LUCKHOFF SOLAR 2 PHOTOVOLTAIC SOLAR ENERGY FACILITY NEAR LUCKHOFF, FREE STATE PROVINCE

AQUATIC ECOLOGICAL ASSESSMENT

FOR

Luckhoff Solar 2 (Pty) Ltd

BY

EnviroSci (Pty) Ltd

Dr Brian Colloty

1 Rossini Road
Pari Park
Gqeberha
6070

DATE

19 December 2022

REVISION 1

EXECUTIVE SUMMARY

The applicant **Luckhoff Solar 2** (Pty) Ltd is proposing the development of a commercial Solar Photovoltaic (PV) Energy Facility and associated infrastructure on a site located North of Luckhoff, in the Free State Province. The findings of this assessment was supported by baseline data collected in a two day site visit conducted November 2022, early summer after decent rainfall.

The regulatory requirements are also discussed with regard the National Water Act and NEMA in Section 3 of this report. While the PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to. This report thus meets the criteria to fulfil a Specialist Verification Assessment Report as the proposed site is located within an area rated as ***LOW*** sensitivity by the DFFE Screening Tool (See Screening Verification Statement – Appendix 2).

The study area is situated predominantly within the Northern Upper Karoo (NKu 3) vegetation unit, associated with the upper reaches of the Lemoenspruit River catchment (D33C), a small subquaternary catchment linked to the Orange / Gariep River

The area is characterised by low lying areas surrounded by inselbergs (koppies). No known or observed watercourses occur within the study area, and only two small depressions were encountered and delineated in this assessment. One of these is located within the proposed PV area and will need to be avoided in the final design process. This pan can also not be used for any stormwater management purposes as this will alter the hydrological function of the system, which would then in turn created permanently wetland aquatic habitat and would then in turn attract birds and animals into the area.

Current waterbody inventories (van Deventer *et al*., 2020), 1: 50 000 topocadastral surveys mapping indicated a general lack of any wetlands within the greater study region. These inventories include wetland spatial data based on landcover 2007 data, previous assessments and wetland information retained by the Provincial authorities, combined into one database that formed part of the updated National Spatial Biodiversity Assessment, 2018. The only wetland hydrogeomorphic unit or type observed in the greater region included small pans or depressions (endorheic), which then correspond to those observed in this site.

Thus a baseline map was then developed and refined using the 2022 survey data, noting that due to the complex nature of the topography and geology, the features were digitised at a scale of 1:5 000. Coupled to the aquatic delineations, information was collected on potential species that could occur within the watercourses, especially any conservation worthy species (Listed or Protected). A detailed account of the potential species and observed species will form part of latter reporting once project development proceeds. However the site was not categorised or listed as follows in the various National Spatial Databases (SNABI, 2018):

- Listed Threatened Ecosystem
- Strategic Water Resource Area
- Wetland Cluster
- NFEPA, although the study area is listed an Upstream FEPA.

Using the baseline description and preliminary field data, while considering the current disturbances and site characteristics, the following features were identified, then categorised into one of number pre-determined sensitivity categories to provide protect and/or guide the layout planning and possibly the design processes. The sensitivity ratings of High (No-Go) to Low were determined through an assessment of the habitat sensitivity and related constraints. However, these No-Go areas (with buffers) relate in general terms to the project and there are areas where encroachment on these areas would occur (i.e. existing road crossings within systems) and is considered acceptable since these areas have already been impacted.

These proposed constraints / buffers do not include bird constraints as theirs buffers along aquatic features are at times far larger around aquatic features, than those required for the known aquatic species within this region.

Results of the sensitivity rating / constraints assessment

Map Key	Sensitivity Rationale	Buffer	Development Constraints and override exceptions
High = No Go	"No go" areas or setbacks and areas or features that are considered of such significance that impacting them may be regarded as fatal flaw or strongly influence the project impact significance profile Therefore areas or features that are considered to have a high sensitivity or where project infrastructure would be highly constrained and should be avoided as far as possible. Infrastructure located in these areas are likely to drive up impact significance ratings and mitigations	85m	No buildings or structures (e.g. PV Panel Areas, Substations, O/M Buildings or temporary laydown areas should be placed within these zones.
Medium	Areas that are deemed to be of medium sensitivity but should still be avoided as this would minimise impacts and or the need for additional Water Use Authorisation in the case of any aquatic features	15m to aid delineation accuracy and prevent bank instability	No buildings or structures (e.g. PV Panel Areas, Substations, O/M Buildings or temporary laydown areas should be placed within these zones. Access roads and grid connection can span these areas, but preferably where existing impacts already occur
Low	Areas of low sensitivity or constraints such as artificial systems with little to no biological value or would not result in any future licensing requirements e.g. dry earth wall farm dams. While from a terrestrial perspective the vegetation or habitat is ubiquitous within the greater region or has seem some form of disturbance.	N/A	N/A
Neutral	Unconstrained areas (left blank in mapping) from aquatic perspective	N/A	N/A

In summary, structures such as PV Panel Areas, buildings, substations and Battery Energy Storage System (BESS), should be placed outside of the High Sensitivity habitats, while remaining structures (roads and transmission lines) could cross or span the Moderate / Low Sensitivity areas. Noting that Low Sensitivity can also = Moderate areas but with existing impacts e.g., current roads, farm tracks of previously disturbed areas but these must be confirmed during the remainder of the assessment phases for areas such as roads or grid access routes

In conclusion, most of the anticipated impacts would include disturbance during the construction phase, while changes to form and function of the site due to increased runoff roads or hard surfaces that would occur in the operational and maintenance (O&M) phase. Based then on this assumption the following impacts were assessed

- Impact 1: Loss of habitat containing protected species or Species of Special Concern
- Impact 2: Loss of any critical corridors and connect habitats that are linked to any future conservation plans or protected areas expansion associated within any riverine or wetland systems
- Impact 3: The potential spread of alien vegetation
- Impact 4: Loss of riparian and or wetland habitat
- Impact 5: Changes to the hydrological regime and increased potential for erosion
- Impact 6: Changes to water quality
- Impact 7: Cumulative Impacts

In summary, the impacts upon aquatic biodiversity associated with the project are of Low significance, after mitigation. The loss of irreplaceable aquatic habitat and/or important biota is highly unlikely. The impacts are considered to be easily mitigated (provided the mitigation measures and monitoring plan within the EMP and this report are implemented and adhered to during all phases of the project).

During the EIA phase, the final impact ratings will be revised based on the layouts that will be developed, and any conflicts will be pointed out to the developer. This may be coupled to additional site visits, but it is not foreseen at this point.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTO PLATES

ACRONYMS

BESS	Battery Energy Storage System
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry, Fisheries and Environment
DWAF	Department of Water Affairs and Forestry, now DWS
DWS	Department of Water and Sanitation formerly the Department of Water Affairs (DWA)
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Plan/Programme Report
ESA	Ecological Support Area
GA	General Authorisation (WUA type)
GIS	Geographic Information System
HGM	Hydrogeomorphic
IHI	Integrated Habitat Index
IUCN	International Union of Conservation of Nature
NAEMP	National Aquatic Ecological Monitoring Program
NEMA	National Environmental Management Act (Act No. 107 of 1998).
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel *et al.*, 2011).
NWA	National Water Act (Act 36 of 1998)
NWCS	National Wetland Classification System
O&M	Operations and Maintenance
OHL	Overhead Line – transmission line cable that is not buried
ORC	Off Road Cable – underground or overhead transmission cable not within a road reserve
PES	Present Ecological State
RTU	Recognisable Taxonomic Unit
SANBI	South African National Biodiversity Institute
SCC	Species of Special Concern
SQ	Subquaternary Catchment
ToR	Terms of Reference
WRC	Water Research Commission
WUA	Water Use Authorisation
WUL	Water Use License
WULA	Water Use License Application

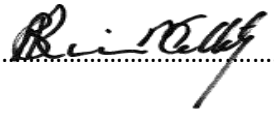
SPECIALIST REPORTP DETAILS

This report has been prepared as per the requirements of the Environmental Impact Assessment Regulations and the National Environmental Management Act (Act No. 107 of 1998), any subsequent amendments and any relevant National and / or Provincial Policies related to biodiversity assessments. This also includes the minimum requirements as stipulated in the National Water Act (Act No. 36 of 1998), as amended in Water Use Licence Application and Appeals Regulations, 2017 Government Notice R267 in Government Gazette 40713 dated 24 March 2017, which includes the minimum requirements for a Wetland Delineation/ Aquatic Report.

Report prepared by: Dr. Brian Colloty Pr.Sci.Nat. (Ecology) / Member SAEIES and Wetland Society of South Africa.

Expertise / Field of Study: BSc (Hons) Zoology, MSc Botany (Rivers), PhD Botany Conservation Importance rating, and has worked as an independent consulting specialist from 1996 to present.

I, **Dr. Brian Michael Colloty** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs and or the Department of Water and Sanitation.

Signed:…  Date:…19 December 2022……

National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	This section
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Attached to EIA
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 3
(cA) an indication of the quality and age of base data used for the specialist report;	Section 6
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6 -9
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6-9
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 8
(g) an identification of any areas to be avoided, including buffers;	Section 8
(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;	Section 8
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1
(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 or activities;	Section 9 and 10
(k) any mitigation measures for inclusion in the EMPr;	Section 9
(l) any conditions for inclusion in the environmental authorisation;	Section 9 and 10
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9 and 10
(n) a reasoned opinion— i. whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 9 and 10

(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**N/A** -No feedback has yet been received from the public participation process regarding the visual environment
(p) any other information requested by the competent authority	**N/A**. No information regarding the visual study has been requested from the competent authority to date.
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	This report in response to the Aquatic Biodiversity Protocol

1 Introduction

The applicant **Luckhoff Solar 2** (Pty) Ltd is proposing the development of a commercial Solar Photovoltaic (PV) Energy Facility associated infrastructure on a site located North of Luckhoff, in the Free State Province. The findings of this assessment was supported by baseline data collected in a two day site visit conducted November 2022, early summer after decent rainfall.

The regulatory requirements are also discussed with regard the National Water Act and NEMA in Section 3 of this report. While the PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to. This report thus meets the criteria to fulfil a Specialist Verification Assessment Report as the proposed site is located within an area rated as ***LOW*** sensitivity by the DFFE Screening Tool (See Screening Verification Statement – Appendix 2).

The study area is situated predominantly within the Northern Upper Karoo (NKu 3) vegetation unit, associated with the upper reaches of the Lemoenspruit River catchment (D33C), a small subquaternary catchment linked to the Orange / Gariep River

The area is characterised by low lying areas surrounded by inselbergs (koppies). No known or observed watercourses occur within the study area, and only two small depression was encountered and delineated in this assessment

Several important national spatial tools were considered, with the results of those studies, where relevant, being included in this report. Most of these plans are produced at a high level, so it is important to verify or groundtruth the actual status of the study area. Groundtruthing of aquatic habitats in the project area is critical for the identification and mapping of important habitat, which is known to contain protected or endangered species within the region.

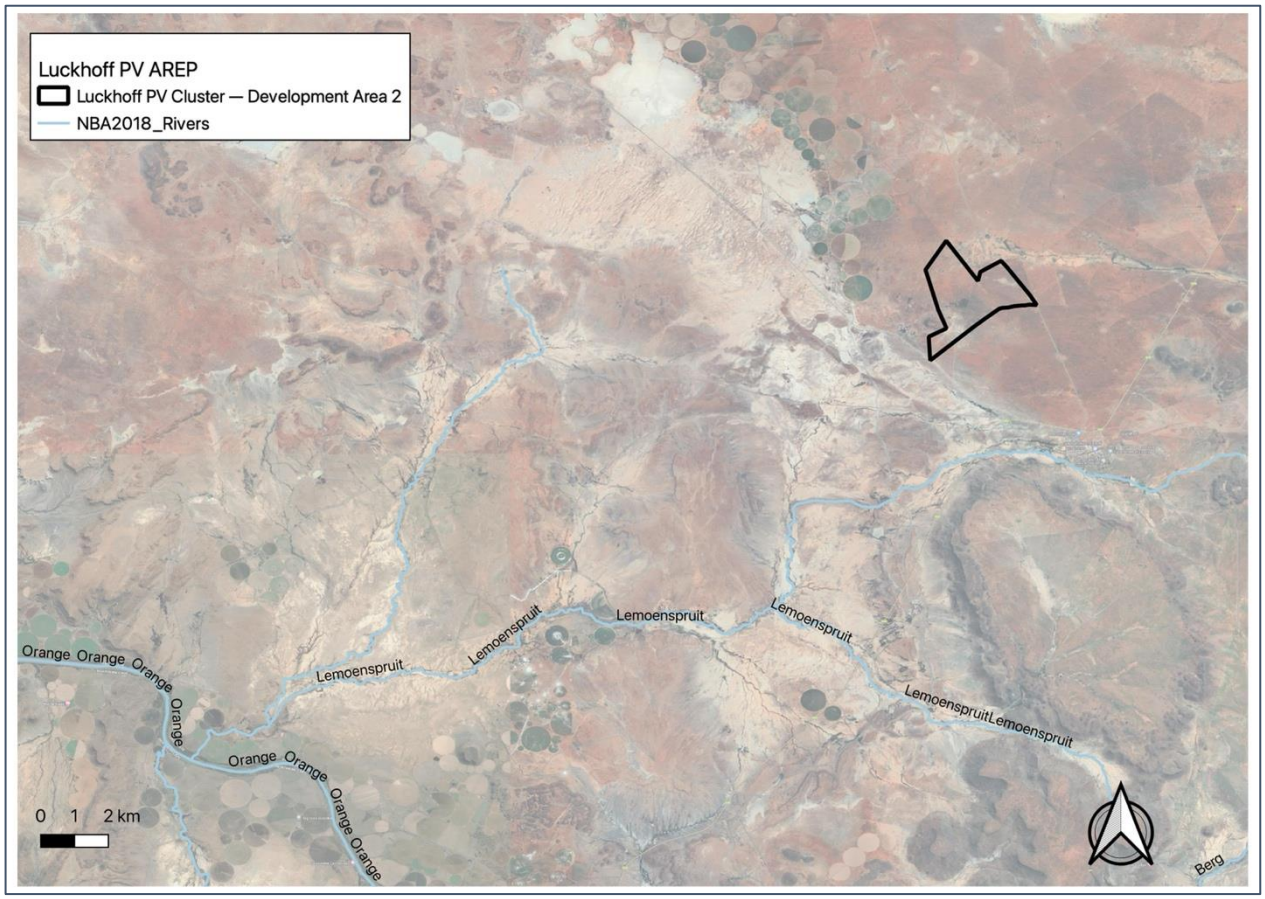


Figure 1: The study area in relation to the surrounding environment near Luckhoff

1.1 Aims and objectives

The aim of this report is to provide a summary of the preliminary aquatic baseline information and identify any No-Go areas for the proposed development. The report also makes recommendations for further management and mitigation, to further reduce, avoid or mitigate the potential negative impacts and enhance positive impacts. The implementation of these management actions and mitigation measures will ensure the responsible and sustainable use of South Africa's natural resources.

Based on the information supplied, coupled with technical constraints, the layout will then be selected for further in-depth assessment during the Environmental Authorisation (EA) process, following the required NEMA Biodiversity Assessment Protocols, where required.

Certain aspects of the proposed development will trigger the need for Section 21, Water Use License Applications (WULAs) (or General Authorisation [GA] applications) such as river crossings or any activities within 500 m of a wetland. Once the final layout receives an EA, these applications must then be submitted to the Department of Water and Sanitation (DWS).

Preliminary information regarding the state and function of the observed water bodies, including suitable No-Go buffer areas, are provided.

1.2 Assumptions and limitations

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of communities within study sites, as well as the status of endemic, rare or threatened species in any study area, assessments should consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints these long-term studies are not feasible, and assessments are mostly based on instantaneous sampling. This limitation is common to many impact assessment type studies, but the findings are deemed adequate for the purposes of decision-making support regarding project acceptability in this phase of the project, unless otherwise stated.

Due to the scope of the work presented in this report, a long-term investigation of the proposed study sites was not possible and as such not perceived as part of the Terms of Reference (ToR) for assessment. However, a concerted effort was made to assess as much of the potential sites, as well as make use of available supporting literature, species distribution data and aerial photography.

Information presented in this report only has reference to the study area as indicated in the accompanying maps and cannot be applied to any other area without detailed investigation.

2 Project Description

The key components of the proposed project are described below:

- PV Panel Array - To produce up to 240MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun or using one-axis tracker structures to follow the sun to increase the Yield.

- Wiring to Inverters - Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.

- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required to step the voltage up to 132kV, after which the power will be evacuated into the national grid. Whilst Luckhoff 2 Solar Power Plant has not yet received a cost estimate letter from Eskom, it is expected that generation from the facility will tie in with the proposed Luckhoff Grid Connection 132kV Overhead Power Line. The Project will inject up to 240MW into the National Grid. The installed capacity will be approximately 240MW.

  In order to evacuate the energy generated by the facilities to the national grid, Luckhoff Solar 2 (Pty) Ltd is proposing to develop a grid connection which consists of the following Electrical Grid Infrastructure (EGI); 132kV single/double-circuit overhead power line (with the associated

infrastructure) to enable the connection and evacuation of the generated electricity of the proposed Luckhoff Solar 1, 2, 3 and 4 Photovoltaic Solar Energy Facilities, to the national grid network:

1. A collector switching station (up to 132kV);
2. A ~2.5 km 132 kV single/double circuit overhead powerline linking the collector switching station to the proposed Luckhoff Main Transmission Substation (MTS)(see below);
3. A new 132 kV / 400 kV MTS; and
4. Three 400kV Loop-in-Loop Out power lines from the existing Eskom powerlines (Hydra/Perseus 2, Hydra/Perseus 3 and Beta/Hydra 1) to the MTS.

-

- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible.

- Supporting Infrastructure – The following auxiliary buildings with basic services including water and electricity will be required on site:

    - A 33 kV switch room,
    - A gate house, ablutions, workshops, storage and warehousing areas, site offices and a control centre.

- Battery storage – A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure.

- Roads - Access will be obtained via the S572 secondary road, off the R48 regional road, an existing gravel road located adjacent to the site. An internal site road network will also be required to provide access to the solar field and associated infrastructure.

1.

- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 3.5 meters will be used.

3 Terms of Reference

The methodology used in this assessment was developed with the renewable industry in mind, coupled with the minimum requirements stipulated by DFFE and the DWS. The methodology has been successful in assessing the direct, indirect and cumulative impacts of 185 proposed renewable energy projects between 2010 and 2022, of which 20 projects have been constructed:

Site sensitivity screening / Scoping report (this report)

The ToR prescribed that the surface water and aquatic biodiversity site sensitivity screening study included the following:

- Desktop analysis
- Site investigation
- Compilation of one draft and one final report for the proposed project which adheres to, but is not limited to, the following:

- Initial Site Sensitivity Verification reporting requirements for environmental themes set out in Government Gazette No. 43110 which was promulgated on 20 March 2020 in terms of section 24(5)(a) and (h) of the NEMA, Act No. 107 of 1998
- Identification and mapping of any discrepancies with the environmental sensitivity as identified on the national web based environmental screening tool.
- Identification of sensitive areas to be avoided (including corresponding spatial data) and the determination of the respective buffers (if applicable) for each of the proposed development sites.
- Recommendations for the layout and allowable development footprint from a surface water and aquatic biodiversity perspective (including corresponding spatial data).
- Provide a list of potentially significant environmental impacts that may arise in the construction, operation and decommissioning phases of the project, including cumulative impacts;
- A detailed impact assessment of each impact including:
  A pre-mitigation and post-mitigation impact assessment
  A list of essential mitigation measures and management interventions;
- A summary table of all the impacts must be included and must show the post-mitigation significance ratings.
- Recommendations regarding the areas to be utilised for solar technologies within the proposed project development sites from a biodiversity perspective (including corresponding spatial data).

4 Relevant legislation, policy and permit requirements

The following is pertinent to this study:

- Section 24 of The Constitution of the Republic of South Africa (1996);
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) (1998);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act (NEM: BA);
- National Water Act, 1998 (NWA, Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (CARA, Act No. 43 of 1983);
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);
- National Forest Act (Act No. 84 of 1998); and
- National Heritage Resources Act (Act No. 25 of 1999) – could apply if cultural use or heritage is linked to any aquatic resources.

NEMA and the CARA identify and categorise invasive plants together with associated obligations on the landowner. Several Category 1 and 2 invasive plants were observed in a number of areas within the sites under investigation.

Based on an assessment of the proposed activities typical of the renewable industry requirements (Table 1) and past engagement with DWS, the following Water Use Authorisations may be required based on the thresholds as listed in the following Government Notices. However ultimately the Department must determine if a GA or full Water Use License Application (WULA) will be required during the pre-application process as it relates to the following, bearing in mind that this will only be conducted once a final project scope is known:

- DWS Notice 538 of 2016, 2 September in GG 40243– Section 21a water uses relating to the abstraction of water.
- Government Notice 509 in GG 40229 of 26 August 2016 – Section 21c and 21i water uses relating to the impediment or diversion of the flow of water in a watercourse and or altering the bed, banks, course or characteristics of a watercourse.
- Government Notice 665, 6 September 2013 in GG 36820 - Section 21g relating to the disposal of waste in a manner that may detrimentally impact on a water source which includes temporary storage of domestic wastewater i.e. conservancy tanks under Section 37 of the notice.

Table 1: Water Use Activities

	Water Use Activity	Applicable to this development proposal
S21(a)	Taking water from a water resource	Yes, if water is abstracted from new and/ or existing boreholes which will also require a change of use from agricultural to industrial. The use of surface water in this region due to the ephemeral nature of the rivers / watercourses is not recommended.
S21(b)	Storing water	Only if water is stored within a instream dam. The use of tanks and or reservoirs is thus advised as these **do not require** a license.
S21(c)	Impeding or diverting the flow of water in a watercourse	If any works (permanent or temporary) are located within a watercourse then a GA process can potentially be followed if the DWS Risk Assessment Matrix indicates that all impacts with mitigation are LOW.
S21(d)	Engaging in a stream flow reduction activity	Not applicable
S21(e)	Engaging in a controlled activity	Not applicable
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Not applicable
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Typically, the conservancy tanks at construction camps and the Operations and Maintenance (O&M) buildings require a license (GA if volumes are less than 10 000 m^3)
S21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Not applicable
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	If any works (permanent or temporary) are located within a watercourse, then a GA process can potentially be followed if the DWS Risk Assessment Matrix indicates that all impacts with mitigation are LOW.
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Not applicable
S21(k)	Using water for recreational purposes	Not applicable

4.1 Wetland and riverine buffer policy

Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane and Bredin (2017) for wetlands, rivers and estuaries was used.

The buffer model is based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of development, as wells as the proposed alteration of hydrological flows. Based on the information known for the proposed development sites, the model provided the following buffers that should extend from the edge of the delineated system in question for each of the project phases as well as an overall or final buffer that is preferred in this assessment:

Minor drainage lines

- Construction period: 15 m
- Operation period: 10 m
- Final: 15 m

Small depressions

- Construction period: 85 m
- Operation period: 70 m
- Final: 85 m

Artificial dams were not buffered.

5 Methodology

This aquatic assessment followed the approaches of several national guidelines with regards to wetland assessment. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study area's aquatic systems, applicable to the specific environment. They were used in a clear and objective manner, to identify and assess the potential impacts associated with the proposed development sites based on information collected within the relevant farm portions.

Current water resource classification systems make use of the Hydrogeomorphic (HGM) approach, and for this reason, the National Wetland Classification System (NWCS) approach was used in this study. It is important to understand the legal definition of a wetland, the means of assessing wetland conservation and importance and the relevant legislation aimed at protecting wetlands. These aspects will be discussed in greater depth in this section of the report, as they form the basis of the study approach to assessing wetland impacts.

For reference the following definitions apply:

- **Drainage line**: Lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may not be present.
- **Perennial and non-perennial:** Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contain flows for short periods, such as a few hours or days in the case of drainage lines.
- **Riparian**: The area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands, for example an area where alluvium is periodically deposited by a stream during floods but which is well drained.
- **Wetland**: Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (NWA, Act No. 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).
- **Water course**: As per the NWA means -

(a) a river or spring;

(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, lake or dam into which, or from which, water flows; and

(d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

5.1.1 Waterbody classification systems

Since the late 1960s, wetland classification systems have undergone a series of international and national revisions. Revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al*., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects. Coupled to this was the inclusion of other

criteria within the classification systems to differentiate between river, riparian and wetland systems, as well as natural versus artificial waterbodies.

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed the newly revised and now accepted NWCS (Ollis *et al*., 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the HGM approach at higher levels, with including structural features at the finer or lower levels of classification (Ollis *et al*., 2013).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is the common driving force, in the formation of wetlands (DWAF, 2005). It is significant that the HGM approach has now been included in the wetland classifications, as this approach has been adopted throughout the water resources management realm with regards to the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. These systems are then easily integrated using the HGM approach in line with the eco-classification process of river and wetland reserve determinations used by the DWS. The Ecological Reserve of a wetland or river is used by DWS to assess the water resource allocations when assessing WULAs.

The NWCS process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are present below:

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State / Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology, and water quality).

Reserve: The quantity and quality of water needed to sustain basic human needs and ecosystems (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The Ecological Reserve pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment or any other activity that qualifies as a water use.

Ecological Water requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an Ecological Water Requirement (EWR) study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the **Reserve Template.**

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions: Geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the Department of Water Affairs and Forestry (DWAF , now DWS) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

5.1.2 Wetland definition

Although NWCS (Ollis *et al*., 2013) was used to classify aquatic habitat types, but it is still necessary to understand the definition of a wetland. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised as the seaward boundary of the shallow photic zone (Lombard *et al.,* 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as they are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (Ollis *et al*., 2013):

Wetland: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the NWA (Act No. 36 of 1998), where wetlands are defined 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 adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a watercourse

(Ollis *et al*., 2013). Table 1 below provides a comparison of the various wetlands included within the main sources of wetland definitions used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the NWA, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (Ollis *et al.*, 2013).

Wetlands must have one or more of the following attributes to meet the above definition (DWAF, 2005):

- A high-water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils.
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines and rivers.

Table 2: Comparison of ecosystems considered to be 'wetlands' as defined by the NWCS, the NWA and ecosystems included in DWAF's delineation manual (2005).

Ecosystem	National Wetland Classification System (NWCS)	National Water Act (NWA)	DWAF (2005) Delineation Manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often described as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES[3]
Riparian [3] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

[1] Although river channels and canals would generally not be regarded as wetlands in terms of the NWA, they are included as a 'watercourse' in terms of the Act.

[2] According to the NWA and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods and would be considered riparian wetlands, as opposed to non–wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

[3] The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's delineation manual (2005).

5.1.3 National Wetland Classification System method

Due to the nature of the wetlands and watercourses observed, it was determined that the newly accepted NWCS should be adopted. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (Ollis *et al*., 2013) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils and vegetation) stemming from the Cowardin approach (Ollis *et al.,* 2013).

The classification system used in this study is thus based on Ollis *et al*. (2013) and is summarised below:

The NWCS has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 2). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular system has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine);
- Biogeographic zones (estuaries); and
- Ecoregions (inland).

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the HGM units discussed earlier. These units are defined as follows:

- Landform – shape and localised setting of wetland;
- Hydrological characteristics – nature of water movement into, through and out of the wetland; and
- Hydrodynamics – the direction and strength of flow through the wetland.

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for inland wetlands.

Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses six descriptors to characterise the wetland types based on biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

- Geology;
- Natural vs. artificial;
- Vegetation cover type;
- Substratum;
- Salinity; and
- Acidity or alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, and these are nested in relation to each other.

The HGM unit (Level 4) is the focal point of the NWCS, with the upper levels (Figure 3 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Levels 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

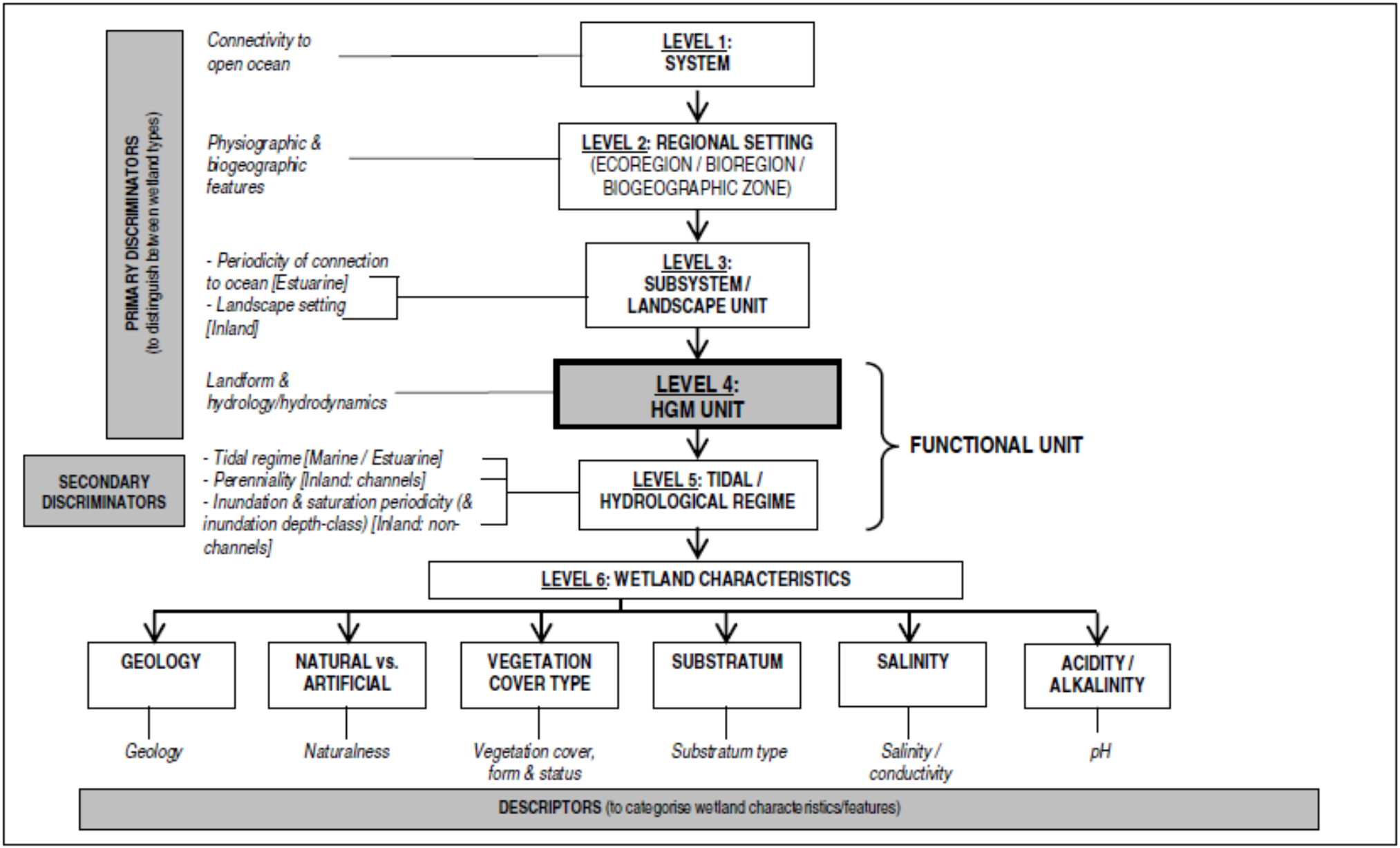


Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied.

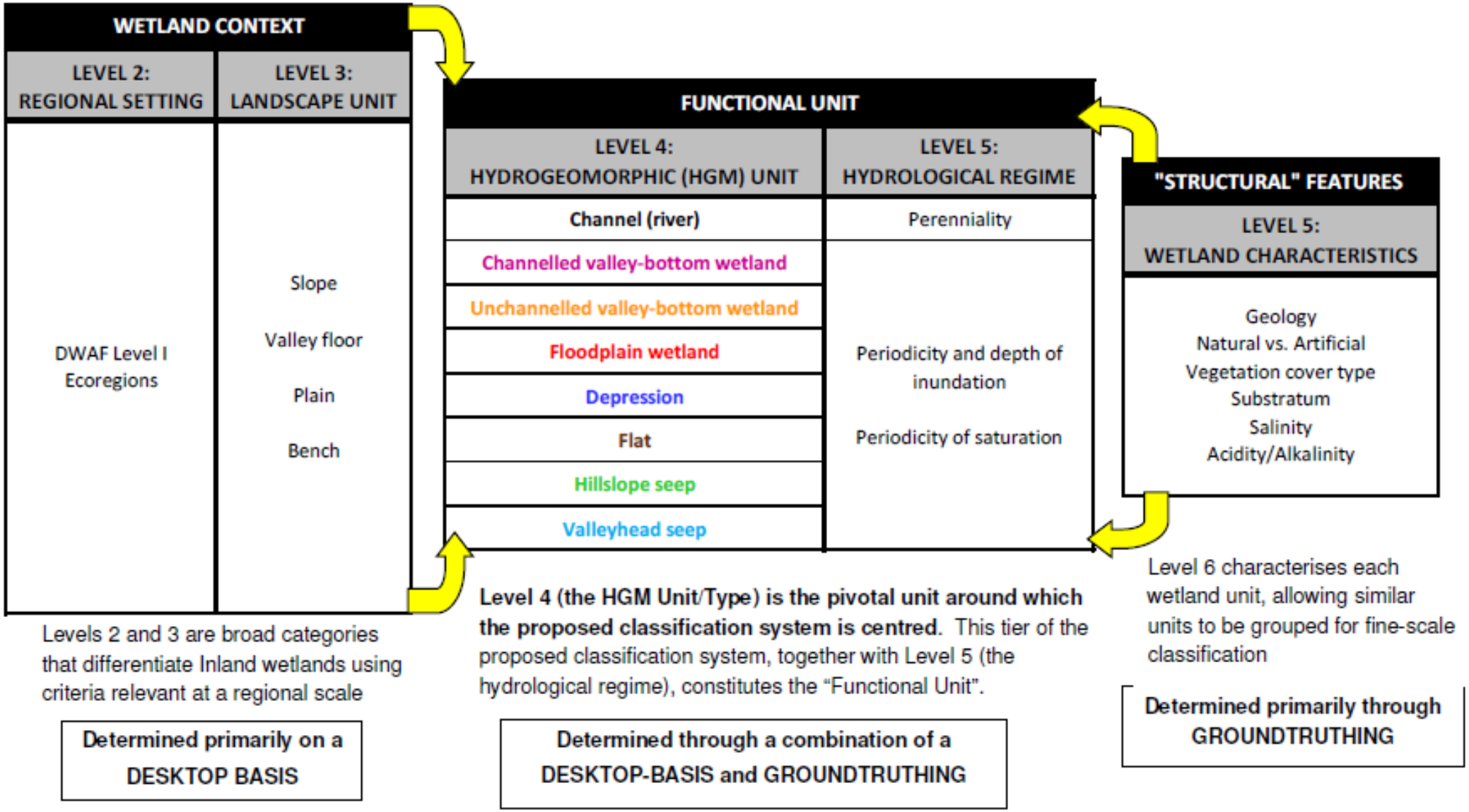


Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (Ollis *et al.*, 2013).

5.1.4 Waterbody condition

To assess the PES or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 3) and provide a score of the PES of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model-based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (Water Research Commission (WRC) 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind and is not always suitable for impact assessments. This coupled with the degraded state of the wetlands in the study area, indicated that a complex study approach was not warranted, i.e. conduct a WET-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 3: Description of A – F ecological categories based on Kleynhans *et al*., 2005.

Ecological Category	Ecological Description	Management Perspective
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
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.	Some human-related disturbance, but mostly of low impact potential
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality
F	Critically / Extremely modified. Modifications have reached a critical level and the 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.	

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human land use activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWA's River EcoStatus models which are currently used for the assessment of PES in riverine environments.

5.1.5 Aquatic ecosystem importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute (SANBI), a requirement under the NEM:BA.

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However, wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.,* 2004).

The most common attributes or goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;
- Trap sediments; and
- Reduce the number of water-borne diseases.

In terms of this study, the wetlands provide ecological (environmental) value to the area acting as refugia for various wetland associated plants, butterflies and birds.

In the past wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 4 below summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al*., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 4: Summary of direct and indirect Ecoservices provided by wetlands from Kotze *et al*., 2008

<table>
<tr><td rowspan="10">Ecosystem services supplied by wetlands</td><td rowspan="8">Indirect benefits</td><td rowspan="7">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>Sediment trapping</td></tr>
<tr><td>Phosphate assimilation</td></tr>
<tr><td>Nitrate assimilation</td></tr>
<tr><td>Toxicant assimilation</td></tr>
<tr><td>Erosion control</td></tr>
<tr><td colspan="2">Carbon storage</td></tr>
<tr><td colspan="3">Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">Provision of water for human use</td></tr>
<tr><td colspan="3">Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">Provision of cultivated foods</td></tr>
<tr><td colspan="3">Cultural significance</td></tr>
<tr><td colspan="3">Tourism and recreation</td></tr>
<tr><td colspan="3">Education and research</td></tr>
</table>

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness;
- Species of conservation concern;
- Habitat fragmentation or rather, continuity or intactness with regards to ecological corridors; and
- Ecosystem service (social and ecological).

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of Conservation Concern (SCC) was observed, in which case it would receive a HIGH rating. Any system that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Natural wetlands or wetlands that resemble some form of the past landscape but receive a LOW conservation importance rating could be included into stormwater management features and should not be developed to retain the function of any ecological corridors.

6 Description of the affected environment

The study area is dominated by three major types of natural aquatic features and a small number of artificial barriers associated with catchments and rivers, characterised as follows:

- Ephemeral watercourses with riparian vegetation that included, *Vachellia karroo*, *Searsia lancea*, *Euclea undulata* and *Gymonsporia buxifolia* (Plate 1);
- Depressions (Plate 2), dominated by grass species and
- Dams and weirs / berms with no wetland or aquatic features.

The study area is situated predominantly within the Northern Upper Karoo (NKu 3) vegetation unit, associated with the upper reaches of the Lemoenspruit River catchment (D33C), a small subquaternary catchment linked to the Orange / Gariep River (Figure 4). This is located within the Orange River Water Management Area (Kimberley), in the Nama Karoo Eco-region.

The area is characterised by low lying areas surrounded by inselbergs (koppies). Two watercourses occur within the study area, and only two small depression was encountered and delineated in this assessment. One of these is located within the proposed PV area and will need to be avoided in the final design process. This pan can also not be used for any stormwater management purposes as this will alter the hydrological function of the system, which would then in turn created permanently wetland aquatic habitat and would then in turn attract birds and animals into the area.

The Department of Environment Fisheries and Forestry (DFFE) identified the aquatic environment for the study area as having a Low Sensitivity, due to the lack of any aquatic features within the site. However the presence of these High, Medium and Low Sensitivity features was confirmed during this assessment (see Appendix 2 for Verification Statement).

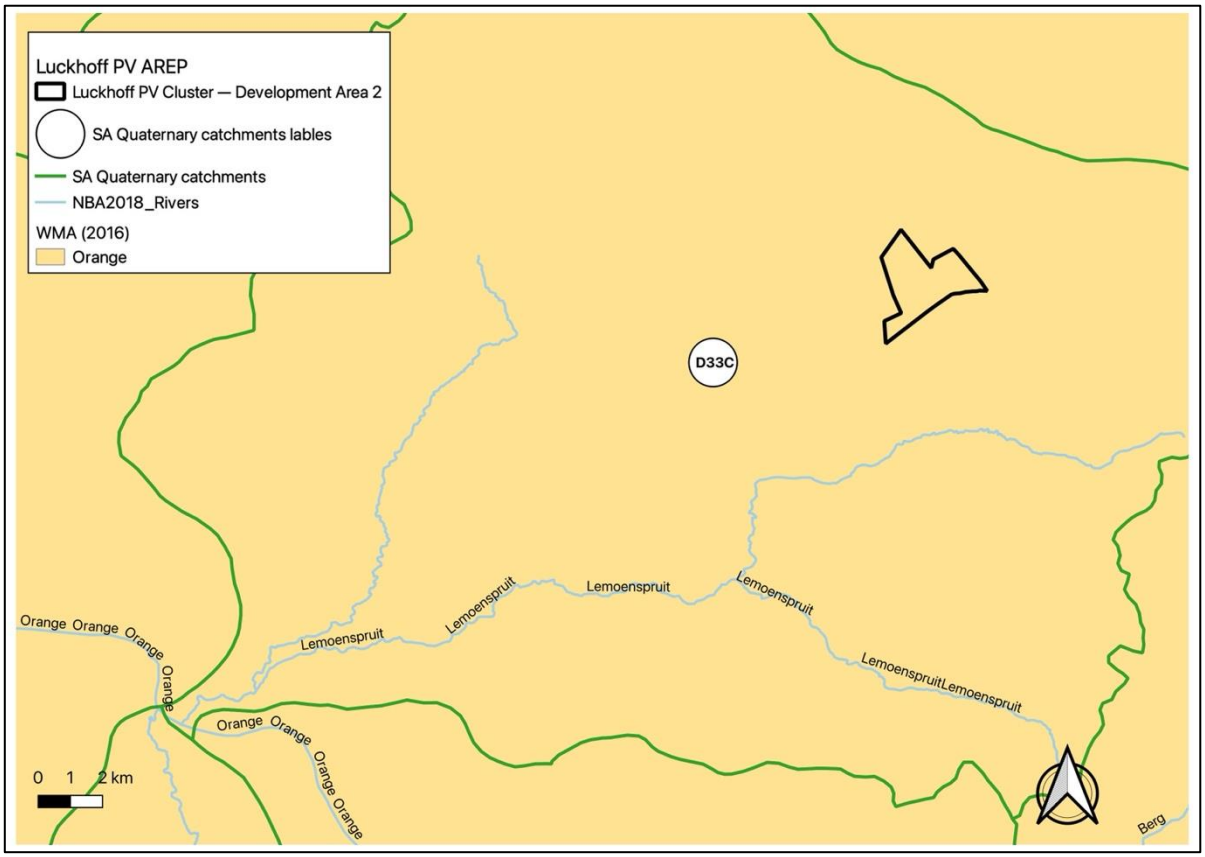


Figure 4: Locality map indicating the various quaternary catchments and mainstem rivers within the proposed project's boundaries. Source: DWS and NGI 2022.

Plate 1: A watercourse with distinct riparian zone within a broad floodplain, composed of sandy alluvium adjacent the study area

Plate 2: A small depression (red circle) dominated by grass species, that only accumulates water for very short periods

Current waterbody inventories (van Deventer *et al*., 2020), 1: 50 000 topocadastral surveys mapping indicated a general lack of any wetlands within the greater study region (Figure 5). These inventories include wetland spatial data based on landcover 2007 data, previous assessments and wetland information retained by the Provincial authorities, combined into one database that formed part of the updated National Spatial Biodiversity Assessment, 2018. The only wetland hydrogeomorphic unit or type observed in the greater region included small pans or depressions (endorheic), which then correspond to those observed in this site.

Thus a baseline map was then developed and refined using the 2022 survey data, noting that due to the complex nature of the topography and geology, the features were digitised at a scale of 1:5 000. Coupled to the aquatic delineations, information was collected on potential species that could occur within the watercourses, especially any conservation worthy species (Listed or Protected). A detailed account of the potential species and observed species will form part of latter reporting once project development proceeds.

However the site was not categorise or listed as follows in the various National Spatial Databases (SNABI, 2018):

- Listed Threatened Ecosystem
- Strategic Water Resource Area
- Wetland Cluster
- NFEPA, although the study area is listed an Upstream FEPA.

Using the baseline description and preliminary field data, while considering the current disturbances and site characteristics were identified, then categorised into one of a number of pre-determined sensitivity categories to provide protect and/or guide the layout planning and possibly the design processes.

The sensitivity ratings of High (No-Go) to Low were determined through an assessment of the habitat sensitivity and related constraints (Figure 6). However, these No-Go areas (with buffers) relate in general terms to the project and there are areas where encroachment on these areas would occur (i.e. existing road crossings within systems) and is considered acceptable since these areas have already been impacted.

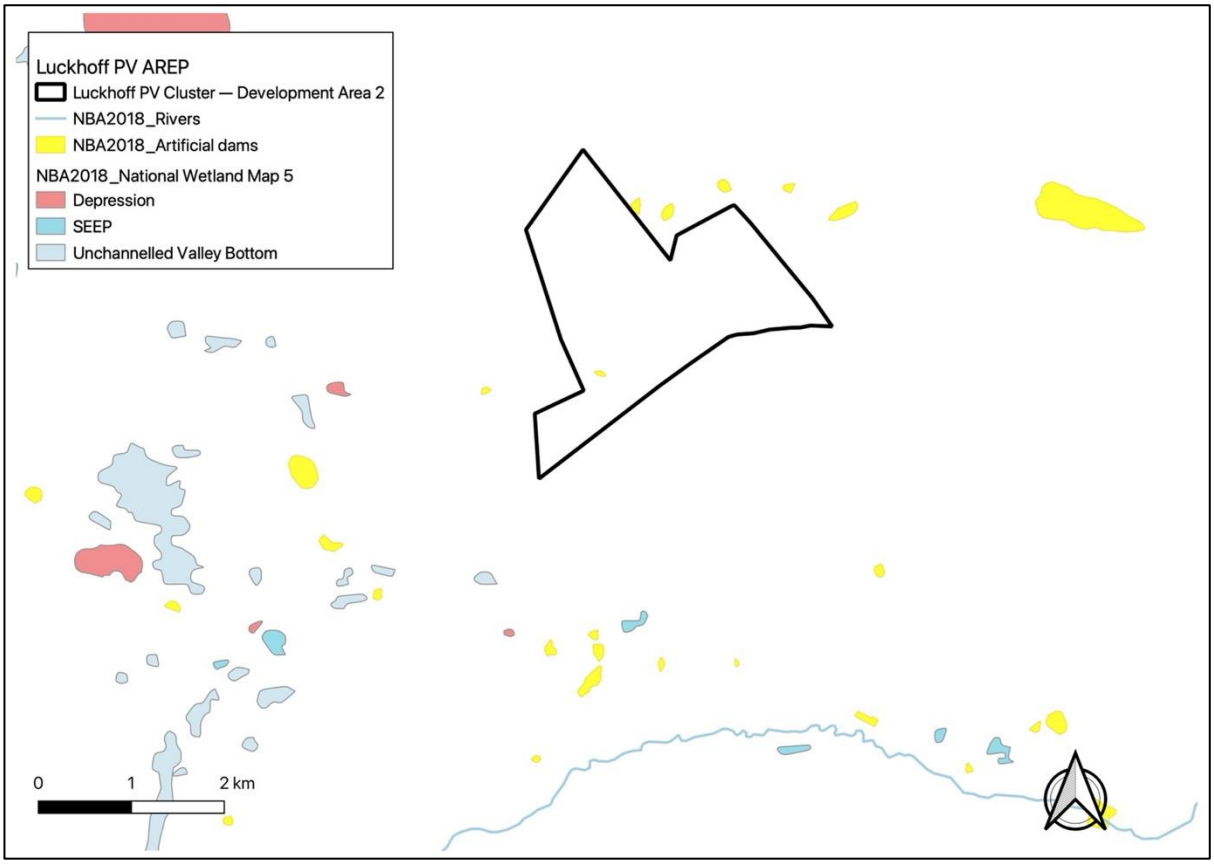


Figure 5: National Wetland Inventory wetlands and waterbodies (van Deventer *et al*., 2020).

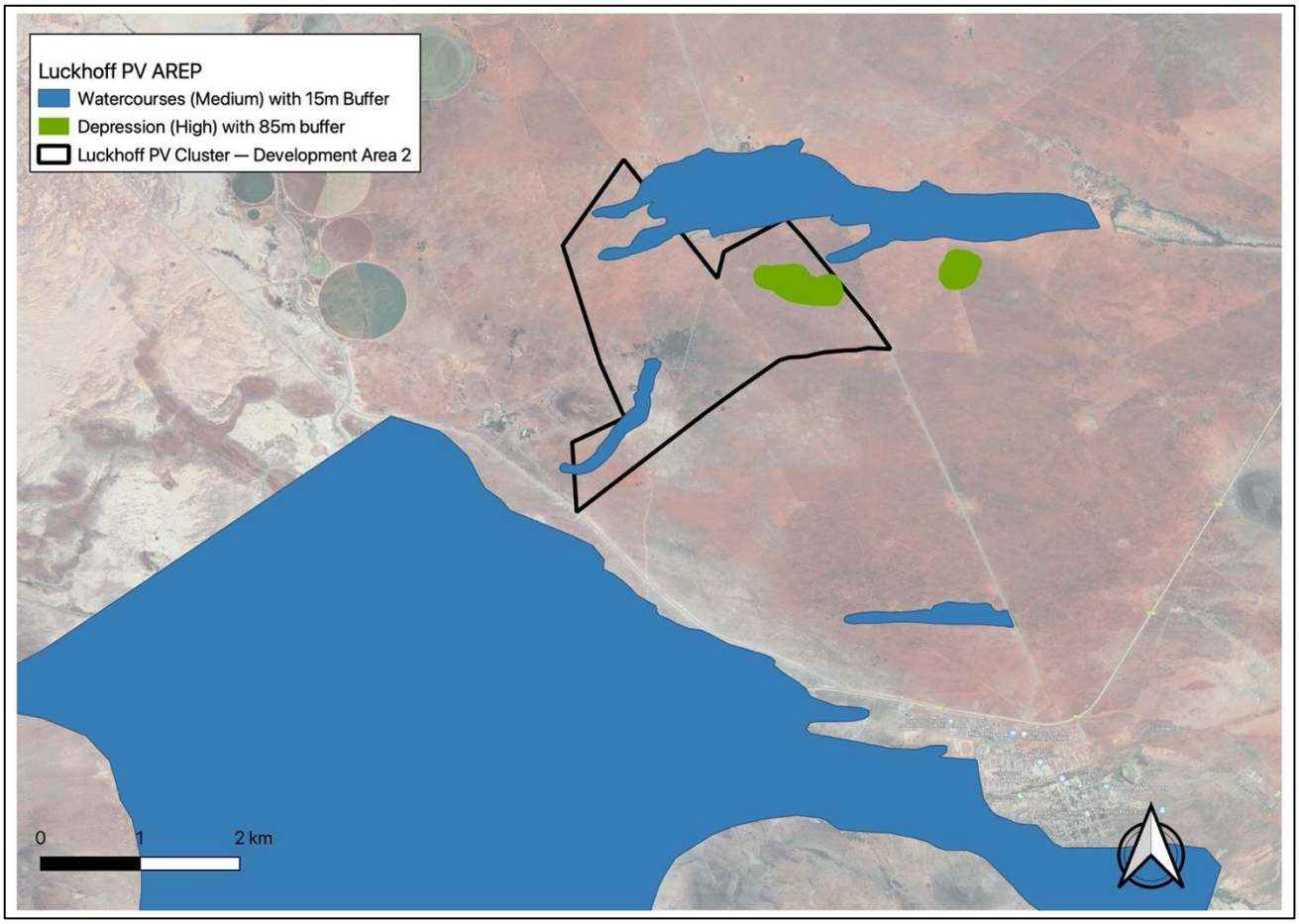


Figure 6: Waterbodies delineated in this assessment based on ground-truthing information collected.

7 Present Ecological State and conservation importance

The Present Ecological State (PES) of a river, watercourse or wetland represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

The PES scores have been revised for the country and based on the new models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014). The new PES system incorporates Ecological Importance (EI) and Ecological Sensitivity (ES) separately as opposed to Ecological Importance and Sensitivity (EIS) in the old model, although the new model is still heavily centred on rating rivers using broad fish, invertebrate, riparian vegetation and water quality indicators. The Recommended Ecological Category (REC) is still contained within the new models, with the default REC being B, when little or no information is available to assess the system or when only one of the above-mentioned parameters are assessed or the overall PES is rated between a C or D.

All of the systems assessed by DWS (2014) on a Subquaternary level within the study area were rated as PES C = Moderately Modified. While these were also rated as Low in terms of Ecological Sensitivity and Moderate in terms of Ecological Importance respectively.

Based on the information collected during the field investigations, these ratings are verified and upheld for the riverine systems. The High Ecological Sensitivity rating for the natural water sources, is further substantiated by the fact that some of the affected catchments are included in both the National Freshwater Priority Atlas (Upstream Area) (Figures 7).

The PES and functional importance of the Depression wetlands (collectively referred to as "HGM1 – DEPRESSION) were assessed together as both wetlands share similar ecological characteristics and have been subjected to the same anthropogenic impacts. The Wet-Health2 assessment determined that the wetlands fall within the 'B' ecological category for present condition (Table 5). The vegetation component scored particularly poorly due to transformation of natural habitat via grazing.

Table 5: Outcomes of WET-Health Version 2 assessment for HGM1-DEPRESSION

	Wetland PES Summary			
Wetland name	**Unnamed**			
Assessment Unit	**HGM1 - DEPRESSION**			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.2	1.4	1.2	4
PES Score (%)	45%	88%	90%	60%
Ecological Category	**D**	**A**	**A**	**D**
Combined Impact Score	2.4			
Combined PES Score (%)	70%			
Combined Ecological Category	**B**			
Confidence	High: Field-based 'Level 2' assessment area			

The trajectory of change for both wetlands is negative. The continuation of the current activities within the catchment, without improved management, will result in a slow decline in aquatic habitat integrity. The recommended management objective is to improve the wetland present ecological state.

7.1 Ecosystem services and functional importance

A WET-Ecoservices (Version 2) field-based assessment was undertaken to assess the ecosystem services supplied by the two wetlands (Kotze *et al.* 2020). The assessment technique has recently been revised and now distinguishes clearly both ecosystem services' supply and the demand for all ecosystem services. This helps determine the potential of the wetland for delivering ecosystem services, by understanding its capacity to produce a service while also considering the societal demand for that service.

The assessment showed that the wetlands are highly important for the provisioning services such as water supply and agricultural uses (Table 6). However, the wetlands scored poorly for the other ecosystem services assessed due to their lowered ecological state (B category for PES). Although there is high demand for the potential regulating and supporting ecosystem services, the biodiversity provisioning services provided are severely restricted due to highlight ephemeral nature of the wetlands via limited obligate aquatic species. The

ongoing disturbances are resulting in the degradation of any remaining habitat. The biodiversity of the wetland is ubiquitous and not sensitive to flow and habitat modifications.

Table 6: Summary of WET-Ecoservices assessment

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.7	0.4	0.0	Very Low
	Stream flow regulation	1.5	3.0	1.5	Moderately Low
	Sediment trapping	1.5	3.0	1.5	Moderately Low
	Erosion control	0.5	3.0	0.5	Very Low
	Phosphate assimilation	0.7	0.4	0.0	Very Low
	Nitrate assimilation	1.3	4.0	1.8	Moderate
	Toxicant assimilation	1.3	2.0	0.8	Very Low
	Carbon storage	1.1	0.0	0.0	Very Low
	Biodiversity maintenance	0.6	4.0	1.1	Low
PROVISIONING SERVICES	Water for human use	0.5	0.0	0.0	Very Low
	Harvestable resources	0.5	0.0	0.0	Very Low
	Food for livestock	3.0	2.0	2.5	Moderately High
	Cultivated foods	0.5	0.0	0.0	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.3	0.0	0.0	Very Low
	Education and Research	0.5	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

Overall, these catchment areas and subsequent rivers / watercourses are largely in a natural state with localised impacts in some areas, which include the following:

- Erosion and sedimentation associated with road crossings, and
- Impeded water flow due to several in channel farm dams and weirs.

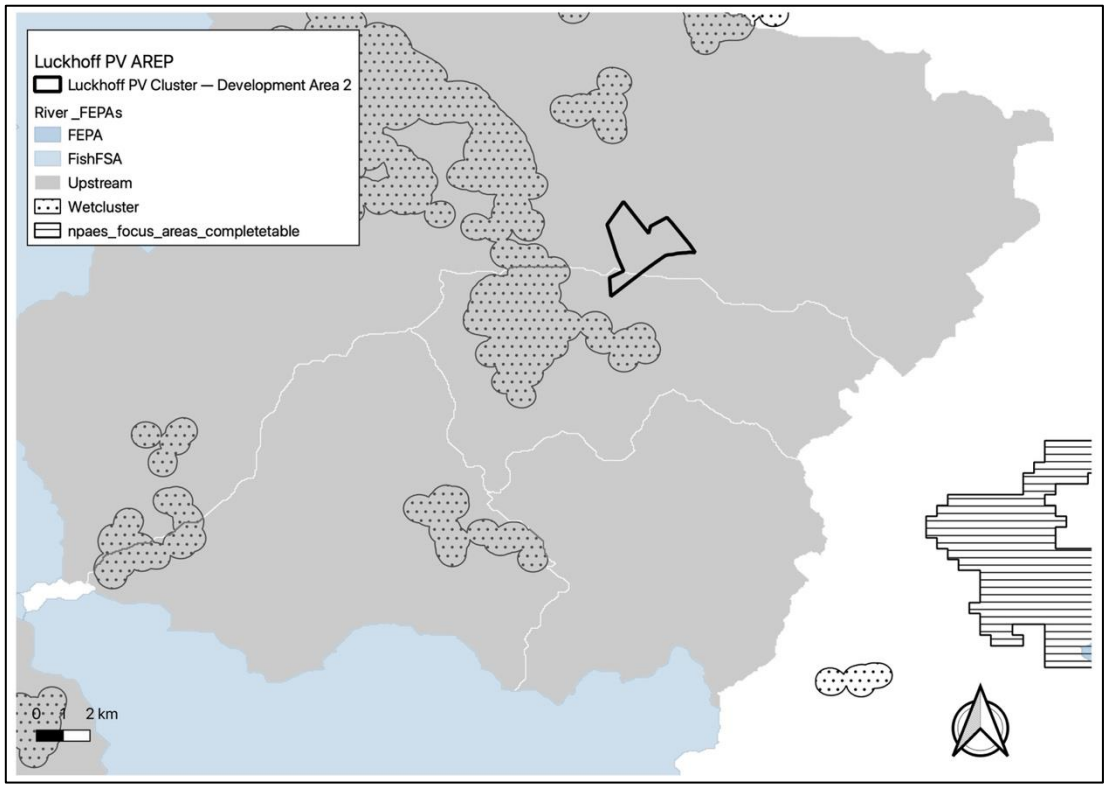


Figure 7: The Freshwater Ecosystem Priority Areas for the study sites (Nel *et al.,* 2011).

8 Site Sensitivity

Using the baseline description and preliminary field data while considering the current disturbances and site characteristics, the following features were identified, then categorised into one of a number of pre-determined sensitivity categories to provide protect and/or guide the layout planning and possibly the design processes:

Table 7 below provides an overview of the sensitivity of features (with buffers distances included) as it relates to the main project component types for the project. The features are shown spatially in Figure 8.

The sensitivity ratings of High (No-Go) to Low were determined through an assessment of the habitat sensitivity and related constraints. However, these No-Go areas (with buffers) relate in general terms to the project and there are areas where encroachment on these areas would occur (i.e. existing road crossings within systems and considered acceptable since these areas have already been impacted).

These proposed constraints / buffers do not include bird constraints as theirs buffers along aquatic features are at times far larger around aquatic features, than those required for the known aquatic species within this region.

Table 7: Results of the sensitivity rating / constraints assessment

Map Key	Sensitivity Rationale	Buffer	Development Constraints and override exceptions
High = No Go	"No go" areas or setbacks and areas or features that are considered of such significance that impacting them may be regarded as fatal flaw or strongly influence the project impact significance profile Therefore areas or features that are considered to have a high sensitivity or where project infrastructure would be highly constrained and should be avoided as far as possible. Infrastructure located in these areas are likely to drive up impact significance ratings and mitigations	85m	No buildings or structures (e.g. PV Panel Areas, Substations, O/M Buildings or temporary laydown areas should be placed within these zones.
Medium	Areas that are deemed to be of medium sensitivity but should still be avoided as this would minimise impacts and or the need for additional Water Use Authorisation in the case of any aquatic features	15m to aid delineation accuracy and prevent bank instability	No buildings or structures (e.g. PV Panel Areas, Substations, O/M Buildings or temporary laydown areas should be placed within these zones. Access roads and grid connection can span these areas, but preferably where existing impacts already occur
Low	Areas of low sensitivity or constraints such as artificial systems with little to no biological value or would not result in any future licensing requirements e.g. dry earth wall farm dams. While from a terrestrial perspective the vegetation or habitat is ubiquitous within the greater region or has seem some form of disturbance.	N/A	N/A
Neutral	Unconstrained areas (left blank in mapping) from aquatic perspective	N/A	N/A

In summary, structures such as PV Panel Areas, buildings, substations and Battery Energy Storage System (BESS), should be placed outside of the High Sensitivity habitats, while remaining structures (roads and transmission lines) could cross or span the Moderate / Low Sensitivity areas. Noting that Low Sensitivity can also = Moderate areas but with existing impacts e.g., current roads, farm tracks of previously disturbed areas but these must be confirmed during the remainder of the assessment phases for areas such as roads or grid access

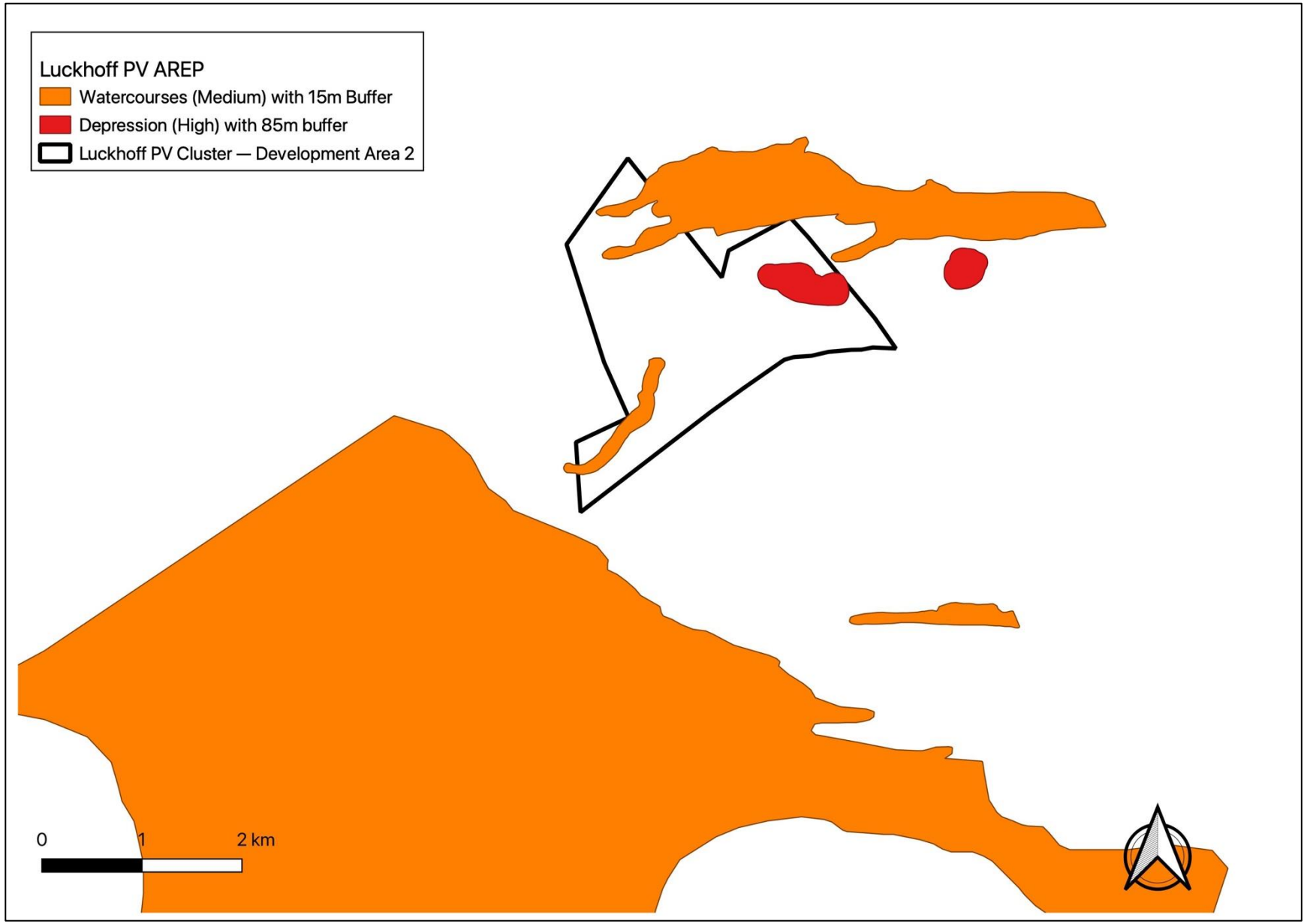


Figure 8: The delineated habitats inclusive of the respective buffers and overall sensitivity ratings.

9 Assessment of Impacts and Identification of Management Actions

During this phase investigation it was found that the greatest number of impacts could occur within the construction phase, but if the High sensitivity / No-Go areas are avoided, then the impacts would be limited on the aquatic environment.

With regard to the decommissioning phase, these impacts would be the same as those in the construction phase, but again limited if all sensitive aquatic habitats are avoided.

The final aquatic impact assessment will be conducted once the proposed designs, that take all of the development constraints into consideration in the EIA phase of the assessment. This will also then focus on any cumulative impacts.

9.1 Alternatives Assessment

The 2014 EIA Regulations require that any feasible and reasonable activity, location and technology alternatives considered must be described and comparatively assessed. No feasible or reasonable alternatives have been identified and in terms of the guidelines on alternatives assessment, the only alternative to being comparatively assessed is the no-go option. This due to the fact that the sites will have been assessed in detail prior to finalising any of the proposed layouts, that will take cognisance of the fine scale sensitivity data provided in this report, as well as other specialists working on this assessment.

9.2 No-Go Option

With regard the No-Go option it is assumed that the site would continue to degrade due to the prevalence of grazing and or erosion within the water courses. This would continue into the long-term with a Low intensity that would impact on the regional scale due to loss of important habitat. Little in the way of mitigation could be proposed due to the social needs of the surrounding residents and their requirement for grazing areas, coupled to the need access.

9.3 Potential aquatic ecosystems impacts

- Impact 1: Loss of habitat containing protected species or Species of Special Concern
- Impact 2: Loss of any critical corridors and connect habitats that are linked to any future conservation plans or protected areas expansion associated within any riverine or wetland systems
- Impact 3: The potential spread of alien vegetation
- Impact 4: Loss of riparian and or wetland habitat
- Impact 5: Changes to the hydrological regime and increased potential for erosion
- Impact 6: Changes to water quality
- Impact 7: Cumulative Impacts

The Tables 8 – 15 below show the draft determination of impact significance for each impact. It was determined that the impacts upon aquatic biodiversity associated with the project are of Low significance, after mitigation. This assumes that the mitigations listed below are considered and that the overall layouts avoid any of the High / No-Go areas, unless making use of areas with impacts such as existing farm tracks

The loss of irreplaceable aquatic habitat and/or important aquatic obligate biota is highly unlikely. The impacts are easily mitigated (provided the mitigation measures and monitoring plan within the EMP and this report are implemented and adhered to during all phases of the project).

Table 8: Impact assessment summary for Impact 1 – Loss of habitat containing protected species or Species of Special Concern

Impact Phase: Construction and Decommissioning							
Nature of the impact: Loss of vegetation and in particular species / habitats that could contain listed as Critically Endangered and or Vulnerable species (direct)							
Description of Impact: Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones. Loss can also include a functional loss, through change in vegetation type via alien encroachment, reducing aquatic biodiversity.							
Impact Status: Negative							
	E	**P**	**R**	**I**	**D**	**C**	**M**
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2
With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1
Significance Calculation	**Without Mitigation**			**With Mitigation**			
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)			Low Negative Impact (9)			
Was public comment received? No							
Has public comment been included in mitigation measures? No							
Mitigation measures to reduce residual risk or enhance opportunities: • A pre-construction walkthrough with an aquatic specialist is recommended and they can assist with the development of the stormwater management plan and Aquatic Rehabilitation and Monitoring plan, coupled to micro-siting of the final layout. • Where large cut and fill areas are required these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation. • Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through whatever additional interventions maybe necessary (i.e., extension, energy dissipaters, spreaders, etc). To minimise the impact of the access roads:							

- Use existing roads or upgrade existing tracks rather than constructing entirely new roads wherever possible.
- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- All pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that headcut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert.
- The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist during a pre-construction walkdown.
- Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities.
- Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated.

It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.

Table 9: Impact assessment summary for Impact 2 – Loss of CBAs or potential areas with conservation potential

Impact Phase: Construction and Decommissioning							
Nature of the impact: Loss of any critical corridors and connect habitats that are linked to any future conservation plans or protected areas expansion (direct)							
Description of Impact: Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones and have been included in any Critical Biodiversity Areas.							
Impact Status: Negative							
	E	**P**	**R**	**I**	**D**	**C**	**M**
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2

With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1

Significance Calculation	Without Mitigation	With Mitigation
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)	Low Negative Impact (9)

Was public comment received? No

Has public comment been included in mitigation measures? No

Mitigation measures to reduce residual risk or enhance opportunities:

- The aquatic systems have been mapped to a finer scale and have taken cognizance of any potential CBAs. If High / No-Go are avoided by the major infrastructure, then aquatic zones associated with the development can be avoided, noting that at Present the Free State Province does not have any spatial data on Aquatic CBAs
- A pre-construction walkthrough with an aquatic specialist is recommended and they can assist with the development of the stormwater management plan and Aquatic Rehabilitation and Monitoring plan, coupled to micro-siting of the final layout.
- Where large cut and fill areas are required these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation.
- Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through whatever additional interventions maybe necessary (i.e., extension, energy dissipaters, spreaders, etc).

To minimise the impact of the access roads:

- Use existing roads or upgrade existing tracks to cross wetlands rather than constructing entirely new roads wherever possible.
- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- All pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert.
- The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist during a pre-construction walkdown.
- Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to

restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities. • Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted. • All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated. It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.	
Residual impact	Very low and acceptable with adoption of mitigation measures

Table 10: Impact assessment summary for Impact 3 – Potential spread of alien vegetation

Impact Phase: Construction and Operation							
Nature of the impact: Any physical disturbance could result in the spread of alien vegetation (direct)							
Description of Impact: During construction, complete clearing of the PV panel areas, as well any ancillary structures (offices and substations) will be required. This disturbance then allows for the alien species to colonise the soils, if left unmanaged.							
Impact Status: Negative							
	E	**P**	**R**	**I**	**D**	**C**	**M**
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2
With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1
Significance Calculation	**Without Mitigation**		**With Mitigation**				
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)		Low Negative Impact (9)				
Was public comment received? No.							
Has public comment been included in mitigation measures? No.							
Mitigation measures to reduce residual risk or enhance opportunities: • Alien vegetation management must be initiated at the beginning of the construction period and must extend into any remaining areas into the operation phase on the facility • The revegetation of any temporary sites as well as any previously degraded areas must begin from the onset of the project, with the involvement of a botanist to assist with the revegetation specifications Regeneration of alien vegetation must be monitored once all areas have been cleared, forming part of a long term alien vegetation management plan							

Residual impact	Very low and acceptable, with adoption of mitigation measures and monitoring

Table 11: Impact assessment summary for Impact 4 – Loss of riparian and or wetland habitat

Impact Phase: Construction and Decommissioning							
Nature of the impact: It is recommended that all wetlands (Depressions) inclusive of the proposed buffer, be avoided. Should any road widening be required, then loss of riparian vegetation would occur (direct)							
Description of Impact: During construction, complete clearing of the PV panel areas, as well any ancillary structures (offices and substations) will be required, which may impact the aquatic function or any corridors or connections between aquatic systems. However, these areas can been avoided by the proposed layout.							
Impact Status: Negative							
	E	**P**	**R**	**I**	**D**	**C**	**M**
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2
With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1
Significance Calculation	**Without Mitigation**		**With Mitigation**				
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)		Low Negative Impact (9)				
Was public comment received? No							
Has public comment been included in mitigation measures? No							

Mitigation measures to reduce residual risk or enhance opportunities:

- A pre-construction walkthrough with an aquatic specialist is recommended and they can assist with the development of the stormwater management plan and Aquatic Rehabilitation and Monitoring plan, coupled to micro-siting of the final layout.
- Where large cut and fill areas are required these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation.
- Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through whatever additional interventions maybe necessary (i.e., extension, energy dissipaters, spreaders, etc).

To minimise the impact of the access roads:

- Use existing roads or upgrade existing tracks to cross wetlands rather than constructing entirely new roads wherever possible.
- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences.

• Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils. • All pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert. • The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist during a pre-construction walkdown. • Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities. • Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted. • All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated. • It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.	
Residual impact	Very low and acceptable with adoption of mitigation measures

Table 12: Impact assessment summary for Impact 5 – Changes to the hydrological regime and increase potential for erosion

Impact Phase: Construction and Decommissioning							
Nature of the impact: It is recommended that all wetlands (depressions) inclusive of the proposed buffer, be avoided. Should any road widening be required, then loss of riparian vegetation would occur (direct)							
Description of Impact: Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones and have been included in any Critical Biodiversity Areas.							
Impact Status: Negative							
	E	**P**	**R**	**I**	**D**	**C**	**M**
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2
With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1

Significance Calculation	Without Mitigation	With Mitigation
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)	Low Negative Impact (9)
Was public comment received? No		
Has public comment been included in mitigation measures? No		

Mitigation measures to reduce residual risk or enhance opportunities:

- The preferred option is recommended as all aquatic systems have been avoided
- No stormwater discharged may be directed to delineated aquatic zones or the associated buffers.
- A stormwater management plan must be developed post EA, detailing the structures and actions that must be installed to prevent the increase of surface water flows directly into any natural systems.
- Effective stormwater management must include measures to slow, spread and deplete the energy of concentrated flows thorough effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed areas

To minimise the impact of the access roads:

- Use existing roads or upgrade existing tracks to cross wetlands rather than constructing entirely new roads wherever possible.
- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- All pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert.
- The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist during a pre-construction walkdown.
- Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities.
- Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated.
- It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.

Residual impact	Very low and acceptable with adoption of mitigation measures

Table 13: Impact assessment summary for Impact 6 –Changes to surface water quality characteristics

Impact Phase: Construction and Decommissioning							
Nature of the impact: Potential impact on localised surface water quality (indirect)							
Description of Impact: During construction or decommissioning, earthworks will expose and mobilise earth materials, and a number of materials as well as chemicals will be imported and used on site and may end up in the surface water, including soaps, oils, grease and fuels, human wastes, cementitious wastes, paints and solvents, etc. Any spills during transport or while works area conducted in proximity to a watercourse has the potential to affect the surrounding biota. This can result in possible deterioration in aquatic ecosystem integrity and species diversity.							
Impact Status: Negative							
	E	P	R	I	D	C	M
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2
With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1
Significance Calculation	**Without Mitigation**		**With Mitigation**				
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)		Low Negative Impact (9)				
Was public comment received? No							
Has public comment been included in mitigation measures? No							

Mitigation measures to reduce residual risk or enhance opportunities:

- All liquid chemicals including fuels and oil, including for the BESS, must be stored in with secondary containment (bunds or containers or berms) that can contain a leak or spill. Such facilities must be inspected routinely and must have the suitable PPE and spill kits needed to contain likely worst-case scenario leak or spill in that facility, safely.
- Washing and cleaning of equipment must be done in designated wash bays, where rinse water is contained in evaporation/sedimentation ponds (to capture oils, grease cement and sediment).
- Mechanical plant and bowsers must not be refueled or serviced within 100m of a river channel or wetland.
- All construction camps, lay down areas, wash bays, batching plants or areas and any stores should be more than 85 m from any demarcated water courses.

• Littering and contamination associated with construction activity must be avoided through effective construction camp management. • No stockpiling should take place within or near a water course. • All stockpiles must be protected and located in flat areas where run-off will be minimised and sediment recoverable. • ESO monitors the site on a daily basis to ensure plant is in working order (minimise leaks), spills are prevented and if they do occur, are quickly rectified.	
Residual impact	Low risk and acceptable, with adoption of mitigation measures and monitoring

Table 14: Impact assessment summary for Impact 7 - Cumulative impact assessment for aquatic biodiversity

Cumulative Impact: Cumulative impacts on the aquatic resources of the area							
Description of Cumulative Impact: The cumulative impact assessment considers the combined impact of the remaining and other renewable projects within a 30km radius, that are also in the development phase and the associated grid lines on the aquatic resources. The rating below is based on the premised that important or sensitive features will be avoided by the various projects, while the mitigations proposed will ensure that the form and or function of downstream areas remain intact.							
Impact Status: Negative							
	E	**P**	**R**	**I**	**D**	**C**	**M**
Without Mitigation	Local	Probable	Irreversible	No Loss	Long Term	Low	Medium
Score	2	3	4	1	3	2	2
With Mitigation	Site	Possible	Partly reversible	No Loss	Short Term	Negligible	Low
Score	1	2	3	1	1	1	1
Significance Calculation	**Without Mitigation**			**With Mitigation**			
S=(E+P+R+I+D+C)*M	Moderate Negative Impact (30)			Low Negative Impact (9)			
Can Impacts be Enhanced?	No						
Enhancement: • The project should share roads and infrastructure where possible to reduce the overall footprint and reduce stormwater and erosion and sedimentation related impacts • The projects should collaborate with provincial roads authority to upgrade the main access routes and improve the crossings and stormwater controls							
Residual impact	Low						

9.4 Draft Specialists Recommendations for the inclusion in the EA

The specialist has no objection to the authorisation of the proposed activities assuming that all mitigations and buffer zones are implemented.

The significant impacts are associated with the access road crossings river systems. These systems are generally in a less modified state and still provide some habitat and important ecological functions. Mitigation should focus on these areas and include measures to halt erosion and rehabilitate habitat in the sections affected by the construction. Without the implementation of mitigation measures, the project has potential to cause a Moderate cumulative impact upon aquatic biodiversity. However, with the adoption of mitigation, the proposed project will have a Low impact upon aquatic biodiversity.

10 Conclusion and Recommendations

In conclusion, most of the anticipated impacts would include disturbance during the construction phase, while changes to form and function of the site due to increased runoff roads or hard surfaces that would occur in the operational and maintenance (O&M) phase.

In summary, the impacts upon aquatic biodiversity associated with the project are of Low significance, after mitigation. The loss of irreplaceable aquatic habitat and/or important biota is highly unlikely. The impacts are considered to be easily mitigated (provided the mitigation measures and monitoring plan within the EMP and this report are implemented and adhered to during all phases of the project).

During the EIA phase, the final impact ratings will be revised based on the layouts that will be developed, and any conflicts will be pointed out to the developer. This may be coupled to additional site visits, but it is not foreseen at this point.

11 References

- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998.
- Agricultural Resources Act, 1983 (Act No. 43 of 1983).
- Davies, B. and Day J., (1998). Vanishing Waters. University of Cape Town Press.
- Department of Water Affairs and Forestry - DWAF (2005). A practical field procedure for identification and delineation of wetland and riparian areas Edition 1. Department of Water Affairs and Forestry , Pretoria.
- Department of Water Affairs and Forestry - DWAF (2008). Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys. and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.
- Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.
- Du Preez, L. And Carruthers, V. 2009. A Complete Guide To Frogs Of Southern Africa. Struik Nature, Cape Town
- Ewart-Smith J.L., Ollis D.J., Day J.A. and Malan H.L. (2006). National Wetland Inventory: Development of a Wetland Classification System for South Africa. WRC Report No. KV 174/06. Water Research Commission, Pretoria.
- IUCN (2019). Red List of Threatened Species. IUCN Species Survival Commission, Cambridge Available: http://www.iucnredlist.org/
- Kleynhans C.J., Thirion C. and Moolman J. (2005). A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.
- Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N. (2008). WET-EcoServices A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No: TT 339/08.
- Macfarlane, D.M. & Bredin, I.P. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. WRC Report No TT 715/1/17 Water Research Commission, Pretoria.
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), as amended.
- Mitsch, J.G. and Gosselink, G. (2000). Wetlands 3rd End, Wiley, NewYork, 2000, 920 pg.
- Mucina, L., and Rutherford, M.C., 2006. The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South Africa.
- National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.
- National Water Act, 1998 (Act No. 36 of 1998), as amended
- Nel, J., Maree, G., Roux, D., Moolman, J., Kleynhans, N., Silberbauer, M. and Driver, A. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Council for Scientific and Industrial Research, Stellenbosch.
- Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.
- Nel, J., Colvin, C., Le Maitre, D., Smith, J. and Haines, I. (2013). South Africa's Strategic Water Source Areas. CSIR Report No: CSIR/NRE/ECOS/ER/2013/0031/A. Report for WWF South Africa
- Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.
- Parsons R. (2004). Surface Water – Groundwater Interaction in a Southern African Context. WRC Report TT 218/03, Pretoria.
- Ramsar Convention, (1971) including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000).

- Rowntree, K., Wadesone, R. and O'Keeffe, J. 2000. The development of a geomorphological classification system for the longitudinal zonation of South African rivers. South African Geographical Journal 82(3): 163-172.
- South African Bird Atlasing Project 2 (SABAP2). 2017. Animal Demographic Unit. Available online: http://sabap2.adu.org.za/
- Stuart, C and Stuart, T. 2007. A field guide to the mammals of Southern Africa. Struik Nature, Cape Town.
van Deventer H., Smith-Adao, L. Petersen C., Mbona N., Skowno A., Nel, J.L. (2020) Review of available data for a South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Water SA 44 (2) 184-199

12 Appendix 1 – Copy of Specialist CV

CURRICULUM VITAE
Dr Brian Michael Colloty
7212215031083

1 Rossini Rd
Pari Park
Gqeberha, 6070
brianc@envirosci.co.za
083 498 3299

Profession: Ecologist & Environmental Assessment Practitioner (Pr. Sci. Nat. 400268/07)
Member of the South African Wetland Society
Specialisation: Ecology and conservation importance rating of inland habitats, wetlands, rivers & estuaries
Years experience: 25 years

SKILLS BASE AND CORE COMPETENCIES

- 25 years experience in environmental sensitivity and conservation assessment of aquatic and terrestrial systems inclusive of Index of Habitat Integrity (IHI), WET Tools, Riparian Vegetation Response Assessment Index (VEGRAI) for Reserve Determinations, estuarine and wetland delineation throughout Africa. Experience also includes biodiversity and ecological assessments with regard sensitive fauna and flora, within the marine, coastal and inland environments. Countries include Mozambique, Kenya, Namibia, Central African Republic, Zambia, Eritrea, Mauritius, Madagascar, Angola, Ghana, Guinea-Bissau and Sierra Leone. Current projects also span all nine provinces in South Africa.
- 15 years experience in the coordination and management of multi-disciplinary teams, such as specialist teams for small to large scale EIAs and environmental monitoring programmes, throughout Africa and inclusive of marine, coastal and inland systems. This includes project and budget management, specialist team management, client and stakeholder engagement and project reporting.
- GIS mapping and sensitivity analysis

TERTIARY EDUCATION

- 1994: B Sc Degree (Botany & Zoology) - NMU
- 1995: B Sc Hon (Zoology) - NMU
- 1996: M Sc (Botany - Rivers) - NMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela University – SAB institute for Coastal Research & Management. Funded by the WRC to develop estuarine importance rating methods for South African Estuaries
- 2001 – January 2003 Training development officer AVK SA (reason for leaving – sought work back in the environmental field rather than engineering sector)
- February 2003- June 2005 Project manager & Ecologist for Strategic Environmental Focus (Pretoria) – (reason for leaving – sought work related more to experience in the coastal environment)
- July 2005 – June 2009 Principal Environmental Consultant Coastal & Environmental Services (reason for leaving – company restructuring)
- June 2009 – August 2018 Owner / Ecologist of Scherman Colloty & Associates cc
- August 2018 Owner / Ecologist - EnviroSci (Pty) Ltd

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Kenmare Mining Pilivilli, Mozambique - wetland (mangroves, peatlands and estuarine) assessment and biodiversity offset analysis - current
- Botswana South Africa 400kv transmission line (400km) biodiversity assessment on behalf of Aurecon - current
- Farim phosphate mine and port development, Guinea Bissau – biodiversity and estuarine assessment on behalf of Knight Piesold Canada – 2016.
- Tema LNG offshore pipeline EIA – marine and estuarine assessment for Quantum Power (2015).
- Colluli Potash South Boulder, Eritrea, SEIA marine baseline and hydrodynamic surveys co-ordinator and coastal vegetation specialist (coastal lagoon and marine) (on-going).
- Wetland, estuarine and riverine assessment for Addax Biofeuls Sierra Leone, Makeni for Coastal & Environmental Services: 2009
- ESHIA Project manager and long-term marine monitoring phase coordinator with regards the dredge works required in Luanda bay, Angola. Monitoring included water quality and biological changes in the bay and at the offshore disposal outfall site, 2005-2011

South African

- Plant and animal search and rescue for the Karusa and Soetwater Wind Farms on behalf of Enel Green Power, Current
- Plant and animal search and rescue for the Nxuba, Oyster Bay and Garob Wind Farms on behalf of Enel Green Power, 2018 - 2019
- Plant and Animal Search and Rescue for the Port of Ngqura, Transnet Landside infrastructure Project, with development and management of on site nursery, Current
- Plant and Animal Search and Rescue for the Port of Ngqura, OTGC Tank Farm Project (2019)
- Plant search and rescue, for NMBM (Driftsands sewer, Glen Hurd Drive), Department of Social Development (Military veterans housing, Despatch) and Nxuba Wind Farm, - current
- Wetland specialist appointed to update the Eastern Cape Biodiversity Conservation Plan, for the Province on behalf of EOH CES appointment by SANBI – current. This includes updating the National Wetland Inventory for the province, submitting the new data to CSIR/SANBI.
- CDC IDZ Alien eradication plans for three renewable projects Coega Wind Farm, Sonop Wind Farm and Coega PV, on behalf of JG Afrika (2016 – 2017).
- Nelson Mandela Bay Municipality Baakens River Integrated Wetland Assessment (Inclusive of Rehabilitation and Monitoring Plans) for CEN IEM Unit - Current
- Rangers Biomass Gasification Project (Uitenhage), biodiversity and wetland assessment and wetland rehabilitation / monitoring plans for CEM IEM Unit – 2017
- Gibson Bay Wind Farm implementation of the wetland management plan during the construction and operation of the wind farm (includes surface / groundwater as well wetland rehabilitation & monitoring plan) on behalf of Enel Green Power - 2018
- Gibson Bay Wind Farm 133kV Transmission Line wetland management plan during the construction of the transmission line (includes wetland rehabilitation & monitoring plan) on behalf of Eskom – 2016.
- Tsitsikamma Community Wind Farm implementation of the wetland management plan during the construction of the wind farm (includes surface / biomonitoring, as well wetland rehabilitation & monitoring plan) on behalf of Cennergi – completed May 2016.
- Alicedale bulk sewer pipeline for Cacadu District, wetland and water quality assessment, 2016
- Mogalakwena 33kv transmission line in the Limpopo Province, on behlaf of Aurecon, 2016
- Cape St Francis WWTW expansion wetland and passive treatment system for the Kouga Municipality, 2015
- Macindane bulk water and sewer pipelines wetland and wetland rehabilitation plan 2015
- Eskom Prieska to Copperton 132kV transmission line aquatic assessment, Northern Cape on behalf of Savannah Environmental 2015.
- Joe Slovo sewer pipeline upgrade wetland assessment for Nelson Mandela Bay Municipality 2014
- Cape Recife Waste Water Treatment Works expansion and pipeline aquatic assessment for Nelson Mandela Bay Municipality 2013
- Pola park bulk sewer line upgrade aquatic assessment for Nelson Mandela Bay Municipality 2013
- Transnet Freight Rail – Swazi Rail Link (Current) wetland and ecological assessment on behalf of Aurecon for the proposed rail upgrade from Ermelo to Richards Bay
- Eskom Transmission wetland and ecological assessment for the proposed transmission line between Pietermaritzburg and Richards Bay on behalf of Aurecon (2012).
- Port Durnford Exarro Sands biodiversity assessment for the proposed mineral sands mine on behalf of Exxaro (2009)
- Fairbreeze Mine Exxaro (Mtunzini) wetland assessment on behalf of Strategic Environmental Services (2007).
- Wetland assessment for Richards Bay Minerals (2013) – Zulti North haul road on behalf of RBM.
- Biodiversity and aquatic assessments for 118 renewable projects in the past 9 years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, Red Cap, ACED Renewables, Mainstream Renewable, GDF Suez, Globeleq, ENEL, Abengoa amongst others. Particular aquatic sensitivity assessment and Water Use License Applications on behalf of Mainstream Renewable Energy (8 wind farms and 3 PV facilities.), Cennergi / Exxaro (2 Wind farms), WKN Wind current (2 wind farms & 2 PV facilities), ACED (6 wind farms) and Windlab (3 Wind farms) were also conducted. Several of these projects also required the assessment of the proposed transmission lines and switching stations, which were conducted on behalf of Eskom.
- Vegetation assessments on the Great Brak rivers for Department of Water and Sanitation, 2006 and the Gouritz Water Management Area (2014)
- Proposed FibreCo fibre optic cable vegetation assessment along the PE to George, George to Graaf Reinet, PE to Colesburg, and East London to Bloemfontein on behalf of SRK (2013-2015).

13 Appendix 2: Site verification report, as per the DFFE Screening Tool guideline

Site verification report

Government Notice No. 645, dated 10 May 2019, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a development footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

(a) Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;

(b) Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;

(c) Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This report has been produced specifically to consider the aquatic and terrestrial ecology theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the Scoping and EIA Reports produced for the projects.

Site sensitivity based on the biodiversity theme included in the Screening Tool and specialist assessment

Based on the DFFE Screening Tool, the site contains areas of Low sensitivity due to the lack of aquatic features (Figures 1)

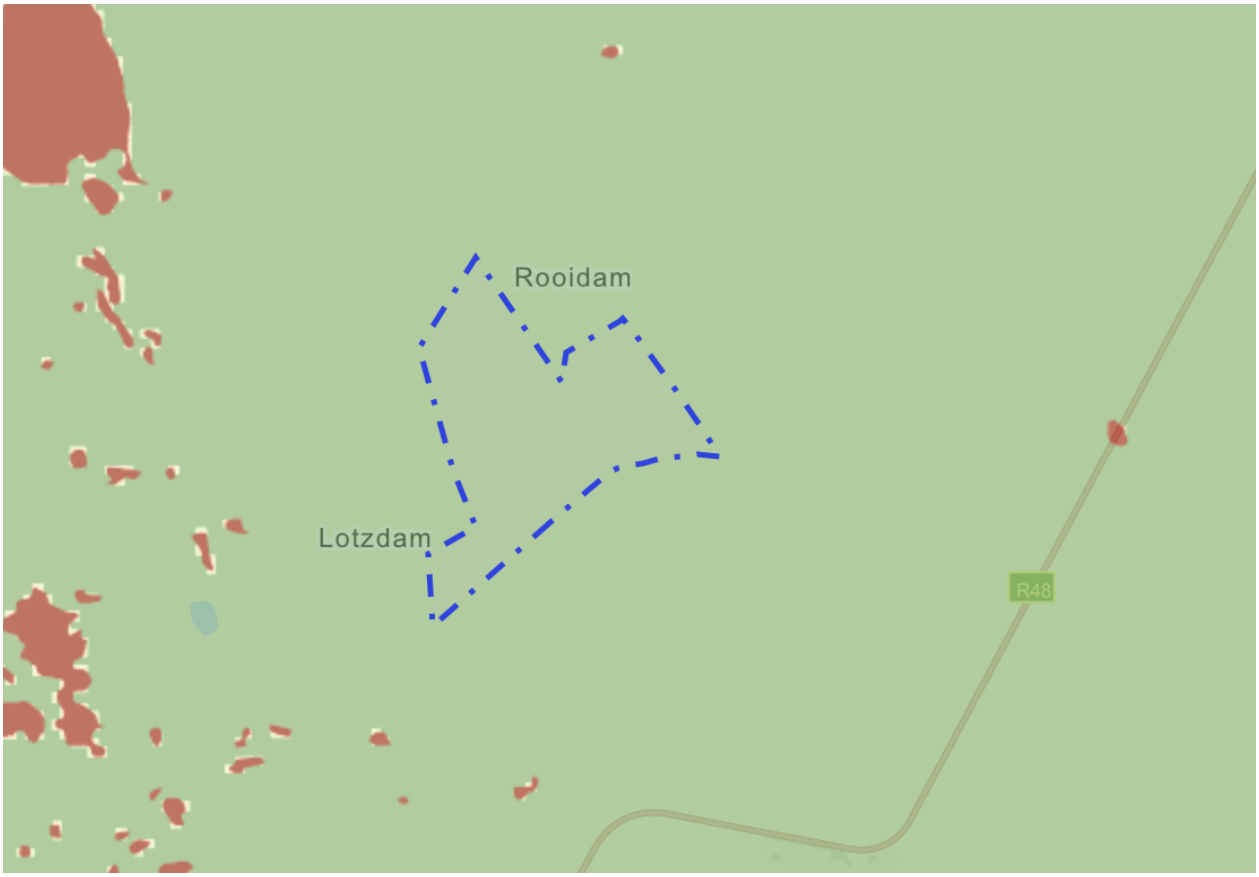


Figure 1. DFFE Screening Tool outcome for the aquatic biodiversity theme, Dark Red = Very High and Green = Low.

Based on the above outcomes, the specialist agrees with the environmental sensitivities identified on site. The findings have been informed by a site visit undertaken by Dr Brian Colloty in 2022.

Figure 2 below shows the sensitivity map produced following the desktop assessment as well as a groundtruthing exercises, with mapping of the observed features at a finer scale.

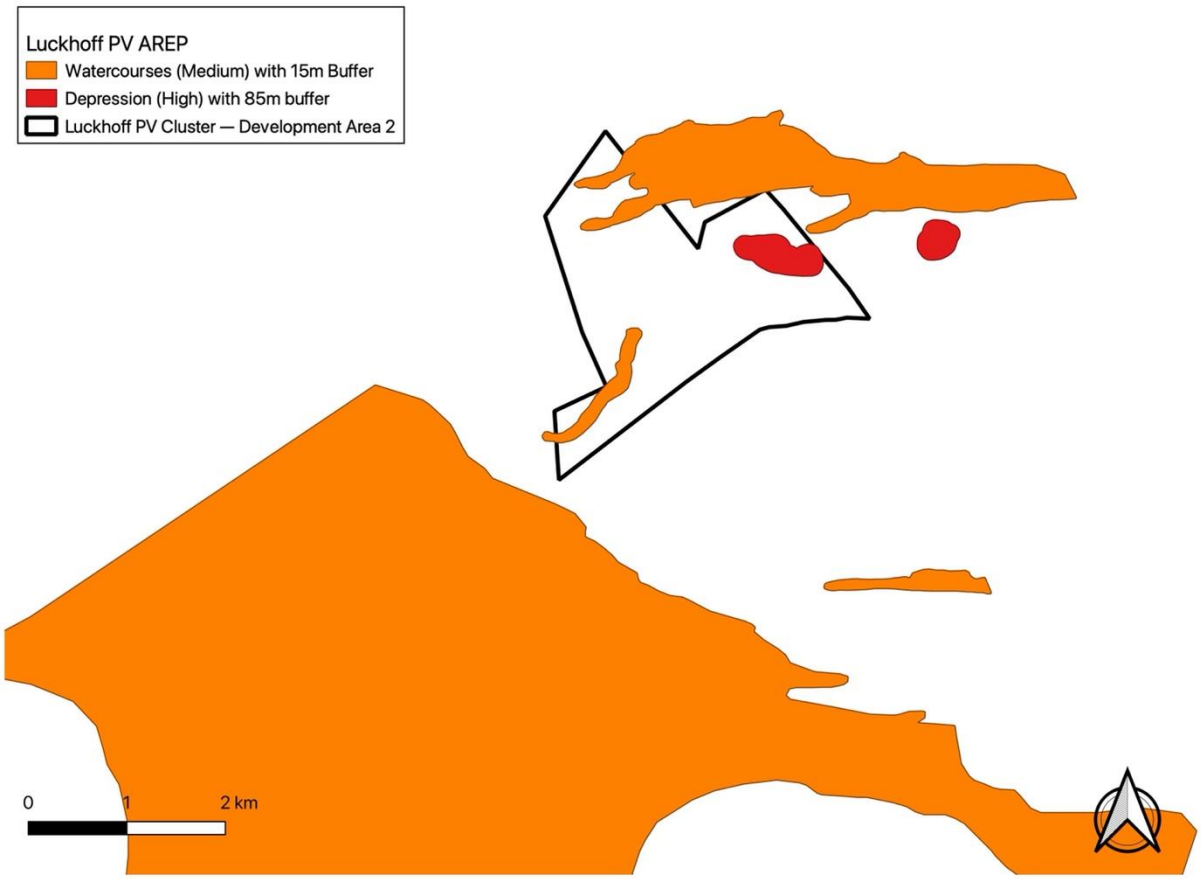


Figure 2. Environmental sensitivity map produced by the specialist.

Motivation of the outcomes of the sensitivity map and key conclusions

In conclusion, the DFFE Screening Tool identified several sensitivity ratings within the study area, High, Medium and Low.

Although there is some overlap with the findings on site and the Screening Tool's outcome, the development footprint will be developed with cognisance of these sensitivities.

Therefore, environmental sensitivity input received from the aquatic ecology specialist will be taken forward and considered within the EIA process and the impact to these areas assessed. Appropriate layout and development restrictions will be implemented within the development footprint to ensure that the impact is deemed acceptable by the ecologist.