

**ENVIRONMENTAL IMPACT ASSESSMENT (BAR) FOR THE PROPOSED KARROID
PV FACILITY NEAR GEELKOP, IN THE NORTHERN CAPE PROVINCE**

AQUATIC IMPACT ASSESSMENT

FOR

KARROID PV (PTY) LTD

BY



EnviroSci (Pty) Ltd

Dr Brian Colloty

1 Rossini Rd
Pari Park
Port Elizabeth
6070

DATE

5 May 2020

REVISION 1

Executive Summary

Karroid PV (Pty) Ltd appointed EnviroSci (Pty) Ltd to conduct a review and assessment of the proposed facility and potential impact of the facility and supporting infrastructure on the aquatic environment, based on a detailed 3 day site visit conducted in February 2020. The study area includes, Geel Kop Farm No 456 RE (inclusive of a 500m buffer) and is located approximately 30 km south west of Upington in the Northern Cape Province. The development area refers to the 240 ha area that will contain the development footprint, which is defined as any areas that will require disturbance when establishing the project should it proceed.

This assessment included the delineation of any natural waterbodies within the property in question, as well as assessing the potential consequences of the proposed layout on the surrounding watercourses and wetlands. This was based on information collected during the site visit and compared to assessment data collected in the same area in April 2010, July 2014, December 2016 and October 2018, spanning various seasons. The February 2020 survey followed heavy rainfall (>100mm) that fell in the region between December 2019 and late January 2020. This allowed for the collection of important detail on the extent and where heavy run-off occurs within these alluvial systems. That and if any extensive habitat / wetlands are supported within the site on a long term basis, i.e. hold water for more than three – four weeks, the typical time period required to support the life cycle on a number of aquatic plants and invertebrates.

The surveys adhered to the assessment criteria contained in the DWAF 2005/2008 delineation manuals, the National Wetland Classification System and the requisite habitat integrity methods to determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the observed aquatic systems. Note the PES rating scale is also used to show the Ecological Category of the system being assessed.

The [PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY](#) (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to.

It should be noted that the aquatic sensitivity spatial data was provided to the applicant prior to the lodging of the application for environmental authorisation, in order for them to develop an optimal layout. This would then allow for the avoidance of any critical habitats and where not possible provide mitigation to reduce the significance of the potential aquatic impacts. This process also then negated the need to assess any alternative sites and or layouts within this development area, especially as this and other projects will result in maximum use of the available space within the remainder of the farm portion for other PV projects by the same proponent. This will consolidate as many projects and the related impacts into one area, rather than have several spread over the region. This also would also allow for the consolidation of access roads, transmission lines and substations, further limiting the overall or cumulative impacts within the greater region, i.e. beyond the Upington / Keimoes area.

The proposed development occurs within the D73F catchment associated with alluvial systems of the Nama Karoo ecoregion. These mainstem watercourses are short tributaries of the Orange River (ca. 8.2 km from the development area), which are ephemeral in nature and did not contain any riverine wetland elements within the development footprint.

Overall, these watercourses are largely in a natural state, when compared to those associated with the Orange River reach, which has modified floodplains and flows. Current and existing impacts occur in localised areas within the development area and includes existing tracks and evidence of grazing (small livestock).

The National Wetland Inventory v5.2 spatial data (NWI), indicated riverine floodplains near the proposed access road, which were confirmed as alluvial channels in that database, as well as pans/depressions that surrounds the development areas. As opposed to other portions of the Farm, the presence of these wetlands and the pans, resulted in portions of the Farm Geel Kop, receiving a Very High Aquatic sensitivity rating in the DEA Screening Tool. However the Karroid PV development area is located in an area of LOW aquatic sensitivity as per the DEA Screening Tool. Thus a minimum of an Aquatic Biodiversity Compliance Statement is required as part of the Environmental Assessment (BAR). However as several of the pans and alluvial areas contained in the NWI were not accounted for, a detailed Aquatic Biodiversity Specialist Assessment (this report) was rather produced, which would then also provide consistency for the other projects being proposed within the same farm portion.

The only wetlands observed, included five depressions, and inclusive of the proposed buffers have been avoided by the development footprint (including the access road). Any activities within 500m of these pan boundaries will require a Water Use License.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the systems within the development area have been assigned a condition score of AB (Nel et al. 2011), indicating that they are largely intact and perform an ecological function. However, the development area systems are ephemeral and only carry water for a short period as previously mentioned, thus the observed systems do not support any wide riparian zones and the vegetation associated with these watercourses were between 0.65 m and 16 m wide and contain mostly terrestrial species.

Fourteen woody plant species were found associated with the riparian and pan systems within the development area. Although none of these were obligate or facultative river/wetland species, they do show a preference for areas exposed to runoff. The few grass or forb species were successfully identified were all associated with the regional vegetation types, namely Kalahari Karroid Shrubland (NKb 5), Bushmanland Arid Grassland (NKb 3) and Gordonia Duneveld (SVkd1).

The only obligate wetland plants observed were those found along the Orange River itself. Species observed included *Typha capensis*, *Phragmites australis*, *Prosopis glandulosa* and *Cyperus marginatus*. Notably the prevalence of *Prosopis*, an alien invasive tree species had increased between 2010 and this survey within the sites that had been visited previously by this report author. However, none of the project components would affect these species or habitats that they occur in, both from a hydrological and physical disturbance standpoint.

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel et al., 2011), also earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchment areas are then classified as Freshwater Ecosystems Priority Areas (FEPAs). The access road portion of the development area falls within a Fish FSA (Fish Support Area or Fish Sanctuary), associated with the Orange River. Although no permanent fish habitat occurs within the proposed development, Fish Sanctuaries are sub-quaternary catchments that are required to meet biodiversity targets for threatened and near threatened fish species indigenous to South Africa. Furthermore, Fish sanctuaries in sub-quaternary catchments associated with a river reach in good condition (A or B Ecological Category) were selected as FEPAs; the remaining fish sanctuaries became Fish Support Areas.

Fish Support Areas also include sub-quaternary catchments that are important for migration of threatened and near threatened fish species. Thus, any river reaches within Fish Support Areas need to

be maintained in a condition that supports the associated populations of threatened fish species, which need not necessarily be an A or B ecological category.

The Present Ecological State scores (PES) for the development area were rated B – largely natural, while the associated reach along the Orange River, located at the confluence of these main watercourse was rated as follows (DWS, 2014 – where C = Moderately Modified):

Subquaternary Catchment Number	Present Ecological State	Catchment Ecological Importance	Catchment Ecological Sensitivity
3151	C	Moderate	High

Although the Orange River reach associated with the study area systems was rated as having a lower ecological state, the surrounding catchments, inclusive of the development area, these were still considered to have a Moderate and High Ecological Importance and Ecological Sensitivity and for this reason the development area was included as a Critical Biodiversity Area Type 2 and Ecological Support Areas as shown in the Northern Cape CBA map.

The unaffected pan / depressions (> 0.5 ha) received a PES score of B, and EIS score of Medium. The score (PES = B) was due to the effect of grazing / trampling by animals searching for shade or water.

The PES and EIS scores were then translated in the respective sensitivity ratings of the various aquatic systems (Very High to Moderate), and used to prepare a sensitivity map, used in guiding the preparation of the layout. This was also conducted in conjunction with the other specialists to determine the layout to reduce the number of overall impacts.

Thus, the layout for the most part, was developed to avoid all Mainstem Alluvial Watercourses and Pans (inclusive of the 48m buffer), which were rated as Very High Sensitivity. These corresponded to the Very High Sensitivity systems considered in the DEA Screening Tool spatial data, although this report considers their actual hydrogeomorphic classification, i.e. only the pans are considered a wetland type.

Small portions of the secondary aquatic systems (highly ephemeral, with no aquatic habitat) are located within the development area were considered Moderately Sensitive. No buffer was proposed, as several technical and other environmental constraints (sensitive vegetation for example), needed to be considered, thus several PV panel areas needed to be placed within these secondary systems. Each of these areas, where panels will be placed was considered on an area for area basis, to ensure that the panels will be placed within areas that won't affect the general hydrology of the region and or result in alteration of the form or function of the respective aquatic systems.

The following direct impacts were then assessed, which are aligned with those contained in the Biodiversity Assessment Protocol and include in the table below and assessed against the layout:

Biodiversity Assessment Protocol Impacts found applicable to this project	Impacts assessed in this report below
Fragmentation (physical loss of ecological connectivity and or CBA corridors)	Impact 1 & 2
Changes in numbers and density of species	Impact 1 & 2
Faunal and vegetation communities inhabiting the site	Impact 1 & 2
Hydrological regime or Hydroperiod changes (Quantity changes such as abstraction or diversion)	Impact 3
Streamflow regulation	Impact 3
Erosion control	Impact 4
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Impact 5
Cumulative Impacts	Impact 6

- Impact 1: Loss of Very High Sensitivity systems, namely the mainstem alluvial water course and a pan through physical disturbance although the proposed layout will avoid any of these systems (Figure 8).
- Impact 2: Impact on secondary alluvial water courses (Moderate Sensitivity), through physical disturbance
- Impact 3: Impact on all riparian and wetland systems through the possible increase in surface water runoff on riparian form and function through hydrological changes
- Impact 4: Increase in sedimentation and erosion
- Impact 5: Risks on the aquatic environment due to water quality impacts
- Impact 6: Cumulative impacts

In summary, the proposed layout for the facility would not have a direct impact on the following:

- Any Very High sensitivity areas identified by the DEA Screening Tool for the Farm Geel Kop 456, RE
- Mainstem rivers and Pans that do contain functioning aquatic environments that received a Very High sensitivity rating as indicated in Figure 8, with the small 110m² section of panel area internal road and fence within the buffer zone being considered negligible.

Some impacts (panel areas & road crossings) are located in secondary alluvial water courses that were either fragmented or contained no riparian zones, with a Moderate sensitivity. With the proposed mitigation (proper stormwater management and post construction rehabilitation), the impacts would be Low and acceptable for development, as these areas contained no aquatic habitat, and only functioned as a means to sustain / convey baseflows within the greater catchment. The proposed development would in essence not impact on this as surface runoff, although managed to prevent erosion, would still emanate from the site (when significant rainfall occurs), thus maintain this aspect of the hydrological system observed

Therefore, based on the results of this report, the significance of the remaining impacts assessed for the aquatic systems after mitigation would be LOW. This includes the internal roads proposed that would need to cross some of these systems. Thus, based on the findings of this study no objection to

the authorisation of any of the proposed activities is made at this point based on the current layout as provided by the developer.

This report also indicates the watercourses and pans within 500m of the development area. Any activities within these areas, the buffers or 500m from the wetland boundary will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998).

As the proposed activities have the potential to create erosion, the following recommendations are reiterated:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment, and suitable dust and erosion control mitigation measures should be included in the EMP to mitigate.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks outside of any delineated waterbodies and their buffers. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel.
- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report.
- All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.
- It is further recommended that a comprehensive rehabilitation plan be implemented from the project onset within watercourse areas (including buffers) to ensure a net benefit to the aquatic environment. This should form part of the suggested walk down as part of the final EMP preparation preconstruction.

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ACRONYMS

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water and Sanitation formerly the Department of Water Affairs
EIA	Ecological Importance and Sensitivity
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GIS	Geographic Information System
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, <i>et al.</i> 2011).
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SQ	Subquaternary catchment
WUL	Water Use License
WULA	Water Use License Application

**COMPLIANCE WITH THE PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT
CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY ISSUED 20
MARCH 2020, REPLACING REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF 7 APRIL
2017**

DEA Screening Tool Summary			
Requirement	Completed / Assessed	Date	Comments
Desktop and satellite imagery analysis	Yes	5 March 2020	
Preliminary On-site inspection	No	27-29 February 2020	Several summer / winter, as well low and high rainfall periods have been observed within the region over the years
Additional information			Results
1:50 000 topocadastral maps	Yes	5 March 2020	Cadastre and indicated features unchanged
Google Earth	Yes	5 March 2020	Used as the basis of GIS mapping and layout verification
National Wetland Inventory Spatial Data	Yes	5 March 2020	Natural and artificial systems present
National Vegetation Spatial Data	Yes	5 March 2020	Kalahari Karroid Shrubland, Bushmanland Arid Grassland & Gordonia Duneveld
Threatened Ecosystems Spatial Data	Yes	5 March 2020	None
Conservation Plans (WCBSP, ECBCP, NCBSP etc)	Yes	5 March 2020	Northern Cape Biodiversity Spatial Plan - ESA
National Freshwater Ecosystem Priority AREA (NFEPA)	Yes	5 March 2020	Fish Support Area (FSA)
Strategic Water Resource Area	Yes	5 March 2020	None
Free flowing Rivers	Yes	5 March 2020	None
Wetland Clusters	No	5 March 2020	None
Critical Biodiversity Area (CBA)	Yes	5 March 2020	Yes
Ecological Support Area (ESA)	Yes	5 March 2020	Yes – access road only
Ecological Importance and Sensitivity of Site (EIS)	Yes	5 March 2020	Moderate
Description of ecosystem processes (movement of surface water, recharge/discharge & sediment transport etc)	Yes	5 March 2020	Ephemeral alluvial systems with little to no riparian zones

Historic Reference Condition and Present Ecological State (PES) of rivers (instream, riparian, floodplain), wetlands or estuaries and possible changes to channel and flow regime (surface & groundwater)	Yes	5 March 2020	PES = B Reference Condition B	
Review of Screening Tool results	Present	Confirmed / Disputed (if disputed photographic evidence must be included into assessment)	Aquatic Biodiversity Specialist Assessment Protocol Required (Y/N or N/A)	Aquatic Biodiversity Compliance Statement Protocol required (Y / N or N/A)
Very High Aquatic Habitat	No	Confirmed, but avoided by the proposed layout	N/A	N/A
Low Aquatic Habitat	YES	Confirmed	YES – reasons stated in this report	N/A
Very High Terrestrial Habitat			NONE PROMULGATED AT THIS POINT	
Low Terrestrial Habitat				
ASSESSMENT AND REPORTING OF IMPACTS ON AQUATIC BIODIVERSITY PROTOCOL REQUIREMENTS				
Aquatic Biodiversity Specialist Assessment Protocol	YES	Aquatic Biodiversity Compliance Statement Protocol		NO
<i>Reason</i>	VERY HIGH aquatic habitats – within proximity of the development	<i>Reason</i>		
Proposed Site (Site Sensitivity)	Moderate only within the footprint	Proposed Site (Site Sensitivity)		
Preferred Site (Site Sensitivity)	Not Assessed as site specific sensitive no-go areas were provided at the onset of the design process in order to avoid the systems that were rated a No-Go where feasible	Preferred Site (Site Sensitivity)		
ANTICIPATED IMPACT AND IF REQUIRING ASSESSMENT IN THE SPECIALIST ASSESSMENT	(Y/N)	AQUATIC BIODIVERSITY COMPLIANCE STATEMENT REQUIREMENTS		(Y/N)
Aquatic features		Aquatic features		
Alteration in baseflow (increase or Reduction of overall flows)	No	Preferred site and proposed development footprint assessed		Yes

Hydrological regime or Hydroperiod changes (Quantity changes such as abstraction or diversion)	Yes	LOW site sensitivity confirmed	Yes with additional No-Go areas provided by the aquatic specialist including buffers
Change in hydrogeomorphic typing (Unchannelled valley bottom wetland to Channelled Valley Bottom Wetland)	No	Confirm whether or not the proposed development will have an impact on the aquatic features	Impacts will still occur
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Yes		
Fragmentation (physical loss of ecological connectivity and or CBA corridors)	Yes		
Loss or degradation of unique characters or features (waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, pans/ depressions)	No		
Ecosystem regulating and supporting services			
Flood attenuation	No		
Streamflow regulation	Yes		
Sediment trapping	No		
Phosphate assimilation	No		
Nitrate assimilation	No		
Toxicant assimilation	No		
Erosion control	Yes		
Carbon storage	No		
Ecosystem Community Composition			
Changes in numbers and density of species	Yes		
Integrity (condition, viability, predator prey ratios, dispersal rates)	Yes		
Faunal and vegetation communities inhabiting the site	Yes		
Estuary function (where applicable)			
Size of estuary	N/A		

Availability of sediment	N/A	
Wave action in mouth	N/A	
Protection of mouth	N/A	
Beach slope	N/A	
volume of Mean Annual Runoff	N/A	
Extent of saline intrusion (especially where relevant to Permanently Open Systems	N/A	

REPORTING REQUIREMENTS ADDRESSED OR INCLUDED IN THE ASSESSMENT / COMPLIANCE STATEMENT (REPLACING SECTION 6 OF NEMA REGULATIONS (REPORTING REQUIREMENTS

Details of SACNASP author included (Registration number, field of expertise and CV	YES	Details of SACNASP author included (Registration number, field of expertise and CV attached in appendix 1.	
Signed statement of independence	YES	Signed statement of independence	
Statement of duration, date and season of site inspection, methods and models use, as well as equipment	YES	A baseline profile description of biodiversity and ecosystems of the site	
Description of assumptions and limitations (uncertainties & knowledge gaps)	YES	The methodology used to verify the sensitivities of the aquatic biodiversity features on the site including the equipment and modelling used where relevant.	
Local of No-Go areas for construction and operation	YES	In the vase of linear activity, confirmation from the aquatic biodiversity specialist that in their opinion, based on the mitigation and remedial measures proposed the land cane be returned to the current state within two years of completion of the construction phase.	
Additional environmental impacts	YES	Proposed impact management actions and impact management outcomes or any monitoring requirements for inclusion in the EMPr.	
Direct, indirect and cumulative impacts assessed	YES	Description of assumptions and limitations (uncertainties & knowledge gaps).	
Degree to which impacts and risks can be mitigated	YES	Any conditions to which approval is subject	
Degree to which impact or risks can be reversed	YES	Signed copy of assessment must be appended to the BAR or EIA	
Degree to which impact or risks can cause the loss of irreplaceable resources	YES		

Inclusion of a suitable construction and operational buffer using accepted methodologies	YES	
Proposed impact management actions and impact management outcomes for inclusion in the EMPr	YES	
Motivation for using High Sensitive Areas versus available Low Biodiversity Sensitive Areas	YES	
Substantiated statement based on the findings of the specialist assessment, regarding the acceptability or no of the proposed development and if the proposed development should receive approval or not	YES	
Any conditions to which approval is subject	YES	
Signed copy of assessment must be appended to the BAR or EIA	YES	

Note: The above screening and protocol summary table remains intellectual property of EnviroSci (Pty) Ltd may not be distributed unless part of this this document.

SPECIALIST DECLARATION



environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

(For official use only)

File Reference Number:

NEAS Reference Number:

Date Received:

DEA/EIA/

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Karroid PV, Northern Cape Province.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at <https://www.environment.gov.za/documents/forms>.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:

Department of Environmental Affairs

Attention: Chief Director: Integrated Environmental Authorisations

Private Bag X447

Pretoria
 0001
Physical address:
 Department of Environmental Affairs
 Attention: Chief Director: Integrated Environmental Authorisations
 Environment House
 473 Steve Biko Road
 Arcadia
 Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
 Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

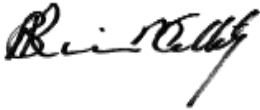
Specialist Company Name:	EnviroSci (Pty) Ltd		
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition
			100
Specialist name:	Dr Brian Colloty		
Specialist Qualifications:	Ph.D		
Professional affiliation/registration:	SACNASP Pr Sci Nat 400268/07 Ecological		
Physical address:	1 Rossini Rd Pari Park Port Elizabeth 6070		
Postal address:	1 Rossini Rd Pari Park Port Elizabeth 6070		
Postal code:	6070	Cell:	0834983299
Telephone:	0413662077	Fax:	-
E-mail:	b.colloty@gmail.com		

2. DECLARATION BY THE SPECIALIST

I, Brian Colloty, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.

- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

EnviroSci (Pty) Ltd

Name of Company:

5 May 2020

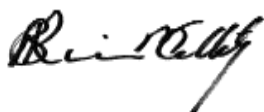
Date

SPECIALIST REPORT DETAILS

Report prepared by: Dr. Brian Colloty Pr.Sci.Nat. (Ecology) / Member SAEIES.

Expertise / Field of Study: BSc (Hons) Zoology, MSc Botany (Rivers), Ph.D Botany Conservation Importance rating (Estuaries) and interior wetland / riverine assessment consultant from 1996 to present.

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



Signed: Date: 5 May 2020.....

Appendix 1 of this report contains a detailed CV

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1. Introduction

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The surveys adhered to the assessment criteria contained in the DWAF 2005/2008 delineation manuals, the National Wetland Classification System and the requisite habitat integrity methods to determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the observed aquatic systems. Note the PES rating scale is also used to show the Ecological Category of the system being assessed.

The [PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY](#) (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to.

It should be noted that the aquatic sensitivity spatial data was provided to the applicant prior to the lodging of the application for environmental authorisation, in order for them to develop an optimal layout. This would then allow for the avoidance of any critical habitats and where not possible provide mitigation to reduce the significance of the potential aquatic impacts. This process also then negated the need to assess any alternative sites and or layouts within the development area, especially as this and other projects will result in maximum use of the available space within the remainder of the farm portion for other PV projects by the same proponent. This will consolidate as many projects and the related impacts into one area, rather than have several spread over the region. This also would also allow for the consolidation of access roads, transmission lines and substations, further limiting the overall or cumulative impacts within the greater region, i.e. beyond the Upington / Keimoes area.

Several important national, provincial and municipal scale conservation plans were also reviewed, with the results of those studies being included in this report. Most conservation plans are produced at a high level, so it is therefore important to verify the actual status of the study area during this initial phase, prior to the final development plan being produced.

1.2 Aims and objectives

The aim of this report is to provide the applicant with the requisite delineation of any natural waterbodies, while providing the competent authority with the relevant information to make an informed decision.

Certain aspects of the development may also trigger the need for a Section 21 c & i, Water Use License Applications (WULAs) (or General Authorisation [GA] applications) such as river or water course crossings or any activities within 500m of a wetland boundary. These applications must be submitted to the Department of Water and Sanitation (DWS) and information contained in this report must be used in the supporting documentation.

Information with regard to the state and function of the observed water bodies, suitable no-go buffers and assessment of the potential impacts are also provided.

1.3 Assumptions and Limitation

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of the aquatic communities, 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. No baseline long-term monitoring was undertaken as part of this assessment. However, a concerted effort was made to assess as much of the potential development area and the study area, as well as make use of any available literature, species distribution data and aerial photography. Furthermore, based on the previous assessments undertaken between 2010 and 2020 in the area, this was not foreseen as a huge limiting factor. The level of investigation undertaken is sufficient to inform this assessment.

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.

For the purposes of this report it is assumed that any existing roads and tracks within the development area will be upgraded (with the exception of a portion of Alternative 1 of the main access roads), while the new roads can avoid or span (Figure 1) the observed watercourses as far as possible. A further assumption is that water will be sourced from the Kai !Garib Local Municipality and not illegally abstracted from any surrounding watercourses, particularly if dust suppression is required.

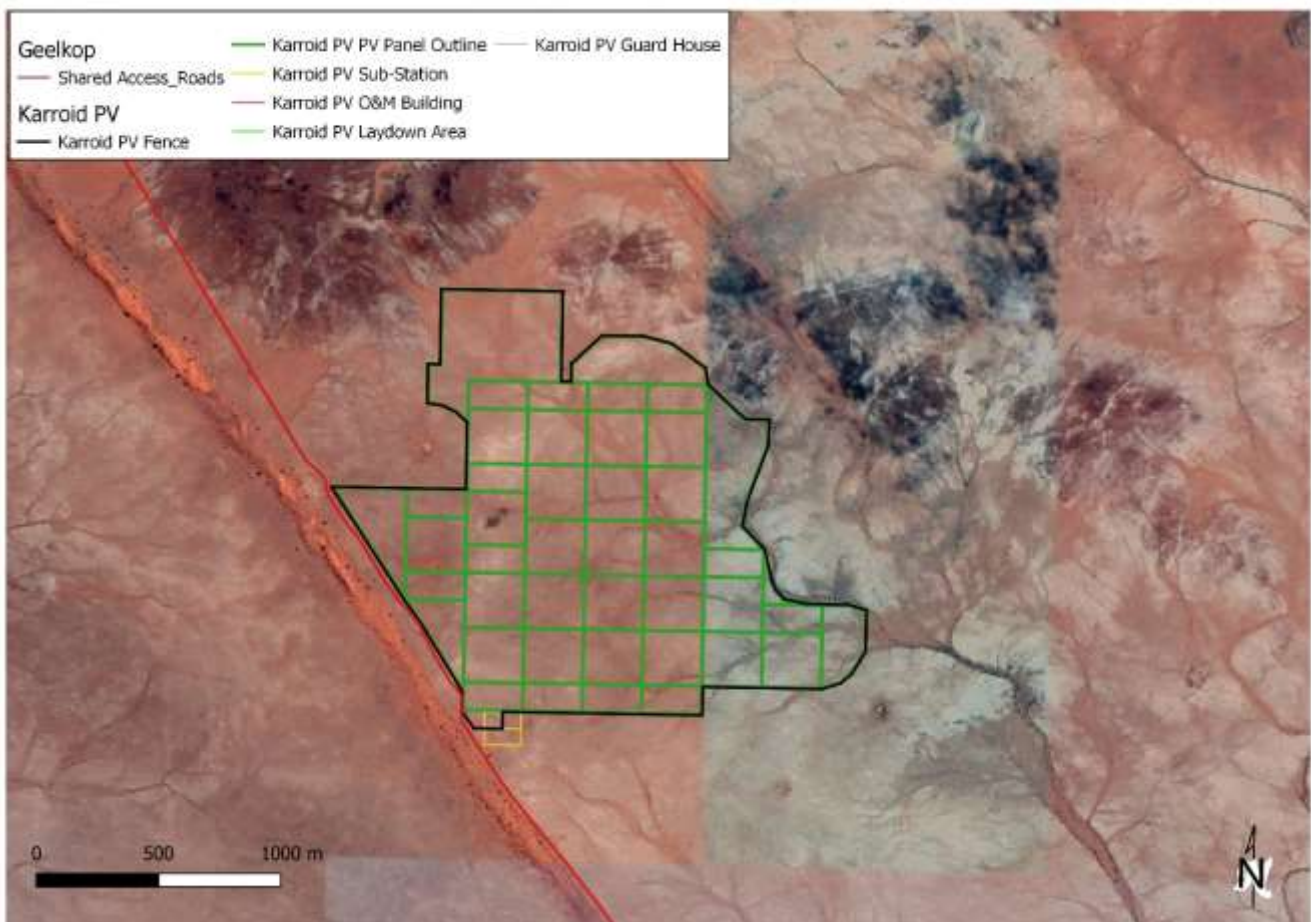


Figure 1: The proposed layout in relation to surrounding landscape

2. Terms of Reference

The following scope of work was used as the basis of this study to fulfil the above requirements as provided by the EAP:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with the Specialist Assessment Protocol 20 March 2020, as amended.
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines;
- Cumulative impact identification and assessment as a result of other developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification of sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
 - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
 - Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
 - Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc) and specialist comment if the proposed development should be authorised.

3. Project Description

The following information was provided by the client:

The Solar PV Development is to consist of solar photovoltaic (PV) technology, fixed-tilt, single-axis tracking or dual-axis tracking mounting structures, with a net generating capacity of 100 MWac as well as associated infrastructure, which will include:

- On-site switching-station / substation;
- Auxiliary buildings (gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Inverter-stations, transformers and internal electrical reticulation (underground cabling);
- Access and internal road network;
- Laydown area;
- Rainwater tanks; and
- Electrified Perimeter fencing and security infrastructure.

Karroid PV, will connect from the onsite sub-stations to the Upington MTS (400/132 kV), via the 132kV Geelkop Collector Substation (this basic assessment process only includes the IPP portion of the onsite sub-station, while the remainder of the grid connection is being assessed in a separate BAR process).

4. Methodology

This study followed the approaches of several national guidelines regarded for aquatic assessment and wetland assessments. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study area systems applicable to the specific environment and in a clear and objective manner, assess the potential impacts associated with the proposed development area based on information collected over a number of years for this and other proposed projects.

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, a system that also differentiates between riverine and wetland aquatic systems.

4.1 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 (DWAF, 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.

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.

4.2 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 (DWAF, 2005):

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

The site surveys included sampling (soil auguring) and species identification to ascertain the presence of any of the listed attributes.

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 1: 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 ¹	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

Where:

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.

4.3 National Wetland Classification System method

During this study, due to the nature of the wetlands and watercourses observed, it was determined that the newly accepted NWCS 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 – natural 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 – 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.

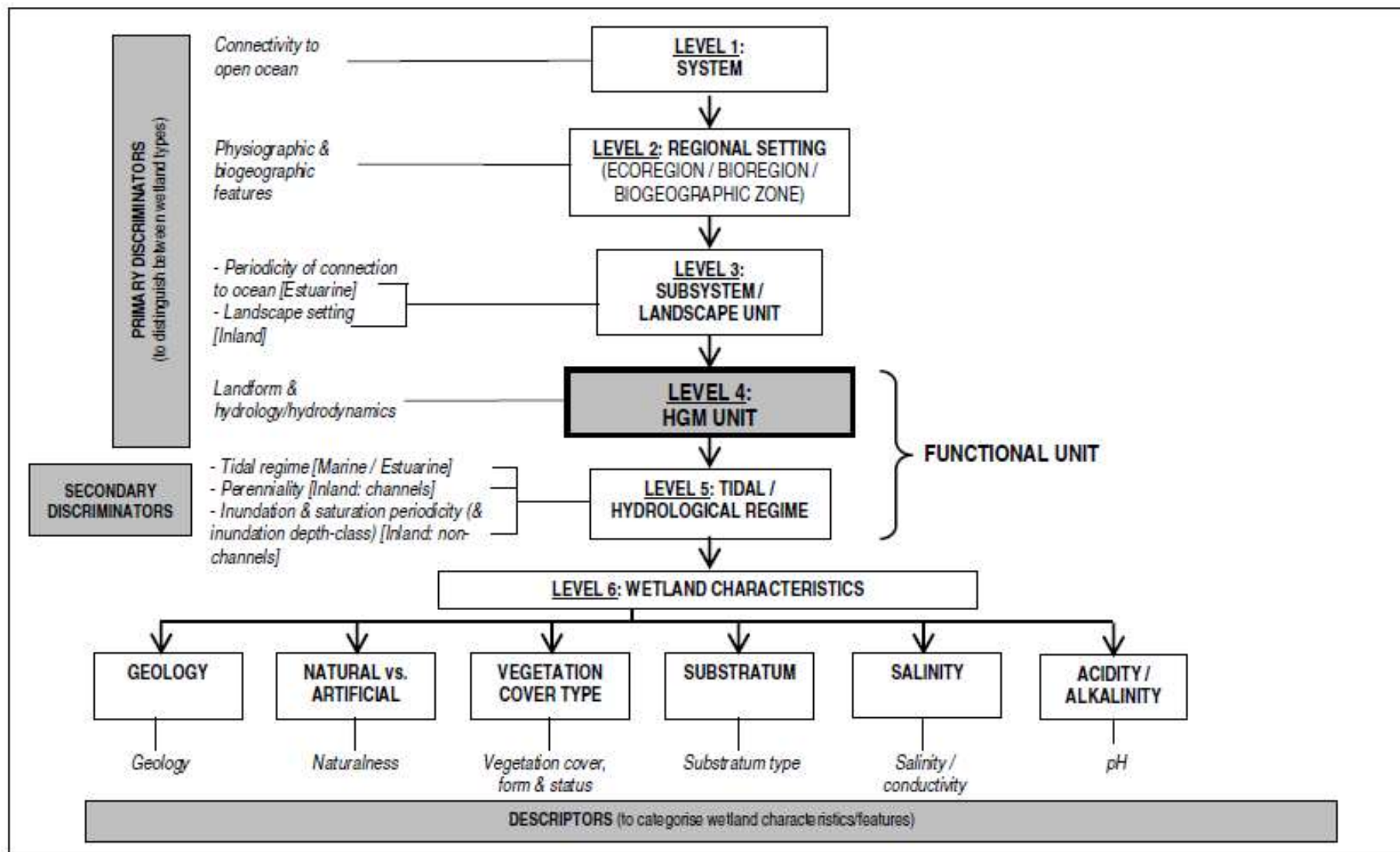


Figure 2: Basic structure of the NWCS, showing how ‘primary discriminators’ are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with ‘secondary discriminators’ applied at Level 5 to classify the tidal/hydrological regime, and ‘descriptors’ applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al.*, 2013).

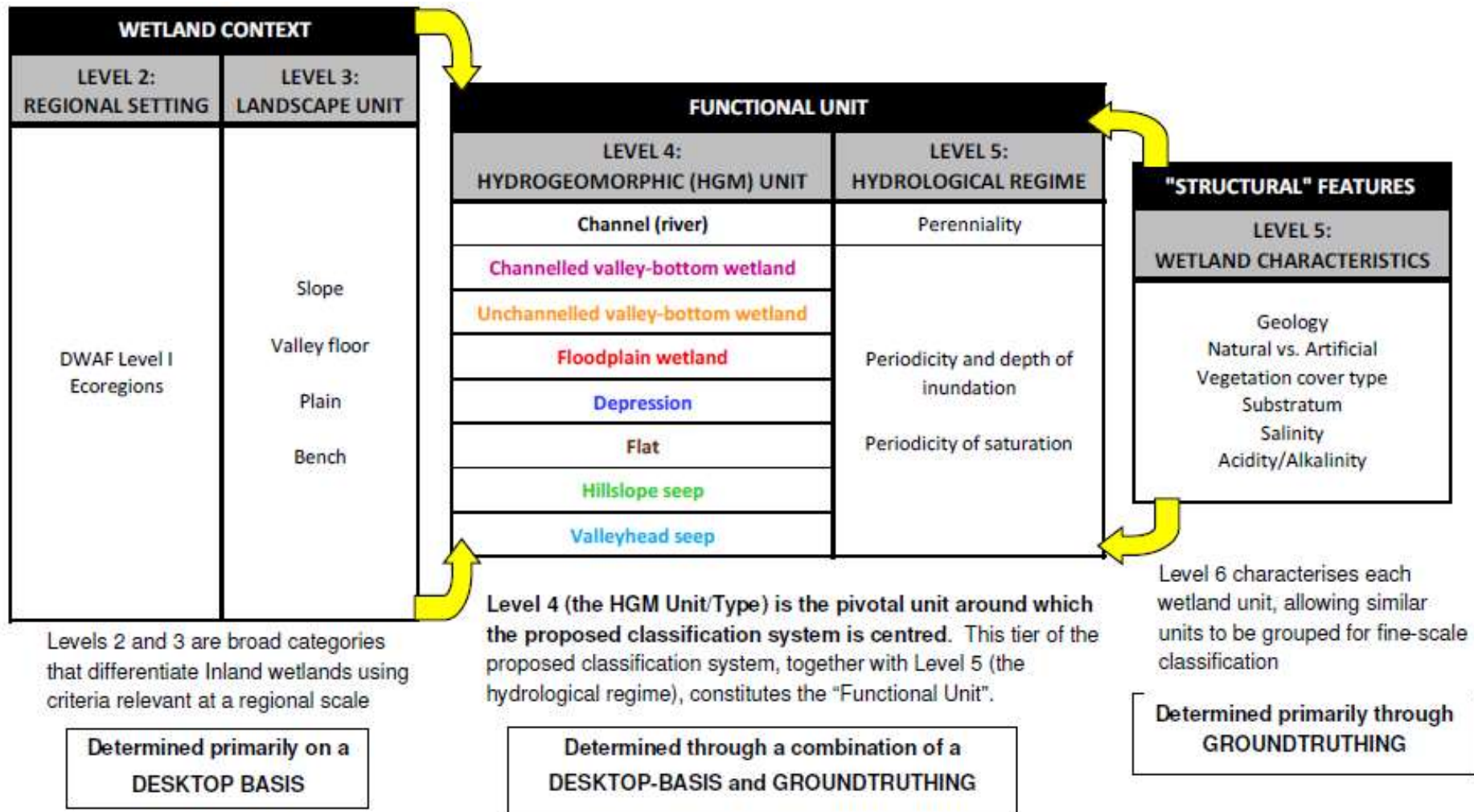


Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al.*, 2013).

4.4 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 2) 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 size and functioning 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 2: 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.

4.5 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 3 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 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al.*, 2008

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits	Flood attenuation	
			Stream flow regulation	
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
		Toxicant assimilation		
		Erosion control		
		Carbon storage		
		Biodiversity maintenance		
		Direct benefits	<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 wetlands were 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.

4.6 Relevant Wetland Legislation and Policy

Locally the South African Constitution, seven (7) Acts and two (2) international treaties allow for the protection of wetlands and rivers. These systems are protected from destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa, 1996;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- The Ramsar Convention, 1971 including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000);
- 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); and
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- Nature and Environmental Conservation Ordinance, 1974 (No. 19 of 1974)
- National Forest Act, 1998 (No. 84 of 1998)
- National Heritage Resources Act, 1999 (No. 25 of 1999)

NEMA and the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) would also apply to this project. These Acts have categorised many invasive plants together with associated obligations on the landowner.

4.7 Provincial Legislation and Policy

Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane & 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 development, as well as the proposed alteration of hydrological flows. Based then on the information known for the site the buffer model provided the following:

Rivers

- Construction period: 48 m
- Operation period: 42 m
- Final: 48 m

Wetlands (Pans)

- Construction period: 47 m
- Operation period: 43 m
- Final: 47 m

Therefore the final buffer for all systems rated as Very High was 48m, noting that development would have to take place within the secondary systems, so no buffer was proposed for these areas as the suitability of each area affected was assessed to determine if infrastructure could be placed within that particular area.

Other policies that are relevant include:

- Provincial Nature Conservation Ordinance (PNCO) – Protected Flora. Any plants found within the development area are described in the ecological assessment.
- National Freshwater Ecosystems Priority Areas (NFEPAs) – (Nel *et al.*, 2011). This mapping product highlights potential rivers and wetlands that should be earmarked for conservation on a national basis.

5. Description of the affected environment

As previously mentioned, the study area (relevant farm portions) was assessed over a period of several years for various other proposals since 2010 onwards, with a site specific visit to assess the development area undertaken late February 2020. The proposed development occurs within the D73F catchment (Figure 4) associated with alluvial systems of the Nama Karoo ecoregion. These mainstem watercourses are short tributaries of the Orange River (ca. 6.5 km from the development area), which are ephemeral in nature and did not contain any wetland elements within the development footprint. This lack of wetlands is an important consideration, as the study area has been highlighted in the Department of Environment Affairs (DEA) Screen Tool, discussed in greater detail in this report.

Overall, these watercourses are largely in a natural state, when compared to those associated with the Orange River reach, which has modified floodplains and flows. Current and existing impacts occur in localised areas within the development area and includes existing tracks and evidence of grazing (small livestock).

The National Wetland Inventory v5.2 spatial data (NWI), indicated riverine floodplains near the proposed access road, which were confirmed as alluvial channels in that database, as well as pans/depressions that surrounds the development areas. As opposed to other portions of the Farm, the presence of these wetlands and the pans, resulted in portions of the Farm Geel Kop, receiving a Very High Aquatic sensitivity rating in the DEA Screening Tool. However the Karroid PV development area is located in an area of LOW aquatic sensitivity as per the DEA Screening Tool. Thus a minimum of an Aquatic Biodiversity Compliance Statement is required as part of the Environmental Assessment (BAR). However as several of the pans and alluvial areas contained in the NWI were not accounted for, a detailed Aquatic Biodiversity Specialist Assessment (this report) was rather produced, which would then also provide consistency for the other projects being proposed within the same farm portion.

The only wetlands observed, included five depressions, and inclusive of the proposed buffers have been avoided by the development footprint (including the access road). Any activities within 500m of these pan boundaries will require a Water Use License.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the systems within the development area have been assigned a condition score of AB (Nel *et al.* 2011), indicating that they are largely intact and perform an ecological function. However, the development area systems are ephemeral and only carried water for a short periods as previously mentioned, thus the observed systems do not support any wide riparian zones and the vegetation associated with these watercourses were between 0.45 m and 12 m wide and contain mostly terrestrial species.

Fourteen woody plant species were found associated with the riparian and pan systems within the development area. Although none of these were obligate or facultative river/wetland species, they do show a preference for areas exposed to runoff. Species outside of the development area were dominated by *Vachellia erioloba* (Camel Thorn, Kameeldoring), *Vachellia haematoxylon* (Grey Camel Thorn), *Boscia albitrunca* (Shepard's Tree) and *Euclea pseudebenus* (Ebony Tree), all protected under the National Forest Act and NEMA Biodiversity Act.

The few grass or forbs species were successfully identified were all associated with the regional vegetation type, namely Kalahari Karroid Shrubland (NKb 5), Bushmanland Arid Grassland (NKb 3) and Gordonias Duneveld (SVkd1).

The only obligate wetland plants observed were those found along the Orange River itself. Species observed included *Typha capensis*, *Phragmites australis*, *Prosopis glandulosa* and *Cyperus marginatus*. Notably the prevalence of *Prosopis*, an alien invasive tree species had increased between 2010 and this survey within the sites that had been visited previously by this report author. However, none of the project components would affect these species or habitats that they occur in, both from a hydrological and physical disturbance standpoint.

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel *et al.*, 2011), also earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of

riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchments areas are then classified as Freshwater Ecosystems Priority Areas (FEPAs). The access road portion of the development area (Figure 6) falls within a Fish FSA (Fish Support Area or Fish Sanctuary), associated with the Orange River. Although no permanent fish habitat occurs within the proposed development area, Fish Sanctuaries are sub-quaternary catchments that are required to meet biodiversity targets for threatened and near threatened fish species indigenous to South Africa. Furthermore, Fish sanctuaries in sub-quaternary catchments associated with a river reach in good condition (A or B Ecological Category) were selected as FEPAs; the remaining fish sanctuaries became Fish Support Areas.

Fish Support Areas also include sub-quaternary catchments that are important for migration of threatened and near threatened fish species. Thus, any river reaches within Fish Support Areas need to be maintained in a condition that supports the associated populations of threatened fish species, which need not necessarily be an A or B ecological category. The Karroid PV development area largely avoids these ephemeral reaches and therefore won't have a significant impact on the FSA.

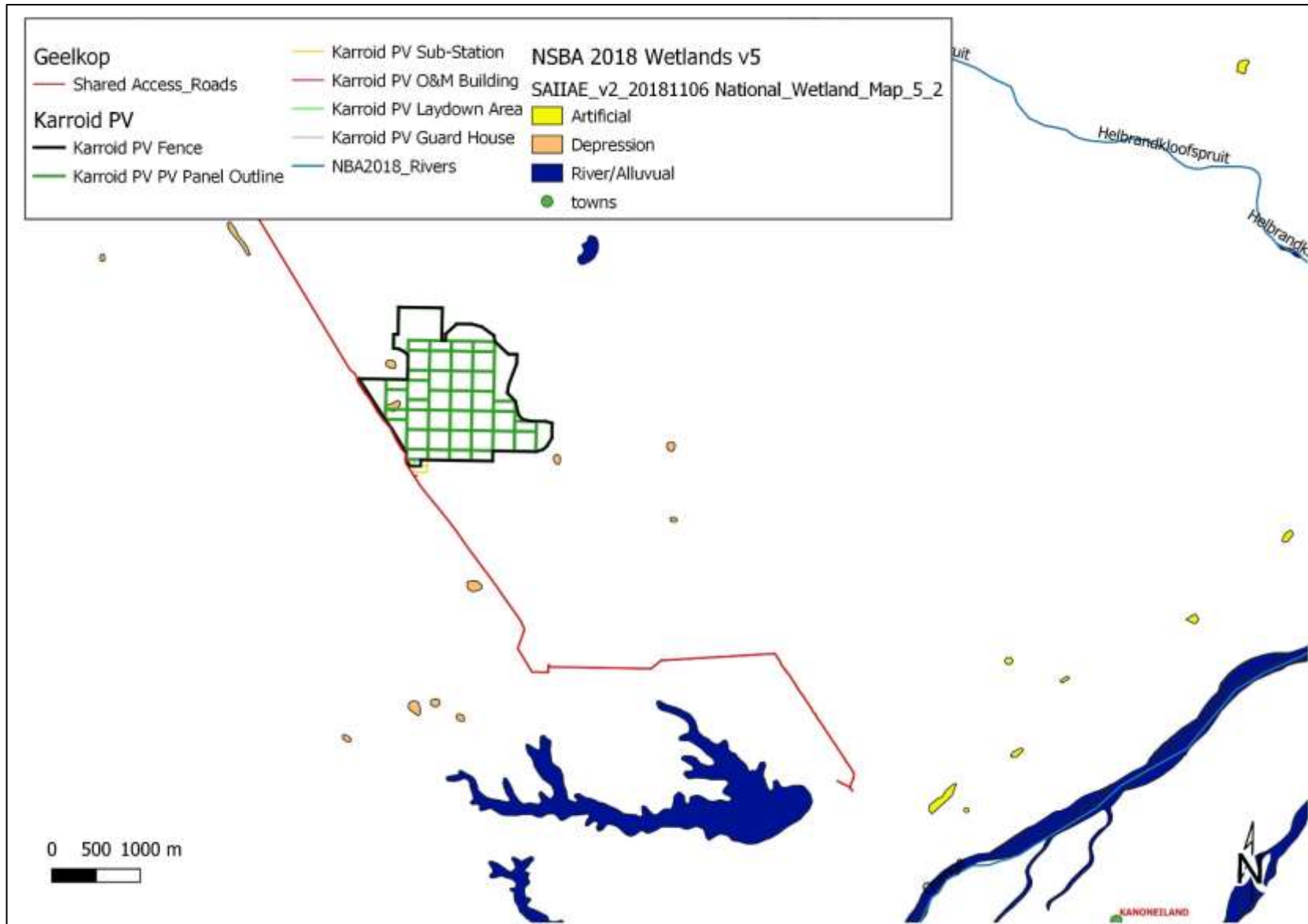


Figure 5: The various waterbodies near the Karroid PV development area identified in the National Wetland Inventory V5.2 (2018)



Figure 6: The respective sub quaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) in relation to the Karroid PV development area

6. Present Ecological State, conservation importance and final sensitivity rating

The Present Ecological State (PES) of an aquatic system 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 also 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.

The Present Ecological State scores (PES) for the development area were rated B – largely natural, while the associated reach along the Orange River, located at the confluence of these main watercourse was rated as follows (DWS, 2014 – where C = Moderately Modified):

Subquaternary Catchment Number	Present Ecological State	Catchment Ecological Importance	Catchment Ecological Sensitivity
3151	C	Moderate	High

Although the Orange River reach associated with the study area systems was rated as having a lower ecological state, the surrounding catchments, inclusive of the development area, these were still considered to have a Moderate and High Ecological Importance and Ecological Sensitivity and for this reason the study area was included as a Critical Biodiversity Area Type 2 and Ecological Support Areas as shown in the Northern Cape CBA map (Figure 7).

The unaffected pan / depressions (> 0.5 ha) received a PES score of B, and EIS score of Medium. The score (PES = B) was due to the effect of grazing / trampling by animals searching for shade or water.

The PES and EIS scores were then translated in the respective sensitivity ratings of the various aquatic systems (Very High to Moderate), and used to prepare a sensitivity map (Figure 8), used in guiding the preparation of the layout. This was also conducted in conjunction with the other specialists to determine the layout to reduce the number of overall impacts.

Thus, the layout for the most part, was developed to avoid all and Pans (inclusive of the 48m buffer), which were rated as Very High Sensitivity (Figure 8). These corresponded to the Very High Sensitivity systems considered in the DEA Screening Tool spatial data, although this report considers their actual hydrogeomorphic classification, i.e. only the pans are considered a wetland type.

A portion of the secondary aquatic systems (highly ephemeral, with no aquatic habitat) are located within the development area that were considered Moderately Sensitive. No buffer was proposed, as several technical and other environmental constraints (sensitive vegetation for example), needed to be considered, thus several PV panel areas needed to be placed within these secondary systems. Each of these areas, where panels will be placed was considered on an area for area basis, to ensure that the panels will be placed within areas that won't affect the general hydrology of the region and or result in alteration of the form or function of the respective aquatic systems.

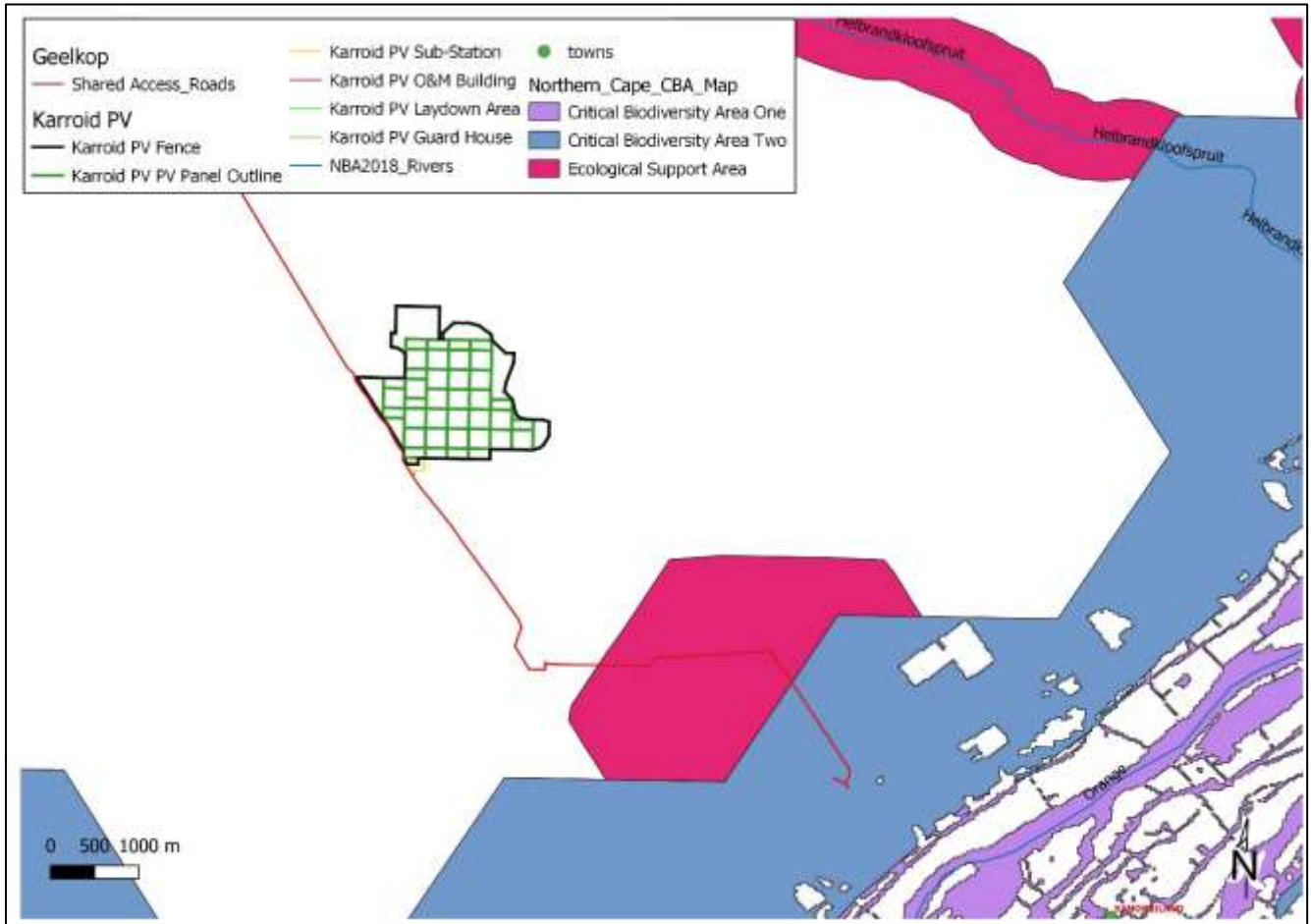


Figure 7: Critical Biodiversity Areas as per the Northern Cape Critical Biodiversity Areas Map

In summary the following aquatic systems were thus observed together with their respective sensitivity ratings based on information collected during this assessment:

Hydrogeomorphic Type and setting	Ecosystem functionality	Sensitivity (Refer to Figure 8)	Comment
Main stem alluvial watercourses (Plate 1) and Pan	Near natural and important alluvial habitat away from the Orange River or unique habitat that contain wetland characteristics (Pans/Depression >5ha)	Very High	Only a small section of panel area and the boundary fence will be located within a buffer area in the north eastern corner of the site.
Secondary alluvial systems, with defined channel and riparian vegetation (scattered trees – non obligate) (Plate 2)	Important in preventing erosion of landscape during high volume flows	Moderate	These areas have been largely avoided by the development layout with the exception of a small areas that will contain panels. Attempts to move the panels or have the panel areas span the affected area was found to be technically not feasible. Specific mitigation to address this has been included in the impact assessment section of this report
Secondary alluvial systems, with <u>no</u> defined channel and riparian vegetation (scattered trees – non obligate) and fragmented	Important in preventing erosion of landscape during high volume flows	Moderate	

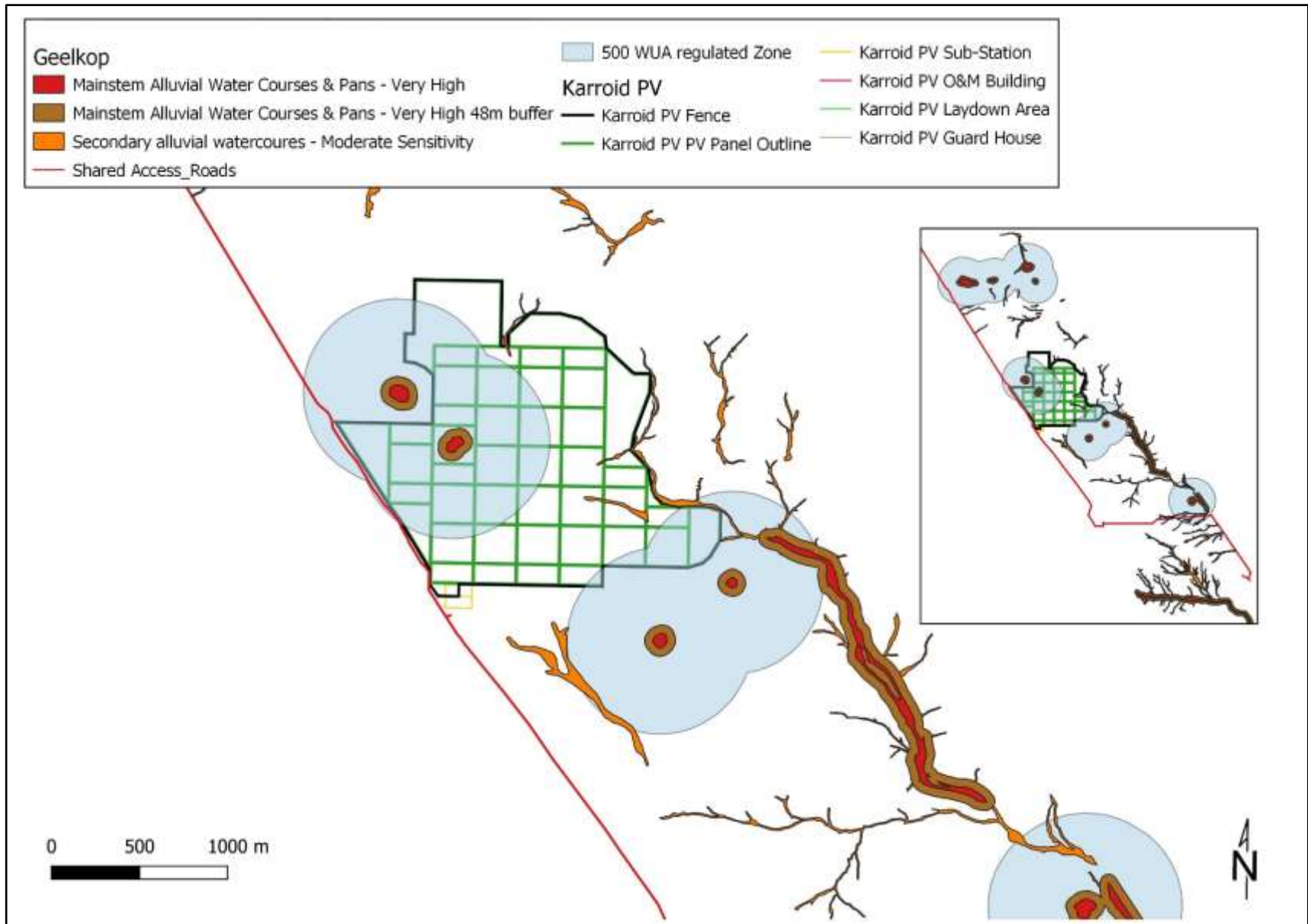


Figure 8: Delineated wetlands (pans) and watercourses in relation to the activities, with buffers, sensitivity ratings and the 500m regulated WULA zone.



Plate 1: Mainstem alluvial watercourse with a Very High sensitivity rating, which will be avoided by the development footprint



Plate 2: Secondary alluvial systems, with defined channel and some riparian vegetation (scattered trees – non obligate)

7. Permit requirements

Based on an assessment of the proposed activities and past engagement with DWS, the following WULs/ GA's could be required based on the following thresholds as listed in the following Government Notices, however ultimately the Department of Water and Sanitation (DWS) will determine if a GA or full WULA will be required during the pre-application process (Phase 1):

- **DWS Notice 538 of 2016, 2 September in GG 40243**– Section 21 a & b, Abstraction and Storage of water.
- **Government Notice 509 in GG 40229 of 26 August 2016** – Section 21 c & i, 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 Disposing of waste in a manner that may detrimentally impact on a water source which includes temporary storage of domestic waste water i.e. conservancy tanks under Section 37 of the notice, where storage is between 5000 – 10 000m³ a General Authorisation is applicable.

	Water Use Activity	Applicable to this development proposal
S21(a)	Taking water from a water resource	Yes if not sourced from the local Water Board or a municipal supply.
S21(b)	Storing water	If the total volume stored is greater than 40 000 m ³ then a full Water Use License will be required. This is however unlikely that onsite water storage for the purpose of the facility would ever exceed this threshold.
S21(c)	Impeding or diverting the flow of water in a watercourse	Yes – several new crossings of watercourses will be required, as well as activities within 500m of a wetland boundary.
S21(d)	Engaging in a stream flow reduction activity	Not applicable
S21(e)	Engaging in a controlled activity	Not applicable
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Not applicable
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Typically, the conservancy tanks at construction camps and then O/M buildings require a license (GA if volumes are below 10 000 m ³)
S21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Not applicable

	Water Use Activity	Applicable to this development proposal
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	Yes – several new crossings of watercourses will be required, as well as activities within 500m of a wetland boundary.
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Not applicable
S21(k)	Using water for recreational purposes	Not applicable

DWS WILL DETERMINE IF A GA OR WULA APPLICATION WILL BE REQUIRED DURING THE PREAPPLICATION PHASE AND TYPICALLY IF ONE OF THE ABOVE WATER USES REQUIRES A WULA THEN ALL APPLICATIONS WILL BE TREATED AS A WULA AND NOT GA. THE SUBMISSION PROCESS AND DETAIL REQUIREMENTS DO HOWEVER NOT DIFFER, ONLY THE PROCESSING TIMEFRAMES (60 vs 300 DAYS) DO.

8. Impact assessment

The following direct impacts were thus assessed aligned with the outcomes of the Biodiversity Assessment Protocol and include those listed in the table below and as assessed in this report against the specific layout:

Fragmentation (physical loss of ecological connectivity and or CBA corridors)	Impact 1 & 2
Changes in numbers and density of species	Impact 1 & 2
Faunal and vegetation communities inhabiting the site	Impact 1 & 2
Hydrological regime or Hydroperiod changes (Quantity changes such as abstraction or diversion)	Impact 3
Streamflow regulation	Impact 3
Erosion control	Impact 4
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Impact 5
Cumulative Impacts	Impact 6

- Impact 1: Loss of Very High Sensitivity systems, namely the mainstem alluvial water course and a pan through physical disturbance although the proposed layout will avoid any of these systems (Figure 8).
- Impact 2: Impact on secondary alluvial water courses (Moderate Sensitivity), through physical disturbance
- Impact 3: Impact on all riparian and wetland systems through the possible increase in surface water runoff on riparian form and function through hydrological changes
- Impact 4: Increase in sedimentation and erosion
- Impact 5: Risks on the aquatic environment due to water quality impacts
- Impact 6: Cumulative impacts

The impacts were assessed as follows:

<p>Nature: Impact 1: Loss of Very High Sensitivity systems, namely the mainstem alluvial water course and a pan through physical disturbance although the proposed layout will avoid any of these systems, with the exception of a very small portion of the buffer area (Figure 8). Only a 110m² section of the 48 buffer for these areas will contain a section of the boundary fence and panel area (internal road), which when compared to the remainder of these sites within the site and the general region is considered negligible.</p>		
	Without mitigation	With mitigation
Extent	High (3)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (7)	Low (4)
Probability	Definite (5)	Probable (3)
Significance	High (70)	Low (27)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	
<p>Mitigation:</p> <p>The most significant form of mitigation would be to select development options that avoided all aquatic features that were rated with a Very High sensitivity, which is being proposed by the layout.</p> <p>All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the development does however not warrant the use of a Landscape Architect and / or Landscape Contractor.</p> <p>It is further recommended that a comprehensive rehabilitation / monitoring plan be implemented from the project onset i.e. during the detailed design phase prior to construction, to ensure a net benefit to the environment within all areas that will remain undisturbed.</p>		
<p>Cumulative impacts:</p> <p>None – no direct connection between this and other systems, such as the Orange River, exist.</p>		
<p>Residual impacts:</p> <p>Possible impact on the remaining catchment due to changes in run-off characteristics in the development area.</p>		

Nature: Impact 2 - Impact on secondary alluvial water courses (Moderate Sensitivity), through physical disturbance

The physical removal of narrow strips of woody riparian zones, disturbance of channels being replaced by hard engineered surfaces will alter the hydrological nature of the area, by increasing the surface run-off velocities, while reducing the potential for any run-off to infiltrate the soils. This impact would however be localised, as it is intended that the PV panels and mounting structures traverse the watercourses as far as possible and any flows would still be allowed to leave the site via the larger systems that will remain intact. Furthermore the layout will leave the more defined channels (Very High sensitivity) intact (Figure 8). The impact on the secondary alluvial systems are however unavoidable due to technical constraints, but it is envisaged that these would not impact on the greater functioning of the catchment.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Probable (3)
Significance	Medium (45)	Low (27)
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

The most significant form of mitigation would be to select a development area, which contained no drainage lines. The proposed layout has been developed to avoid the important systems, thus requiring only crossings or footprints within areas rated as having a Moderate sensitivity to physical disturbance, although hydrological function (surface flows) would still remain.

Vegetation clearing should occur in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment. Suitable dust and erosion control mitigation measures should be included in the EMP to mitigate these impacts.

Cumulative impacts:

The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration is likely to occur, considering that the development area is near the main drainage channels, however the annual rainfall figures are low.

Residual impacts:

Diversion of run-off away from downstream systems is unlikely to occur as the annual rainfall figures are low. Therefore negligible residual impacts area expected.

Nature: Impact 3 - Impact on riparian systems through the possible increase in surface water runoff on riparian form and function

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 the riparian systems, which are currently ephemeral, i.e. riparian systems species composition changes, which then results in habitat change / loss.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (2)
Probability	Definite (5)	Probable (3)
Significance	Medium (35)	Low (21)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

Any stormwater within the development area must be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities (e.g. water used when washing the panels).

The project should also try to capture and recycle any form of run-off created by the daily operations. This would minimise the amount of water required by the project, but also serve to limit the downstream impacts on the riparian systems through an increase in run-off, a situation that these systems are currently unaccustomed too.

Cumulative impacts:

Downstream alteration of hydrological regimes due to the increased run-off from the area.

Residual impacts:

Possible impact on the remaining catchment due to changes in run-off characteristics in the development area.

Nature: Impact 4 - Increase in sedimentation and erosion within the development footprint		
An increase in hard surface areas, and or roads that require stormwater management increases runoff from a site through the concentration of surface water flows. These higher volume flows, with increased velocity can result in downstream erosion and sedimentation if not managed.		
	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (1)
Probability	Definite (5)	Probable (3)
Significance	Medium (35)	Low (18)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	
Mitigation:		
Any stormwater within the development area must be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments and reduce flow velocities (e.g. water used when washing the PV Panels).		
Suitable stormwater management features with erosion control measures (gabions) should also be installed in areas where concentrated flows are anticipated as indicated in the Storm Water Management Plan (SWMP).		
Cumulative impacts:		
Downstream erosion and sedimentation of the downstream systems and farming operations. During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will be washed into the Orange River, although currently no direct connections with the Orange River, extreme high flows do enter the river from the development area.		
Residual impacts:		
Possible impact on the remaining catchment due to changes in run-off characteristics in the development area.		

Nature: Impact 5 – Impact on localised surface water quality		
During both preconstruction, construction and to a limited degree the operational activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet cement, shutter-oil, etc.) associated with site-clearing machinery and construction activities, as well as maintenance activities, could be washed downslope via the ephemeral systems.		
	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (1)
Probability	Definite (5)	Probable (3)
Significance	Medium (35)	Low (18)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes (high)	
Mitigation:		
<ul style="list-style-type: none"> • Strict use and management of all hazardous materials used on site. • Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles & machinery, cement during construction, etc.) within demarcated / bunded areas • Containment of all contaminated water by means of careful run-off management on site. • Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the facility. These must be situated outside of any delineated water courses or the buffers shown • Strict control of the behaviour of construction workers. • Appropriate waste management. • Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced. 		
Cumulative impacts:		
None as no direct connection between the development area and Orange River remains		
Residual impacts:		
Residual impacts will be negligible after appropriate mitigation.		

Nature: Impact 6 – Cumulative Impacts

In the assessment of this project, a number of projects have been assessed by the report author within a 35km radius and or other sites were accessed during the course of travelling between the various projects. Of these potential projects, this report author has been involved in the initial EIA aquatic assessments or has managed / assisted with the WUL process for several of these projects.

All of the projects have indicated that their intention with regard to mitigation, i.e. selecting the best possible sites to minimise the local and regional impacts, or improving the drainage or hydrological conditions within these rivers, the cumulative impact could be seen as a net benefit. However, the worse-case scenario has been assessed below, i.e. only the minimum of mitigation be implemented by the other projects such as stormwater management, and that flows within these systems are sporadic.

	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (1)	Low (2)
Probability	Probable (3)	Definite (5)
Significance	Low (18)	Medium (35)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes (high)	

Mitigation:

- Improve the current stormwater and energy dissipation features not currently found along the tracks and roads within the region by local landowners / public works entities where possible
- Install properly sized culverts with erosion protection measures at the present road / track crossings are already installed by local landowners / public works entities

Residual impacts:

Residual impacts will be negligible after appropriate mitigation.

9. Conclusion and Recommendations

In summary, the proposed layout for the facility would not have a direct impact on the following:

- Any Very High sensitivity areas identified by the DEA Screening Tool that occur within the Geel Kop Farm No 456 RE.
- Mainstem rivers and Pans that do contain functioning aquatic environments that received a Very High sensitivity rating as indicated in Figure 8.

Some impacts (panel areas & road crossings) are located in secondary alluvial water courses that were either fragmented or contained no riparian zones, with a Moderate sensitivity. With the proposed mitigation (proper stormwater management and post construction rehabilitation), the impacts would be Low and acceptable for development, as these areas contained no aquatic habitat, and only functioned as a means to sustain / convey baseflows within the greater catchment. The proposed development would in essence not impact on this as surface runoff, although managed to prevent erosion, would still emanate from the site (when significant rainfall occurs), thus maintain this aspect of the hydrological system observed

Therefore, based on the results of this report, the significance of the remaining impacts assessed for the aquatic systems after mitigation would be LOW. This includes the internal roads proposed that would need to cross some of these systems. Thus, based on the findings of this study no objection to the authorisation of any of the proposed activities is made at this point based on the current layout as provided by the developer.

Thus, based on the findings of this study no objection to the authorisation of any of the proposed activities is made at this point based on the current layout for Karroid PV as provided by the developer.

This report also indicates the watercourses and pans within 500m of the development area. Any activities within these areas, the buffers or 500m from the wetland boundary will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998). Should any of the present road crossings need to be upgraded that have not been upgraded in the past, then the opportunity exists to improve the current state (lack of habitat continuity) for example by replacing pipe culverts with box culverts.

As the proposed activities have the potential to create erosion, the following recommendations are reiterated:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment, and suitable dust and erosion control mitigation measures should be included in the EMP & SWMP to mitigate.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks outside of any delineated waterbodies and their buffers. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel.
- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report.
- All alien plant re-growth must be monitored, and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.
- It is further recommended that a comprehensive rehabilitation plan be implemented from the project onset within watercourse areas (including buffers) to ensure a net benefit to the aquatic environment. This should form part of the suggested walk down as part of the final EMP preparation preconstruction.

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12. Appendix 1 - Specialist CV

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Years experience: 25 years

SKILLS BASE AND CORE COMPETENCIES

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

TERTIARY EDUCATION

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

EMPLOYMENT HISTORY

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

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

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

South African

- Plant 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 – current.
- 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 - current
- 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 Exxaro 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 105 renewable projects in the past 6 years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, RedCap, 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 farm), 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).