time with further overgrazing and consequent change in surface roughness.

The wetland ecosystem services were determined for all wetlands (collectively scored). The wetland ecosystem services **that scored highest included maintenance of biodiversity, sediment trapping and erosion control**. The wetlands therefore offered good potential for sediment and erosion control in the area. The wetlands were also identified to be important from a maintenance of biodiversity function due to the potential for red data species to occur in the area. This refers to the regionally endemic Red Lark species. In addition to this, invertebrates like *branchiopods* and *dipterans* hatch out, and algae can be reactivated when wetlands fill up sufficiently. Wildlife, especially water birds, are also known to gather to feed in such resurrected systems. As such, unique populations can be expected to be present after sufficient rainfall.

The ecological importance and sensitivity (EIS) of the ephemeral depression wetlands was assessed taking into account the various determinants of the wetland systems. The EIS of the ephemeral depression wetlands were assessed to be **Class B systems** due to relatively high scores for ecological integrity, protected status, hydrological and geomorphological functional role and importance from a biodiversity perspective. The wetlands were therefore considered to be highly ecologically important and sensitive at a regional scale.

For the watercourses, the present state of the vegetation was found to closely resemble the natural state, with the exception of grazing disturbance and vehicle tracks. No exotic vegetation was noticed however, despite the disturbance factors described above. Other disturbances include the existing farm boundary fence line and farm tracks through the watercourses. Taking existing impacts into consideration, the Ecological Condition (EC) of the riparian habitat of the ephemeral watercourses were collectively assessed to be **Class C moderately modified systems**.

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 collectively provided included sediment trapping, bank stabilisation and maintenance, flood attenuation, ecological corridor for migration of species and erosion control. The function of the watercourses to provide these ecosystem services was assessed to be relatively significant for the local area. **The EIS of all the watercourses (including large ephemeral watercourse no. 1 and no. 2) were assessed to be Class C systems,** which are considered to be moderately ecologically important and sensitive on a regional scale.

A **buffer zone of 15m** for all the freshwater resources was determined to offer adequate protection, and which is to be implemented in accordance with the explanation which follows. Given the nature and type of the development, the footprint of the power lines was deemed to be relatively minimal. In addition, the power lines are able to easily span any of the freshwater resources (wetlands and watercourses). Importantly, no pylons for the power lines are to be positioned in the freshwater resources to avoid any direct impacts. Issues of sedimentation and erosion are the main concern as a result of indirect impacts and which can be easily mitigated. In addition to this, the collector substation is not near (<100m) of any surface water resources. Therefore, no direct or indirect impacts can be expected that would require special mitigation measures for this component.

A comparative assessment of the two (02) alternative power line corridors and collector substations was undertaken in which it was determined that **Alternative Power Line Corridors 1 and 2, and the associated collector substation alternatives, are both viewed as acceptable, with Alternative 1 being more favourable.**

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 wetlands and watercourses during the construction and decommissioning phases**. The significance ratings of the potential impacts ranged from **Medium to Low without mitigation, and Low with mitigation measures**. With regards to the **operation phase**, potential impacts as a result of **vehicle movement through wetlands and watercourses 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 grid connection infrastructure developments**, including the proposed development, would be **Medium cumulatively and Low rated in isolation**. Suitable mitigation measures were proposed to avoid impacts where possible and to minimise potential impacts as far as possible.

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

- No pylon towers are to be placed directly within the wetlands and watercourses or the associated buffer zones, and are rather to be spanned across watercourses and the associated buffer zones;
- Existing service roads and tracks are to be used where reasonable and feasible;
- 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 so as not to affect the present ecological state of the wetlands and the ecological condition of the riparian habitat of the freshwater resources assessed; and
- Prior to construction, a risk assessment is to be undertaken for the construction of a power line through the wetlands and watercourses where required. This is to be undertaken to determine the need for appropriate water use licensing with 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 freshwater resources affected. With the implementation of the mitigation measures and recommendations stipulated, the potential impacts can be minimised. **The proposed construction of the power line and associated collector substation as per the proposed corridors and layout 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, where required.**

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APPENDIX A
SPECIALIST CV

savannah environmental

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Woodlands Drive, Woodmead
Johannesburg, South Africa

Email: shaun@savannahsa.com
Tel: +27 (11) 656 3237

CURRICULUM VITAE OF SHAUN TAYLOR

Profession : Environmental and Permitting Lead Consultant

Specialisation: Environmental Impact Assessments; Strategic Environmental Assessments; Environmental permitting compliance, advice & assurance; Water Use Licenses; Project Management; Wetland Assessments.

Work Experience: Eleven (11) years' experience in the environmental field

OCATIONAL EXPERIENCE

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). Over and above a number of other projects, Shaun has successfully conducted and obtained environmental approvals for numerous renewable energy (wind and solar) developments as well as for infrastructure (roads, water pipeline and power line) related projects. Shaun has excellent experience in dealing with the entire environmental authorization (EA) process from beginning to end i.e. submission of applications, undertaking Environmental Impact Assessments and Basic Assessments (BAs), conducting EA amendments, extension applications and compiling Draft and Final Environmental Management Programmes (EMPrs). Shaun is well acquainted and experienced in dealing with the key provincial and national environmental authorities, other organs of state as well as any other key stakeholders.

Within the water field, Shaun has completed numerous water use license applications (WULAs), General Authorisations (GAs), Risk Assessments and WULA compliance monitoring for various developments. Shaun is also specialised in wetland ecology and operates as a wetland specialist. Shaun has undertaken and completed numerous wetland and riparian assessments for renewable energy, linear projects as well as site specific projects. Shaun has also undertaken a wetland offset plan and several wetland rehabilitation plans for various developments.

SKILLS BASE AND CORE COMPETENCIES

- Environmental Project Management
- Environmental Impact Assessments and Basic Assessments
- Environmental Management Programmes
- Environmental Compliance Monitoring
- Environmental Amendments
- Strategic Environmental Assessments
- Environmental Management
- Public and Stakeholder Engagement
- Water Use License Applications
- General Authorisations

- Risk Assessment Matrix
- Wetland Delineation, Functional and Impact Assessments
- Geographic Information Systems (GIS)

EDUCATION AND PROFESSIONAL STATUS

Degrees:

- M.Sc. Aquatic Health, University of Johannesburg, Johannesburg (2011)
- B.Sc (Hons) Geography and Environmental Studies, University of Witwatersrand, Johannesburg (2010)
- B.A Geography and Environmental Science, Monash University, Johannesburg (2008)

Short Courses:

- National Training and Development Buffer Zone Workshop, Eco-pulse (2015)
- Integrated Water Resources Management (IWRM), the National Water Act (NWA), and Water Use Authorisations, focusing on Water Use License Applications – Procedures, Guidelines, Integrated Water and Waste Management Plan (IWWMP), Carin Bosman Sustainable Solutions (2014)
- Grass identification short course, Bushveld Eco Services (2010)
- Wildflower identification short course, Bushveld Eco Services (2010)
- Veld management short course, Bushveld Eco Services (2010)
- Short course and certification in Wetland Delineation and Rehabilitation Training Course from the School of Continuing Education, University of Pretoria (2008)

Professional Society Affiliations:

- Member of the South African Wetland Society (SAWS) (Current)
- Registration pending with the South African Council for Natural Scientific Professions as a Professional Natural Scientist: Environmental Scientist (Current)

Other Relevant Skills:

- Project Management Course, SiVEST (2017)

EMPLOYMENT

Date	Company	Roles and Responsibilities
June 2018 – Current:	Savannah Environmental (Pty) Ltd	Environmental and Permitting Lead Consultant *Tasks include: undertaking strategic environmental assessments, environmental impact assessments, basic assessments, environmental management programmes (EMPrs), environmental amendments, environmental screening and due diligence assessments, water use license applications, wetland assessments and rehabilitation plans. Ensuring environmental compliance on permitting processes. Client liaison and relationship management.*
November 2010 – May 2018	SiVEST South Africa (Pty) Ltd	Environmental Scientist *Tasks included: conducting environmental impact assessments, basic assessments and water use license application processes, undertaking amendment and exemption*

Date	Company	Roles and Responsibilities
		applications, general project management, report writing, marketing and proposal writing, client liaison and relationship management, invoicing, conducting specialist riparian/wetland delineation and functional assessments, environmental and water related compliance monitoring and auditing.
October 2009 – March 2010	Envirokey cc	Junior Environmental Consultant and GIS support *Tasks included: being responsible for managing basic assessments, report writing, conducting specialist wetland assessments, auditing procedures and GIS mapping.*
August 2007 – September 2009	Holgate Meyer and Associates Environmental Management Services	Junior Environmental Consultant *Tasks included: being responsible for managing basic assessments, report writing, conducting specialist wetland assessments, environmental auditing procedures and GIS mapping.*

PROJECT EXPERIENCE

Project experience includes environmental approvals for numerous renewable energy (wind and solar) developments as well as for infrastructure (roads, water pipeline and power line) related projects. Within the water field, project experience includes numerous water use license applications, general authorisations, risk assessments and compliance monitoring for various developments. In terms of wetland assessments, project experience includes numerous wetland and riparian delineation, functional and impact assessments for renewable energy, linear projects and site-specific projects. The wetland experience also includes a wetland offset plan and several wetland rehabilitation plans (various types of developments).

RENEWABLE POWER GENERATION PROJECTS: SOLAR ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Hyperion 1, 2, 3 and 4 – 75MW Photovoltaic (PV) Plants near Kathu, Northern Cape Province	*Building Energy South Africa*	*Project leader, environmental consultant, public participation*
Loeriesfontein PV Plant, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Renosterberg PV Plant near De Aar, Northern Cape Province	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Environmental consultant, public participation, wetland specialist*
Droogfontein II - 70MW Solar Photovoltaic Power Plant near Kimberley, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Construction of a Concentrated PV/ PV Plant in De Aar, Northern Cape	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Sirius Solar 3 and 4 100MW PV Plants near Upington, Northern Cape Province	*SOLA Future Energy*	*Project leader, environmental consultant, public participation*
Aggeneys 2 X 100MW PV Plants, Northern Cape Province	*Atlantic Energy Partners & ABO Wind*	*Project leader, environmental consultant, public participation*
Proposed development of a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, public participation, wetland specialist*
Proposed development of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, public participation, wetland specialist*
Loeriesfontein 70MW PV Plant, Northern Cape Province	*Biotherm Energy*	*Environmental consultant*
Droogfontein II - 70MW Solar Photovoltaic Power Plant near Kimberley, Northern Cape Province	*SunEdison*	*Project leader, environmental consultant*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Sol Invictus 3 & 4 PV Part 2 Amendment Application, Northern Cape Province	*Building Energy South Africa*	*Project leader, environmental consultant*
Aries PV Part 1 Amendment Application, Northern Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Konkoonsies PV Part 1 Amendment Application, Northern Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Steynsrus PV 1 & PV 2 Financial Close, Free State Province	*Cronimet*	*Project leader, environmental consultant*
Heuningspruit PV 1 Financial Close, Free State Province	*Cronimet*	*Project leader, environmental consultant*
Integrated Water Use License Application for the Construction of a Concentrated PV/ PV Plant in De Aar, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Proposed Construction of the De Wildt Solar Photovoltaic Power Plant, General Authorisation and Risk Assessment, Gauteng Province	*SunEdison*	*Project leader, environmental consultant, wetland specialist*
Loeriesfontein Photovoltaic (PV) Plant Vegetation Permits, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant*
Droogfontein II 70MW Solar Photovoltaic Power Plant near Kimberley Vegetation Permits, Northern Cape Province	*SunEdison*	*Environmental consultant*

RENEWABLE POWER GENERATION PROJECTS: WIND ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Noupoort Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant & public participation*

Loeriesfontein Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Khobab Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Renosterberg Wind Farm near De Aar, Northern Cape Province	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Environmental consultant, public participation, wetland specialist*
Ithemba Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Harte Beeste Leegte Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Gras Koppies Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Xha! Boom Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*

Screening Studies

Project Name & Location	***Client Name***	***Role***
Environmental Constraints Analysis Report for the establishment of four Wind Farms in the Northern and Eastern Cape Provinces	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*

Compliance Advice and ESAP reporting

Project Name & Location	***Client Name***	***Role***
Noupoort Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental advisor*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Perdekraal West Wind Farm Part 2 Amendment Application, Western Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Witberg Wind Farm Part 2 Amendment Application, Western Cape Province	*Building Energy South Africa*	*Project leader, environmental consultant*
Karreebosch Wind Farm Part 2 Amendment Application, Northern & Western Cape Provinces	*G7 Renewable Energies*	*Project leader, environmental consultant*
Dassiesklip Wind Farm Part 1 Amendment Application, Western Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Water Use License for the Dwarsrug Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Water Use License for the Victoria West Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Khobab Wind Farm Vegetation Permits, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant*

Loeriesfontein Wind Farm Vegetation Permits, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant*

RENEWABLE POWER GENERATION PROJECTS: CONCENTRATED SOLAR FACILITIES (CSP)

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Integrated Water Use License Application for the Construction of a CPV/ PV Plant in De Aar, Northern Cape Province of South Africa	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Water Use License for the Rooipunt Concentrated Solar Power Project, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*
Water Use License for the Limestone Concentrated Solar Power Project, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*

RENEWABLE POWER GENERATION PROJECTS: GAS POWER FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Richards Bay Combined Cycle Gas Turbine Power Plant near Richards Bay, KwaZulu Natal Province	*Eskom*	*Environmental consultant & public participation*

CONVENTIONAL POWER GENERATION PROJECTS (COAL)

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Proposed Installation of a 500m³ Bulk Storage Fuel Oil Tank at Grootvlei Power Station, Mpumalanga Province	*Eskom Generation*	*Environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Water Use License Compliance Auditing for Grootvlei Power Station, Mpumalanga Province, South Africa	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Armcor Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Ash Dump Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Pollution Dams Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Stream Diversion and Water Pipeline Crossings Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Geotechnical Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*

GRID INFRASTRUCTURE PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Mookodi Integration Project Environmental Impact Assessment, North West Province	*Eskom Distribution*	*Environmental consultant, wetland specialist*
Eskom Thyspunt Nuclear Integration Project – Transmission and Substation Infrastructure (Northern and Southern Corridor), Eastern Cape Province	*Eskom Transmission*	*Environmental consultant, wetland specialist*

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Wilger 132kV Overhead Distribution Power Line, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Project leader, environmental consultant, wetland specialist*
Limestone 1 – 132kV Overhead Distribution Power Line, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*
Limestone 2 – 132kV Overhead Distribution Power Line, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*
Proposed Tweespruit to Welroux Power Line and Substations, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Proposed Construction of a 132kV Power Line and Associated Infrastructure for the evacuation of power from the proposed 200MW Concentrated Solar Power (CSP) Plant on the Farm Rooipunt Number 617 near Upington, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Project leader, environmental consultant, wetland specialist*
Loeriesfontein 132kV Power Line, Northern Cape Province	*Biotherm Energy*	*Project leader, environmental consultant, wetland specialist*
Proposed Construction of a 132kV Power Line and Associated Infrastructure for the evacuation of power from the Kalkaar Concentrating Solar Thermal Power Project on the Remainder of Portion 1 of the Farm Kalkaar 389 near Jacobsdal, Free State and Northern Cape Provinces	*SolarReserve South Africa (Pty) Ltd*	*Project leader, environmental consultant, wetland specialist*
Droogfontein II – 132kV power line and substation near Kimberley, Northern Cape Province	*SunEdison*	*Project leader, environmental consultant*
Mookodi Integration Project II – 132kV Power Line, Havelock Loop-in/Loop-out, Ganyesa Substation, North West Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Environmental Compliance Auditing for the Nigel Substation to Jameson Park (Inland Terminal 2) 88kV power lines	*Eskom Distribution*	*Environmental auditor*

Ga-rankuwa 11kV Underground Power Cable Water Use License Compliance Audit, Gauteng Province	*Eskom Distribution*	*Project leader, environmental auditor*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Water Use License / General Authorisation for Ga-rankuwa Substation, Gauteng Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Water Use License / General Authorisation for Klevebank to Dalkieth 88kV Power Line, Gauteng Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Water Use License Application for the Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Water Use License / General Authorisation Proposed Tweespruit to Welroux Power Line and Substations, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*

MINING SECTOR PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Karowe Diamond Mine Environmental Management Plan Review and Update, Boteti District, Botswana	*Karowe Diamond Mine*	*Environmental consultant*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Post-rehabilitation Assessment of Three Wetland Crossing Sites for the Re-working of a Tailings Dam Project near Stilfontein, North West Province	*Chemwes (Pty) Ltd*	*Environmental auditor*

TRANSPORT SECTOR PROJECTS

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Polokwane Integrated Rapid Public Transport Network, Limpopo Province	*City of Polokwane*	*Environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Transnet Rail Water Use License Compliance Audit, Northern Cape Province	*Hatch-Goba / Transnet*	*Environmental auditor*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Water Use Licensing for the Polokwane Integrated Rapid Public Transport Network, Limpopo Province	*City of Polokwane*	*Environmental consultant, wetland specialist*
General Authorisation for the proposed eThekwini Integrated Rapid Public Transport Network (IRPTN) -	*Nako Iliso*	*Environmental consultant, wetland specialist*

BRT Phase 1: Route C1A, General Authorisation and Risk Assessment, Kwa-Zulu Natal Province		

INFRASTRUCTURE DEVELOPMENT PROJECTS (BRIDGES, PIPELINES, ROADS, WATER RESOURCES, STORAGE, ETC)

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Sir Lowry's Pass River Flood Alleviation Project, Western Cape Province	*City of Cape Town*	*Environmental consultant*

Screening Studies

Project Name & Location	***Client Name***	***Role***
Environmental Screening Assessment for a vegetable oil pipeline in Richards Bay Industrial Development Zone, KwaZulu Natal	*Wilmar Processing (Pty) Ltd*	*Environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Wetland Post-rehabilitation Assessment of the Inland New Multi-Purpose Pipeline in the Mpumalanga and Gauteng Provinces	*Transnet SOC Ltd*	*Wetland specialist*

HOUSING AND URBAN PROJECTS

Screening Studies

Project Name & Location	***Client Name***	***Role***
Social Housing Projects in Sasolburg and Secunda, Gauteng Province	*Provincial Department of Human Settlements*	*Environmental consultant, wetland specialist*

INDUSTRIAL PROJECTS

Basic Assessments

Project Name & Location	***Client Name***	***Role***
PPC Slurry Plant decommissioning of Kilns 5 & 6, North West Province	*PPC Limited*	*Project leader, environmental consultant*
SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Project leader, environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Environmental Compliance Auditing for the Meadow Feeds Standerton Broiler Feed Mill, Mpumalanga Province	*Meadow Feeds*	*Environmental consultant, wetland specialist*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Water Use License for the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Project leader, environmental consultant, wetland specialist*

Water Use License for the Proposed Tissue Manufacturing Capacity at the Kliprivier Operations Base, General Authorisation and Risk Assessment, Gauteng Province	*Twinsaver Group*	*Project leader, environmental consultant, wetland specialist*

ENVIRONMENTAL MANAGEMENT TOOLS

Strategic Environmental Assessments

Project Name & Location	***Client Name***	***Role***
Molemole Local Municipality Strategic Environmental Assessment, Limpopo Province	*Capricorn District Municipality*	*Environmental consultant, wetland specialist*
Blouberg Local Municipality Strategic Environmental Assessment, Limpopo Province	*Capricorn District Municipality*	*Environmental consultant, wetland specialist*

SPECIALIST STUDIES

Wetland and Riparian Delineation, Functional and Impact Assessments

Project Name & Location	***Client Name***	***Role***
Wetland delineation assessment for a vegetable oil pipeline in Richards Bay, KwaZulu Natal Province	*Wilmar Processing (Pty) Ltd*	*Wetland specialist*
Surface water assessment for the Dwarsrug Wind Farm Access Road near Loeriesfontein, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a Wind Farm in Prieska, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a Wind Farm in Loeriesfontein, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a 132KV Distribution Line from the Kudu Substation to Dorstfontein Substation in Mpumalanga Province	*Eskom Distribution*	*Wetland specialist*
EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Northern Corridor: Eastern Cape Province	*Eskom Transmission*	*Wetland specialist*
EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Southern Corridor: Eastern Cape Province	*Eskom Transmission*	*Wetland specialist*
Surface Water Assessment for the Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Environmental Management Framework for the Mogale City Local Municipality Surface Water Report – Desired State Report: Gauteng Province	*Mogale City*	*Wetland specialist*
Surface Water Assessment for the Proposed Township Development on the Remainder of Portion 27 of the Farm Middelburg and Townsland 287 JS, Mpumalanga Province	*Steve Tshwete Local Municipality*	*Wetland specialist*
Surface Water Assessment for the Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a CSP and a CPV/ PV Plant in Kimberley, Northern Cape Province, South Africa	*Mainstream Renewable Power South Africa*	*Wetland specialist*

Surface Water Assessment for the Westrand Strengthening Project from Westgate Substation to Hera Substation and Westgate Substation Extension, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Mookodi Integration Project 2 Basic Assessment Surface Water Impact Assessment, North West Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Construction of a Gabion Structure at Waterval Substation in the Midrand Area, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Single 400kV Power Line from Borutho to Nzhlele, North West Province	*Eskom Transmission*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 88kv Power Line at Palmridge in the Ekurhuleni Metropolitan Municipality, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Rebuilding of an 88kV Power Line from Henneman Substation to Serfontein Substation near Kroonstad, Free State Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Deconstruction and Construction of an 11kV Power Line near Delmas, Mpumalanga Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Solar Photovoltaic Power Plant near De Aar, Northern Cape Province, South Africa	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Wind Farm near De Aar, Northern Cape Province	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Low-Cost Housing Development in the Soutpan area of Tshwane, Gauteng Province	*Makole Property Development*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 132kV Power Line near Kimberley, Northern Cape Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Extension of Delmas Substation and Associated Power Lines, Mpumalanga Province, South Africa	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Substation in the Midrand area of Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Construction of an 88kV Power Line at Lochvaal Kudu in the Emfuleni Municipality, Gauteng Province	*Eskom Distribution*	*Wetland specialist*

Surface Water Assessment for the Proposed construction of an 88kV Power Line from Klevebank Substation to Dalkeith Substation, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 88kV Power Line from Heilbron Substation to Villiers Substation, Free State Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 132kV Power Line, Substation and the Extension of Homestead Substation Associated with the 75MW Concentrating Photovoltaic (CPV) / Photovoltaic (PV) Plant (PV 3) on the Farm Droogfontein in Kimberley, Northern Cape Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Moddershaft Underground to Overhead Cable Replacement of an 11kV Power Line from Moddershaft Substation to a Minisub near Anzac, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 11kV Underground Power Cable from Civic Centre to Zola Substation, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Substation on Portion 265 Randjesfontein 405-JR, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Mathibestad Danhauser 33kV Power Line Network, North West Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Mathibestad-Danhauser Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Mothutlung North Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Mothutlung South Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Nonyane Madidi North Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Nonyane Swartdam Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Rebuild of a Section of the Existing 33kV Pelly Klipdrift Network, Gauteng and North West Provinces	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Zonderwater Kraal Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Hammanskraal Lusthof Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*

Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Klipgat Circle Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of Sections of the Existing 33kV Erasmus Aviva Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 11kV Underground Power Cable at the Ga-Rankuwa Substation, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Mamatwan Manganese Mine, Northern Cape Province	*Groundwater Consulting Services (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Dwarsrug Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Manzimtoti Sewer Line Project, Kwa-Zulu Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Surface Water Assessment for the Compensation Flats Development, Kwa-Zulu Natal Province	*Tongaat Hulett*	*Wetland specialist*
Surface Water Assessment for the Tinley Manor South Road Development, Kwa-Zulu Natal Province	*Tongaat Hulett*	*Wetland specialist*
Surface Water Assessment for the Ntuzuma Sewer Line Project, Kwa-Zulu Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Surface Water Assessment for the Esphiva Sewer Line Project, Kwa-Zulu Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Frankfort 132kV Power Line Wetland Walk-down Assessment, Free State Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Esphiva Water Pipeline near Ulundi, KwaZulu-Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Surface Water Assessment for the Grootvlei Power Station, Mpumalanga Province	*Eskom Generation*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Embangweni and Bhekabantu Irrigation Schemes, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Nondabuya and Khwehle Primary Agriculture Schemes, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Expansion of the Makhathini Irrigation Scheme, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Mbaliyezwe Irrigation Schemes, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Mixed Use Development on the Remainder of Portion 27 of the Farm Middelburg Town and Townlands 287 JS, Steve Tshwete Local Municipality in the Mpumalanga Province	*Steve Tshwete Local Municipality*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of Two Power Lines and Two	*Mainstream Renewable Power South Africa*	*Wetland specialist*

Substations for the Mainstream Wind Facilities near Beaufort West, Western Cape Province		
Surface Water Assessment for the Proposed eThekwini Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province	*Nako Iliso*	*Wetland specialist*
Surface Water Assessment for the Proposed Coal Railway Siding at the Welbedacht Marshalling Yard and associated Milder Road Upgrade near Springs, Gauteng Province	*Canyon Coal*	*Wetland specialist*
Surface Water Assessment for the Proposed Development of a 22kV Medium Voltage Power Line in Mofofutso, North West Province	*Eskom Distribution*	*Wetland specialist*
Wetland Walk-down Assessment for the Mookodi Integration Power Line Project, North West Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Coal Loading Facility within the existing Bronkhorstspruit Railway Siding near Bronkhorstspruit, Gauteng Province	*Canyon Coal*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Two 75MW Tlisitseng Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Two 75MW Sendawo Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Sendawo Solar Substation and associated 400kV Power Line near Lichtenburg, North West Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Helena 1, 2 & 3 Photovoltaic Energy Facilities near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 70MW Photovoltaic Facility and 132kV Power Line near Loeriesfontein, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Expansion of the Tissue Manufacturing Capacity at the Kliprivier Operations Base, Gauteng Province	*Twinsaver Group*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Eureka West 140MW Wind Farm near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Eureka East 140MW Wind Farm near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Eureka 132kV Power Line near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*

Surface Water Assessment for the Proposed Construction of the Aletta 140MW Wind Farm near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Ithemba Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Harte Beeste Leegte Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Gras Koppies Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Xha! Boom Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the 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	*Shangoni Management Services (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Linking Station, Power Lines and Substations for the Mainstream Wind Energy Facilities near Beaufort West, Western Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction 132kV Power Lines and a Substation for Tsakane Ext 10 and 22, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Harte Beeste Leegte Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Ithemba Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Gras Koppies Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Xha! Boom Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 140MW Wind Farm and Associated Infrastructure near Hutchison, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Maintenance of the Water Pipeline in Parys, Ngwathe Local Municipality, Free State Province	*Gedezar Consulting*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Rietkuil Coal Railway Siding near Bronkhorstspruit, Gauteng Province	*Canyon Coal*	*Wetland specialist*

Surface Water Assessment for the Proposed Construction of a 75MW Solar Photovoltaic Power Plant near Dennilton, Limpopo Province	*Nokukhanya Energy (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 9.9 MW Solar Photovoltaic (PV) Energy Facility on the Farm Wildebeestkuil near Leeudoringstad, North West Province	*Leeudoringstad Solar Plant (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the 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	*Leeudoringstad Solar Plant (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the De Wildt Solar Photovoltaic Power Plant, Gauteng Province	*SunEdison*	*Wetland specialist*

Wetland and Riparian Rehabilitation Plans

Project Name & Location	***Client Name***	***Role***
Wetland and River Rehabilitation Plan for the Fourways 22kV Feeder Cable, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Wetland and Riparian Rehabilitation Plan for the Proposed eThekwini Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province	*eThekwini Metropolitan Municipality*	*Wetland specialist*
Wetland Rehabilitation Plan for the Delmas Pedestrian Bridge, Mpumalanga Province	*Canyon Coal*	*Wetland specialist*
Wetland Remediation Plan for the Graspan Colliery Extension on the Remaining Extent of Portion 31 on the Farm Elandspruit 291 JS, Mpumalanga Province	*GiBB*	*Wetland specialist*

Wetland Offset Plans

Project Name & Location	***Client Name***	***Role***
Wetland Offset Plan for the Proposed Construction of the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Wetland specialist*

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	Service infrastructure	Land use relating to the provision of all necessary utility services such as communication, municipal waste handling facilities and associated transfer pipeline infrastructure for fuels and water.
	Sub-Sector	Above-ground communication/power (electricity) infrastructure	Above-ground infrastructure designed for the transfer of power (electricity cables) or data (telephone lines).

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	N/A	N/A	
	2. Alteration of patterns of flows (increased flood peaks)	VL	VL	
	3. Increase in sediment inputs & turbidity	H	M	Ephemeral watercourses typically high in sedimenation due to the natural climate. A level of increased sedimentation can be expected due to excavations for pylon structures.
	4. Increased nutrient inputs	N/A	N/A	
	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)	L	VL	No alteration of acidity expected.
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	N/A	N/A	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	
hase	1. Alteration to flow volumes	M	VL	No contribution or reduction to flow volumes expected in terms of the power line development.
	2. Alteration of patterns of flows (increased flood peaks)	VL	VL	
	3. Increase in sediment inputs & turbidity	VL	VL	
	4. Increased nutrient inputs	VL	VL	

Operational Phase	5. Inputs of toxic organic contaminants	M	VL	No toxic organic contaminants expected.
	6. Inputs of toxic heavy metal contaminants	L	VL	No inputs of toxic heavy metal contaminants expected.
	7. Alteration of acidity (pH)	VL	VL	
	8. Increased inputs of salts (salinization)	VL	VL	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	

Desktop buffer requirement (m)	25

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		Site-Based Risk Class	Justification for increasing the sensitivity to cater for any important biodiversity elements including special habitats and species of conservation concern.
		Water Resource	Biodiversity		
Construction Phase	1. Alteration to flow volumes	M		N/A	
	2. Alteration of patterns of flows (increased flood peaks)	M		VL	
	3. Increase in sediment inputs & turbidity	M		M	
	4. Increased nutrient inputs	M		N/A	
	5. Inputs of toxic organic contaminants	M		VL	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	L		VL	
	8. Increased inputs of salts (salinization)	L		N/A	
	9. Change (elevation) of water temperature	L		N/A	
	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		VL	
	3. Increase in sediment inputs & turbidity	M		VL	
	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		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	**15**	**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	N/A			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	M	Excavation to take place oustide of the rainy season (between Feburary and April). Use of bunding for stockpiles. Limited vegetatino clearance.	L	Limiting sedimentation potenital from the surrounding landscape during construction somewhat.
	4. Increased nutrient inputs	N/A			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	N/A			
	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)	VL			
	3. Increase in sediment inputs & turbidity	VL			
	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)	VL			
	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 pylons in 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?	N/A	
Have operational-phase monitoring requirements been defined?	N/A	

Reference: Macfarlane, D.M. Bredin, I.P. Adams, J.B., M.M. Zungu, O'Brien, G.C., Bate, G.C. and Dickens, C.W.S. 2014. Buffer zone tool for the determination of aquatic impact buffers and additional setback requirements for river ecosystems. Version 1.0. Prepared for the Water Research Commission, Pretoria.

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

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

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 wetland boundary?	Site-based delineation	Wetland type	Depression

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

Present Ecological State	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.
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	Service infrastructure	Land use relating to the provision of all necessary utility services such as communication, municipal waste handling facilities and associated transfer pipeline infrastructure for fuels and water.
	Sub-Sector	Above-ground communication/power (electricity) infrastructure	Above-ground infrastructure designed for the transfer of power (electricity cables) or data (telephone lines).

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	N/A	N/A	
	2. Alteration of patterns of flows (increased flood peaks)	VL	VL	
	3. Increase in sediment inputs & turbidity	H	M	Ephemeral wetlands typically high in sedimenation due to the natural climate. A level of increased sedimentation can be expected due to excavations for pylon structures.
	4. Increased nutrient inputs	N/A	N/A	
	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)	L	VL	No alteration of acidity expected.
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	N/A	N/A	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	
Phase	1. Alteration to flow volumes	M	VL	No contribution or reduction to flow volumes expected in terms of the power line development.
	2. Alteration of patterns of flows (increased flood peaks)	VL	VL	
	3. Increase in sediment inputs & turbidity	VL	VL	
	4. Increased nutrient inputs	VL	VL	

Operational Phase	5. Inputs of toxic organic contaminants	M	VL	No toxic organic contaminants expected.
	6. Inputs of toxic heavy metal contaminants	L	VL	No inputs of toxic heavy metal contaminants expected.
	7. Alteration of acidity (pH)	VL	VL	
	8. Increased inputs of salts (salinization)	VL	VL	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	

Desktop buffer requirement (m)	25

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

Overall size	Size of the wetland relative to (as a percentage of) its catchment	Average slope of the wetland's catchment	The inherent runoff potential of the soil in the wetland's catchment	The extent to which the wetland (HGM) setting is generally characterized by sub-surface water input
0.5-5 ha	Small (<2%)	<3%	Moderately high	Intermediate (The remaining HGM types)
Perimeter to area ratio	**Vulnerability of the HGM type to sediment accumulation**	**Vulnerability of the site to erosion given the site's slope and size**	**Extent of open water, particularly water that is naturally clear**	**Sensitivity of the vegetation to burial under sediment**
Low (<500 m per ha)	Depression – endorheic, Flat	Low (Vulnerability score <2)	Very low (<0.5%)	High (e.g. short growing & slow colonizing)
Peat versus mineral soils	**Inherent level of nutrients in the landscape: is the wetland and its catchment underlain by sandstone?**	**Sensitivity of the vegetation to increased availability of nutrients**	**Sensitivity of the vegetation to toxic inputs, changes in acidity & salinization**	**Natural wetness regimes**
Mineral	Yes	High (e.g. short and/or sparse vegetation cover with high natural diversity)	Low (e.g. low natural diversity)	Dominated by temporarily saturated soils
Natural salinity levels	**Level of domestic use**	**Mean Annual Temperature**	Note: See the guideline document for further information on the rationale for indicator selection and how these attributes affect the sensitivity of wetlands to lateral inputs.	
Naturally saline systems	Low	Zone 5 (19.5 - 24.2 Deg C)		

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		N/A	
	2. Alteration of patterns of flows (increased flood peaks)	M		VL	
	3. Increase in sediment inputs & turbidity	M		L	
	4. Increased nutrient inputs	M		N/A	
	5. Inputs of toxic organic contaminants	M		VL	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	M		VL	
	8. Increased inputs of salts (salinization)	L		N/A	
	9. Change (elevation) of water temperature	L		N/A	
	10. Pathogen inputs (i.e. disease-causing organisms)	L		VL	
Operational Phase	1. Alteration to flow volumes	M		VL	
	2. Alteration of patterns of flows (increased flood peaks)	M		VL	
	3. Increase in sediment inputs & turbidity	M		VL	
	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)	M		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)	L		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	Very Gentle (0 - 2%)			
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	Uniform topography: Smooth topography with no concentrated flow paths anticipated.			
Site-based aquatic impact buffer requirements (without additional mitigation measures)				
Construction Phase	**15**	**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	N/A			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	M	Excavation to take place oustide of the rainy season (between Feburary and April). Use of bunding for stockpiles. Limited vegetatino clearance. No pylons in the wetlands	L	Limiting sedimentation potenital from the surrounding landscape during construction somewhat.
	4. Increased nutrient inputs	N/A			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	N/A			
	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)	VL			
	3. Increase in sediment inputs & turbidity	VL			
	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)	VL			
	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?		
Have additional mitigation measures been identified to cater for potential groundwater impacts?		

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
Has the wetland boundary 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?	Y	
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	

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 pylons in the wetlands.
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?	N/A	

Have operational-phase monitoring requirements been defined?	N/A	

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Established 1952

Savannah Environmental Pty Ltd
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Woodmead

Your reference: SE2206 Aggeneys 2
Our reference: Aggeneys 2 Review
Date: 23rd April 2019

ATTENTION: THALITA KOSTER

By Email

RE: PEER REVIEW OF THE FRESHWATER REPORT FOR THE GRID CONNECTION INFRASTRUCTURE FOR THE AGGENEYS PV2 SOLAR PHOTOVOLTAIC FACILITY.

Having reviewed the above report I find that it provides a description of the project and the freshwater environment within which the project will unfold. It also provides an indication of the biophysical impacts on freshwater resources that are likely to arise as a result of the proposed project and suggests appropriate optimisation and mitigation measure. The review was concluded on 23rd of April, 2019 and the following comments are made.

1. The terms of reference are acceptable;
2. The methodology is clearly explained and acceptable;
3. The findings are based on acceptable evidence;
4. The mitigation measures and recommendations are appropriate;
5. No apparent shortcomings are identified;
6. The reference literature is appropriate;
7. No site-inspection was carried out as part of this peer review;
8. The report is well-written and easy to understand.

It can be concluded in considering the freshwater report that the process and assessment followed was adequate, providing a fair indication of the impacts likely to arise as a result of the project. Attached is a schedule, in accordance with Appendix 6 of the National Environmental Management Act, 1998 (ACT NO.

107 OF 1998). Environmental Impact Assessment Regulations, 2014, indicating the level of compliance of the report in respect of this regulation.

DECLARATION OF INDEPENDENCE

I, Stephen Burton, as authorised representative of SiVEST SA Pty Ltd hereby confirm my independence as a specialist and declare that neither I nor SiVEST SA have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which SiVEST SA was appointed as freshwater impact assessment specialists in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed. This declaration is specifically in connection with the review of the Freshwater Report for the Proposed Grid Connection Infrastructure for the Aggeneys 2 Solar Photovoltaic Facility.

Should you have any queries please do not hesitate to contact the undersigned on telephone (033) 347-1600 or alternatively, (083) 795-2804.

Yours faithfully

Stephen Burton (Pr. Sci. Nat.)
Environmental Scientist, Faunal & Wetland Specialist
SiVEST Environmental Division

Aggeneys PV2 Grid Infrastructure -Freshwater Report	
Appendix 6: Specialist reports	**Check**
A specialist report prepared in terms of these Regulations must contain-	
(a) details of-	
(i) the specialist who prepared the report; and	Page iii - vi & Appendix A
(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page iii - vi & Appendix A
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii & iii
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1: Page 1
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5: Page 27
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 3: Pages 8 - 21
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 5: Pages 27 -41
(g) an identification of any areas to be avoided, including buffers;	Section 5.9: Page 41 Appendix B
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 5.1: Page 28
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.11: Page 20
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Section 7 & 8: Pages 43 - 51
(k) any mitigation measures for inclusion in the EMPr;	Section 8: Pages 45 - 51
(I) any conditions for inclusion in the environmental authorisation;	Sections 9: Page 54
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8: Pages 45 - 51
(n) a reasoned opinion-	
(i) as to whether the proposed activity or portions thereof should be authorised; and	Section 9
(ii)if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 9
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q) any other information requested by the competent authority.	N/A