



SiVEST SA (PTY) LTD

**PROPOSED CONSTRUCTION OF THE BONSMARA
SOLAR PHOTOVOLTAIC (PV) FACILITY AND BASIC
ASSESSMENT (BA) FOR ASSOCIATED GRID
CONNECTION INFRASTRUCTURE, NEAR
KROONSTAD, FREE STATE PROVINCE**

Aquatic Biodiversity Assessment

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Report Prepared by: EnviroSci (Pty) Ltd
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SiVEST SA (PTY) LTD

PROPOSED CONSTRUCTION OF THE BONSMARA SOLAR PHOTOVOLTAIC (PV) FACILITY AND BASIC ASSESSMENT (BA) FOR ASSOCIATED GRID CONNECTION INFRASTRUCTURE, NEAR KROONSTAD, FREE STATE PROVINCE

AQUATIC BIODIVERSITY ASSESSMENT

EXECUTIVE SUMMARY

Bonsmara Solar PV (RF) (Pty) Ltd, has appointed SiVEST SA (Pty) Ltd (hereafter referred to as “SiVEST”) to undertake the required EIA and BA Processes for the proposed construction of the Bonsmara Solar PV Energy Facility and associated grid infrastructure near Kroonstad in the Free State Province.

The overall objective of the development is to generate electricity by means of renewable energy technology capturing solar energy to feed into the National Grid via short grid connection.

Bonsmara Solar PV (RF) (Pty) Ltd is proposing the construction of the 100MW Bonsmara Solar PV Facility, BESS and associated infrastructure on a site approximately 12km south-east from the town of Kroonstad, in the Free State Province. The facility will be located on Portion 0 of Farm 636 and Portion 1 of Farm 636 located in the Moqhaka Local Municipality, in the Fezile Dabi District Municipality. The facility will comprise of several arrays of PV panels and associated infrastructure that includes BESS and will have a contracted capacity of 100MW. The Solar PV facility will connect to the grid via a 2km 132kv powerline from the on-site substation to the Kroonstad Switching Station.

In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 [GNR 982, 983, 984 and 985] and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Environment, Forestry and Fisheries (DFFE), prior to the commencement of such activities. Specialist studies have been commissioned to assess and verify the project under the new Gazetted specialist protocols.

The regulatory requirements are also discussed with regard the NEMA and the National Water Act in Section 4 of this report. The PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON BIODIVERSITY and in

particular Aquatic Biodiversity related to Government Gazette 43110, 20 March 2020 and Appendix 6 of the NEMA EIA Regulations, have been adhered to.

This report fulfils the Biodiversity Specialist Assessment Report criteria for assessment listed under the various Theme Sensitivity Protocols, where the following sensitivity ratings were contained in the Screening Tool Report Aquatic Biodiversity – Very High sensitivity related to presence of Wetlands and Strategic Water Resources areas related to the PV site and the grid alignment. The remaining areas of the site was rated as Low.

The verification of any of the Very High Sensitivity rated habitats / species localities is thus critical as the proposed development should then avoid these areas. During the scoping assessment, a two-day site visit of the area was conducted in September 2022, in which the habitats listed above were considered, together with a description of the general environment and species assemblages found present. This spatial data supplied to the Applicant will be used to develop the layout outside of these areas (inclusive of suitable buffers) as a mechanism of impact avoidance using fine scale mapping data.

The study area had received some rainfall, which aided in critically assessing the ecological character of the site, with particular reference to any linkages between the aquatic and terrestrial environment as indicated in the Screening Tool Results. The information collected, was also compared to previous assessments within the region by members of EnviroSci, used in the assessment various roads and quarries in the region.

In summary four key aquatic habitats were observed and mapped and then rated based on their sensitivity to the proposed development. These habitats included:

1. Mainstem river (Valsrivier) with riparian vegetation
2. Ephemeral watercourse some with seepage areas but most with head-cuts and or erosion channels
3. Depression wetland (ca. 1.4 km from the closest PV Panel Area)
4. Artificial dams

The sensitivity assessment mentioned considered the habitats observed and these were categorised or rated based on the presence/absence of the following:

- Unique or sensitive habitats
- Presence of importance or listed taxa (faunal & floral)
- Presence of any mainstem rivers or wetlands (e.g. Depressions)
- Intact and functional habitat associated with sensitive areas indicated in the DFFE Screening Tool results

Several High Sensitivity Habitats were observed and mapped, and these were then considered No-Go for any new infrastructure, while Low sensitivity areas could be considered for development. The only exception being road crossings and transmission lines which would be considered acceptable within No-Go areas, if these areas are spanned and/ or located within existing disturbance footprints (e.g. roads within existing farm tracks) and/or suitably mitigated after and inspection is conducted by the specialist once the localities have been finalised.

The following direct impacts were identified, which are aligned with those contained in the Biodiversity Assessment Protocol and will be assessed in greater detail in the EIA phase of the assessment: Construction and to a degree the Operational and Decommissioning Phases where relevant

Construction & Decommissioning Phases

- Impact 1: Loss of aquatic species of special concern
- Impact 2: Damage or loss of riparian systems, ephemeral watercourses and wetland systems in the construction phase
- Impact 3: Potential impact on localised surface water quality

Operational phase

- Impact 4: Impact on aquatic systems through the possible increase in surface water runoff on form and function - Increase in sedimentation and erosion

The project overall has aligned the proposed footprint with the aquatic features, allowing for retention of much of the natural environment so that the systems should remain largely unaffected. Therefore, the PV site and grid, is such that it carries a low intensity impact on the aquatic resources, but requiring the clearing of areas with some areas, especially when considering the associated roads, cables that may need to cross some of the aquatic systems.

However, the current layout has the potential, to a large degree, to avoid these sensitive features, but will need to take cognizance of some of the buffer areas, that will further reduce the potential overall impact and environmental risk.

The overall and cumulative impacts, as assessed, are linked to instances where complete avoidance was not possible, or the nature of the activities involve a potential risk to aquatic resources even at great distance. Overall, it is expected that the impact on the environment would be Low (-). Noteworthy areas, that should be avoided, include the Very High Sensitivity areas as shown in this report. Existing crossings may be used and/or upgraded that intersect these systems however, but these crossings, detailed monitoring plan must be developed in the pre-construction phase.

Based on the findings of this study, the specialist finds no reason to withhold to an authorisation of any of the proposed activities, assuming that key mitigations measures are implemented. However, this must all still be assessed once the final layout has been provided, coupled to a micro-siting walkdown once all information is available.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT 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
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 1 CV
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Attached to Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1 and 1.3 of this report
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.3 and 5
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Appendix 3
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 5.1
g) an identification of any areas to be avoided, including buffers;	Section 5 & 6
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 5
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
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 6 & 8

k) any mitigation measures for inclusion in the EMPr;	Section 6
l) any conditions for inclusion in the environmental authorisation;	Section 5. 6 and 8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6
n) a reasoned opinion- <ul style="list-style-type: none"> i. (as to) whether the proposed activity, activities or portions thereof should be authorised; <ul style="list-style-type: none"> (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, and where applicable, the closure plan; 	Section 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2) Where a government notice <i>gazetted</i> 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.	Yes - Appendix 2

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AQUATIC BIODIVERSITY ASSESSMENT

Contents

1.	INTRODUCTION	10
1.1	Terms of Reference	11
1.2	Specialist Credentials	11
1.3	Assessment Methodology	11
2.	ASSUMPTIONS AND LIMITATIONS	12
3.	TECHNICAL DESCRIPTION	13
3.1	Project Location	13
3.2	Project Description.....	13
4.	LEGAL REQUIREMENT AND GUIDELINES	14
5.	DESCRIPTION OF THE RECEIVING ENVIRONMENT	15
5.1	Present Ecological State and conservation importance.....	20
5.2	Ecosystem services and functional importance.....	21
5.3	Aquatic buffer zone.....	22
6.	SPECIALIST FINDINGS / IDENTIFICATION AND ASSESSMENT OF IMPACTS	23
6.1	Construction & Decommissioning Phase	26
6.2	Operation.....	30
6.3	No go Impact	31
6.4	Cumulative Impacts	33
6.5	Overall Impact Rating	35
7.	CONCLUSION AND SUMMARY	38
7.1	Summary of Findings	38
7.2	Conclusion and Impact Statement	38

8.	REFERENCES.....	39
8.1	Waterbody classification systems	46
8.2	Wetland definition	47
8.3	National Wetland Classification System method	48
8.4	Waterbody condition	1
8.5	Aquatic ecosystem importance and function	1

List of Tables

Table 1: Outcomes of WET-Health Version 2 assessment	20
Table 2: Summary of WET-Ecoservices assessment.....	21
Table 3: Determination of buffer zone requirements	22
Table 4: Species and habitat sensitivity rating definitions	23
Table 5: Rating of impacts for the construction and decommissioning phase.....	26
Table 6: Rating of impacts for the operational phase	30
Table 7: Rating of impacts (No-go)	31
Table 8: Rating of cumulative impacts	34
Table 9: Overall Impact Significance for the WEF (Pre- and Post-Mitigation)	35

List of Figures

Figure 1: Project Location	13
Figure 2: Project locality map indicating the various quinary catchments and mainstem rivers (Source DWS and NGI) within the project boundary	16
Figure 3: National Wetland Inventory wetlands and waterbodies (van Deventer et al., 2020).....	18
Figure 4: Waterbodies delineated in this assessment based on groundtruthing information collected	19
Figure 5: Habitat sensitivity map inclusive of aquatic habitats assessed	24

List of Appendices

Appendix 1 Specialist CV
Appendix 2 DFFE Site verification statement
Appendix 3 Detailed study methodology

Glossary of Terms

- **Drainage line:** A drainage line is a 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 contains 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 (e.g. 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 (Water Act 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 National Water Act 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

List of Abbreviations

AER	Along Existing Roads – cables that are included in existing road servitudes
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DDD	Data Deficient
DWS	Department of Water and Sanitation formerly the Department of Water Affairs
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme Report
EN	Endangered
EO	Environmental Office
ESA	Ecological Support Area
GA	General Authorisation (WUA type)
GBIF	Global Biodiversity Information Facility
GIS	Geographic Information System
LC	Least Concern
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, <i>et al.</i> 2011).
NT	Near Threatened
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
SANBI	South African National Biodiversity Institute
SQ	Subquaternary catchment = Quinary catchment
VU	Vulnerable
WEF	Wind Energy Facility
WUA	Water Use Authorisation
WUL	Water Use License
WULA	Water Use License Application

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1.1 Terms of Reference

Please refer to Specialist ToR provided.

1.2 Specialist Credentials

Please see Appendix 1 - Specialist CVs

1.3 Assessment Methodology

These assessments were conducted using the following assessment process based on 2 days field work conducted in September 2022, early Spring, with several of the associated plants showing early growth.

Methodology summary

- Initiated the assessment with a review of the available information for the region and the proposed project, this will also include review of the proposed project in relation to any conservation plans or assessments known for the area, e.g. Critical Biodiversity Area maps, National Waterbody Inventory and high-level groundwater availability maps etc.
- Conducted a site visit (September 2022) to inspect the surrounding waterbodies / features, to developed maps.
- Prepared a map demarcating the respective watercourses or wetland/s, i.e. the waterbody, its respective catchment and other areas within a 500m radius of the study area. This demonstrated, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence while classifying the hydrogeomorphic type of the respective water courses / wetlands in relation to present land-use and their current state. The maps depicting demarcated waterbodies were delineated to a scale of 1:10 000, following the methodology described by the DWS, together with an estimation of their functionality, Habitat Integrity (IHI), Wet-Ecoservices (Wet-Health) and Socio-Cultural Importance of the delineated systems, whichever is relevant to the systems.

- Recommended buffer zones using the Macfarlane & Bredin (2017) approach to indicate any No-go / Sensitive areas around any delineated aquatic zones supported by any relevant legislation, e.g. any bioregional plans, conservation guidelines or best practice.
- Determined the Present Ecological State (PES) of any waterbodies including wetlands, estimating their biodiversity, conservation importance with regard ecosystem services during the site visit using recognised PES / EIS assessment methods to determine the state, importance and sensitivity of the respective wetland / watercourse systems.
- Identified and assessed the potential impacts of the proposed project using the revised project layout and description, based on a supplied impact assessment methodology (provided by Aurecon), including cumulative impacts and for construction, operations and decommissioning phases. Also assess the potential impact of the “no go” alternative.
- Provided recommendations and mitigations regarding project related impacts for inclusion into the Environmental Management Program (EMPr).
- Supplied the client with geo-referenced GIS shape files of the wetland / riverine areas and associated buffers to be used in the finalisation of the project layout and management of the project going forward.

2. ASSUMPTIONS AND LIMITATIONS

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of communities within a study site, as well as the status of endemic, rare or threatened species in any area, assessments should always 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 are thus 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, unless otherwise stated.

Therefore, due to the scope of the work presented in this report, a long-term investigation of the proposed site was not possible and as such not perceived as part of the Terms of Reference. However, a concerted effort was made to sample and assess as much of the potential site, as well as make use of any supporting literature, species distribution data and aerial photography.

It should be emphasised that information, as presented in this document, only has reference to the study area as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

3. TECHNICAL DESCRIPTION

3.1 Project Location

The project site is located approximately 12 km south-east of Kroonstad in the Moqhaka Local Municipality and the Fezile Dabi District, in the Free State Province.

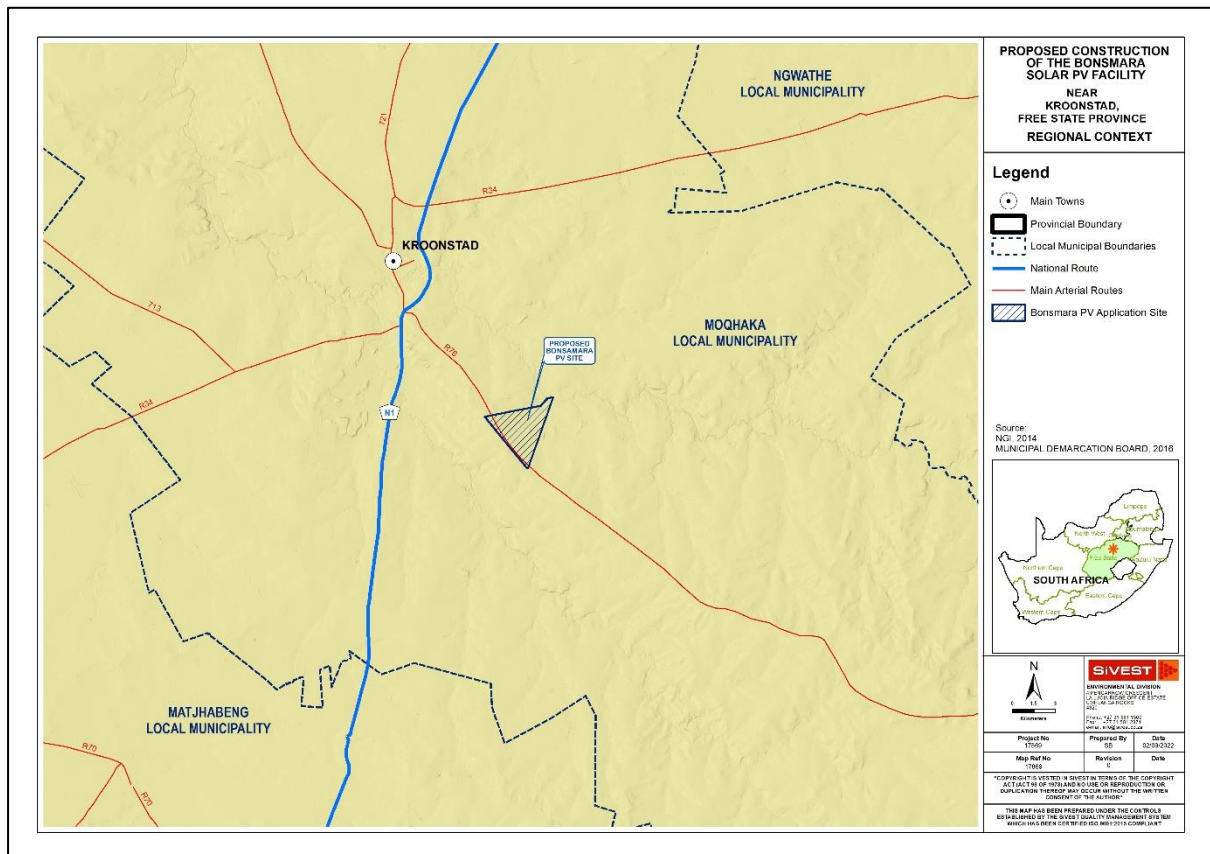


Figure 1: Project Location

3.2 Project Description

The 100 MW PV Facility will comprise several arrays of PV panels, BESS and associated infrastructure. An on-site substation and a 2 km 132 kV powerline will evacuate the power to the grid.

Preliminary PV Facility components include:

- PV modules and mounting structures (monofacial or bifacial) with fixed, single or double axis tracking mounting structures;
- Associated stormwater management infrastructure;
- BESS;
- Site and internal access roads (up to 6 m wide);
- Temporary laydown area during the construction phase for the construction camp and laydown area (which will be a permanent laydown area for the BESS during the operational phase);

- Infrastructure including offices, operational control centre, operation and maintenance area, ablution facilities etc;
- Grid connection infrastructure including medium-voltage cabling between the project components and the facility substation (underground cabling will be used where practical (up to 33 kV));
- Perimeter fencing; and
- Rainwater and/or groundwater storage tanks and associated water transfer infrastructure.

The on-site 33 kV/132 kV substation (facility substation) will step up power from 33 kV to 132 kV for transmission to the national grid. The power will then be evacuated to the national grid by the proposed ~2 km 132 kV powerline that connects the on-site substation to the Kroonstad Switching Station. A 300 m powerline corridor was assessed (150 m on either side).

4. LEGAL REQUIREMENT AND GUIDELINES

The following is pertinent to this study:

- Section 24 of The Constitution of the Republic of South Africa;
- 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;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);
- Nature and Environmental Conservation Ordinance (No. 19 of 1974);
- National Forest Act (No. 84 of 1998); and
- National Heritage Resources Act (No. 25 of 1999) – could apply if cultural use or heritage is linked to any natural resources

Based on an assessment of the proposed activities and past engagement with DWS, the following Water Use Authorisations may be required based on thresholds as listed in the following Government Notices, however ultimately the Department of Water and Sanitation (DWS) must determine if a General Authorisation (GA) or full WULA will be required during the pre-application process as it relates to the following:

- DWS Notice 538 of 2016, 2 September in GG 40243– Section 21 a & b water uses relating to the Abstraction and Storage of water.
- Government Notice 509 in GG 40229 of 26 August 2016 – Section 21 c & l water uses relating to the Impeding or diverting 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 disposing 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.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

The study area contains four key aquatic habitats that were observed and mapped and then rated based on their sensitivity to the proposed development. These habitats included:

1. Mainstem river (Valsrivier) with riparian vegetation (Plate 1)
2. Ephemeral watercourse some with seepage but most with head-cuts and or erosion channels (Plate 2 & 3)
3. Depression wetland (ca. 1.4 km from the closest PV Panel Area)
4. Artificial dams

The features listed above, drain the study area in a westerly region, forming part of the C60D Quinary Catchment, as these systems form part of the headwaters of the Valsrivier (Vals River), which flows beyond the site (Figure 2). A small portion of the PV panel area and grid (substation) falls within the C60F catchment of the Blomspruit, a tributary of the Vals River, however no watercourses associated with this catchment would be affected (situated on the catchment divide).

Furthermore, the study area is located within portions of the Highveld Ecoregions of the Vaal Water Management Area. Thus, the plant species associated with these aquatic systems are typical of this region represented by species associated with the Central Free State Grasslands (Gh6) such as. *Vachellia karroo*, *Searsia lancea*, *Euclea undulata*, *Erianthus capensis*, *Aristida congestas*, *Cynodon dactylon*, *Themeda triandra*, *Tragus spp*, *Berkheya spp*, *Hibiscus pusillis*, *Oxalis* and *Helichrysum dregenum*.

Very small seepages areas were below the proposed panel areas, but due to the dry conditions, it is recommended that the final delineation for these is completed in late summer, as these would trigger the need for Section 21 c & i Water Uses with regard the 500m regulated zone. It is advised that these areas be visited during the micro-siting process and before the WUA submissions.

The site however does not contain any wetland clusters, Important Bird Areas (IBAs) associates with aquatic systems, or surface water features listed as important or of conservation concern.

The northern portion the site does however form part of the Kroonstad Groundwater Strategic Water Resource area (SWSA gw). A Strategic Water Source Area (SWSA) is one where the water that is supplied is of national importance for water security (Le Maitre *et al.* 2018). Surface water SWSAs are found in areas with high rainfall and produce most of the runoff. Groundwater SWSAs have high groundwater recharge and are located where the groundwater forms a nationally important resource. There are 22 national-level SWSAs for surface water (SWSA-sw) and 37 for groundwater (SWSA-gw). The SWSA-gw cover 9% of the area of South Africa, account for 15% of the recharge, 46% of the groundwater used by agriculture and 47% of the groundwater used by industry. It is this for this reason that the site was rated as having a Very High sensitivity in the DFFE Screening Tool.

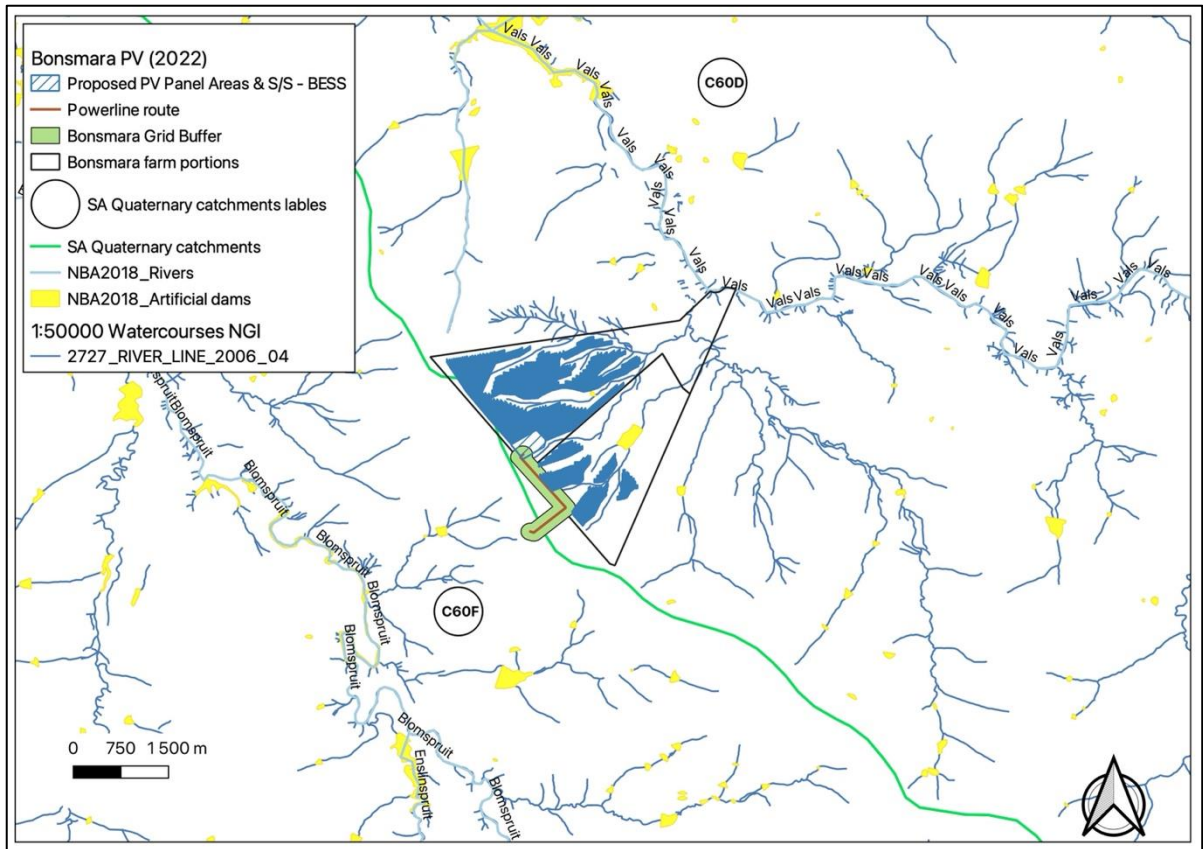


Figure 2: Project locality map indicating the various quinary catchments and mainstem rivers (Source DWS and NGI) within the project boundary



Plate 1: A narrow watercourse, that bisects the study area



Plate 2: Broader area of a watercourse associated mostly with the headwaters of the observed systems, with limited aquatic obligates, but will contain flows during peak rain fall periods (Red arrow = direction of flow)



Plate 3: Several areas within the observed watercourse show signs of erosion and head cut formation, especially in the lower reaches of the systems before they join the mainstem rivers

Figure 3 indicates the available spatial data with regard potential wetlands and or riverine systems within the study area (van Deventer *et al.*, 2020). During the field work, the site was then groundtruthed as well as compared to 1: 50 000 topocadastral surveys mapping data and that which was observed on site. A baseline map was then refined using the September 2022 survey data (Figure 4).

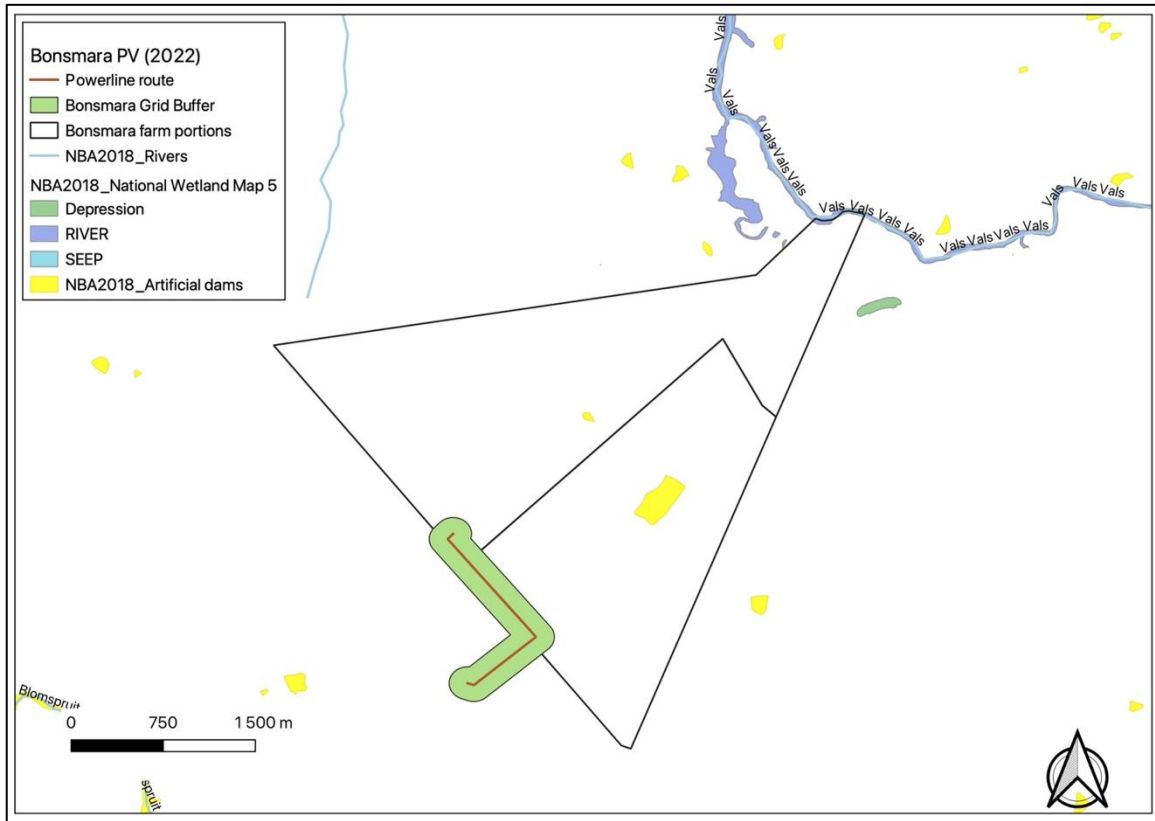


Figure 3: National Wetland Inventory wetlands and waterbodies (van Deventer et al., 2020)

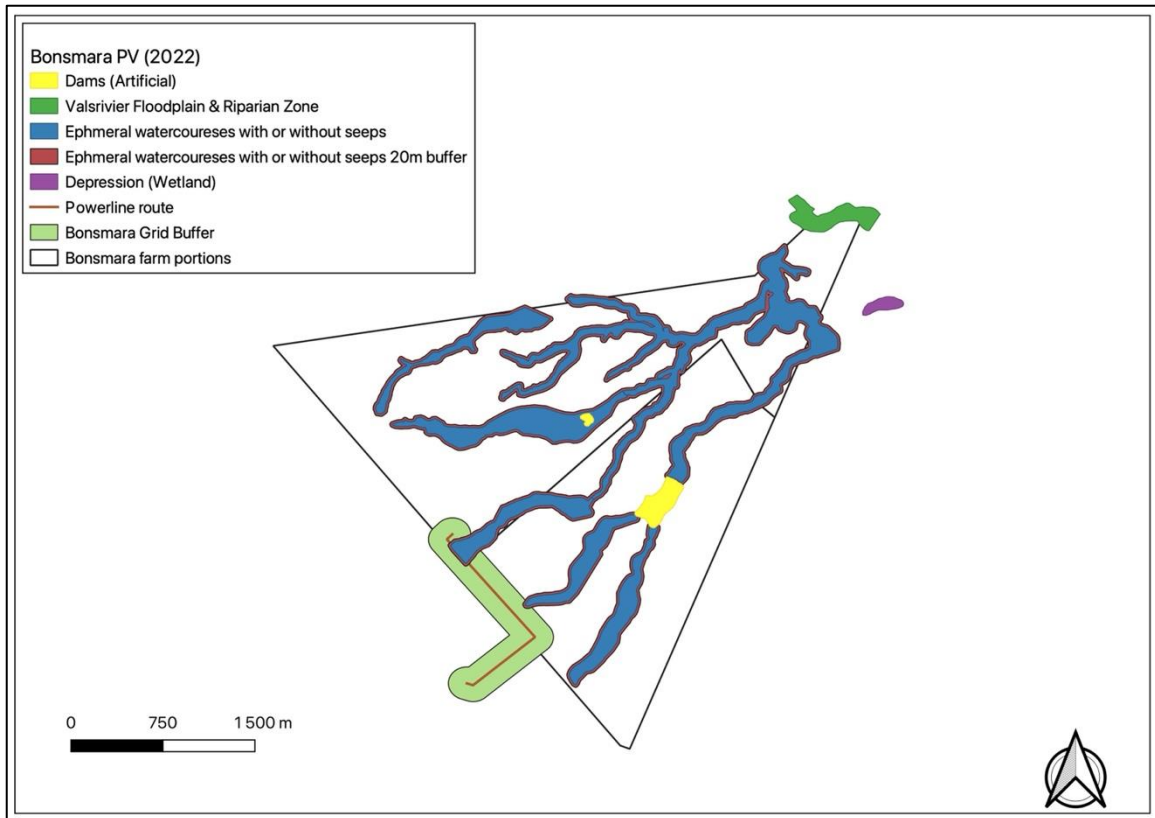


Figure 4: Waterbodies delineated in this assessment based on groundtruthing information collected

5.1 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 = D (SQ2473) or Largely Modified. While these were also rated as High in terms of Ecological Sensitivity and High in terms of Ecological Importance respectively.

The PES and functional importance of the systems were assessed together as they share similar ecological characteristics all contained and or support some form of seepage area, while they have been subjected to the same anthropogenic impacts. The Wet-Health2 assessment determined that the systems fall within the 'D' ecological category for present condition (Table 1). The vegetation component scored particularly poorly due to transformation of natural habitat and erosion.

Table 1: Outcomes of WET-Health Version 2 assessment

Wetland PES Summary				
Wetland name	Unnamed			
Assessment Unit	UCVB1			
PES Assessment	HYDROLOGY	GEOMORPHOLOGY	WATER QUALITY	VEGETATION
Impact Score	4.8	3.5	3.0	7.0
PES Score (%)	52%	65%	70%	30%
Ecological Category	D	C	C	E
Combined Impact Score	4.6			
Combined PES Score (%)	54%			
Combined Ecological Category	D			

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.

5.2 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 2). However, the wetlands scored poorly for the other ecosystem services assessed due to their degraded ecological state (D 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 channel incision and lateral habitat loss. The ongoing disturbances are resulting in the degradation of any remaining habitat. The biodiversity of the wetland is ubiquitous and no longer sensitive to flow and habitat modifications.

Table 2: 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	1.3	3.0	1.3	Moderately 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	2.4	4.0	2.9	High
	Harvestable resources	0.5	0.0	0.0	Very Low
	Food for livestock	3.0	2.0	2.5	Moderately High
	Cultivated foods	3.0	3.0	3.0	High

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

5.3 Aquatic buffer zone

An aquatic impact buffer zone is defined as a zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels (Macfarlane and Bredin 2016). Aquatic buffer zones are designed to act as barriers between human activities and sensitive water resources in order to protect them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions and have therefore been adopted as a standard measure to protect water resources and associated biodiversity.

Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane & Bredin (2017) for wetlands, rivers and estuaries was used. These buffer models are based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of activity, as well as the proposed alteration of hydrological flows. Based then on available information for the site, the buffer model recommends a 20m buffer zone between wetland habitat and the activities (Table 3).

Table 3: Determination of buffer zone requirements

Final aquatic impact buffer requirements (including practical management considerations)	
Construction Phase	20
Operational Phase	20
Final aquatic impact buffer requirement	20

6. SPECIALIST FINDINGS / IDENTIFICATION AND ASSESSMENT OF IMPACTS

Using the baseline description and field data while considering the current disturbances and site characteristics, the following features were identified, then categorized into one of a number of pre-determined sensitivity categories to provide, protect and/or guide the layout planning and design processes of the corridor and a suitable alignment for the grid within.

The SEI protocol used in this assessment provides a species and habitat ranking approach to assessing the importance and thus indirectly the sensitivity of a particular site. This was adapted from SANBI, 2020 Ver 3.1 2022, and Table 4 indicates the Sensitivity Ratings, calculated as follows and then summarised spatially in Figure 5.

Note SEI is calculated as follows based on Section 8 of SANBI (2020):

$$\text{Site Ecological Importance} = \text{Biodiversity Importance (BI)} + \text{Receptor Resilience (RR)}$$

Where BI = Conservation Importance (CI) + Functional Integrity (FI)

Table 4: Species and habitat sensitivity rating definitions

Sensitivity Rating	Description
Very High (No Go)	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation is not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Not sensitive (uncatergorised)	Minimisation mitigation – development activities of medium to high impact are acceptable and restoration activities may not be required.

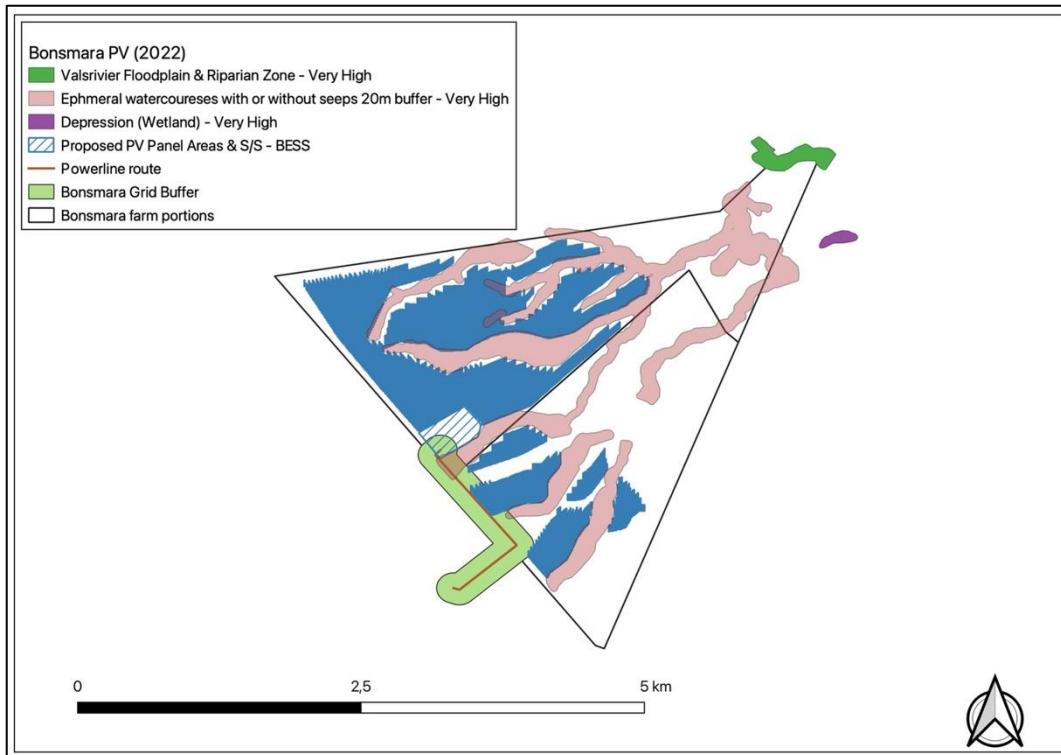


Figure 5: Habitat sensitivity map inclusive of aquatic habitats assessed

The following impacts were then assessed (Table 5 & 6 below), which are aligned with those contained in the Biodiversity Assessment Protocols and included in the table below and assessed against the proposed alignment and potential activities:

Biodiversity Assessment Protocol Impacts found applicable to this project	Impacts assessed in this report below
Faunal and vegetation communities inhabiting the site	Impact 1, 2, 3 and 4
Fragmentation (physical loss of ecological connectivity and or CBA corridors)	Impact 2 and 4
Changes in numbers and density of species	Impact 2, 3, and 4
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Impact 3
Hydrological regime or Hydroperiod changes (Quantity changes such as abstraction or diversion)	Impact 4
Streamflow regulation	Impact 4
Erosion control	Impact 4
No-Go Impact	Impact 5
Cumulative Impacts	Impact 6

As highlighted above, the following impacts on the environment have been identified and will be assessed in greater detail as follows, as well as separately the No-Go and Cumulative impacts:

Construction & Decommissioning Phases

- Impact 1: Loss of aquatic species of special concern
- Impact 2: Damage or loss of riparian systems, ephemeral watercourses and wetland systems in the construction phase
- Impact 3: Potential impact on localised surface water quality

Operational phase

- Impact 4: Impact on aquatic systems through the possible increase in surface water runoff on form and function - Increase in sedimentation and erosion

6.1 Construction & Decommissioning Phase

Table 5: Rating of impacts for the construction and decommissioning phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S
Construction/ Decommissioning Phase																				
Impact 1: Loss of aquatic species of special concern	The construction activities will result in the disturbance of aquatic habitats that may contain listed and or protected plant or animal species. However, none of these were observed during this assessment	1	1	1	1	1	1	5	-	LOW (-ve)	Develop and implement an Rehabilitation and Monitoring plan post Environmental Authorisation. This must be developed following the finalisation of the panel / road layout and a walk down has been completed. This plan should include relocation of suitable plant species, but more important protect any topsoil stores and promote the collection of vegetative material and propagules / seed to assist with the revegetation of the site Where possible, temporary construction lay-down or assembly areas should be sited on transformed areas; and Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the re-establishment of plant	1	1	1	1	1	1	5	-	LOW (-ve)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION																											
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S																			
												cover is desirable to prevent erosion.																											
Impact 2: Damage or loss of riparian systems, ephemeral watercourses and wetland systems in the construction phase	Construction could result in the loss of drainage systems that are fully functional and provide an ecosystem services within the site especially where new access roads are required or road upgrades will widen any current bridges or drifts. Loss can also include a functional loss, through change in vegetation type via alien encroachment for example.	2	3	2	2	3	2	24	-		MEDIUM (-ve)	A pre-construction walkthrough with an aquatic specialists 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. All alien plant re-growth, which is currently low within the greater region must be monitored and should it occur, these plants must be eradicated within the project footprints and especially in areas near the proposed crossings. Where roads and crossings are upgraded, the following applies: Existing pipe culverts must be removed and replaced with suitable sized box culverts, especially where road levels are raised to accommodate any large vehicles. River levels, regardless of the current state of the river / water course must be reinstated thus preventing any	1	3	2	1	2	2	18	-		LOW (-ve)																	

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION									
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S	
												impoundments from being formed. The related designs must be assessed by an aquatic specialist during a pre-construction walkdown. 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). A detailed monitoring plan must be developed in the pre-construction phase by an aquatic specialist, where any delineated system occurs within 50 m of existing crossings.									
Impact 3: Potential impact on localised surface water quality (construction materials and fuel storage facilities)	During construction earthworks will expose and mobilise earth materials, and a number of materials as well	1	3	2	2	3	3	33	-	MEDIUM (-ve)	<ul style="list-style-type: none"> All liquid chemicals including fuels and oil, including the BESS must be stored in with secondary containment (bunds or containers or berms) that can contain a 	1	3	2	1	2	2	18	-	LOW (-ve)	

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION															
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S							
during the construction and decommissioning phases	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. Leaks or spills from storage facilities also pose a risk and due consideration to the safe design and management of the 30 000l fuel storage facility must be given. Although unlikely, consideration must also be provided for the proposed Battery Energy Storage System (BESS), with regard safe handling during the											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. <ul style="list-style-type: none"> 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 refuelled or serviced within 100m of a river channel. All construction camps, lay down areas, wash bays, batching plants or areas and any stores should be more than 50 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 															

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION																	
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S									
	construction phase. This to avoid any spills or leaks from this system																			be minimised and sediment recoverable;									

6.2 Operation

Table 6: Rating of impacts for the operational phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S
Operation Phase																				
Impact 4 Impact on aquatic systems through the possible increase in surface water runoff on form and function during the operational phase	Increase in hard surface areas, and roads that require stormwater management will increase through the concentration of surface water flows that could result in localised changes to flows (volume) that would result in form and function changes within aquatic systems, which are currently ephemeral. This then increases the rate of erosions and sedimentation of downstream areas.	2	3	2	2	3	3	36	-	MEDIUM (-ve)	A stormwater management plan must be developed in the preconstruction phase, detailing the stormwater structures and management interventions that must be installed to manage the increase of surface water flows directly into any natural systems. This stormwater control systems must be inspected on an annual basis to ensure these are functional. Effective stormwater management must include effective stabilisation (gabions and Reno mattresses) of exposed soil and	1	1	1	1	1	1	5	-	LOW (-ve)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S
											the re-vegetation of any disturbed riverbanks									

6.3 No go Impact

Table 7: Rating of impacts (No-go)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS	S		E	P	R	L	D	I / M	TOTAL	STATUS	S
No-Go																				
Impact on aquatic resources should the project not go ahead (i.e. the No Go Alternative)	Should the project not proceed, then current status quo with regard the environment would remain unchanged. Overall, the area is largely in a natural state. But present day impacts do occur in localised areas and included the following: <ul style="list-style-type: none"> Increase in unpalatable species due to past grazing activities Erosion as a result of road crossings; Several farm dams; and Undersized culverts within 	1	3	2	1	2	2	18	-	LOW (-ve)	Improve current grazing management, although this is occurring within the surrounding conservation areas and or areas that are used for any hunting / game farming Improve the current stormwater and energy dissipation features not currently found along the tracks and roads within the region Install properly sized culverts with erosion protection measures at the present road / track crossings	1	3	2	1	2	2	18	-	LOW (-ve)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATU S	S		E	P	R	L	D	I / M	TOTAL	STATU S	S
	present day road crossings.																			

6.4 Cumulative Impacts

A cumulative impact assessment was conducted by assessing this project in relation to any other proposed projects within a 30km radius. However, all of the reports were based on the premise that all layouts were developed on the basis of impact avoidance, with particular reference to the avoidance of Very High Sensitivity areas. Consequently, all the impacts that remain could be mitigated mostly through revegetation and / or proper stormwater management. Thus all the impacts would be Medium to Low depending on the scale of the sites, but found acceptable.

Table 8: Rating of cumulative impacts

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION										RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION									
		E	P	R	L	D	I/M	TOTAL	STATUS	S	E		P	R	L	D	I/M	TOTAL	STATUS	S		
Cumulative Phase																						
Cumulative Impact of various proposed projects and associated grid lines on the natural environment	The cumulative assessment considers the various proposed renewable projects that occur within a 35km radius of this site, where the author has either been involved in the assessment of these projects and or review of the past assessments as part of any required Water Use Licenses	1	1	1	1	1	1	5	-	LOW (-ve)	The premise of all the reviewed or assessed projects has been the avoidance of impacts on the Very High Sensitivity environments, which have been achieved by the various proposed layouts. The only remaining impacts will be the crossing of internal roads over minor watercourse / drainage lines or areas rated as LOW sensitivity.	1	3	2	1	2	2	18	-	LOW (-ve)		

6.5 Overall Impact Rating

Table 9: Overall Impact Significance for the WEF (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction Phase			
Impact 1: Loss of aquatic species of special concern	Low	<p>Develop and implement an Rehabilitation and Monitoring plan post Environmental Authorisation. This must be developed following the finalisation of the panel / road layout and a walk down has been completed. This plan should include relocation of suitable plant species, but more important protect any topsoil stores and promote the collection of vegetative material and propagules / seed to assist with the revegetation of the site</p> <p>Where possible, temporary construction lay-down or assembly areas should be sited on transformed areas; and</p> <p>Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the re- establishment of plant cover is desirable to prevent erosion.</p>	Low
Impact 2: Damage or loss of riparian systems, ephemeral watercourses and wetland systems in the construction phase	Medium	<p>A pre-construction walkthrough with an aquatic specialists 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. All alien plant re-growth, which is currently low within the greater region must be monitored and should it occur, these plants must be eradicated within the project footprints</p> <p>Where roads and crossings are upgraded, the following applies: Existing pipe culverts must be removed and replaced with suitable sized box culverts, especially where road levels are raised to accommodate any large</p>	Low

		<p>vehicles.</p> <p>River levels, regardless of the current state of the river / water course must be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist during a pre-construction walkdown.</p> <p>Where large cut and fill areas are required these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation.</p> <p>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).</p> <p>A detailed monitoring plan must be developed in the pre-construction phase by an aquatic specialist, where any delineated system occurs within 50 m of existing crossings.</p>	
<p>Impact 3: Potential impact on localised surface water quality (construction materials and fuel storage facilities) during the construction and decommissioning phases</p>	<p>Medium</p>	<ul style="list-style-type: none"> • All liquid chemicals including fuels and oil, including 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 refuelled or serviced within 100m of a river channel. • All construction camps, lay down areas, wash bays, batching plants or areas and any stores should be more than 50 m from any demarcated water courses. Note comment regards Camp A that requires micro-siting. 	<p>Low</p>

		<ul style="list-style-type: none"> • 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; 	
Operation Phase			
Impact 4 Impact on aquatic systems through the possible increase in surface water runoff on form and function during the operational phase	Medium	A stormwater management plan must be developed in the preconstruction phase, detailing the stormwater structures and management interventions that must be installed to manage the increase of surface water flows directly into any natural systems. This stormwater control systems must be inspected on an annual basis to ensure these are functional. Effective stormwater management must include effective stabilisation (gabions and Reno mattresses) of exposed soil and the re-vegetation of any disturbed riverbanks	Low
No-Go	Low	<p>Improve current grazing management, although this is occurring within the surrounding conservation areas and or areas that are used for any hunting / game farming</p> <p>Improve the current stormwater and energy dissipation features not currently found along the tracks and roads within the region</p> <p>Install properly sized culverts with erosion protection measures at the present road / track crossings</p>	Low
Cumulative Impacts	Low	The premise of all the reviewed or assessed projects has been the avoidance of impacts on the Very High Sensitivity environments, which have been achieved by the various proposed layouts. The only remaining impacts will be the crossing of internal roads over minor watercourse / drainage lines or areas rated as LOW sensitivity.	Low

7. CONCLUSION AND SUMMARY

7.1 Summary of Findings

The project overall has aligned the proposed footprint with the aquatic features, allowing for retention of much of the natural environment so that the systems should remain largely unaffected. Therefore, the PV site and grid, is such that it carries a low intensity impact on the aquatic resources, but requiring the clearing of areas with some areas, especially when considering the associated roads, cables that may need to cross some of the aquatic systems.

However the current layout has the potential, to a large degree, to avoid these sensitive features, but will need to take cognizance of some of the buffer areas, that will further reduce the potential overall impact and environmental risk.

The overall and cumulative impacts, as assessed, are linked to instances where complete avoidance was not possible, or the nature of the activities involve a potential risk to aquatic resources even at great distance. Overall, it is expected that the impact on the environment would be Low (-). Noteworthy areas, that should be avoided, include the Very High Sensitivity areas as shown in this report. Existing crossings may be used and/or upgraded that intersect these systems however, a detailed monitoring plan must be developed in the pre-construction phase for these crossings.

7.2 Conclusion and Impact Statement

Based on the findings of this study, the specialist finds no reason to withhold an authorisation of any of the proposed activities, assuming that key mitigations measures are implemented. However, this must all still be assessed once the final layout has been provided, coupled with a micro-siting walkdown once all information is available.

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Appendix 1 Specialist CV

CURRICULUM VITAE Dr Brian Michael Colloty 7212215031083

1 Rossini Rd
Pari Park
Gqeberha, 6070
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

- 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 Biofuels 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 behalf 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).

Appendix 2 – Site Verification Report

SITE SENSITIVITY VERIFICATION (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

INTRODUCTION

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

SITE SENSITIVITY VERIFICATION

Using the result of the specialist ecological impact assessment, that made use of past and current spatial databases, aerial images and field work conducted within and adjacent to the site over a number of years / seasons, various habitats were delineated and the rated in terms of their sensitivity.

OUTCOME OF SITE SENSITIVITY VERIFICATION

Similar to the results of the Screening Tool, the study area contained three types of sensitivity, namely Very High Medium and Low (Figure 1-4). However, the extent of the Very High Sensitivity areas was found be greater in extent as shown in Figure 5.

NATIONAL ENVIRONMENTAL SCREENING TOOL

Based on the DFFE Screening Tool, the site contains areas of very high sensitivity due to the presence of wetlands and a Strategic Water Resources Area. The remaining area within the development footprint is deemed to be of Low sensitivity (Figure 1-2).

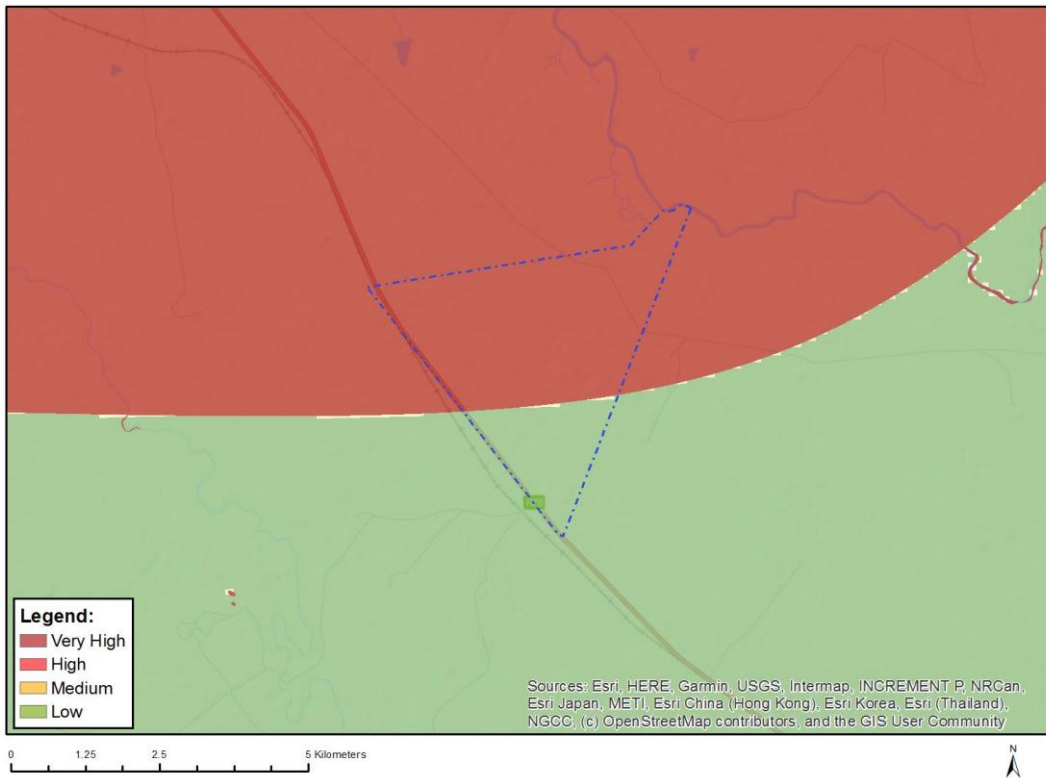


Figure 1. DFFE Screening Tool outcome for the aquatic biodiversity theme for the PV farm area

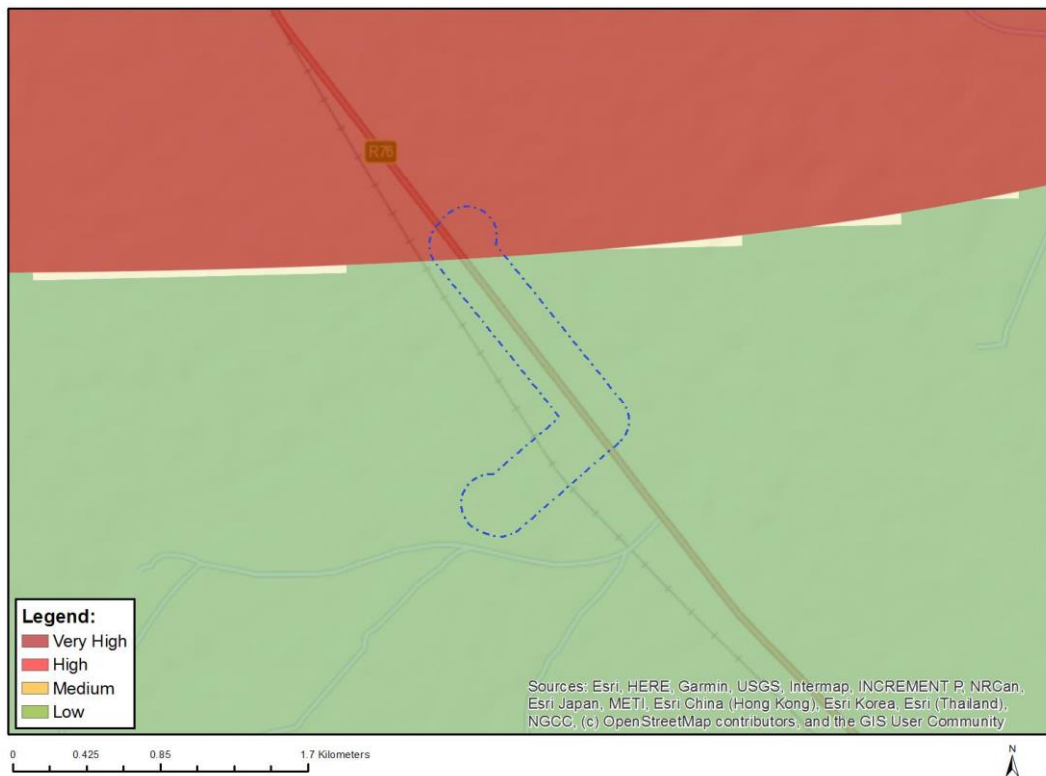


Figure 1. DFFE Screening Tool outcome for the aquatic biodiversity theme for the PV farm area

Figure 3 below shows the sensitivity map produced following the ecological assessment as well as a ground-truthing exercises, with mapping of the observed features at a finer scale.

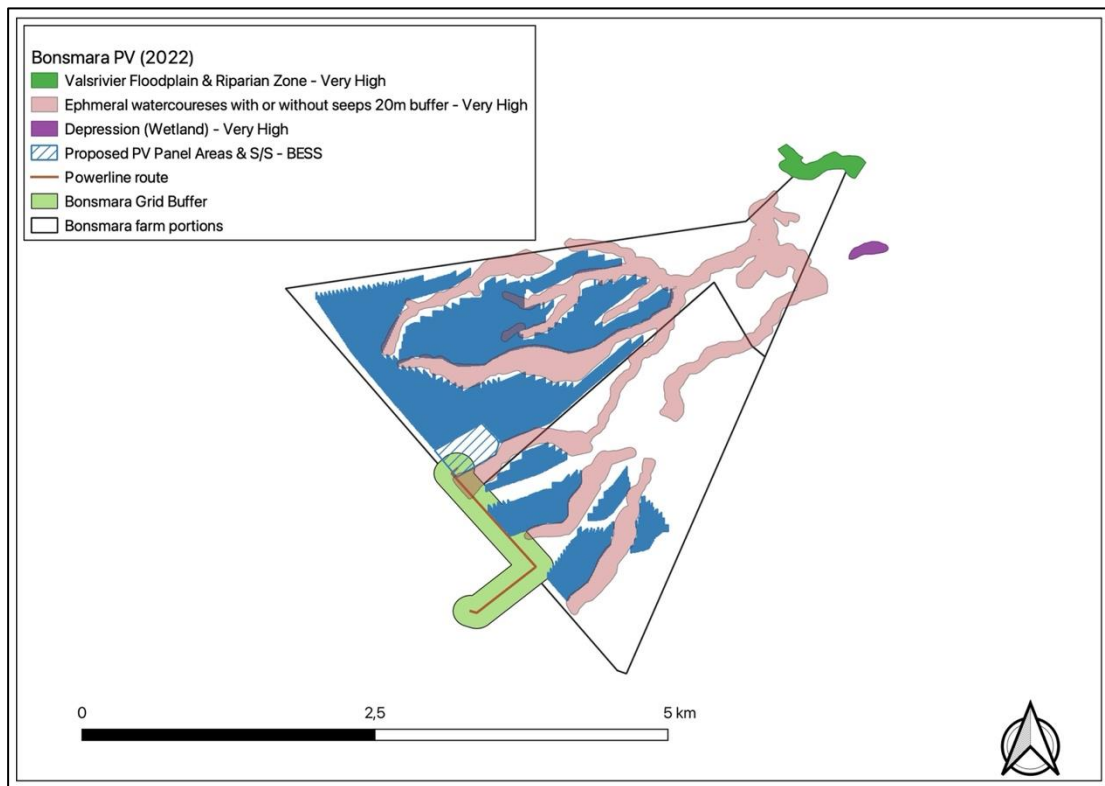


Figure 3. Environmental sensitivity map produced by the aquatic specialist

CONCLUSION

In conclusion, the DFFE Screening Tool identified two sensitivity ratings within the development study area, very high, and low. Although there is some overlap with the findings on site and the Screening Tool’s outcome, the extent of the Very High sensitivity areas was found to be greater than the extent in the Screening Tool.

However and appropriate layout can be developed to minimise the impact on the Very High areas, but must be verified once the final layout inclusive of roads has been developed.

Appendix 3: Detailed aquatic assessment methodology

This study 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 aquatic systems, applicable to the specific environment and, in a clear and objective manner, identify and assess the potential impacts associated with the proposed development site 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 will be used in this study. It is also 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 are as follows:

- **Drainage line:** A drainage line is a 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 contains 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 (e.g. 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 (Water Act 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 National Water Act 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

8.1 Waterbody classification systems

Since the late 1960's, wetland classification systems have undergone a series of international and national revisions. These 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 National Wetland Classification Systems (NWCS) (Ollis *et al.*, 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (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 thus the common driving force, in the formation of wetlands (DWA, 2005). It is significant that the HGM approach has now been included in the wetland classifications as the HGM 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. All 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 Department of Water and Sanitation (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 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 are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: 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 & Forestry (DWAFF) 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.

8.2 Wetland definition

Although the National Wetland Classification System (NWCS) (Ollis *et al.*, 2013) is used to classify wetland types 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 fens 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 National Water Act (Act No. 36 of 1998) (NWA), 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 therefore have one or more of the following attributes to meet the above definition (DWAFF, 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 proposed NWCS, the NWA and ecosystems included in DWAF’s (2005) delineation manual.

Ecosystem	NWCS “wetland”	National Water Act wetland	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 National Water Act, they are included as a ‘watercourse’ in terms of the Act

² According to the National Water Act 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 (2005) delineation manual.

8.3 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 & 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)
- 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 hydrogeomorphic (HGM) units discussed earlier. The HGM 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
- 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-hierarchical 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 thus nested in relation to each other.

The HGM unit (Level 4) is the focal point of the NWCS, with the upper levels (Figure 3 Figure – 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 Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

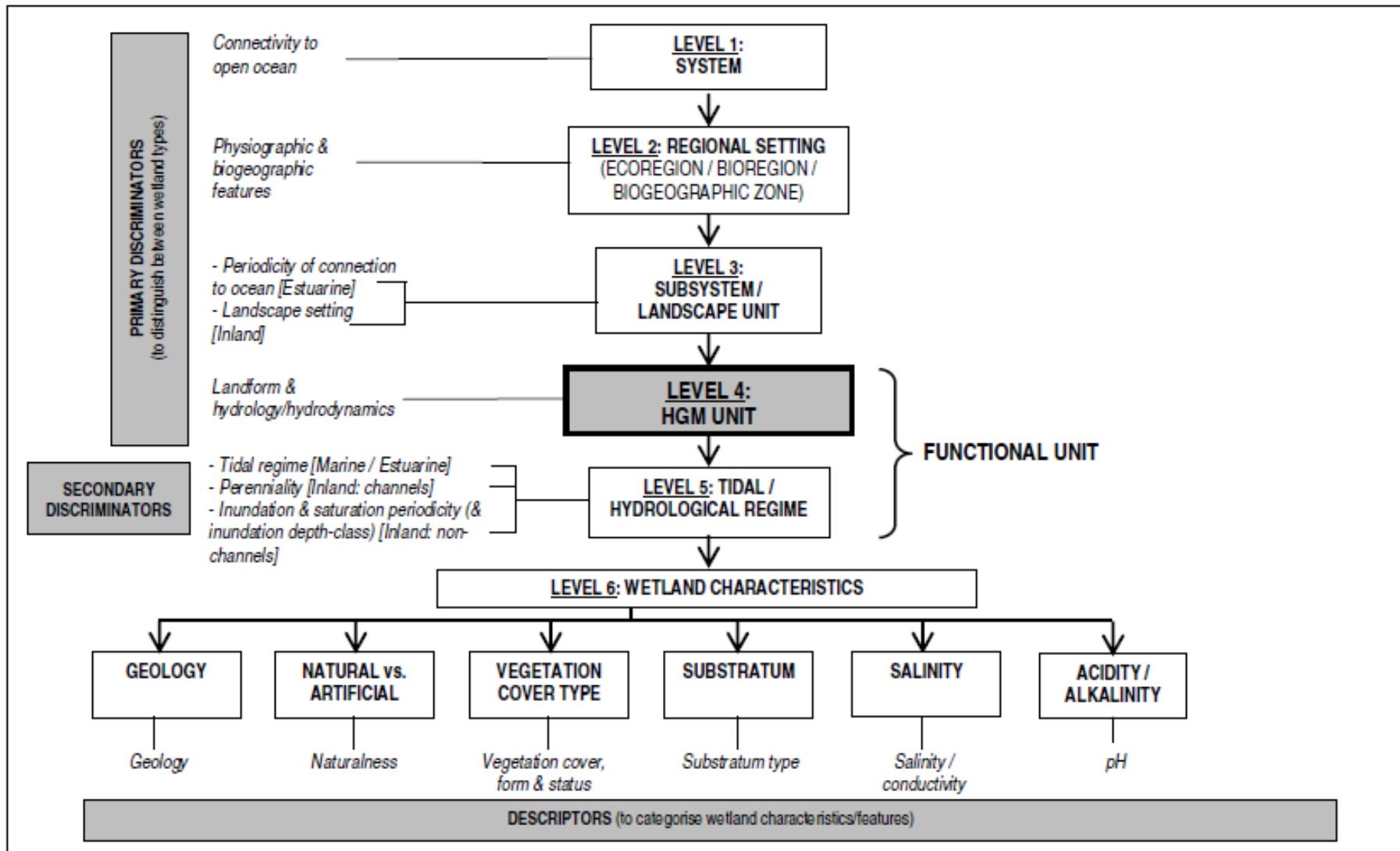


Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied

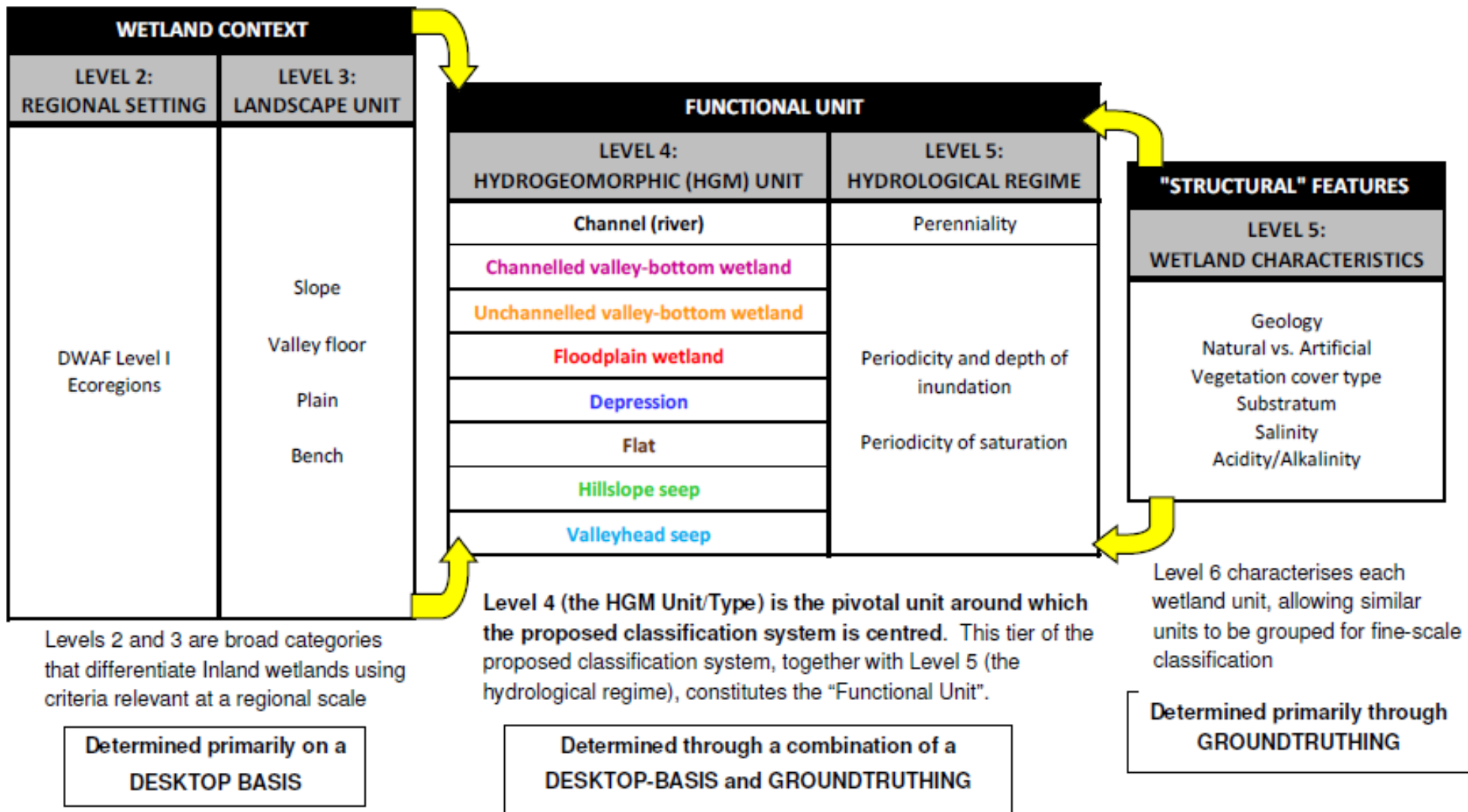


Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al.*, 2013)

8.4 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) 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 (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.

8.5 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, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

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 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

Ecosystem services supplied by wetlands	<i>Indirect benefits</i>	Hydro-geochemical benefits	Flood attenuation		
			Stream flow regulation		
			Water quality enhancement benefits	Sediment trapping	
				Phosphate assimilation	
				Nitrate assimilation	
				Toxicant assimilation	
				Erosion control	
	Carbon storage				
	<i>Direct benefits</i>	Biodiversity maintenance			
		<i>Provision of water for human use</i>			
		<i>Provision of harvestable resources²</i>			
		<i>Provision of cultivated foods</i>			
		<i>Cultural significance</i>			
		<i>Tourism and recreation</i>			
<i>Education and research</i>					

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.