WATERCOURSE IMPACT ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED HYPERION SOLAR DEVELOPMENT 2, NEAR KATHU, NORTHERN CAPE PROVINCE

Prepared for

Savannah Environmental

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Prepared by: **Scientific Aquatic Services**
Report author: **C. du Preez (M. Sc)**
Report reviewers: **A. Mileson**
K. Marais (Pr. Sci. Nat)
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Scientific Aquatic Services CC
CC Reg No 2003/078943/23
Vat Reg. No. 4020235273
PO Box 751779
Gardenview
2047
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvgroup.co.za

EXECUTIVE SUMMARY

Based on the outcome of the freshwater ecological impact assessment, the proposed Hyperion Solar Development 2 will have an overall 'low' impact on the watercourses assessed as part of this study. It is the opinion of the freshwater ecologist that access road Alternative 4 should be selected, as from a freshwater conservation perspective, it would pose the least impact to any watercourses. Since this access road alternative doesn't directly traverse any watercourses, and the closest watercourse is located approximately 245m away, a negligible quantum of risk to the watercourse is expected. Although access road Alternative 2 and 3 are located outside of any watercourses, they are approximately within 120m and 45m, respectively, from any watercourses. As such, these access road alternatives could potentially have an indirect impact on the watercourses, however, this could be considered acceptable, provided that the recommended mitigation measures be implemented, and relevant authorisations applied for.

After conclusion of the assessment, it is the opinion of the freshwater ecologist that the proposed development be considered favourably and acceptable, provided that the essential mitigation measures as listed in this report are strictly adhered to.

MANAGEMENT SUMMARY

INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a watercourse impact assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Hyperion Solar Development 2, near Kathu in the Northern Cape Province.

This project entails the construction of surface infrastructure (buildings, laydown area and a solar field) and energy storage area within the development area. Four access road alternatives were identified for consideration as part of this project (access road Alternatives 1 - 4). To identify all watercourses that may potentially be impacted by the proposed development as a whole, a 500m "zone of investigation" around the development area and all associated project activities was investigated (hereafter referred to as the 'investigation area').

RESULTS OF DESKTOP ANALYSIS

A desktop study was conducted, in which possible watercourses were identified for on-site investigation. In addition, relevant national, provincial and municipal databases were consulted. The results of the desktop study are contained in Section 4 of this report. A summary is provided below:

- According to the National Freshwater Ecosystem Priority Areas (NFEPA) database (2011), several natural wetlands are located within the investigation area. All the wetlands identified by the NFEPA database (2011) are considered to be in a natural or good ecological condition (Class AB). These areas were investigated during the site assessment to verify the presence of the wetlands. One of these wetlands were identified as a natural wetland during the site assessment, while the others was identified as an artificial impoundment;
- The episodic Vlermuisleegte River bisects the eastern portion of the investigation area associated with the development area and is located just east of the proposed Access Road Alternative 1. This river is considered largely natural according to the PES 1999; however, according to the NFEPA database, the river is moderately modified (Class C).

RESULTS OF THE WATERCOURSE ASSESSMENT

During the site assessments undertaken on the 28th of November 2018 and 25th February 2019, several watercourses were identified within the investigation area associated with the development area and the proposed access road alternatives. This includes the Vlermuisleegte River (proposed to be directly traversed by access road Alternative 1), a perched wetland and several other pan wetlands. The table below provides a summary of the outcome of the ecological assessment of these watercourses.

Table A: Summary of the outcome of the ecological assessment of the watercourses identified.

Watercourse	Locality	PES	Ecoservices	EIS	REC / RMO
Vlermuisleegte River	Located within the eastern portion of the investigation area of the development area and proposed to be traversed by proposed access road Alternative 1.	C/D (Moderately to Largely modified)	Moderately Low	Moderate	RMO: C (Maintain) REC: C (Moderately modified) BAS: C
Perched depression wetland	Located on the north-eastern boundary of the investigation area associated with the development area.	B (Largely natural with few modifications)	Moderately Low	Marginal/ Moderate	RMO: B (Maintain) REC: B (Largely natural with few modifications) BAS: B
Pan wetlands 1 -11	Located within the investigation area associated with access road Alternative 3 and 4.	B (Largely natural with few modifications)	Moderately Low	Marginal/ Moderate	RMO: B (Maintain) REC: B (Largely natural with few modifications) BAS: B

The area surrounding the identified watercourses is mainly natural, untransformed areas; however, the river was noted to have been historically cultivated. Trampling and grazing of livestock was identified within almost all the watercourses. Sand mining and various informal roads were the only identified anthropogenic activities occurring within the local catchment of these watercourses.

LEGISLATIVE REQUIREMENTS

Based on the applicable legislation, the following Zones of Regulation (ZoR) were applied:

- A 32m Zone of Regulation in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) was applied to all the watercourses associated with the development and investigation areas.
- Zones of Regulation in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (NWA):
  - 500m Zone of Regulation applied to the wetlands (Pan wetlands and perched depression wetland); and
  - 100m Zone of Regulation applied to the Vlermuisleegte River.

The following should be considered as part of the environmental authorisation of the proposed development activities:

- Although the development area encroaches on the southern portion of the 500m GN509 ZoR of the perched depression wetland, no infrastructure nor internal roads are located within the 100m/500m GN509 ZoR of the watercourses. Thus, the proposed construction and operational activities associated with these activities do not pose any legislative or freshwater conservation constraints;
- Only the proposed access road Alternative 1 traverses the Vlermuisleegte River. If this road is to be constructed, authorisation in terms of Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) is required;
- No other proposed access road alternative traverses any other watercourse. However, proposed access road Alternatives 3 and 4 are located within the 500m GN509 ZoR of the pan wetlands (Alternative 3 located approximately 45m to Pan wetland 8 and Alternative 4 located approximatley 245m from Pan Wetland 11); and
- The water purification plant is located outside of the 100m GN509 ZoR associated with the Vlermuisleegte River. Furthermore, since water will be abstracted for an existing borehole within the project site, in terms of the definition of a water resource (which includes a watercourse, surface water, estuary or aquifer), any taking and storing of water will also be regulated by Section 21(a) and (b) of the National Water Act, 1998 (Act No. 36 of 1998) and consideration must therefore be given to GN 538 of as published in the Government Gazette 40243 of 2016 which stipulates that any groundwater taken within 500m radius from the boundary of a wetland or estuary or within 100m radius from the delineated edge of a water

course will trigger the need for a full Water Use Licence (WUL) Application regardless of the volumes.

IMPACT ASSESSMENT

Following the assessment of the watercourses, an impact assessment was applied to ascertain the significance of potential impacts on the receiving environment should the proposed development proceed. A summary of the impact assessment is provided in the table below, followed by a brief discussion of the outcome thereof.

Table B: A summary of the outcome of the impact assessment.

Activity/Nature:	Phase	Without Mitigation	With Mitigation
Access Road Alternative 1	Construction Phase	Medium	Medium
	Operational Phase	Medium	Low
Access Road Alternative 2	Construction Phase	Low	Low
	Operational Phase	Low	Low
Access Road Alternative 3 & 4	Construction Phase	Low	Low
	Operational Phase	Low	Low
Proposed surface infrastructure and internal access roads	Construction Phase	Low	Low
	Operational Phase	Low	Low
Proposed water purification plant	Construction and Operational Phase	Low	Low

Due to the distance of the proposed surface infrastructure and the internal roads associated with the development area from the watercourses, with the implementation of the recommended mitigation measures, a low to very low impact on the watercourses are expected to occur. As this infrastructure is located outside of the applicable GN 509 ZoR of the watercourses, the proposed construction and operational activities associated with these activities do not pose any legislative or freshwater conservation constraints.

Since the proposed purification plant is located approximately 175m west of the Vlermuisleegte River and outside its 100m GN509 and GN538 stipulated ZoR, the construction and operation thereof are of such low impact significance that no significant quantum of risk in terms of impeding or diverting the flow of water in a watercourse or altering the beds, banks, course or characteristics of a watercourse is anticipated. In terms of the definition of a water resource (which includes a watercourse, surface water, estuary or aquifer), any taking and storing of water needs to be regulated by Section 21(a) and (b) of the National Water Act, 1998 (Act No. 36 of 1998) and the relevant Water Use Authorisation will need to be obtained.

Proposed access road Alternative 1 was determined to pose a Medium impact significance to the Vlermuisleegte River during the construction and operational phase, with the application of the recommended mitigation measures. This is due to it directly traversing the Vlermuisleegte River. Despite this access road alternative traversing the river, it is not considered a no-go area for the development of access road Alternative 1, as the existing road has already impacted on the Vlermuisleegte River. Although the impacts associated with the construction of access road Alternative 1 can be considered acceptable, if all the proposed mitigation measures as stipulated in this report are implemented, it is not considered the preferred route from a freshwater ecological perspective. As for all other proposed access road alternatives, their construction and operation would pose a Low impact significance (with the implementation of the recommended mitigation measures) to the watercourses (various identified pan wetlands). This is predominantly attributed to their distance from the identified watercourses. A summary of the motivation for selecting Alternative 4 in comparison to the other access road alternatives is provided below.

Table C: Access road alternative feasibility assessment summary.

Access Road Alternative	Watercourses associated with this alternative	Recommendation
Alternative 1	Directly traverses the Vlermuisleegte River.	Despite this access road alternative traversing the river, it is not considered a no-go area for the development of access road Alternative 1, as the existing road has already impacted on the Vlermuisleegte River. Although the impacts associated with the construction of access road Alternative 1 can be considered acceptable, if all the proposed mitigation measures as stipulated in this report are implemented, it is not considered the preferred route from a freshwater ecological perspective.
Alternative 2	Located west of the Vlermuisleegte River just outside its 100m GN509 Zone of Regulation.	Despite this access road not traversing any watercourses, nor is it within any zone of regulation of a watercourse, this option entails the construction of a new road. This would cause disturbance to the surrounding natural environment (albeit terrestrial vegetation), which could impact on the natural buffer zone surrounding the Vlermuisleegte River. This access road alternative is not recommended, however, the impacts it will potentially have on the Vlermuisleegte River can be mitigated to within acceptable levels, provided that the recommended mitigation measures herein be implemented
Alternative 3	Ten pan wetlands are located within the investigation area associated with this road. The closest pan wetlands are Pan 8 (approximately 45m from the road) and Pan 7 (approximately 55m from the road).	Despite this access road not traversing any watercourses, it is located within the 500m GN509 Zones of Regulation surrounding most of the pan wetlands identified within its investigation area. Due to this access road alternatives' relatively close proximity to the pan wetlands (approximately 45m from the closest pan wetland; albeit determined to be of low impact significance), this road alternative is not recommended. However, the impacts it will potentially have on the pan wetlands can be mitigated to within acceptable levels, provided that the recommended mitigation measures herein be implemented.
Alternative 4	A pan wetland (Pan 11) is located within the investigation area of this road, located approximately 245m from the proposed layout.	This access road alternative is considered the preferable option, primarily due to its distance from Pan Wetland 11, and no other watercourses located within close proximity to it. It is unlikely that this access road alternative would pose any quantum of risk to the pan wetlands.

CONCLUSION

It is the opinion of the freshwater ecologist that access road Alternative 4 should be selected, as from a freshwater conservation perspective, it is likely to pose the least impact to any watercourses. Since this access road alternative doesn't directly traverse any watercourses, and the closest watercourse is located approximately 245m away, a negligible quantum of risk to the watercourse is expected.

Notwithstanding the fact that a clear preference has emerged in respect of the various access road alternatives, this is not compelling in that the impacts along all access road alternatives can be mitigated to acceptable levels (with the implementation of the provided mitigation measures). Consequently, the preference can be overridden by either technical and/or biodiversity requirements if these requirements are compelling.

Based on the outcome of the impact assessment, the proposed Hyperion Solar Development 2 will have an overall low impact on the various aspects of freshwater ecology (i.e. habitat and ecology, ecological and socio-cultural service provision and hydrological function and sediment balance) during the construction and operation phases, provided that well-conceived, strictly implemented and managed impact minimisation takes place.

After the conclusion of the assessment, it is the opinion of the freshwater ecologist that the proposed development be considered acceptable, provided that the essential mitigation measures as listed in this report are strictly adhered to.

DOCUMENT GUIDE

The table below provides the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) Regulations 2014 (as amended in 2017) for Specialist Reports, and the relevant sections in the reports where these requirements are addressed.

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix F
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix F
b)	A declaration that the specialist is independent	Appendix F
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
cA)	An indication of the quality and age of base data used for the specialist report	Section 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 7
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modeling used	Section 1.1 and Appendix C
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 5
g)	An identification of any areas to be avoided, including buffers	Section 6
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 6
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.2
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 7
k)	Any mitigation measures for inclusion in the EMPr	Section 7.4
l)	Any conditions for inclusion in the environmental authorisation	Sectin 6
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 7
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 7 and 8
(iA)	Regarding the acceptability of the proposed activity or activities	Section 7 and 8
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 7 and 8
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

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ACRONYMS

°C	Degrees Celsius.
AC	Alternating Current
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
DC	Direct Current
DM	District Municipality
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
kV	KiloVolt
LM	Local Municipality
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NBA	National Biodiversity Assessment
NC CBA	Northern Cape Critical Biodiversity Areas
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWCS	National Wetland Classification System
OHPL	Overhead Power Line
ONA	Other Natural Area
PES	Present Ecological State
PoSEIA	Plan of Study for Environmental Impact Assessment
PV	Photovoltaic
REC	Recommended Ecological Category
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
SEF	Solar Energy Facility
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WRC	Water Research Commission
WULA	Water Use License Application

GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial river:	Alluvial river channels are self-formed features, meaning that they are shaped by the magnitude and frequency of the floods that they experience, and the ability of these floods to erode, deposit, and transport sediment. Alluvial channels are, therefore, formed in material that is able to move during moderate floods. This means that the bed and banks of an alluvial river channel are characteristically made up of unconsolidated mobile sediments such as silt, sand or gravel, or (in some cases) cobbles and small boulders. Alluvial river channels tend to erode their banks and deposit the eroded material on bars and on their floodplains.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status

Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

1 INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a watercourse impact assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Hyperion Solar Development 2, near Kathu in the Northern Cape Province. The proposed Solar Energy Facility (SEF) include multiple arrays (of photovoltaic (PV) solar panels with a contracted capacity of up to 75MW and will be developed on the remaining extent of the Farm Lyndoch 432 (the project site). The footprint area of the proposed development within the project site is hereafter referred to as the "development area". A detailed project description is provided in Section 2.

To identify all watercourses that may potentially be impacted by the proposed development as a whole, a 500m "zone of investigation" around the development area and all associated project activities were investigated (hereafter referred to as the 'investigation area'). This is a precautionary principle where the presence of any watercourses within the outer most extent of the development area, as stipulated by Government Notice (GN) 509 of 2016 (referred to the GN 509 regulated area of a watercourse), are identified.

The purpose of this report, as part of the Impact Assessment Phase, is to define the ecology of the development and investigation areas in terms of watercourse aspects as well as detailed mapping of the watercourses. The Ecological Importance and Sensitivity (EIS) and Present Ecological State (PES) of the watercourses will be defined. In addition, this report aims to define the socio-cultural and ecological service provision of the watercourses as well as the Recommended Ecological Category (REC), Resource Management Objectives (RMO) and Best Attainable State (BAS) thereof. It is the objective of this study to provide detailed and ground-truthed information to guide the activities associated with the proposed development in relation to the watercourses to ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

This report, after consideration and description of the ecological integrity of the development area and proposed access road alternatives, must guide the Environmental Assessment Practitioner (EAP) and all competent authorities, by means of reasoned opinion and recommendations, as to the viability of the proposed development activities.

1.1 Structure of this report

This report investigates the impact significance of the proposed Hyperion Solar Development 2 in terms of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA) as well as the National Water Act, 1998 (Act No. 36 of 1998) (NWA). The following structure applies to this report:

Section 1: Introduction
Provides an Introduction, the structure of this report, the assumptions and limitation and indemnity of use.

Section 2: Project Description
This section provides a detailed project description and the locality and layout of all proposed activities.

Section 3: Assessment Approach
Provides the relevant methodology and definitions, a description of the sensitivity mapping and the risk assessment approach. Additional information regarding the methodology is provided in Appendix C.

Section 4: Desktop Assessment Results
Reports on the findings from the relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2011 database, the Northern Cape Critical Biodiversity Areas (NCCBA) (2016) database and the Department of Water and Sanitation (DWS) Resource Quality Information System (RQIS) PES/EIS, 2014 database) were considered to aid in defining the PES and EIS of the watercourses.

Section 5: Site Based Watercourse Assessment Results
This section reports on the following scope of work:

- Delineation of all the watercourses associated with the development area, the proposed access road alternatives and their associated 20m corridors according to the Department of Water Affairs and Forestry (DWAF) 2008[1] guideline: "A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". All watercourses are mapped according to their ecological sensitivity;
- Delineation of all watercourses (utilising desktop methods) within 500m of the development area, the proposed access road alternatives and their associated 20m corridors in accordance with Government Notice 509 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- The watercourse classification according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the watercourses according to the method described by Rountree and Kotze (2013);
- The services provided by the watercourses according to the method of Kotze *et al.* (2009) in which services to the ecology and the people are determined;
- Wetland Health/IHI of the watercourses according to the resource directed measures guideline as advocated by Macfarlane *et al.,* (2008) and DWAF (2008) respectively; and
- The allocation of a suitable REC, RMO and BAS to the watercourses based on the results obtained from the PES, Ecoservices and EIS assessments.

Section 6: Legislative Requirements
Provides the applicable legislative requirements based on the findings from Section 4 and indicates any applicable zones of regulation in accordance with the relevant legislations that may trigger various authorisation requirements.

Section 7: Impact Assessment
Provides the impact assessment outcomes and highlight all potential impacts and that may affect the watercourses. Management and mitigation measures are provided which should be implemented during the various development phases to assist in minimising the impact on the receiving environment.

Section 8: Conclusion
Summarises the key findings and recommendations based on the watercourse findings as well as the impact assessment.

1.2 Assumptions and Limitations

The following assumptions and limitations apply to this report:

- The determination of the watercourse boundaries and the assessment thereof is confined to the watercourses within the development area, the proposed access road alternatives and their associated 20m corridors as presented in Figure 1 and 2 (see Section 2). All watercourses

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

identified within 500m of the development area and within close proximity to the development area, the proposed access road alternatives and their associated 20m corridors were delineated on a desktop level in fulfilment of Government Notice 509 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). However, these resources were not assessed individually. The general surroundings were considered in the desktop assessment of the development area;

- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. This is especially applicable given the semi-arid climatic conditions of the Northern Cape;
- The identification of the watercourses' temporary zone proved difficult in some areas as a result of historical agricultural disturbance and transformation of the watercourses within the surrounding area. The on-site delineation was therefore supplemented with the use of digital satellite imagery to assist in the delineation of some segments of the disturbed watercourses;
- Watercourse and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative and obligate freshwater species. Within this transition zone some variation of opinion on the watercourse boundary may occur, however, if the DWAF (2008) method is followed, all assessors should get largely similar results;
- The delineations as presented in this report are regarded as the best estimate of the boundaries of the watercourse based on the site conditions present at the time of assessment (November 2018 and February 2019). Limitations in the accuracy of the delineation due to low water levels within the systems and anthropogenic disturbances are deemed possible; and
- Global Positioning System (GPS) technology is inherently inaccurate, and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the watercourses will need to be surveyed and pegged according to surveying principles.

Notwithstanding the limitations listed above, the level of detail undertaken in the study is considered sufficient to ensure that the results of this assessment accurately define the ecological character of the watercourses. This is also considered appropriate to provide the relevant planners and decision makers with the required information to formulate an opinion on the viability of the proposed SEF project from an ecological conservation viewpoint.

2 PROJECT DESCRIPTION

Hyperion Solar Development 2 is proposed on the remaining extent of the Farm Lyndoch 432 (the project site), which is located approximately 16km north of Kathu in the Gamagara Local Municipality (LM) and within the greater John Taolo Gaetsewe District Municipality (DM), in the Northern Cape Province. This project has a contracted capacity of up to 75MW and will make use of either fixed-tilt, single-axis tracking, or dual-axis (double-axis) tracking photovoltaic (PV) solar technology for the generation of electricity.

The proposed project will comprise the following key infrastructure and components:

- Arrays of PV panels (static or tracking PV system) with a contracted capacity of up to 75MW;
- Mounting structures to support the PV panels;
- On-site inverters (to convert the power from Direct Current (DC) to Alternating Current (AC)), and distribution power transformers;
- An on-site substation to facilitate the connection between the project and the Eskom electricity grid;
- A new 132kV power line between the on-site substation and the existing national grid.
- Cabling between the project's components (to be laid underground where practical);
- Battery storage mechanism with a storage capacity of up to 300MWh;

- Water purification plant;
  - The water purification plant (12m^2 in extent) will purify borehole water, (abstracted from two existing boreholes located on the project site), to drinking water standards, to be utilised during both the construction and operational phases. Furthermore, during the operational phase, the water will be utilised to clean the PV panels.
- Site offices and maintenance buildings, including workshop areas for maintenance and storage;
- A batching plant;
- Temporary laydown area; and
- Main access road to the site, internal access roads and fencing around the development area.

Based on the outcome of the meetings and consultations with affected landowners during the Scoping Phase, the following four access road alternatives were identified for consideration for the Hyperion Solar Development 2 within the EIA study:

- Alternative 1:
  This alternative formed part of the Scoping Phase and entails the upgrade of approximately 3.6km of the existing T26 gravel road situated between the project site and the N14 national road. The existing road will be upgraded from approximately 5m to 9m in width and will traverse four properties; the remaining extent of the Farm Lyndoch 432; Portion 1, 2 and the remaining extent of the Farm Cowley 457.

- Alternative 2:
  This is a new alternative identified for consideration in the EIA process. Alternative 2 entails the establishment of a new access road approximately 3.6km in length and 9m in width. The new access road is proposed to be located adjacent to the existing T26 gravel road and will traverse four properties; the remaining extent of the Farm Lyndoch 432, Portion 1, 2 and the remaining extent of the Farm Cowley 457.

- Alternative 3:
  Alternative 3 entails the establishment of a new access road approximately 5.1km in length and 9m in width and the upgrade of approximately 10.3km of the existing T25 gravel road from approximately 5m in width to 9m in width. This alternative was previously known as Alternative 2 in the Scoping Phase and was realigned to avoid the protected Kathu Forest. Alternative 3 will traverse five properties; the remaining extent of the Farm Lyndoch 432, Portion 1 of the Farm Selsden 464, the remaining extent of the Farm Kathu 465, Portion 1 of the Farm Halliford 466 and the remaining extent of the Farm Marsh 467.

- Alternative 4:
  Access road Alternative 4 entails the establishment of a new access road approximately 6.2km in length and 9m in width situated between the western boundary of the project site and the R380 regional road. This alternative will traverse four properties; the remaining extent of the Farm Lyndoch 432, Portion 1, the remaining extent of the Farm Selsden 464 and the remaining extent of the Farm Halliford 466.

A 20m wide corridor for all four access road alternatives has been considered and assessed during the EIA Phase to determine the most preferred access route from an environmental perspective.
The locality of the development and investigation areas and the proposed layout for this project is presented in Figures 1 to 3.

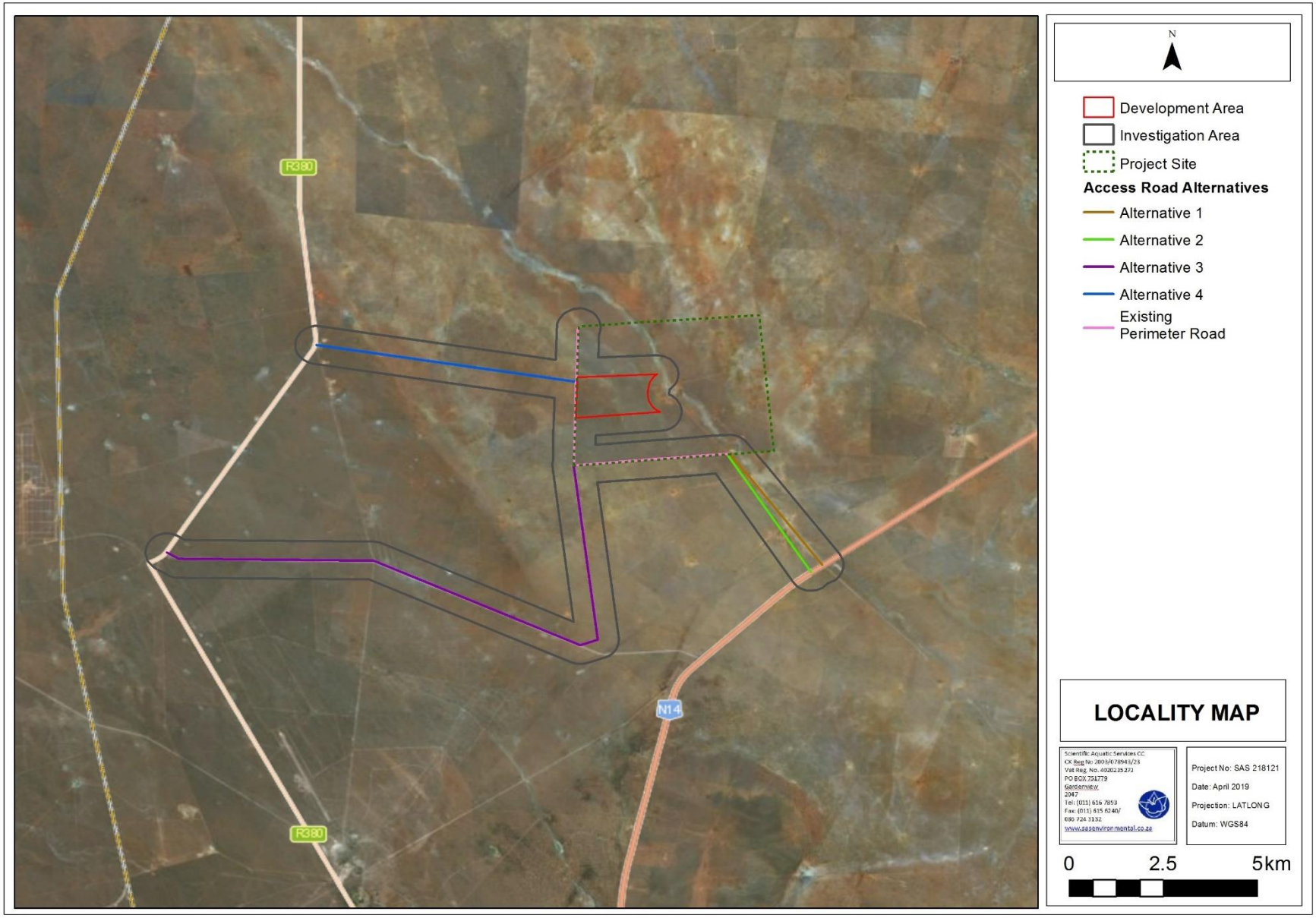


Figure 1: Digital satellite image depicting the development site and associated 500m investigation area in relation to surrounding areas.

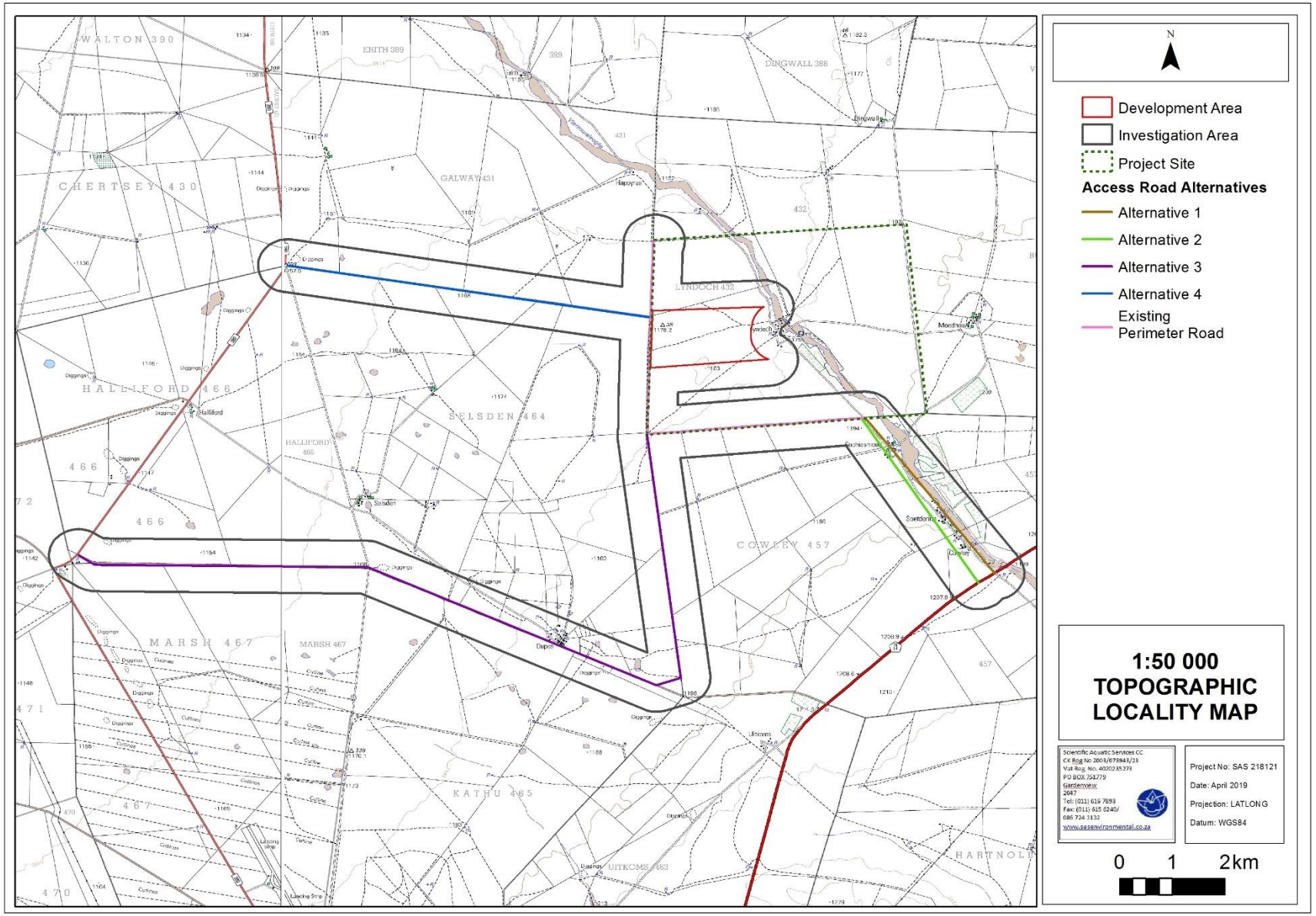


Figure 2: Location of the development site and associated 500m investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.

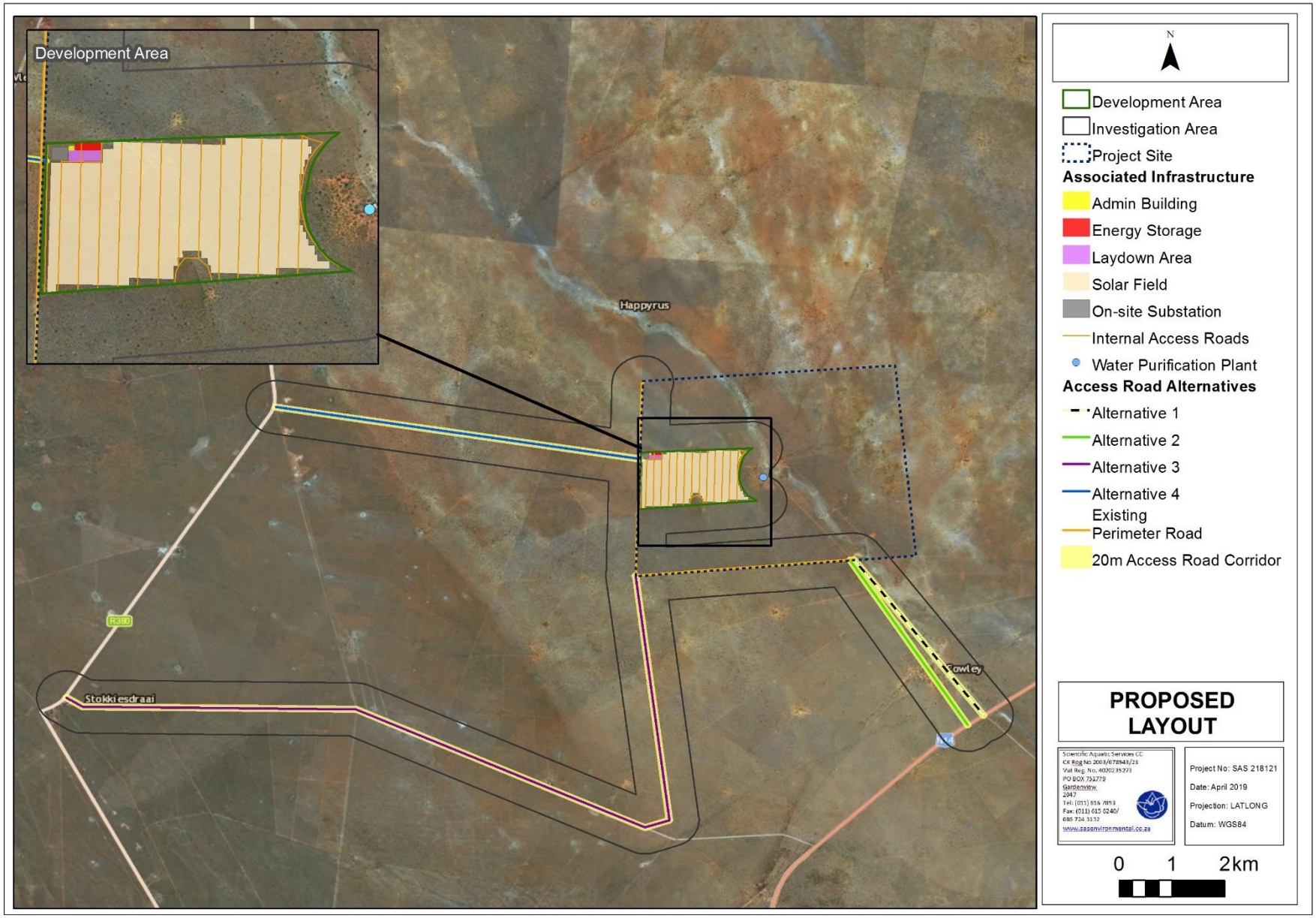


Figure 3: Proposed layout of the infrastructure and access road alternatives associated with the proposed SEF development.

3 ASSESSMENT APPROACH

3.1 Watercourse Site Selection and Field Verification

For this investigation, the definition of a watercourse, wetland and riparian habitat was taken as per that in the National Water Act, 1998 (Act No. 36 of 1998) (NWA). The definitions are as follows:

A **watercourse** means:
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse, and a reference to a watercourse includes where relevant, its bed and banks.

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

Riparian habitat includes-
"The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas".

During the desktop phase, use was made of topographical maps, digital satellite imagery, and available provincial and national freshwater databases to identify points of interest before the field survey. Details of the relevant databases which were consulted are contained in Section 4 of this report. Points of interest were defined considering the following:

- Encompassing a geographic spread of points to ensure that all conditions in the area were adequately addressed; and
- Ensuring that features displaying a diversity of digital signatures were identified to allow for field verification. In this regard specific mention is made of the following:
  - Freshwater vegetation: a distinct increase in density as well as tree size near drainage lines;
  - Hue: with drainage lines and outcrops displaying soils of varying chroma created by varying vegetation cover and soil conditions identified; and
  - Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions being identified.

A site visit was undertaken during November 2018 and February 2019 to assess as many of the points of interest as possible. The watercourse delineation took place according to the method presented in "A practical field procedure for identification and delineation of wetlands and riparian areas" (DWAF, 2008) as far as practically feasible, given the condition of the onsite characteristics at the time of assessment. The foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

Factors influencing the habitat integrity of each feature group identified during the field survey were noted, and the functioning, environmental and socio-cultural services provided by the various features were determined. In addition to the delineation of the watercourses, a detailed assessment of the systems was undertaken to define the following important aspects of the watercourse ecology:

- Watercourse characterisation and classification up to Level 4, according to the method of Ollis *et al.* (2013) in line with the requirements of the DWS;
- Watercourse PES definition according to either the Wetland IHI method or WET Health Ecostatus tool as applicable;
- Watercourse ecoservice provision using the application of the Wet-Ecoservices tool according to the method of Macfarlane (2008); and
- Watercourse EIS assessment according to the method of the Department of Water Affairs (DWA) (1999).

A detailed explanation of the method of assessment is provided in Appendix C of this report.

3.2 Sensitivity Mapping

All the ecological features associated with the development area, the proposed access road alternatives and their associated 20m corridors were considered and all sensitive areas were delineated with the use of a GPS as well as digital satellite imagery. A Geographic Information System (GIS) was used to project these watercourses onto aerial photographs and topographic maps. The sensitivity map is provided in Section 6 of this report.

3.3 Impact Assessment and recommendations

Following the completion of the Scoping Phase, an Impact Assessment was conducted (please refer to Appendix C for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the SEF from planning, through construction and operation. The detailed mitigation measures are outlined in Section 7 of this report, while the general management measures, which are considered to be best practice mitigation applicable to a project of this nature, are outlined in Appendix E.

4 RESULTS OF THE DESKTOP ANALYSIS

The following section contains data accessed as part of the desktop assessment which is presented as a “dashboard-style” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible, to allow the reader to understand how this information has been integrated into the findings of this report.

It is important to note that although all data sources used within this report are useful and often verifiable and of high quality, some of the information and databases may not be entirely accurate, provide actual site characteristics at the scale required to inform this environmental permitting process and/or water use licensing process. However, this information is considered to be the most relevant and accurate information to use as desktop background information, to indicate areas and aspects of increased conservation importance associated with the development and investigation areas. The areas highlighted to be of conservation importance were investigated during the site-specific field verification survey as part of the EIA Phase.

Table 1: Desktop data relating to the character of the watercourses associated with the development and investigation areas.

Aquatic ecoregion and sub-regions in which the development area is located		Detail of the development area in terms of the National Freshwater Ecosystem Priority Area (NFEPA, 2011) database (Figure 4)	
Ecoregion	The development area is located within the Southern Kalahari Ecoregion	FEPACODE	The development area is situated in an area defined as an upstream management catchment (FEPACODE 4). Upstream management catchments are required to prevent the downstream degradation of Freshwater Ecosystem Priority Areas (FEPAs) and Fish Support Areas (FSAs).
Catchment	Orange		
Quaternary Catchment	D41K		
WMA	Lower Vaal		
subWMA	Molopo		
Dominant characteristics of the Southern Kalahari (29.02) Aquatic Ecoregion Level 2 (Kleynhans *et al.,* 2007)		NFEPA Wetlands (Figure 4)	According to the NFEPA database (2011) a natural wetland, classified by NFEPA as a depression, is located on the boundary of the north-eastern portion of the investigation area around the development area. Two natural depression wetlands are also identified by the NFEPA database (2011) to be associated with the most southern portion of the investigation area associated with access road Alternative 3. A large wetland flat was identified by this database, to be associated with the central portion of the investigation area, associated with Access Road Alternative 3. Another natural depression wetland was identified by the NFEPA database (2011) to be associated with the most western portion of the investigation area, associated with access road Alternative 4. All the wetlands identified by the NFEPA database (2011) are considered to be in a natural or good ecological condition (Class AB).
Ecoregion	Southern Kalahari		
Dominant primary terrain morphology	Mountains: moderate to high relief, Closed Hills		
Dominant primary vegetation types	Kimberley Plateau Bushveld, Kimberley Plains Thornveld Bushveld		
Altitude (m a.m.s.l)	1100 to 1700		
MAP (mm)	200 to 500		
The coefficient of Variation (% of the MAP)	30 to 40		
Rainfall concentration index	50 to 65		
Rainfall seasonality	Late Summer		
Mean annual temp. (°C)	16 to 20		
Winter temperature (July)	0 to 20		
Summer temperature (Feb)	16 to 32		
Median annual simulated runoff (mm)	5 to 60	Wetland Vegetation Type	Eastern Kalahari Bushveld Group 1 (Least Threatened according to SANBI, 2012 and Mbona *et al.*, 2014).
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)		NFEPA Rivers (Figure 4)	The episodic Vlermuisleegte River bisects the eastern portion of the investigation area associated with the development area and is located just east of the proposed access road Alternative 1. This river is considered largely natural according to the PES 1999; however, according to the NFEPA database, the river is moderately modified (Class C).
Sub-quaternary reach	D41K-02240 (Vlermuisleegte River)		
Proximity to the development area?	Approximately 8,8 km north-west of the development area		
Assessed by an expert?	No		
Mean Ecological Importance (EI) Class	Moderate		
Stream Order	1		
Default Ecological Class (based on median PES and highest EI or ES mean)	Moderate (Class C)		

Detail of the development area in terms of the Northern Cape Critical Biodiversity Areas (2016) (Figure 5)	
Critical Biodiversity Area (CBA) 1	The most southern portion of the investigation area associated with the proposed access road Alternative 3 is categorised as a Critical Biodiversity Area 1. According to the Technical Guidelines for CBA Maps document (SANBI, 2017), CBAs are areas that must remain in good ecological condition in order to meet biodiversity targets for ecosystem types, species of special concern or ecological processes. CBA 1 areas that are considered to be irreplaceable or near irreplaceable for meeting biodiversity targets.
Critical Biodiversity Area (CBA) 2	The area surrounding the abovementioned CBA 1 area (within the southern portion of the investigation area associated with the proposed access road Alternative 3) falls within areas categorised as CBA2. CBA2 are areas that have been selected as the best option for meeting biodiversity targets, based on complementary, efficiency, connectivity and/or avoidance of conflict with other land or resource users.
Ecological Support Areas (ESA)	Several portions of the investigation area are located in areas classified as ESAs (this includes the north-eastern corner of the development area, proposed access road Alternative 1 and 2, the western and eastern portions of proposed access road Alternative 3, and the most western portion of proposed access road Alternative 4). According to the Technical Guidelines for CBA Maps document, ESAs are areas which must retain their ecological processes to meet biodiversity targets for ecological processes that have not been met in CBAs or protected areas. Furthermore, these areas must meet biodiversity targets for representation of ecosystem types or species of special concern when it's not possible to meet them in CBAs, support ecological functioning of protected areas or CBAs or a combination of these (SANBI, 2017).
Other Natural Areas (ONA)	The remaining extent of the development area, the central portion of proposed access road Alternative 3, and the central and eastern portion of proposed access road Alternative 4 are areas defined as "Other Natural Areas" (ONA). According to the Technical Guidelines for CBA, Maps document, ONA'a consist of all areas in good or fair ecological condition, that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017).

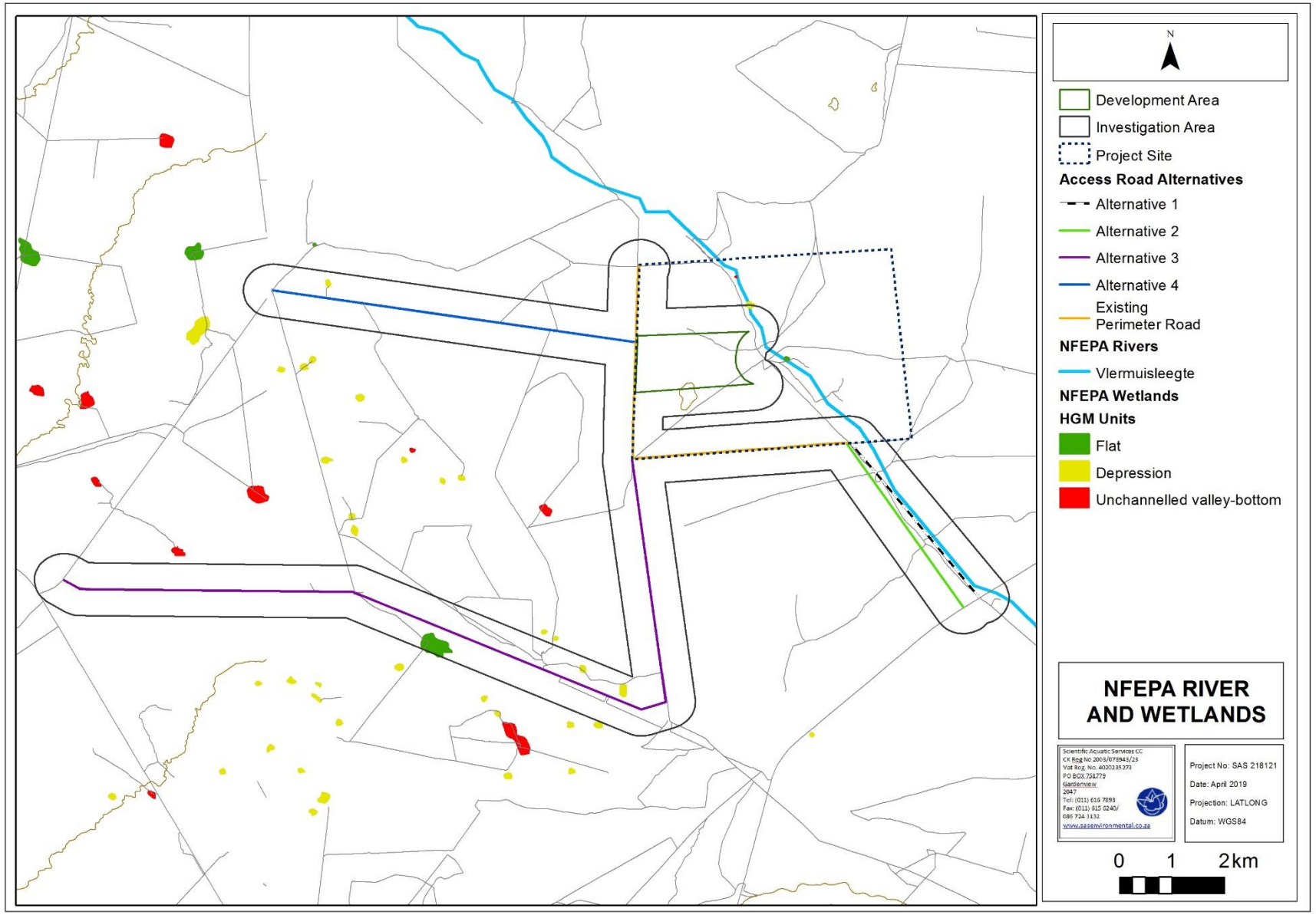


Figure 4: The hydrogeomorphic (HGM) units and rivers associated with the development area and investigation areas according to the NFEPA database (2011).

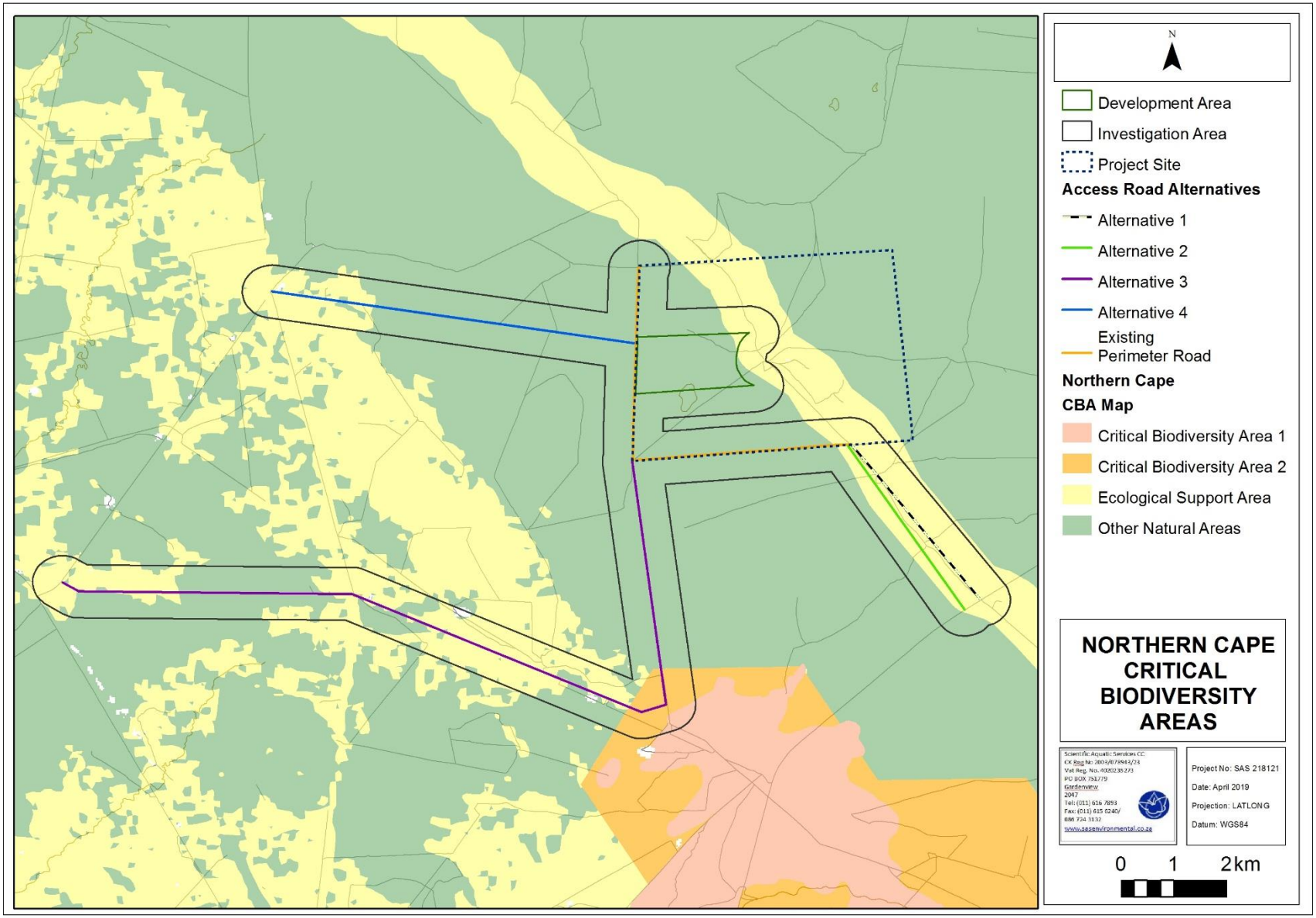


Figure 5: The Critical Biodiversity Areas and Ecological Support Areas associated with the development area and investigation areas according to the Northern Cape Critical Biodiversity Area Database (2016).

5 RESULTS: WATERCOURSE ASSESSMENT

5.1 Watercourse characterisation

No watercourses were identified to be associated with the development area, however, as noted in Section 4 of this report, the eastern portion of the investigation area associated with the development area is bisected by the Vlermuisleegte River which drains in a south-eastern to north-western direction. This river is traversed by the proposed access road Alternative 1. A perched depression wetland was also identified on the north-eastern boundary of the investigation area within the Vlermuisleegte River.

The Vlermuisleegte River is highly episodic[1], only flowing for brief periods during irregular flood events. The climate in which the development and investigation areas are located is considered to be semi-arid with the Mean Annual Rainfall (MAR) ranging from 200 to 500 mm (see Section 3), most of which falls from late November to March (usually as heavy downpours of short duration). The Vlermuisleegte River is also considered to be an alluvial river. These systems are known to be self-formed rivers, that are shaped by the magnitude and frequency of the floods that they experience, and as part of these floods, erode, deposit, and transport sediment (Ollis *et al.,* 2013). Alluvial rivers are therefore formed by materials that can move during moderate floods. In this case, the Vlermuisleegte River is characterised by thick, red sandy soils which have been deposited within the valley bottom position, forming a floodplain landform (due to the uniformity and thickness of the sand) rather than having a distinctive river channel. The Vlermuisleegte River is considered to be a no-go area for all infrastructure except for the construction of access road Alternative 1 (if proven feasible as part of the development). This proposed access road Alternative 1 has an existing impact on the Vlermuisleegte River (refer to Section 7 for further details).

Ten (10) pan wetlands (systematically numbered in Figure 6 and 7 below for ease of reference), were identified scattered within the investigation area associated with access road Alternative 3, the closest of which is located approximately 45 m from the proposed route location (Pan 8). Furthermore, a pan wetland (Pan 11) was also identified within the investigation area associated with access road Alternative 4, although this system is located approximately 245m from the proposed route. Thus, none of these pan wetlands are located within the 20m corridor associated with access road Alternative 3 or 4.

The delineated boundaries of these watercourses are indicated in Figure 6 and 7 below. The watercourses mentioned above were classified according to the classification system (Ollis *et al*., 2013) as an Inland Systems, falling within the Southern Kalahari Ecoregion, and the Eastern Kalahari Bushveld Group 1 WetVeg (wetland vegetation) group, which is summarised in the table below.

Table 2: Characterisation of the watercourses associated with the investigation area according to the Classification System (Ollis *et al.,* 2013).

Watercourse	Level 3: Landscape unit	Level 4: HGM Type
Vlermuisleegte River	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes.	**River:** a linear landform with a clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Perched depression wetland and Pan Wetlands		**Depression**: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.

[1] "Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period, or may flow only once in several years." (Uys and O'Keeffe, 1997, in Rossouw *et al*., 2006).

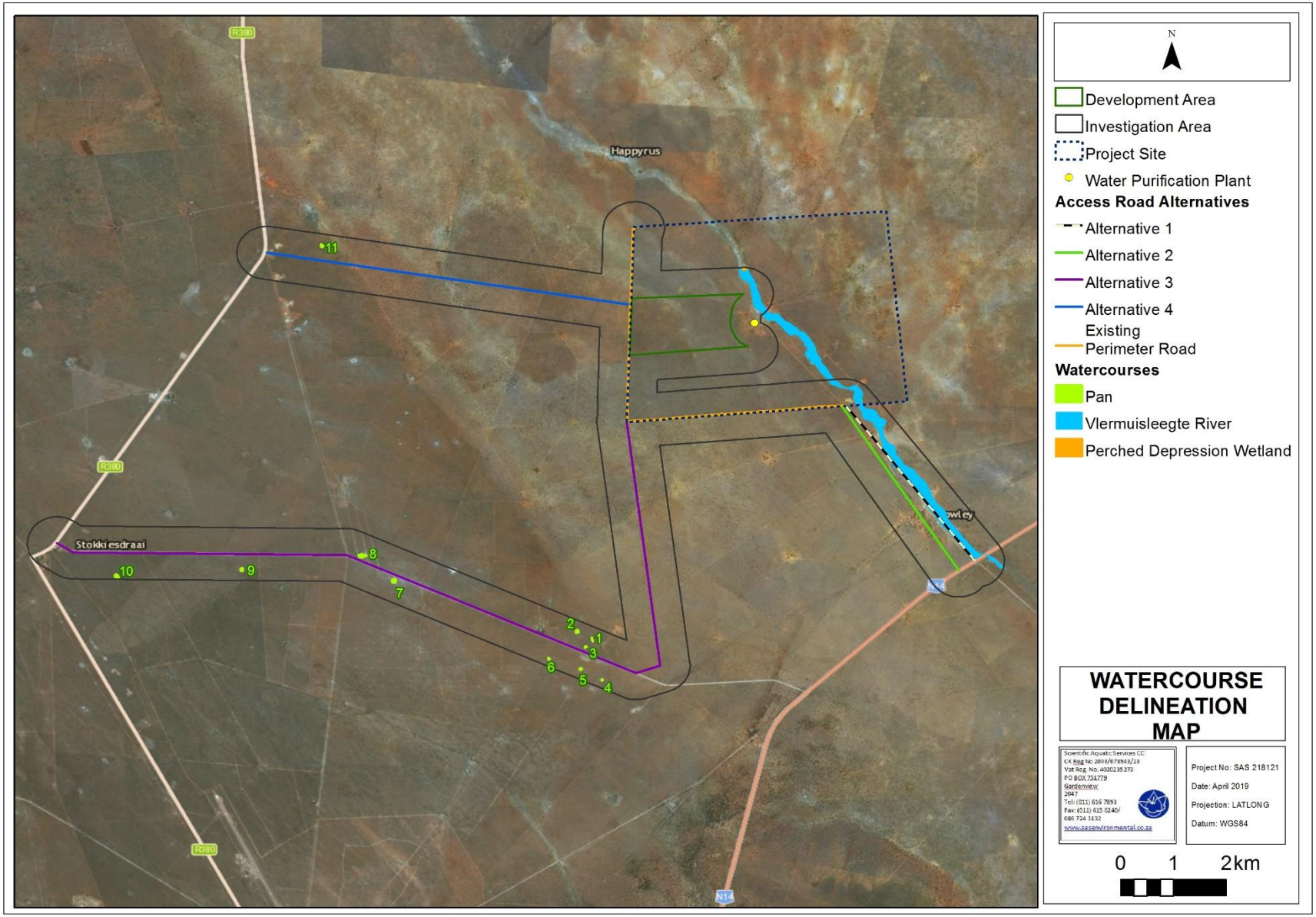


Figure 6: The locality of the watercourses associated with the proposed development and access road alternatives.

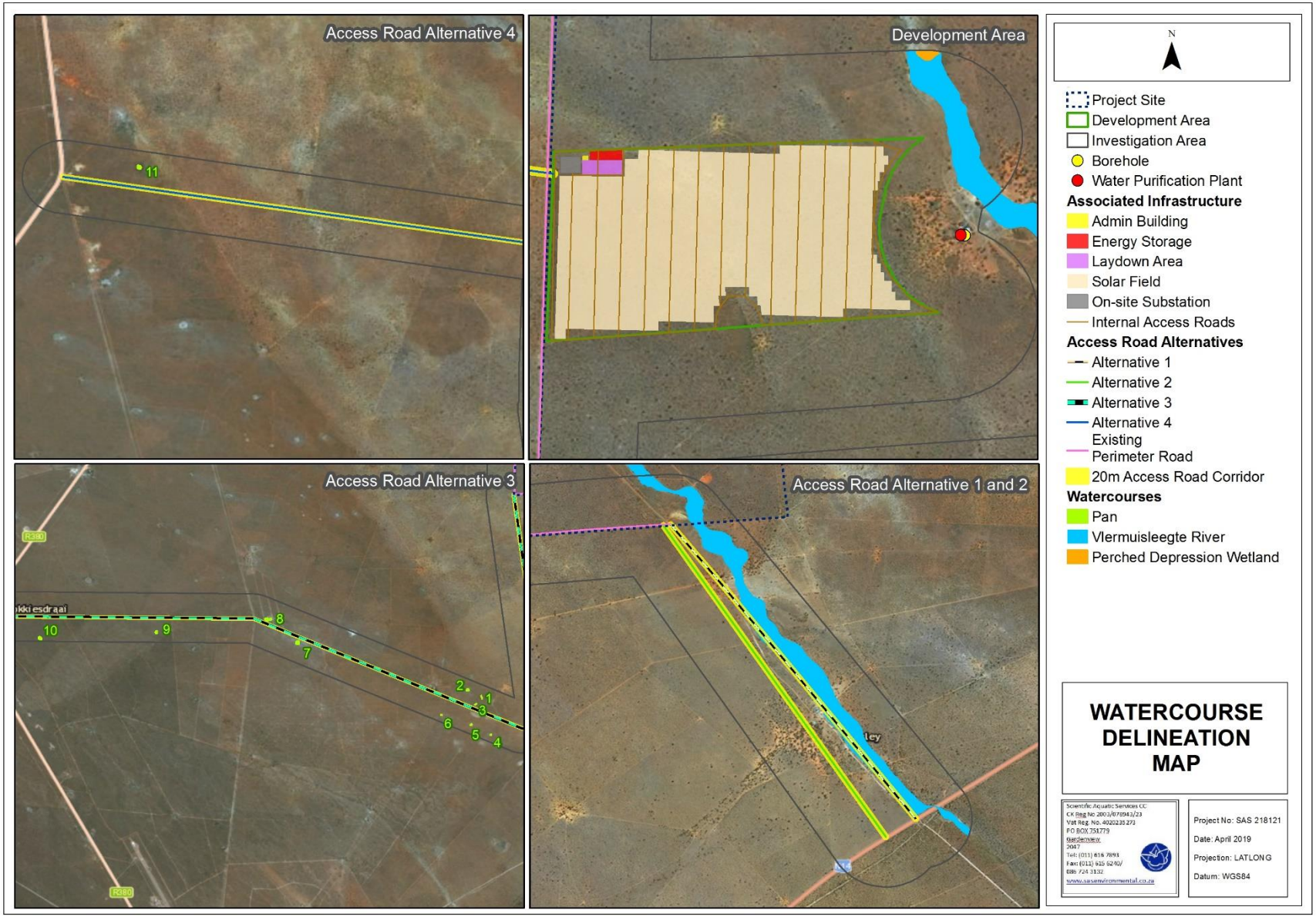


Figure 7: Specific focus areas of the watercourses identified to be associated with the proposed development and access road alternatives.

Several instream impoundments (Figure 8), created using an earth berm, were identified within the Vlermuisleegte River. During the site assessment, these impoundments were noted to be dry, and are likely to only contain surface water during and after rainfall events. It is considered likely that these systems were historically created by local residents in order to store water for watering of livestock. Due to the artificial nature of these systems they were not mapped or further assessed.

Figure 8: Two earth berm impoundments identified within the Vlermuisleegte River.

Other anthropogenic activities identified during the site visits which have impacted on the integrity of the identified watercourses in the surrounding area include:

- Small scale sand mining (historic and currently active) (Figure 9) – Active sand mining activities are located within the south-eastern portion of the project site, just outside of the delineated boundary of the Vlermuisleegte River. Vehicles transporting the excavated sand make use of an informal road crossing (no culverts or other associated road infrastructure were noted to be associated with this crossing) through the river. Sand mining activities were also identified within the most southern portion of the investigation area associated with proposed access road Alternative 3. These activities were noted to be approximately 100m from Pan 1 and 3 as well as along the western portion of proposed access road Alternative 4.

Figure 9: Sand mining identified along the outer edge of the Vlermuisleegte River, within the south-eastern portion of the project site.

- Historical agricultural activities (as identified from digital satellite imagery (Figure 10)) indicate several agricultural fields that were developed within the floodplain area associated with the Vlermuisleegte River. These activities resulted in the clearing of all natural vegetation

associated with the river system. Currently, only graminoid species persist within the historically cultivated fields.

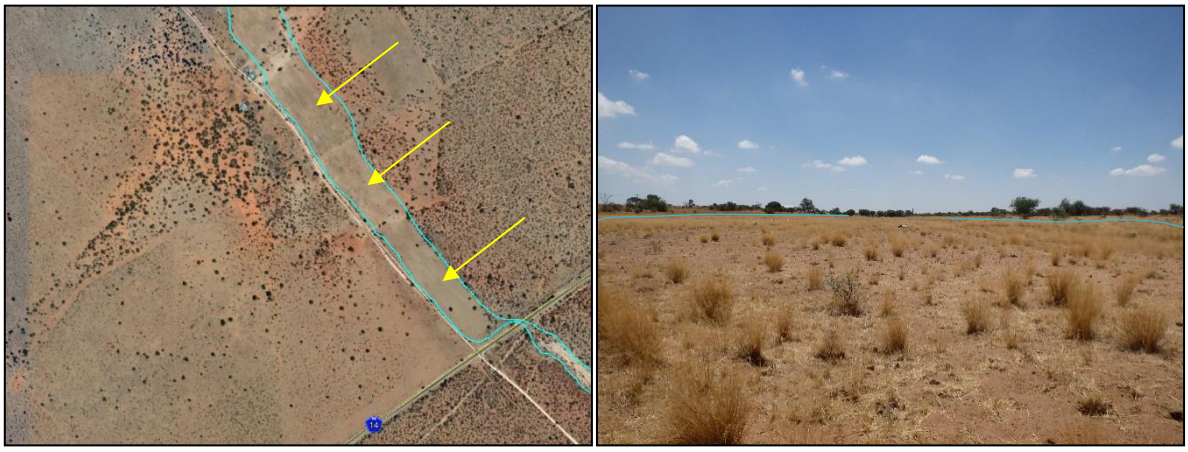


Figure 10: (Left) The most southern portion of the Vlermuisleegte River (blue line) depicted on digital satellite imagery (sourced from November 2017). The yellow arrows indicate areas which have historically been cultivated. (Right) Only graminoid species were identified within these historically cultivated fields within the Vlermuisleegte River (blue line). On the edge of the river, some larger shrub and tree species are still present.

5.2 Delineation of watercourses

The watercourses were delineated according to the guidelines advocated by DWAF (2008). Onsite delineation was supplemented with the use of digital satellite imagery to assist in the delineation of disturbed portions, specifically within the Vlermuisleegte River. The delineations as presented in this report are regarded as the best estimate of the watercourse boundaries based on the site conditions present at the time of assessment. During the assessment, the following indicators were used to determine the wetland boundaries:

- Topography/Elevation was used to determine in which parts of the landscape the watercourses were most likely to occur. Based on the geomorphological characteristics of the landscape, the Vlermuisleegte River is located within the valley bottom position of the landscape, which are easily identifiable on site (Figure 11). Some of the pan wetlands were also easily identifiable due to their closed elevation contours, which increase in depth from the perimeter to the central area of greatest depth (Figure 12).

Figure 11: The Vlermuisleegte River is located within the valley bottom landscape position (yellow line). This photograph indicates the river bank, which comprises sediment deposited by the river channel.

Figure 12: A photograph of Pan 8 indicating a circular depressional area (red outline).

- Due to the semi-arid climate of the development area, watercourses located in these climatic regions are likely to have a limited discernible difference between terrestrial and riparian vegetation. Therefore, the use of riparian vegetation as an indicator of the boundary of the river was restricted. As illustrated in Figure 10 above, cultivated fields within the river have further reduced the already limited natural vegetation available within the river. As such this indicator was not extensively used for the delineation of the Vlermuisleegte River and digital satellite imagery was thus utilised in conjunction with the field verification process to delineate the boundaries of the riparian zone associated with the Vlermuisleegte River.
- Soil form was considered; however, the sandy soils within the river did not show soil variations such as gleying (leaching out of iron) or the presence of mottles (soils with variegated colour patterns). Therefore, this indicator was not extensively utilised to determine the boundaries of the watercourses as differences between terrestrial and riparian soils could not be reliably

discerned using soil morphology characteristics (Figure 13). However, in some of the pan wetlands, when soil samples were taken using a manual hand-held auger, mottling was evident (Figure 14) within the shallow upper layer of the bottom of the pans. Due to the nature of the underlying rocky soil layers, it was not possible to auger to a depth of 50cm.

Figure 13: A representative example of a soil sample taken within the Vlermuisleegte River. This river has deep and sandy soils which are uniform in color throughout the 50cm sample pit taken.

Figure 14: Faint mottling apparent in a soil samples taken within the basin of a pan wetland.

5.3 Results of Field Verification

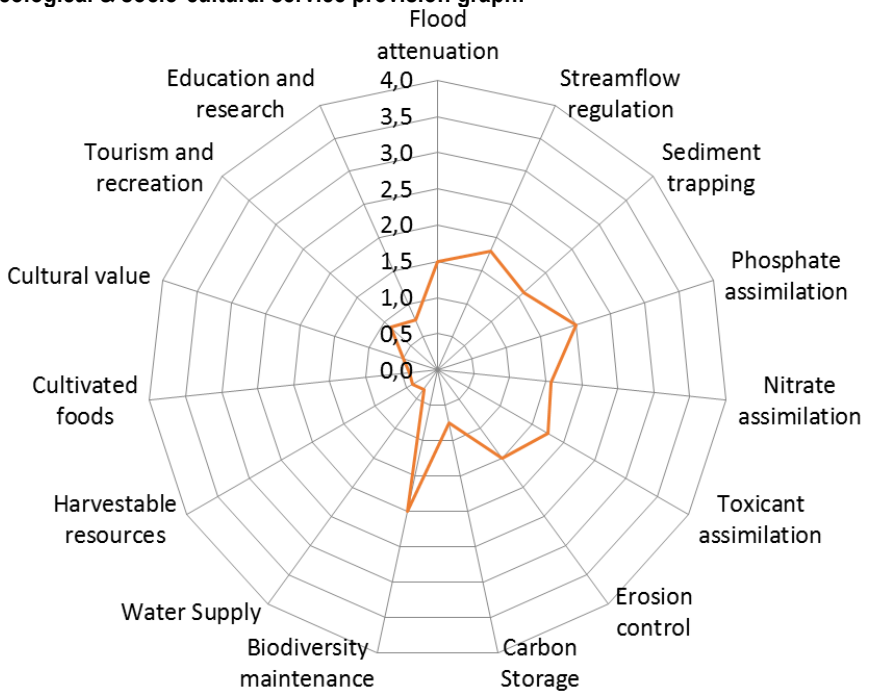
SAS undertook field assessments on the 28th of November 2018 and 25th to determine the extent and condition of the watercourses associated with the development area, the proposed access road alternatives and their associated 20m corridors, as described above. The tables below (Tables 3 - 5) summarise the findings of the field verification in terms of relevant aspects (hydrology, geomorphology and vegetation aspects) of freshwater ecology. The details on the method of assessment used to assess the watercourses are contained in Appendix C of this report.

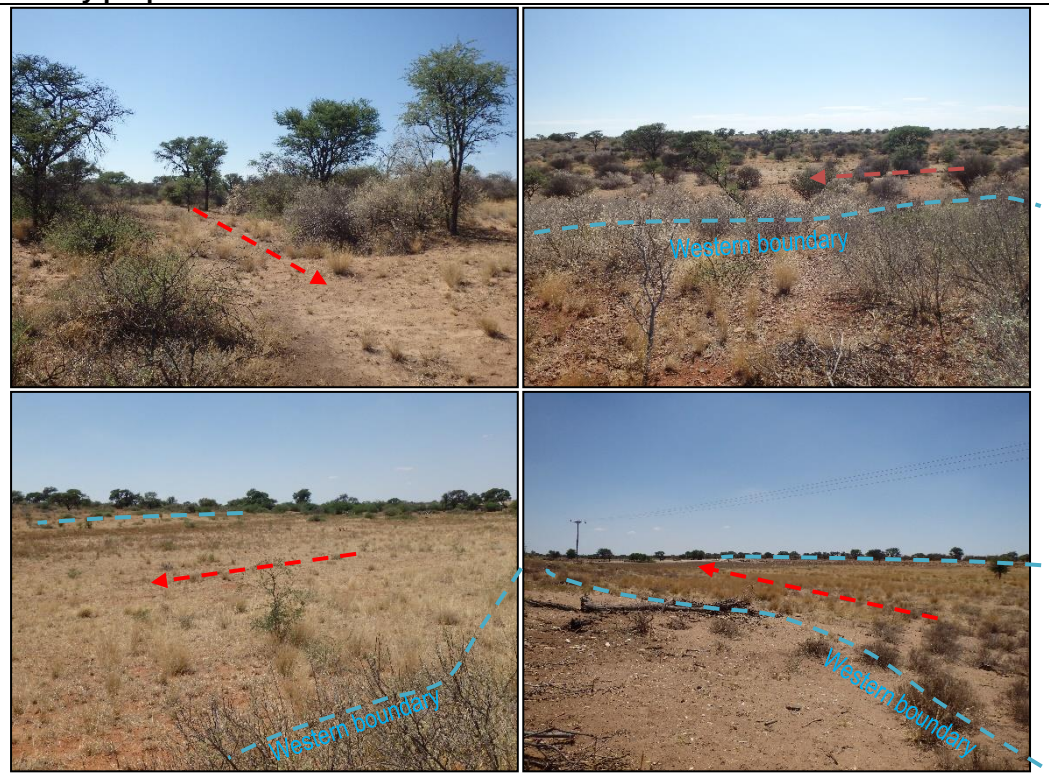
It should be noted that while consideration is given to water quality in line with the requirements of the DWS, testing of water quality parameters could not take place during the site assessment since no surface water was available. Therefore, the water quality assessment was based on information contained within available databases, as well as the anticipated impacts of the surrounding land uses within the catchment on water quality.

Due to the relatively homogenous wetland characteristics of the pan wetlands, the assessment of these wetlands is reported upon in a combined fashion (see Table 5) and not individually.

Table 3: Summary of the assessment of the Vlermuisleegte River to be traversed by proposed access road Alternative 1.

Ecological & socio-cultural service provision graph:





*Boundary of the Vlermuisleegte river is indicated by the blue line and flow direction is indicated by the red arrow.

IHI and VEGRAI discussion	**IHI Category: C/D (Moderately to Largely modified)** **VEGRAI: C/D (Moderately to Largely modified)** Modifiers to this river include informal road crossings, cultivation within the river and the construction of instream impoundments. These factors have caused some degree of impact to the river, most notably, an impact on the riparian vegetation community of the river (specifically the upstream reach, north of the N14). Geomorphology remains intact, however, and although some areas of bank incision were observed, these were not considered severe nor were they extensive in extent.
Photograph notes	Representative photographs of the reach of the Vlermuisleegte River associated with the investigation area. (Top left and right). The northern portion of this river is well vegetated, consisting of grasses, shrubs and a variety of tree species. Alluvial soils were identified in areas where the vegetation density is low. (Bottom left and right) The southern portion of the Vlermuisleegte river has been historically cultivated. In channel vegetation is dominated by grass species, while larger tree and shrub species are located along the river boundary.

Ecoservice provision	**Moderately Low** Due to the episodic nature of the river, as well as the disturbances to vegetation, a diminished capacity to provide ecological functions which would typically be provided by wetland or riverine resources is anticipated. However, the opportunity to provide services such as sediment trapping, nutrient and toxicant assimilation and biodiversity maintenance is considered to be moderate. The river was found to provide habitat to a variety of biota and is therefore considered of intermediate biodiversity maintenance functionality. It should be noted that while low scores were obtained for the provision of direct human benefits such as cultivated foods and water supply, this is primarily due to the location of the river within an undeveloped area. In reality, the climatic conditions combined with the predominantly friable, well-draining soils which are likely to have low arable potential (despite historical cultivation), greatly minimise the potential and opportunity for the river to provide such direct benefits to the local community.	**EIS discussion**	**EIS Category: Moderate** The river is deemed to be of moderate importance on a landscape scale, as well for potential biodiversity support. It is considered a relatively resilient system, since flow variability in episodic systems such as the Vlermuisleegte River is a major ecological driver, and intolerant taxa cannot establish under such conditions. The area in which the river is located is also considered to be an ESA by the NCCBA database (2016), which aims to support the ecological functioning of protected areas or CBAs. Furthermore, the highly variable flow means that the assessed portion of the river is not deemed important for hydrological functioning or direct human benefits such as the provision of water for domestic purposes.

RMO and REC Discussion

RMO: C (Maintain)
REC Category: C (Moderately modified)
BAS: C

As it is proposed that the existing T26 road will be upgraded as part of the proposed access road Alternative 1 (which directly traverses the Vlermuisleegte River), impacts on the river are considered unavoidable. Therefore, the upstream reach of the river where no activities are planned, must at a minimum, be maintained in its current state. Further degradation of the river where the road construction activities would take place should prevent significant impacts to the vegetation and geomorphological components of the river. As such, access road Alternative 1 is not considered favourable from a freshwater ecological perspective. No other proposed activities will likely impact on the river, and the river must be maintained in its current PES.

Watercourse characteristics:

a) Hydrologic regime

Since the Vlermuisleegte River is considered to be episodic, it only experiences flows (as flash floods) during high intensity, short duration rainfall events. Flow occurs when the watershed has received enough rain to saturate the soil and generate runoff into the river. The period of flow also differs, and may last days, hours or only minutes, depending on the rainfall intensity and duration. While infrastructure such as culverts, gravel roads and fences traverse the river in several localities, due to the episodic nature of the river, these are not deemed to be significant 'modifying factors' insofar as hydrological functioning is concerned.

b) Water quality

No surface water was present at the time of the assessment; therefore, water quality parameters could not be assessed. However, due to the remote locality of the river, and the low levels of domestic and industrial activities in the vicinity, surface water quality, when present, is unlikely to be significantly impacted in terms of pollutants.

c) Habitat and biota

Due to the erratic flow conditions of this river, it does not have the same diversity of aquatic and semi-aquatic fauna and flora when compared to perennial rivers. Nevertheless, the marginal and non-marginal vegetation of the river is considered intact, except for the upstream reach of the river which was historically cultivated. Terrestrial trees and shrubs are the most obvious and permanently established biota associated with the non-marginal zone of the river. Grass species primarily dominate the active channel of the river. As this river has a variety of habitat types, the river could potentially provide refugia or a migratory corridor for fauna. Some alien vegetation species were identified only where disturbances (such as fence crossings or cattle pens) are located within or close to the river. Although not extensive at this time, it is considered essential that these species be removed if the proposed project proceeds, as part of the duty of care and ongoing environmental management relating to the project.

d) Topography: Geomorphology and sediment balance

The river is characterised by relatively flat, uniform topography. The sparse vegetation cover within the active channel of the river and poorly developed soils produce more runoff and erosion per unit area for a given intensity of rainfall. When flow is present, it quickly drains through the river reach (due to decreased surface roughness) and gains a high sediment load. When the flow reaches the downstream portion of the river (just east of the development area) where vegetation is more abundant, the flow velocity slows, and the sediment is deposited. Some evidence of trampling by domestic livestock was present within the instream impoundments, but it is not considered to be extensive in extent nor severity.

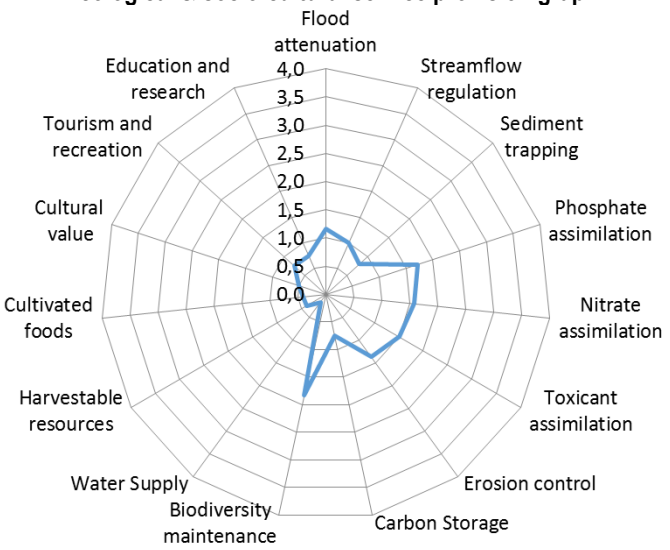
Possible significant impacts, Business case, Conclusion and Mitigation Requirements:

As per the proposed layout plan for the development area (Figure 3), no surface infrastructure (including internal roads) are located within the 100m GN509 Zone of Regulation of this river; thus, these activities do not pose any legislative or freshwater conservation constraints. Nevertheless, these activities were considered as part of the impact assessment and the potential for indirect impacts to occur on the Vlermuisleegte River was determined to be Low.

The layout of proposed access road Alternative 1 does directly traverse the Vlermuisleegte River. The impact of the construction of this road was determined to have a Medium impact significance during the construction thereof, and a Low impact significance during the operational phase, with the implementation of the recommended mitigation measures. Despite this access road alternative traversing the river, it is not considered a no-go area for the development of access road Alternative 1, as an existing road has already impacted on the Vlermuisleegte River. This access road alternative is not recommended to be authorised as it directly traverses a watercourse. However, if it would be constructed, the impacts thereof can be mitigated (albeit the construction thereof would pose Medium impact significance, with the implementation of mitigation measures) and authorisation in terms of Sections 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) will be required from the Department of Water and Sanitation. If access road Alternative 1 is not constructed, no infrastructure proposed as part of Hyperion Solar Development 2 would be located within the Vlermuisleegte River or it's associated zone of regulation, and all potential impacts posed by the proposed development can be considered Low.

Table 4: Summary of the assessment of the perched depression wetland located on the north-eastern boundary of the investigation area associated with the development area.

Ecological & socio-cultural service provision graph:

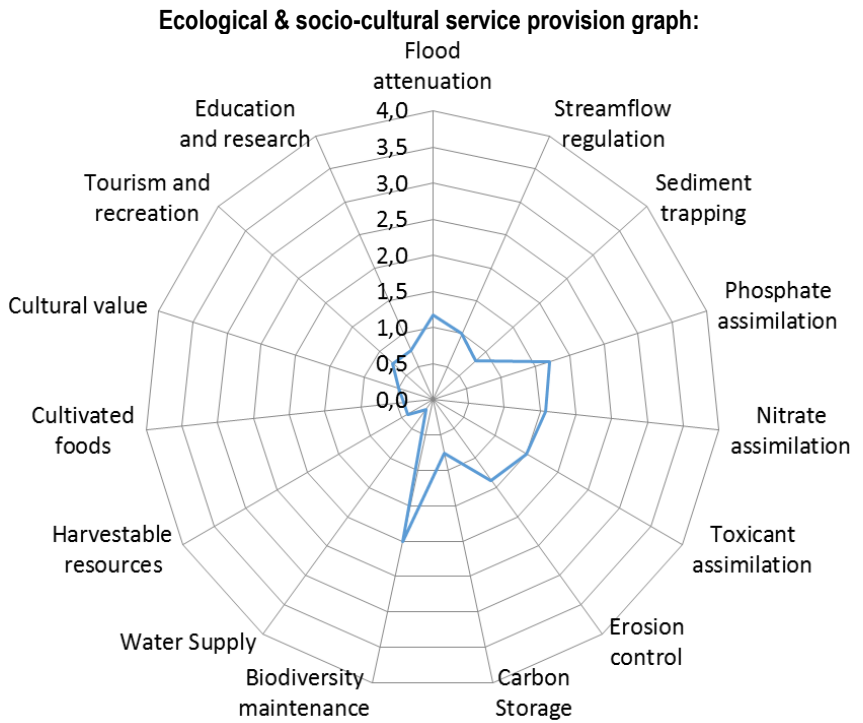


Photograph notes: (Left) The perched depression wetland (dashed blue outline) located within the Vlermuisleegte River (yellow line). (Right) Rocky outcrops line the base of the pan. Very few vegetation species were present within the depression itself, with only a few shrub species identified.

PES discussion	**WET Health Category: B (Largely natural with few modifications)** Since very few anthropogenic factors are within close proximity to this depression, it is considered to be mostly unaffected. A slight change in ecosystem processes is discernible, and a small loss of natural habitat and biota may have taken place due to livestock trampling and grazing. Grazing from livestock was the only apparent factor, impacting the vegetation component of the depression.	**Ecoservice provision**	**Moderately Low** Since this depression is located within a semi-arid area, surface water is only present during certain periods of the year. The ecoservice provision is thus considered to have a moderately low ecological functionality. The flood attenuation services provided by this system are considered to be limited due to the position in the landscape and lack of vegetation. Due to its inward draining nature, the pan is not considered to play a significant role in streamflow regulation. Seasonally, this depression and the surrounding area potentially provide habitat for a variety of species which rely on the presence of surface water.
EIS discussion	**EIS Category: Marginal/Moderate** Due to the lack of habitat diversity and moderately low hydro-functionality, this depression is not of significant ecological importance on a landscape scale. However, since it forms part of the larger Vlermuisleegte River, it does potentially aid in retaining water during rainfall events (albeit limited). Since this depression is also located within an area considered to be an ESA by the NCCBA database (2016), it does play a role to support ecological functioning of protected areas or CBAs within the larger catchment.	**RMO and REC Discussion**	**RMO: B (Maintain)** **REC Category: B (Largely natural with few modifications)** **BAS: B** Since no infrastructure is proposed to be within close proximity of this depression (all proposed infrastructure as located outside of its 500m GN509 zone of regulation), it is considered unlikely that edge effects could potentially impact on the depression. Nevertheless, all efforts should be made to maintain the current PES of the depression and to prevent any impacts from occurring on this depression.

<table>
<tr><th colspan="2">Watercourse characteristics:</th></tr>
<tr><td>a) Hydrologic regime
Precipitation and surface water runoff are most likely the hydrological driver of this depression. Due to the high evaporation rate of this area, surface water is only present within the depression for short periods, most likely just after rainfall events.</td><td>b) Water quality
No surface water was present at the time of the assessment; therefore, water quality parameters could not be assessed. However, due to the remote locality of the depression, and the low levels of domestic and industrial activities in the vicinity, surface water quality, when present, is unlikely to be significantly impacted in terms of pollutants.</td></tr>
<tr><td>c) Topography: Geomorphology and sediment balance
Few impacts to the geomorphological processes were noted, and it is anticipated that under the current conditions, natural deterioration of the geomorphology is considered unlikely. The most notable impact on the geomorphology is the extent of grazing activities by livestock within and surrounding the depression.</td><td>d) Habitat and biota
The inner basin of the depression is sparsely vegetated with grass species and dwarf shrubs; however, the area surrounding the depression is considered to be well vegetated. The buffer zone surrounding the pan provides refugia for faunal, and specifically avifaunal, species. It is expected that the abundance of faunal species increases within the area surrounding the depression when surface water is present. Thus, the depression does have biodiversity importance on a local scale during certain periods.</td></tr>
<tr><th colspan="2">Possible significant impacts, Business case, Conclusion and Mitigation Requirements:</th></tr>
<tr><td colspan="2">As per the proposed layout of the development footprint (Figure 3), no surface infrastructure (including internal roads) is located within the 500m GN509 Zone of Regulation of this wetland; thus, these activities are unlikely to pose any legislative or freshwater conservation constraints. Nevertheless, these activities were considered as part of the impact assessment and the potential for indirect impacts occurring on the wetland was determined to be Low. During the construction and operational phases of the proposed development, no construction personnel may be permitted within close proximity (i.e. within 32m) of this wetland. As part of the concurrent rehabilitation activities associated with the development, effort should be made to ensure that no alien and invasive vegetation species establish within the wetland due to disturbances within the local catchment of the wetland.</td></tr>
</table>

Table 5: Summary of the assessment of the pan wetlands (Pan 1 - 11) associated with the investigation areas of proposed access road Alternatives 3 and 4.



Photograph notes:
(Top left) Pan 2 (located north of proposed access road Alternative 3) and Pan 7 (top right) are representative of the pans identified along access road Alternatives 3 and 4. These pans are shallow and dominated by short graminoid species, with shrubs and small tree species on the outer perimeter. (Bottom left) Burrowing was identified in Pan 3 and trampling in Pan 11, which are the most common impacting factors on these pans.

PES discussion	**WET Health Category: B (Largely natural with few modifications)** The pans are considered to be mostly natural with no significant impacts to their hydrological or geomorphological properties. Some disturbance to the vegetation was evident primarily due to the trampling and grazing of livestock within and surroundings the pans. This has caused a slight change in ecosystem processes within the pans. No edge effects relating to anthropogenic activities were apparent at the time of the assessment.	**Ecoservice provision**	**Moderately Low** The functioning of the ecosystem services provided by these pans is considered moderately low, which was primarily attributed to the inherent characteristics of pan wetlands. Due to these wetlands being small endorheic pans, they naturally lack the capacity to attenuate floods and provide any streamflow regulating services. They do, however, act as sinks for the assimilation of nutrients and toxicants. These pans provide habitat for a variety of faunal species, specifically avifaunal species, as well as providing important sources of water for wildlife, particularly during the rainy season, thus increasing their contribution to biodiversity maintenance. In addition, due to their remote locality, they have been largely protected from any anthropogenic impacts.
EIS discussion	**EIS Category: Marginal/Moderate** These pans are of some importance on a landscape scale, primarily due to the provisioning of habitat (albeit seasonally) by the pans. These pans are also located within areas considered to be ESAs by the NCCBA database (2016) which support ecological processes to meet the biodiversity targets that have not been reached in the CBAs.	**RMO and REC Discussion**	**REC Category: B (Largely natural with few modifications)** **RMO: B (Maintain)** **BAS: B** Since no infrastructure is proposed to be within close proximity (at least not within their 32m NEMA zone of regulation) to these pans, it is considered unlikely that edge effects will impact on them. Nevertheless, all efforts should be made to maintain the current PES of the pans and to prevent any impact from occurring on them.

Watercourse characteristics:

a) Hydrologic regime The hydrological drivers of these pans are considered to be natural, mainly due to their isolated locality, away from immediate impacting factors. Precipitation and surface water runoff are most likely the hydrological driver of these pans. Due to the high evaporation rate of this area, surface water is only present within the pans for short periods, most likely just after rainfall events. Due to the high surface roughness of the surrounding area (their natural surrounding terrestrial buffer), surface flow diffusely enters the pans.	**b) Water quality** No surface water was present at the time of the assessments therefore water quality parameters could not be assessed. Due to the relatively remote location of the pans and the distance from any urbanised areas, industry (despite sand mining activities within the vicinity of the pans), and so forth, surface water quality is expected to be relatively unimpacted in terms of pollutants but may be enriched with some nutrients due to defecation by resident wildlife and livestock.
c) Topography: Geomorphology and sediment balance Some disturbance to the soil of these pans has occurred as a result of vegetation disturbance caused by trampling of livestock, increasing the extent of loose sediment within the pans. Burrowing within Pan 3 was also evident, which could potentially increase the sediment load of the pan too; however, this was not extensive and is considered a natural impact from local fauna (not anthropogenically caused). Due to the shallow nature of some of the pans, the sediment balance is considered sensitive and needs to remain as near natural as possible.	**d) Habitat and biota** The outer edge of the pans is well vegetated; however, the inner basins consist mainly of grass species. The area surrounding the pans provides a natural buffer zone (comprising terrestrial vegetation species) which aid in the protection of the pans, specifically from wind erosion. It is likely that the faunal biodiversity of the pans and the surrounding area increases when surface water is present. The pans do not necessarily host a large variety of faunal species; however, they do have the potential to provide seasonal ecological services (provision of surface drinking water).

Possible significant impacts, Business case, Conclusion and Mitigation Requirements:
As per the proposed layout of the development footprint (Figure 3), none of the proposed access road alternatives directly traverse any of these pans. The proposed access road Alternatives 3 and 4 are, however, located within their 500m GN509 Zone of Regulation. Based on the outcome of the impact assessment, the proposed access roads would pose a Low impact significance to these pans during both the construction and operational phases. This can primarily be attributed to the distance these pans are from the proposed access roads. Nevertheless, edge effects are expected to occur on the pans located closest to the proposed access roads (i.e. Pan Wetland 7 and 8). It is recommended that airborne dust should controlled as far as feasibly possible during the construction phase of the access road by damping dust generation areas with freshwater (although not in sufficient quantities to generate runoff). This would prevent the sedimentation of the pans. After construction of the access road, the surrounding area must be revegetated with suitable indigenous vegetation (terrestrial vegetation) to prevent the establishment of alien vegetation species and their potential spread into the pans. It is the opinion of the freshwater ecologist that the proposed access road Alternative 4 be recommended for authorisation, as from a freshwater conservation perspective, it would pose the least impact to any watercourses. This is mainly attributed to the single watercourse (Pan Wetland 11) identified within its investigation area, located approximately 245m from the proposed road.

6 LEGISLATIVE REQUIREMENTS

The following legislative requirements were considered during the assessment. A detailed description of these legislative requirements is presented in Appendix B of this report:

- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

THE NATIONAL WATER ACT, 1998 (ACT NO 36 OF 1998)

It is important to note that in terms of the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998) (NWA) (See Appendix B), all of the natural watercourses associated with the development area and the proposed access roads will be regulated by Section 21(c) and (i) of the NWA as well as the applicable zones of regulation. Furthermore, since water will be abstracted for an existing borehole within the project site, in terms of the definition of a water resource (which includes a watercourse, surface water, estuary or aquifer), any taking and storing of water will also be regulated by Section 21(a) and (b) of the National Water Act, 1998 (Act No. 36 of 1998) and consideration must therefore be given to GN 538 of as published in the Government Gazette 40243 of 2016 which stipulates that any groundwater taken within 500m radius from the boundary of a wetland or estuary or within 100m radius from the delineated edge of a water course will trigger the need for a full Water Use Licence (WUL) Application regardless of the volumes.

In accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998), is defined as:

a) the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

b) in the absence of a determined 1 in-100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or

c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO 107 OF 1998) (NEMA)

The definition and motivation for a regulated zone of activity associated with a watercourse in accordance with the requirements of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA) can be summarised as follows:

- **Activity 12** of Listing Notice 1 (GN 327) of the NEMA EIA regulations, 2014 (as amended) states that:

  The development of:

  (xii) infrastructure or structures with a physical footprint of 100 square metres or more;

  Where such development occurs—

  (a) Within a watercourse;

  (b) In front of a development setback; or

  (c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse.

- **Activity 19** of Listing Notice 1 (GN 327) of the NEMA EIA regulations, 2014 (as amended) states "*The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;"*

Based on the above applicable legislation, the following Zones of Regulation (ZoR) were applied:

- A 32m Zone of Regulation in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) was applied to all the watercourses associated with the development and investigation areas;
- Zones of Regulation in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (NWA):
    - 500m Zone of Regulation applied to the wetlands (Pan wetlands and perched depression wetland); and
    - 100m Zone of Regulation applied to the Vlermuisleegte River.

The applicable Zones of Regulation are depicted in Figures 15 and 16 below, which indicated the following:

- Despite the development area encroaching onto the southern portion of the 500m GN509 ZoR of the perched depression wetland, no infrastructure nor internal roads are located within the 100m/500m GN509 ZoR of the watercourses;
- Only the proposed access road Alternative 1 traverses the Vlermuisleegte River. No other proposed access road alternative, nor its 20m corridor crosses any other identified watercourses. Proposed access road Alternatives 3 and 4 are, however, located within the 500m GN509 ZoR of the pan wetlands. The 20m corridor associated with proposed access road Alternative 3 slightly encroaches on the 32m NEMA ZoR of Pan Wetland 8; and
- The water purification plant is located outside of the 100m GN509 ZoR of the Vlermuisleegte River.

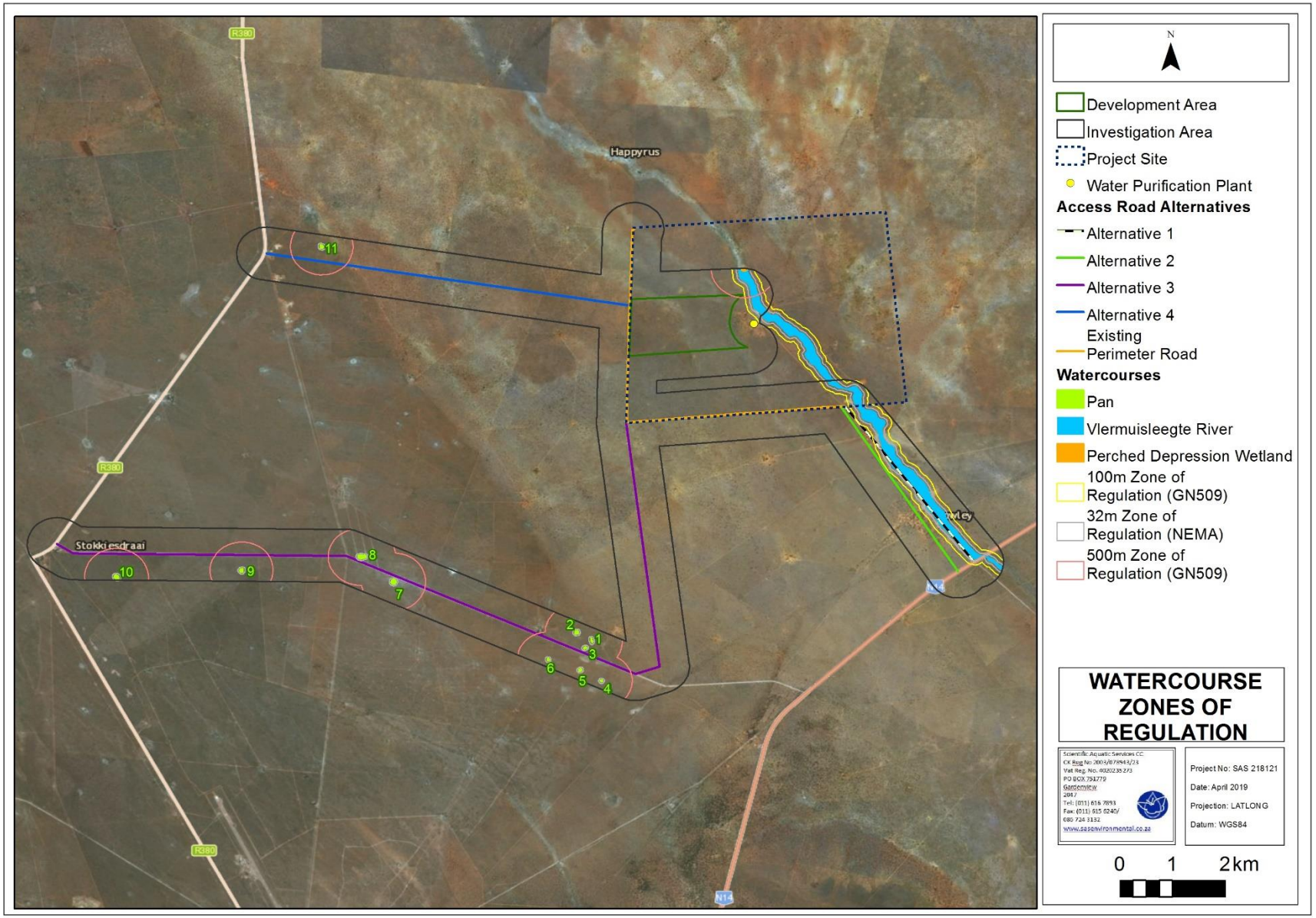


Figure 15: Conceptual presentation of the zone of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the assessed watercourses.

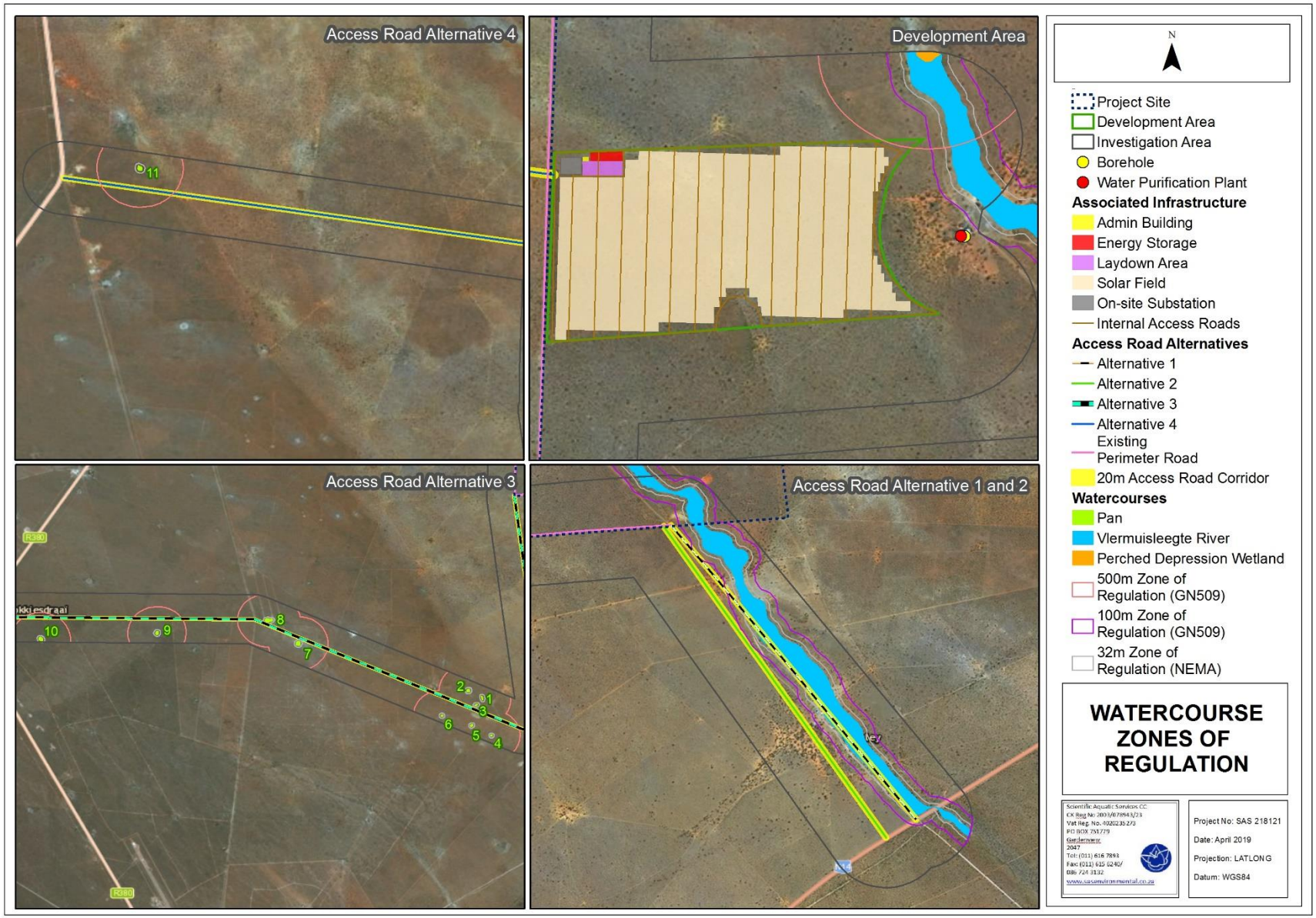


Figure 16: Focus areas depicting the conceptual presentation of the zone of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA in relation to the assessed watercourses.

'Areas of sensitivity' were developed following the onsite delineation of the watercourses, and after determining their applicable regulated areas.

Based on the provided map (see Figure 17 below), the following was concluded:

- **No-go Area (only applicable to new developments):** includes the extent of the delineated boundaries watercourses.
- **High Sensitivity Area:** the 32m regulated area of a watercourse as stipulated by the NEMA EIA Regulations of 2017 (as amended) applicable to the watercourses. No infrastructure should be placed in these areas. Roads should only be planned within these areas if it is absolutely unavoidable to circumnavigate these watercourses;
- **Moderate Sensitivity Area:** includes the GN 509 regulated area of the watercourse (100m zone surrounding the Vlermuisleegte River and the 500m zone surrounding the depression wetland and pan wetlands. Development within these areas could take place but should be avoided, if possible, to avoid triggering Section 21 (c) & (i) water uses (exception for specified activities as per Appendix D2 of GN 509 of 2016 as it relates to the NWA); and
- **Low Sensitivity Area:** all other areas remaining in the development area and investigation areas. These areas are considered the least sensitive from a watercourse conservation point of view.

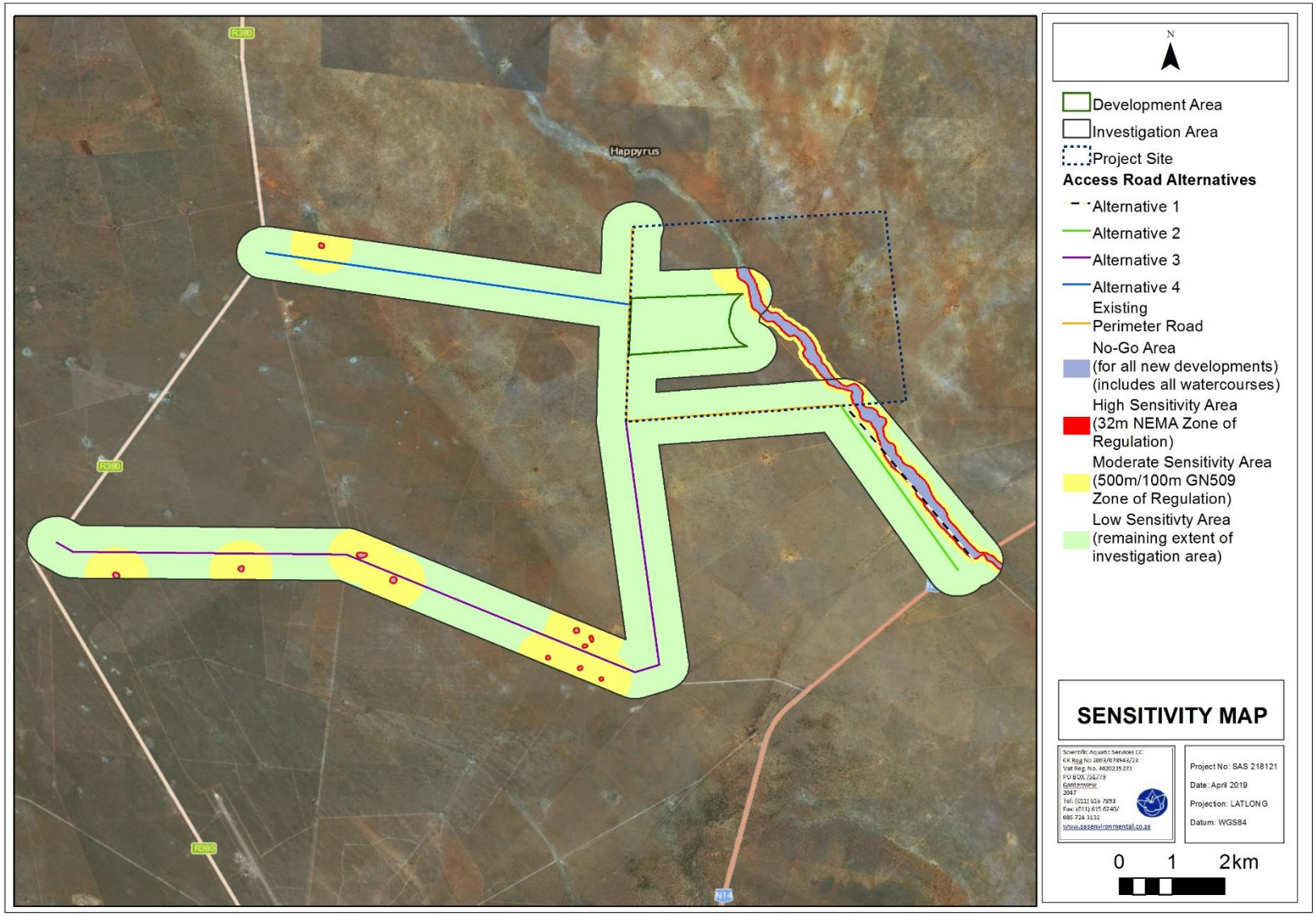


Figure 17: Areas of sensitivity identified in accordance with the watercourses (No-go areas – only applicable to new developments) and their and 32m NEMA regulated area (High Sensitivity Area), their respective GN509 regulated areas (Moderate Sensitivity Area) and all other areas in which development could occur (Low Sensitivity Area).

7 IMPACT ASSESSMENT

This section presents the significance of potential impacts on the ecology of the identified watercourses associated with the proposed Hyperion Solar Development 2. In addition, it also indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed development and access road alternatives and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures.

7.1 Impact Assessment Outcome

Following the assessment of the watercourses associated with the development and investigation areas, the impact assessment was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat, and biota) of these watercourses. The impact assessment was undertaken for the proposed layout as provided by the proponent and as presented in Figure 3. The points below summarise the considerations made when applying the impact assessment:

- Proposed access road Alternatives 2, 3 and 4 do not directly traverse any watercourses nor are they located within the 32m NEMA ZoR of any of the watercourses (closest pan wetland is approximately 45m from access road Alternative 3). It is not expected that these access road alternatives would have a direct impact on the watercourses, nevertheless, the expected indirect impacts from these road alternatives were assessed.
- Proposed access road Alternative 1 directly traverses the Vlermuisleegte River. The impacts associated with this access road option were assessed.
- No proposed infrastructure within the development area is located within the 500m nor 100m GN509 ZoR in accordance with the National Water Act, 1998 (Act 36 of 1998) of the perched depression wetland and the Vlermuisleegte River. Thus, the proposed construction and operational activities associated with these activities do not pose any legislative or freshwater conservation constraints. Nevertheless, these activities were considered as part of the impact assessment as a precautionary approach.
- The proposed purification plant is located approximately 175m west of the Vlermuisleegte River and outside of the 100m GN509 ZoR in accordance with the National Water Act, 1998 (Act 36 of 1998) of the Vlermuisleegte River. Due to the distance thereof from the river, the construction and operation thereof are of such low impact significance from a Section 21(c) and (i) water use perspective that no significant quantum of risk is posed to the watercourses. Nevertheless, the construction and operation thereof were considered as part of the impact assessment and it is recommended that a geohydrological investigation be undertaken for the borehole to ensure sustainable abstraction that does not impact other water users in the area.

Tables 6 - 14 below provide the outcome of the impact assessment for the above-listed activities, based on the methods presented in Appendix C. All general good housekeeping mitigation measures are provided in Appendix E.

Table 6: Impact table summarising the impact significance with and without mitigation for the construction of proposed access road Alternative 1.

Nature:				
The upgrade of the existing T26 gravel road as part of the development of proposed access road Alternative 1. This will entail the following activities and their resulting impacts on the Vlermuisleegte River: *Site preparation before construction activities surrounding the existing road. This will disturb the vegetation and soil associated with the Vlermuisleegte river and potentially increase the volume of sediment entering the river system. *Disturbance to the vegetation and habitat of the Vlermuisleegte river and its surrounding buffer area could lead to the proliferation of alien invasive vegetation species. *Potential trampling by construction personnel within the Vlermuisleegte river beyond the construction footprint, impacting on the geomorphology of the river. *Altered topography/geomorphology of the river, leading to altered runoff patterns and formation of preferential flow paths.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Very short (0–1 years)	1	Very short (0–1 years)	1
Magnitude	High	8	Moderate	6
Probability	Definite	5	Highly Probable	4
Significance	**Medium**	**55**	**Medium**	**36**
Status	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
*Contractor laydown areas, and material storage facilities to remain outside of the Vlermuisleegte river and its 32m NEMA ZoR; *All vehicle re-fuelling is to take place outside of the Vlermuisleegte river and its 32m NEMA ZoR; *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; *Retain as much indigenous freshwater vegetation as possible; *All vegetation removed as part of the road widening should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility; *During the construction of the access road Alternative 1, a buffer of no more than 5m on either side of the proposed road reserve within the Vlermuisleegte river may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; *It should be feasible to utilise existing roads to gain access to the proposed access road construction area. No indiscriminate crossing of the river outside of the proposed crossing point may be permitted; *The area of the river where no construction activities are proposed should be demarcated as a no-go area (for construction personnel and vehicles) with danger tape; *Material to be used (gravel) as part of the widening of the road must be stockpiled outside the 32m NEMA ZoR of the river to prevent sedimentation of the river. These stockpiles may not exceed a height of 2m and should be protected from wind using tarpaulins; *The road should be permeable to allow for drainage from the road surface. In this regard, suitable stormwater management should be implemented to allow for water to drain from the road without causing erosion; *Any concrete or mixing of materials as part of the construction activities should be done within a designated batching area only and must not be mixed within the 32m NEMA ZoR of the Vlermuisleegte River. *Regular spraying of non-potable water or through the use of chemical dust suppressants to reduce dust must be considered mandatory to ensure no smothering of vegetation within the Vlermuisleegte River occurs from excessive dust settling; *After construction of the road, the area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring; *It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; *All alien and invasive vegetation should be removed. Any vegetation removed should be taken to a registered landfill site to prevent the proliferation of alien and invasive species.				
Cumulative Impacts				
As this access road alternative entails upgrading of an existing road (T26), initial impacts to the vegetation and geomorphological components of this Vlermuisleegte river have already occurred. Nevertheless, widening of the road would entail a larger road footprint area within the river and add to the cumulative negative impact (with specific mention of its vegetation component) this access road would have on the river, such as increased hardened surfaces within its catchment.				

Residual Risks
There is a residual risk that a decrease in habitat provision by the Vlermuisleegte River may occur due to vegetation not being able to re-establish within and directly surrounding the construction footprint area.

Table 7: Impact table summarising the impact significance with and without mitigation for the operation of proposed access road Alternative 1.

Nature:				
Operation of the proposed access road Alternative 1. This will entail the following activities, and their resulting impacts on the Vlermuisleegte River: *Runoff from the road entering the river could be contaminated and could impact on the surface water quality of the river (if surface water is present). *Runoff from the road can potentially create preferential flow paths in the river, thus causing erosion of the embankment of the river.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Low	4	Minor	2
Probability	Highly Probable	4	Probable	3
Significance	**Medium**	**44**	**Low**	**27**
Status	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
*Ensure that routine inspections and monitoring of the road are implemented. Monitoring should occur biannually (or as specified by the relevant engineer), and specifically after significant rainfall events; *Regular inspection (during the rehabilitation phase by the appointed Environmental Compliance Officer (ECO) and during the operational phase by the Operation and Maintenance (O&M) Manager) for alien and invasive vegetation along the road should occur, to limit their spread into the river; *Stormwater runoff from the road into the river may not form preferential surface flow paths into the river. If this does occur, the areas should be rehabilitated (erosion gullies infilled) and revegetated to aid in dispersing the flow of water from the road into the river; *No unauthorised or indiscriminate movement of vehicles in the Vlermuisleegte River may be permitted during the visual inspection; *If repair activities to the road are required, the mitigation measures as per that of the construction phase must be implemented.				
Cumulative Impacts				
The larger footprint area of this road contributes to the cumulative impact on the river, although this is considered to be of limited extent since the road is already existing (T26 road) prior to the upgrade thereof.				
Residual Risks				
Constant usage of the road could potentially decrease the biodiversity (mainly faunal species) within and directly surrounding the portion of the river associated with the access road.				

Table 8: Impact table summarising the impact significance with and without mitigation for the construction of proposed access road Alternative 2.

Nature:				
Construction of access road Alternative 2. This proposed access road is located outside of the 100m ZoR of the Vlermuisleegte River in accordance with the National Water Act, 1998 (Act 36 of 1998). Thus, the proposed construction and operational activities of this access road alternative does not pose any legislative or freshwater conservation constraints. Nevertheless, the potential of edge effects to occur on the closest watercourse (i.e. the Vlermuisleegte River) were considered as a precautionary approach. The construction of access road Alternative 2 will entail the following activities and their resulting impacts on the Vlermuisleegte River: : *Disturbance to the natural buffer zone surrounding the Vlermuisleegte River, including the vegetation and soil components. This can impact on the habitat provisioning and biodiversity of the river.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Very short (0–1 years)	1	Very short (0–1 years)	1
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**10**	**Low**	**5**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
*All vehicle re-fuelling is to take place outside of the 100m GN509ZoR of the Vlermuisleegte River; *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; *Retain as much indigenous vegetation as possible; *All vegetation removed as part of the road construction should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility; *It should be feasible to utilise existing roads to gain access to the proposed access road construction area. No indiscriminate driving within the 100m GN509 ZoR of the Vlermuisleegte River may be permitted; *Material to be used (gravel) as part of the widening of the road must be stockpiled outside the 100m GN509 ZoR of the river to prevent sedimentation of the river. These stockpiles may not exceed a height of 2m and should be protected from wind using tarpaulins; *The road should be permeable to allow for drainage from the road surface. In this regard, suitable stormwater management should be implemented to allow for water to drain from the road without causing erosion; *Any concrete or mixing of materials as part of the construction activities should be done within a designated batching area only and must not be mixed within the 100m GN509 ZoR of the Vlermuisleegte River. *Regular spraying of non-potable water or through the use of chemical dust suppressants to reduce dust must be considered mandatory to ensure that no smothering of vegetation within the natural buffer area surrounding the Vlermuisleegte River occurs from excessive dust settling; *After construction of the road, the area surrounding the road must be revegetated with suitable indigenous vegetation (terrestrial vegetation) to prevent the establishment of alien vegetation species and their potential spread into the river. *It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; *All alien and invasive vegetation should be removed. Any vegetation removed should be taken to a registered landfill site to prevent the proliferation of alien and invasive species.				
Cumulative Impacts				
Increased hardened surfaces in the vicinity of the river may potentially increase the volume and velocity of runoff entering the river during rainfall events. This is not considered significant as the existing T26 road, located between this access road alternative and the Vlermuisleegte River, would likely prevent runoff from entering the river.				
Residual Risks				
There is a residual risk that a decrease in habitat provision of the Vlermuisleegte River may occur due to vegetation not being able to re-establish within and surrounding the construction footprint area.				

Table 9: Impact table summarising the impact significance with and without mitigation for the operation of proposed access road Alternative 2.

Nature:				
Operation of access road Alternative 2. This proposed access road is located outside of the 100m ZoR of the Vlermuisleegte River in accordance with the National Water Act, 1998 (Act 36 of 1998). Thus, the operational activities of this access road alternative do not pose any legislative or freshwater conservation constraints. Nevertheless, the potential of edge effects to occur on the closest watercourse (i.e. the Vlermuisleegte River) were considered as a precautionary approach. The operation of access road Alternative 2 will entail the following activities and their resulting impacts on the Vlermuisleegte River: *Potential disturbance to the natural buffer zone surrounding the Vlermuisleegte River during maintenance activities, including disturbance to the vegetation and soil components. This can impact on the habitat provisioning and biodiversity of the river. *Increased hardened surfaces in the vicinity of the river may potentially alter the pattern of runoff entering the river.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**18**	**Low**	**9**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
See Table 7 for applicable mitigation measures. The below mitigation measures also apply: *Regular inspection of the area surrounding the road should occur to monitor the establishment of vegetation and prevent the establishment of alien and invasive vegetation species, and their potential spread into the river; *Stormwater runoff from the road should be monitored (during the rehabilitation phase by the appointed Environmental Compliance Officer (ECO) and during the operational phase by the Operation and Maintenance (O&M) Manager), so it does not result in erosion. Stormwater should be allowed to diffusely spread across the landscape.				
Cumulative Impacts				
Increased hardened surfaces in the vicinity of the river may potentially increase the volume and velocity of runoff entering the river during rainfall events. This is not considered significant as the existing T26 road, located between this access road alternative and the Vlermuisleegte River, would likely prevent runoff from entering the river.				
Residual Risks				
There is a residual risk that a decrease in habitat provision of the Vlermuisleegte River may occur due to vegetation not being able to re-establish along the road. Constant usage of the road could potentially decrease the biodiversity (mainly faunal species) of the portion of the river associated with the access road.				

Table 10: Impact table summarising the impact significance with and without mitigation for the construction of proposed access road Alternative 3 and 4.

Nature:

Construction of access road Alternative 3 and 4.
The impact assessment of these two access road alternatives was undertaken in a combined fashion due to the distance of the access roads from the pan wetlands (the closest pan wetland to an access road is Pan Wetland 8, approximately 45m from access road Alternative 3).

Proposed access road Alternative 3 (The establishment of a new access road. A portion of this road is existing):
Pan wetlands were identified within the investigation area associated with this road (the existing T25 gravel road) (Figure 18), but none within its associated 20m corridor. Although it is not expected that this road would require significant construction activities (since it is already an existing wide, gravel road), the potential impacts of edge effects from the construction activities on the pan wetlands were assessed.

Figure 18: Photograph of the existing T25 gravel road. Several pan wetlands were identified within its 500m investigation area, the closest being approximately 45m from this road (Pan Wetland 8).

Proposed access road Alternative 4 (The establishment of a new access road):
Only Pan wetland 11 was identified within the investigation area associated with this proposed access road alternative (which will be a new gravel road), approximately 245m north of the road, thus not within its 20m corridor.

The construction of proposed access road Alternative 3 and 4 will entail the following activities and their resulting edge effect impacts on the pan wetlands are determined to be:
*Disturbance to the natural buffer zone surrounding the pan wetlands, including the vegetation and soil components. This can impact on the habitat provisioning and biodiversity of the pan wetlands.
*Construction activities may potentially cause dust, which could enter the pan wetlands within the closest proximity to the road construction footprint.

	Without Mitigation		With Mitigation	
Extent	Local	2	Local	2
Duration	Very short (0–1 years)	1	Very short (0–1 years)	1
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**10**	**Low**	**5**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				

*Contractor laydown areas, material storage facilities, and refuelling of construction activities must to remain outside the 32m NEMA ZoR of any of the pan wetlands; *All vehicle re-fuelling is to take place outside of the 32m NEMA ZoR of the pan wetlands; *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; *Retain as much indigenous vegetation as possible; *All vegetation removed as part of the road construction should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility; *It should be feasible to utilise existing roads to gain access to the proposed access road construction area. No indiscriminate movement within the 32m NEMA ZoR of the pan wetlands may be permitted; *Material to be used (gravel) as part of the widening of the road must be stockpiled outside the 32m NEMA ZoR of the pan wetlands to prevent sedimentation of the pans. These stockpiles may not exceed a height of 2m and should be protected from wind using tarpaulins; *The road should be permeable to allow for drainage from the road surface. In this regard, suitable stormwater management should be implemented to allow for water to drain from the road without causing erosion; *Any concrete or mixing of materials as part of the construction activities should be done within a designated batching area only and must not be mixed within the 32m NEMA ZoR of the pan wetlands. *Regular spraying of non-potable water or through the use of chemical dust suppressants to reduce dust must be considered mandatory to ensure that no smothering of vegetation within the pan wetlands occurs from excessive dust settling; *After construction of the road, the area surrounding the road must be revegetated with suitable indigenous vegetation (terrestrial vegetation) to prevent the establishment of alien vegetation species and their potential spread into the pan wetlands.*It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; *All alien and invasive vegetation should be removed. Any vegetation removed should be taken to a registered landfill site to prevent the proliferation of alien and invasive species.
Cumulative Impacts
Increased hardened surfaces in the vicinity of the pan wetlands may potentially increase the volume and velocity of runoff entering the pan wetlands during rainfall events. Due to the distance of the identified pan wetlands associated with the two alternative access roads considered, and the relatively high surface roughness (terrestrial vegetation) between the access roads and the pan wetlands, the development of either Alternative 3 of Alternative 4 are not considered to provide any significant contribution to the cumulative impacts on the pan wetlands.
Residual Risks
There is a residual risk that a decrease in habitat of the pan wetlands may occur due to vegetation not being able to re-establish within the construction footprint area. Constant usage of the proposed access road could potentially decrease the biodiversity (mainly faunal species) within the areas surrounding the pans.

Table 11: Impact table summarising the impact significance with and without mitigation for the operation of proposed access road Alternative 3 and 4.

Nature:				
Operation of access road Alternative 3 and 4. The potential of edge effects to occur on the pan wetlands to these access road alternatives were considered: *Disturbance to the natural buffer zone surrounding the pan wetlands during maintenance activities, which can impact on the vegetation and soil components. This can impact on the habitat provisioning and biodiversity of the pans. *Increased hardened surfaces in the vicinity of the pans may potentially alter the pattern of runoff entering the pans.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**18**	**Low**	**9**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
See Table 7 for applicable mitigation measures. The below mitigation measures also apply: *Regular inspection for alien and invasive vegetation along the road should occur, to limit their spread into the pan wetlands; *Stormwater runoff from the road may not form preferential surface flow paths. If this does occur, the areas should be rehabilitated (erosion gullies infilled) and revegetated to aid in dispersing the flow of water from the road into the landscape; *If repair activities to the road are required, the mitigation measures as per that of the construction phase must be implemented.				
Cumulative Impacts				
Increased hardened surfaces in the vicinity of the pan wetlands may potentially increase the volume and velocity of runoff entering the pan wetlands during rainfall events. Due to the distance of the identified pan wetlands associated with the two alternative access roads considered, and the relatively high surface roughness (terrestrial vegetation) between the access roads and the pan wetlands, the operation of either Alternative 3 of Alternative 4 are not considered to provide any significant contribution to the cumulative impacts on the pan wetlands.				
Residual Risks				
There is a residual risk that a decrease in habitat of the pan wetlands may occur due to vegetation not being able to re-establish within the road reserve. Constant usage of the proposed access road could potentially decrease the biodiversity (mainly faunal species) within the areas surrounding the pans.				

Table 12: Impact table summarising the impact significance with and without mitigation for the construction of the proposed surface infrastructure and internal access roads associated with the development area.

Nature:				
Construction of the proposed surface infrastructure and internal access roads in the development area are located outside of the 100m/500m GN509 ZoR of the Vlermuisleegte River and perched depression wetland. As these activities are located outside of the applicable GN509 ZoR of the watercourses in accordance with the National Water Act, 1998 (Act 36 of 1998), the proposed construction and operational activities thereof do not pose any legislative or freshwater conservation constraints. Nevertheless, the potential of edge effects to occur on the closest watercourse (i.e. the Vlermuisleegte River) were considered as a precautionary approach. Due to the distance of the surface infrastructure and internal access roads form the perched depression wetland, a negligible quantum of risk to this depression form these activities are expected. The construction of the proposed surface infrastructure and internal access roads in the development area will entail the following activities, and their resulting edge effect impacts on the closest watercourse (i.e. the Vlermuisleegte River) is provided below: *Disturbance to the natural buffer zone surrounding the Vlermuisleegte River, including the vegetation and soil components. This can impact on the habitat provisioning and biodiversity of the river.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Very short (0–1 years)	1	Very short (0–1 years)	1
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**10**	**Low**	**5**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
*Contractor laydown areas, material storage facilities, and refuelling of construction activities must remain outside the 100m GN509 ZoR of the Vlermuisleegte River and outside of the 500m GN509 of the perched depression wetland; *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; *Retain as much indigenous vegetation as possible; *Water imported to the construction site may not be allowed to drain into the Vlermuisleegte River or the perched depression wetland, and should be managed with appropriate stormwater management systems; *Any concrete or mixing of materials as part of the construction activities should be done within a designated batching area only; *All stockpiles created from excavated soils may not be higher than 2m and must be protected from wind erosion. These stockpiles should be levelled, or the soil be used as part of rehabilitation activities within the development area; *It should be feasible to utilise existing roads to gain access to the construction area; *After construction of the surface infrastructure, the surrounding area thereof must be revegetated with suitable indigenous vegetation (terrestrial vegetation) to prevent the establishment of alien vegetation species and their potential spread into the river.				
Cumulative Impacts				
Increased hardened surfaces in the vicinity of the Vlermuisleegte River may potentially increase the volume and velocity of runoff to enter the river during rainfall events. This is not considered to be a significant contribution to the overall cumulative impacts on the Vlermuisleegte River as the proposed development activities are located at least 250m from the edge of the river, and the surrounding natural buffer zone (terrestrial vegetation) would prevent any concentrated runoff from entering the river.				
Residual Risks				
There is a residual risk that a decrease in habitat provision of the Vlermuisleegte River may occur due to vegetation not being able to re-establish within and surrounding the construction footprint area.				

Table 13: Impact table summarising the impact significance with and without mitigation for the operation of the proposed surface infrastructure and internal access roads.

Nature:				
Operation of the proposed surface infrastructure and internal access roads in the development area, located outside of the 100m/500m GN509 ZoR of the Vlermuisleegte and perched depression wetland. As these activities are located outside of the applicable GN509 ZoR of the watercourses in accordance with the National Water Act, 1998 (Act 36 of 1998), the proposed operational activities thereof do not pose any legislative or freshwater conservation constraints. Nevertheless, the potential of edge effects to occur on the closest watercourse (i.e. the Vlermuisleegte River) were considered as a precautionary approach: *Disturbance to the natural buffer zone surrounding the Vlermuisleegte River during maintenance activities (such as cleaning of the PV panels), including the vegetation and soil components. This can impact on the habitat provisioning and biodiversity of the area surrounding the river. *Increased hardened surfaces in the vicinity of the river may potentially alter the pattern of runoff entering the river.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**18**	**Low**	**9**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
See Table 7 for applicable mitigation measures. The below mitigation measures also apply: *Regular inspection of the area surrounding the surface infrastructure should occur to monitor the establishment of vegetation and prevent the establishment of alien and invasive vegetation species, and their potential spread into the river; *Stormwater runoff from the internal roads should be monitored, not to cause erosion and to be diffusely spread across the landscape; *No water used as part of the solar panel cleaning activities may enter the river. It should be ensured that the water is collected in stormwater management systems within the development area. *Borehole water will be abstracted for use as part of the construction phase. As such it is considered imperative that a suitably qualified geohydrologist undertakes a yield test for the borehole to determine the sustainable yield that can be abstracted as well as the required rest periods to ensure no impacts on other users.				
Cumulative Impacts				
Increased hardened surfaces in the vicinity of the Vlermuisleegte River may potentially increase the volume and velocity of runoff to enter the river during rainfall events. This is not considered to be a significant contribution to the overall cumulative impacts on the Vlermuisleegte River as the proposed development activities are located at least 250m from the edge of the river, and the surrounding natural buffer zone (terrestrial vegetation) would prevent any concentrated runoff from entering the river.				
Residual Risks				
There is a residual risk that a decrease in habitat provision of the Vlermuisleegte River may occur due to vegetation not being able to re-establish within the area surrounding the development area.				

Table 14: Impact table summarising the impact significance with and without mitigation for the construction and operation of the proposed water purification plant.

Nature:				
Construction and operation of the proposed water purification plant located approximately 175m west of the Vlermuisleegte River and outside of the 100m GN509 ZoR in accordance with the National Water Act, 1998 (Act 36 of 1998) of the Vlermuisleegte River. The construction and operational activities of this water purification plant do not pose any freshwater conservation constraints, however, in terms of the definition of a water resource (which includes a watercourse, surface water, estuary or aquifer), any taking and storing of water needs to be regulated by Section 21(a) and (b) of the National Water Act, 1998 (Act No. 36 of 1998). Due to the distance of this purification plant from the river, the construction and operation thereof are of such low impact significance that no significant quantum of risk is expected to occur on the river. Nevertheless, the following potential indirect impacts were considered as a precautionary approach: *Increased disturbance within the surrounding natural area surrounding the river, may potentially lead to the proliferation of alien and invasive species establishment and spread into the river.				
	Without Mitigation		**With Mitigation**	
Extent	Local	2	Local	2
Duration	Very short (0–1 years)	1	Very short (0–1 years)	1
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**10**	**Low**	**5**
Status	Neutral		Neutral	
Reversibility	High		High	
Irreplaceable loss of recourses?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation				
*Water stored prior to purification/after purification should be in a sealed container which must be regularly inspected for leaks; *Regular inspection of the area surrounding the water purification plant should occur to monitor the establishment of vegetation and prevent the establishment of alien and invasive vegetation species, and their potential spread into the river; *Stormwater runoff from water purification plant should be monitored, not to cause erosion and to be diffusely spread across the landscape; *No untreated water may enter the river. If water is spilt, it should be ensured that the water is collected in stormwater management systems within the development area. *The borehole should be monitored, and a data log kept for daily abstraction rates to ensure that abstraction is sustainable and does not impact surrounding water users. A geohydrologist should undertake annual audits to ensure compliance with authorised abstraction volume. *In terms of the definition of a water resource (which includes a watercourse, surface water, estuary or aquifer), any taking and storing of water needs to be regulated by Section 21(a) and (b) of the National Water Act, 1998 (Act No. 36 of 1998). A Water Use License may therefore be required.				
Cumulative Impacts				
Increased hardened surfaces and the potential of leaks in the vicinity of the river may potentially increase the volume and velocity of runoff to enter the river during rainfall events. This is not considered to be a significant contribution to the overall cumulative impacts on the river as the borehole is an existing feature, but the water purification plant overall will be located at least 175m from the edge of the river, and the current developments between the river and the purification plant are expected to prevent any runoff from entering the river.				
Residual Risks				
There is a risk that a decrease in habitat provisioning of the river may occur due to vegetation not being able to re-establish within the construction footprint area surrounding the water purification plant.				

7.2 Impact Assessment Discussion

Due to the distance of the proposed surface infrastructure and the internal roads from the watercourses (the perched depression wetland and the Vlermuisleegte river), with the implementation of the recommended mitigation measures (Table 12 and 13), a low to very low impact on the watercourses are expected to occur. As this infrastructure is located outside of the applicable GN 509 ZoR of the watercourses, the proposed construction and operational activities associated with these activities do not pose any legislative or freshwater conservation constraints.

Since the proposed purification plant is located approximately 175m west of the Vlermuisleegte River and outside its 100m GN509 and GN538 stipulated ZoR, the construction and operation thereof are of such low impact significance (Table 14) that no significant quantum of risk in terms of impeding or diverting the flow of water in a watercourse or altering the beds, banks, course or characteristics of a watercourse is anticipated. In terms of the definition of a water resource (which includes a watercourse, surface water, estuary or aquifer), any taking and storing of water needs to be regulated by Section 21(a) and (b) of the National Water Act, 1998 (Act No. 36 of 1998) and the relevant Water Use Authorisation will need to be obtained.

As per the outcome of the impact assessment, proposed access road Alternative 1 was determined to pose a Medium impact significance to the Vlermuisleegte River during the construction phase, with the application of the recommended mitigation measures (Table 6). Although access road Alternative 1 will entail the upgrading of an existing road (increasing its width), which have already caused an impact to the Vlermuisleegte River, increasing the footprint of this access road within the Vlermuisleegte River will result in further disturbance to the vegetation and geomorphological components of the river during the construction phase. During the operational phase, if the recommended mitigation measures are implemented, the impacts significance would be Low (Table 7). Proposed access road Alternative 1 was determined to pose a Medium impact significance to the Vlermuisleegte River during the construction and operational phase, with the application of the recommended mitigation measures. This is due to it directly traversing the Vlermuisleegte River. Despite this access road alternative traversing the river, it is not considered a no-go area for the development of access road Alternative 1, as the existing road has already impacted on the Vlermuisleegte River. Although the impacts associated with the construction of access road Alternative 1 can be considered acceptable, if all the proposed mitigation measures as stipulated in this report are implemented, it is not considered the preferred route from a freshwater ecological perspective.

As for all other proposed access road alternatives, their construction and operation would pose a Low impact significance (with the implementation of the recommended mitigation measures) to the watercourses (various identified pan wetlands). This is predominantly attributed to their distance from the identified watercourses. Nevertheless, the potential of edge effects from the construction and operation of theses access road alternatives was considered, and the recommended mitigation measures as per Table 8 – 11 should be implemented.

It is the opinion of the freshwater ecologist that access road Alternative 4 should be selected, as from a freshwater conservation perspective, it is likely to pose the least impact to any watercourses during both its construction and operation. Since this access road alternative doesn't directly traverse any watercourses, and the closest watercourse is located approximately 245m away, a negligible quantum of risk to the watercourse is expected. Table 15 below provides a summary of the considerations take and motivation for selecting access road Alternative 4 as the most feasible option.

Table 15: Access road alternative feasibility assessment summary.

Access Road Alternative	Watercourses associated with this alternative	Recommendation
Alternative 1	Directly traverses the Vlermuisleegte River.	Despite this access road alternative traversing the river, it is not considered a no-go area for the development of access road Alternative 1, as the existing road has already impacted on the Vlermuisleegte River. Although the impacts associated with the construction of access road Alternative 1 can be considered acceptable, if all the proposed mitigation measures as stipulated in this report are implemented, it is not considered the preferred route from a freshwater ecological perspective.
Alternative 2	Located west of the Vlermuisleegte River just outside its 100m GN509 Zone of Regulation.	Despite this access road not traversing any watercourses, nor is it within any zone of regulation of a watercourse, this option entails the construction of a new road. This would cause disturbance to the surrounding natural environment (albeit terrestrial vegetation), which could impact on the natural buffer zone surrounding the Vlermuisleegte River. This access road alternative is not recommended, however, the impacts it will potentially have on the Vlermuisleegte River can be mitigated to within acceptable levels, provided that the recommended mitigation measures herein be implemented
Alternative 3	Ten pan wetlands are located within the investigation area associated with this road. The closest pan wetlands are Pan 8 (approximately 45m from the road) and Pan 7 (approximately 55m from the road).	Despite this access road not traversing any watercourses, it is located within the 500m GN509 Zones of Regulation surrounding most of the pan wetlands identified within its investigation area. Due to this access road alternatives' relatively close proximity to the pan wetlands (approximately 45m from the closest pan wetland; albeit determined to be of low impact significance), this road alternative is not recommended. However, the impacts it will potentially have on the pan wetlands can be mitigated to within acceptable levels, provided that the recommended mitigation measures herein be implemented.
Alternative 4	A pan wetland (Pan 11) is located within the investigation area of this road, located approximately 245m from the proposed layout.	This access road alternative is considered the preferable option, primarily due to its distance from Pan Wetland 11, and no other watercourses located within close proximity to it. It is unlikely that this access road alternative would pose any quantum of risk to the pan wetlands.

7.3 Cumulative Impacts

Table 16 and Figure 19 below provides the various known SEF that already occur in the area surrounding the project site. Table 17 presents the potential cumulative impacts as assessed for the proposed Hyperion Solar Development 2. Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future considered together with the impacts identified in Section 7.1 above.

Table 16: A summary of all the SEF developments within a 30km radius from the project site (as provided by Savannah Environmental).

Project Name	DEA Reference Number(s)	Location	Approximate distance from the project site	Project Status
Kalahari Solar Power Project (CSP) (1 x 100MW project)	12/12/20/1994/1	Remaining Extent of the Farm Kathu 465	~9.3km south west	Preferred Bidder (already constructed)
Kalahari Solar Power Project (CSP) (1 x 150MW project)	12/12/20/1994/2	Remaining Extent of the Farm Kathu 465	~9.3km south west	Approved
Kalahari Solar Power Project (CSP) (1 x 150MW project)	12/12/20/1994/3	Remaining Extent of the Farm Kathu 465	~9.3km south west	Approved
Bestwood Solar Farm (PV)	12/12/20/1906	Remaining Extent of the Farm Bestwood 459	~14km south	Approved
Boitshoko Solar Power Plant (PV) (1 x 115MW project)	14/12/16/3/3/2/935	Remaining Extent of Portion 1 of the Farm Lime Bank 471	~15.4km south west	Approved
Sishen Solar Farm (PV) (1 x 75MW project)	12/12/20/1860	Portion 6 of the Farm Wincanton 472	~15.8km west	Preferred Bidder (already constructed)
Kathu SEF (PV) (1 x 75MW project)	12/12/20/1858/1	Portion 4 of the Farm Wincanton 472	~15.8km west	Preferred Bidder (already constructed)
Kathu SEF (PV) (1 x 25MW project)	12/12/20/1858/2	Portion 4 of the Farm Wincanton 472	~15.8km west	Approved
Shirley Solar Park (PV) (1 x 75MW project)	14/12/16/3/3/2/616	Portion 1 of the Farm Shirley 367	~17.9km north west	Approved
Adams Solar Power Generation Plant (PV) (1 x 19MW project)	12/12/20/2566	Remaining Extent of the Farm Adams 328	~22km north	Approved
Adams PV SEF (PV) (1 x 75MW project)	12/12/20/2567	Remaining Extent of the Farm Adams 328	~22km north	Preferred Bidder (already constructed)
AEP Kathu Solar PV Energy Facility (PV) (1 x 75MW project)	14/12/16/3/3/2/911	Remaining Extent of the Farm Legoko 460	~22.4km south	Approved
AEP Legoko PV Solar Facility (PV) (1 x 75MW)	14/12/16/3/3/2/819	Portion 2 of the Farm Legoko 460	~22.4km south	Approved
Roma Energy Mount Roper Solar Plant (PV) (1 x 10MW project)	14/12/16/3/3/1/474	Portion 4 of the Farm Whitebank 379	~25km north east	Approved
Whitebank Solar Plant (PV) (1 x 10MW project)	14/12/16/3/3/1/475	Portion 4 of the Farm Whitebank 379	~25km north east	Approved
Mogobe PV SEF (1 x 75MW project)	14/12/16/3/3/2/820	Portion 1 of the Farm Legoko 460	~25km south	Approved
Roma Energy Mount Ropers Solar Plant (PV) (1 x 5MW project)	14/12/16/3/3/1/1753	Remaining Extent of the Farm Mount Roper 321	~25.7km north east	Approved
Perth – Kuruman Solar Farm (PV) (1 x 75MW project)	14/12/16/3/3/2/761	Remaining Extent of the Farm Part 276	~30km north	Approved
Perth – Hotazel Solar Farm (PV) (1 x 75MW project)	14/12/16/3/3/2/762	Remaining Extent of the Farm Part 276	~30km north	Approved
Kagiso Solar Power Plant (PV) (1 x 115MW project)	14/12/16/3/3/2/934	Remaining Extent of the Farm Part 276	~30km north	Approved
Tshepo Solar Power Plant (PV) (1 x 115MW project)	14/12/16/3/3/2/936	Remaining Extent of Farm 275	~30km north	Approved

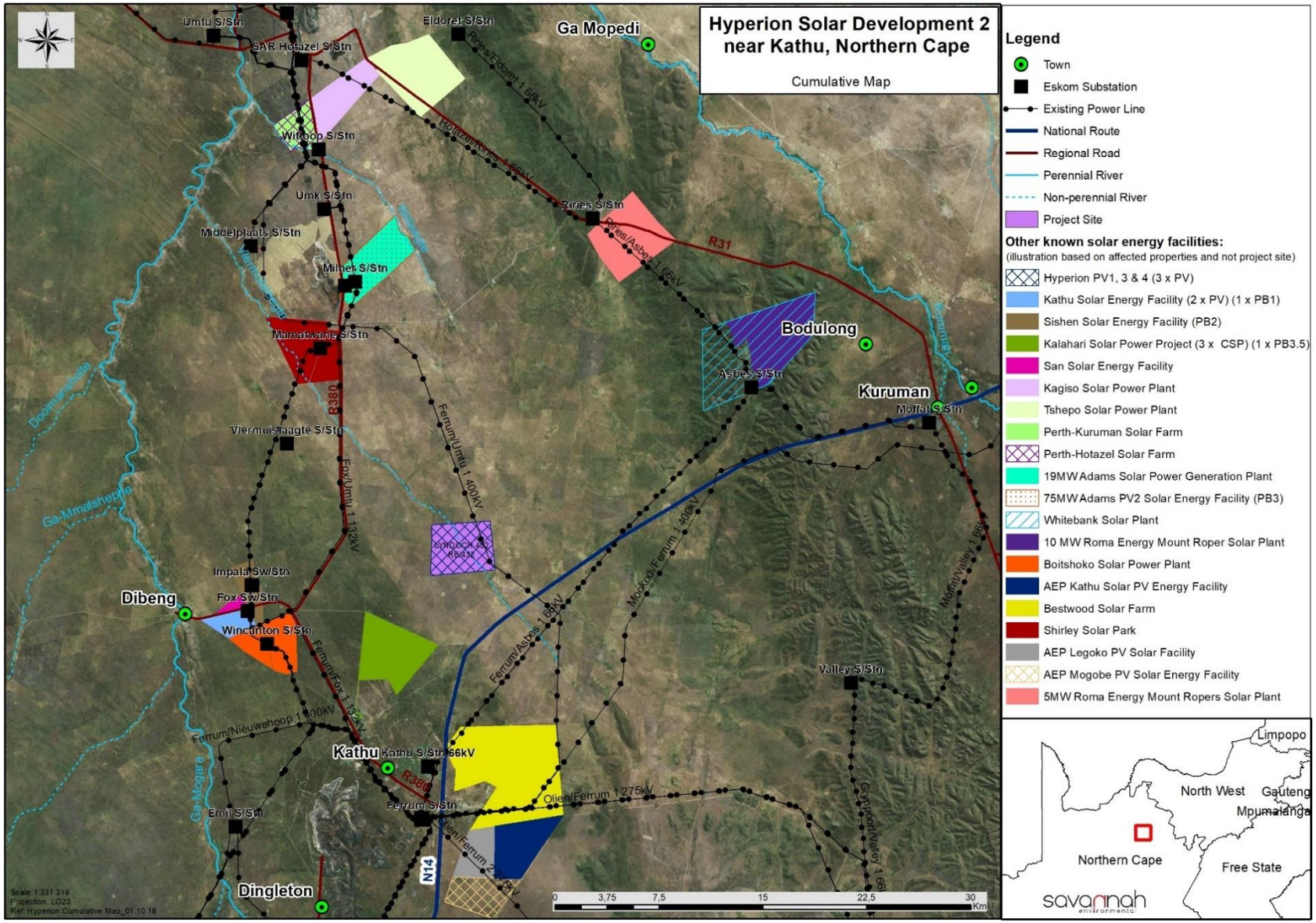


Figure 19: Cumulative map of other SEFs in the area surrounding the Hyperion Solar Development 2 (as provided by Savannah Environmental). The proposed Hyperion site is indicated in purple.

Table 17: Cumulative Impact Table

Nature:				
Other activities within the vicinity of the proposed Hyperion Solar Development 2 include an existing SEFs (approximately 9.3km south west of the project site), natural and untransformed areas, road crossings and bridges as well as urban areas (the Hyperion Solar Development 2 is located approximately 14 km north of Kathu). Aspects pertaining to the cumulative impacts include: *Site clearing, compaction and disturbance of soils in the vicinity of watercourses; *Changes to biodiversity maintenance, streamflow regulation capabilities, sediment balance etc. of the watercourses; and *Erosion, canalisation, increased runoff and sedimentation of the watercourses. The proposed Hyperion Solar Development 2 would contribute in a similar way to the cumulative impacts on the natural environment in the vicinity of the proposed project as the existing SEFs within a 30km radius of the project site and other anthropogenic activities would. Since no surface infrastructure associated with the development area is located within any of the identified watercourses and if either access road Alternatives 2, 3 or 4 are to be implemented, the significance of the cumulative impacts of the proposed project are therefore regarded to be low. If the mitigation measures, as set out in this report are adhered to, impacts from the proposed Hyperion Solar Development 2 construction activities will not exceed the boundaries of the development and investigation area and the cumulative impact on the larger catchment can, therefore, be considered very low/limited.				
	The overall impact of the proposed project considered in isolation		**The cumulative impact of the project and other projects in the area**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Minor	2	Minor	2
Probability	Improbable	2	Very Improbable	1
Significance	**Low**	**18**	**Low**	**9**
Status	Neutral		Neutral	
Reversibility	High		High	
Loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	
Confidence in findings:	**High**			
Mitigation:				
Please refer to all mitigation stipulated in Tables 6 - 14				

The cumulative impact of this project is considered to be of Low impact significance on the freshwater environment due to almost all proposed construction activities (with the exception of proposed access road Alternative 1) being located outside of any watercourses. Similarly, the cumulative impact of the proposed SEF and other similar projects in the area are considered of Low impact significance to the freshwater environment.

Overall, the added cumulative impact of this SEF to the freshwater environment will therefore be of Low impact significance.

7.4 Environmental Management Plan

The following table includes mitigation that must be included in the Environmental Management Plan (EMP). It should be noted that all mitigation measures as contained in Table 18 below were extracted from Section 7.1.

Table 18: Mitigation measures to be included as part of the EMP document.

Objective: Reduce the potential loss of habitat and ecological structure provided by the watercourses.			
Project Component:	*Compaction of soil. *Site clearing and disturbance of soils. *Movement of construction vehicles.		
Potential Impact:	*Removal of freshwater habitat. *Compaction of soils within and surrounding the watercourses. *Erosion of soils surrounding watercourses. *Potential proliferation of alien and invasive species within the watercourses.		
Activity/Risk source:	*Development of new access road Alternative 1 within the delineated boundary of the Vlermuisleegte River. *Increased hardened surfaces within the GN509 ZoR of the pan wetlands.		
Target/Objective	Reduce potential loss of habitat and ecological structure		
Mitigation: Action/Control		**Responsibility**	**Timeframe**
Mitigation: • All watercourses should be demarcated as a no-go area, unless at authorised footprint areas within the watercourses (such as access road Alternative 1 within the Vlermuisleegte River).		Contractor	Prior to Construction
• During the construction of the new access road, a buffer of no more than 5m on either side of the proposed road reserve may be impacted (if Alternative 1 would be constructed). If any other access road alternative would be constructed, no construction activities may occur within the 32m NEMA ZoR of the watercourses. These areas must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area. • All alien and invasive vegetation should be removed. Any vegetation removed should be taken to a registered landfill site to prevent the proliferation of alien and invasive species. • Avoid unnecessary site clearing/vegetation clearing as far as possible.		ECO & Contractor	Prior to and during Construction.
• Any cement mixing should be done within the designated batching area only and must not be mixed within or near any watercourses or within the 32m NEMA ZoR. • Measures must be put in place to control illegal dumping of construction waste as this may result in the pollution of surface water run-off. Furthermore, no pollution of groundwater resources may occur. • Storage of equipment and materials must remain within the designated construction areas and may not be left in unauthorised areas. • Any stockpiling of materials may not exceed two metres in height to reduce materials being blown away during high wind velocity events. • Regular spraying of non-potable water or through the use of chemical dust suppressants to reduce dust must be considered mandatory to ensure no smothering of freshwater vegetation occurs from excessive dust settling.		Contractor	Prior to and during Construction.
• Construction vehicles must be confined to designated roadways and the indiscriminate movement of construction vehicles through terrestrial or freshwater habitat falling outside of the construction footprint must be strictly prohibited.		Contractor	Prior to and during Construction.
• Concurrent rehabilitation of the watercourses impacted by the proposed development activities (with specific reference of access road Alternative 1) is to take place, and footprint areas should be minimised as far as possible. • All exposed soils should be revegetated as soon as possible to prevent erosion and loss of topsoil.		ECO & Contractor	During and Post Construction.
• Any exposed soils must be protected using covering with a geotextile such as hessian sheeting or Geojute, and/ or stabilised with sandbags.		Contractor	During and Post Construction

Objective: Prevent changes to the ecological and socio-cultural services of the watercourses.			
Project Component:	*Site clearing and vegetation removal. *Construction of new access road within the watercourse (applicable to access road Alternative 1). *Pollutants (Oil from construction vehicles).		
Potential Impact:	*Removal of freshwater vegetation. *Potential alteration of the hydrological regime which impacts on flood attenuation and streamflow regulation capabilities of the Vlermuisleegte River specifically. *Potential loss of ecosystem services (such as habitat provision) *Potential changes to surface water quality (when present).		
Activity/Risk source:	*Development of new access road Alternative 1 within the delineated boundary of the Vlermuisleegte River. *Increased hardened surfaces within the GN509 ZoR of the pan wetlands.		
Target/Objective	Prevent changes to the ecological and socio-cultural service.		
Mitigation: Action/Control		**Responsibility**	**Timeframe**
• It is strongly recommended that alien and invasive species be cleared from the Vlermuisleegte River as part of the proposed development if either access road Alternative 1 or 2 is constructed. This clearing should focus on the greater freshwater network and not only selective areas. If access road Alternative 3 is constructed, alien vegetation control along the access road should be implemented to prevent the spread thereof into the identified surrounding pan wetlands.		ECO & Contractor	Prior to and during Construction.

Objective: Avoid significant changes to the hydrological functioning and sediment balance of the watercourses.			
Project Component:	*Site clearing and vegetation removal. *Excavation activities associated with the access road construction activities. *Movement of construction vehicles.		
Potential Impact:	*Removal of freshwater vegetation. *Sheet erosion and gully formation. *Compaction of soils within and surrounding the watercourses. *Sedimentation of watercourses.		
Activity/Risk source:	*Development of new access road Alternative 1 within the delineated boundary of the Vlermuisleegte River. *Increased hardened surfaces within the GN509 ZoR of the pan wetlands.		
Mitigation	*Avoid significant changes to the hydrological functioning and sediment balance of the freshwater features.		
Target/Objective	Prevent changes to the hydrological functioning and sediment balance of the watercourses most likely to be impacted by the proposed development.		
Mitigation: Action/Control		**Responsibility**	**Timeframe**
• Stormwater management around the construction footprint areas must be considered to ensure that sediment-laden run-off does not enter the surrounding watercourses. Of specific mention is the development of access road Alternative 1 and 2 which may potentially impact on the Vlermuisleegte River, and access road Alternative 3 which may potentially impact on Pan Wetlands 3 and 8. • The water purification plant and the use of water during the construction and operational phases would be monitored, to ensure than no water enters the Vlermuisleegte River.		Contractor	During Construction

8 CONCLUSION

SAS was appointed to conduct a watercourse impact assessment as part of the EIA and authorisation process for the proposed Hyperion Solar Development 2. During the site assessment, several watercourses were identified within the investigation area associated with the development area, the proposed access road alternatives and their associated 20m corridors. This includes the Vlermuisleegte River (proposed to be directly traversed by access road Alternative 1), a perched depression wetland and several other pan wetlands. The table below provides a summary of the outcome of the ecological assessment of these watercourses.

Table 19: Summary of the outcome of the ecological assessment of the watercourses identified.

Watercourse	Locality	PES	Ecoservices	EIS	REC / RMO
Vlermuisleegte River	Located within the eastern portion of the investigation area of the development area and proposed to be traversed by proposed access road Alternative 1.	C/D (Moderately to Largely modified)	Moderately Low	Moderate	RMO: C (Maintain) REC: C (Moderately modified) BAS: C
Perched depression wetland	Located on the north-eastern boundary of the investigation area associated with the development area.	B (Largely natural with few modifications)	Moderately Low	Marginal/ Moderate	RMO: B (Maintain) REC: B (Largely natural with few modifications) BAS: B
Pan wetlands 1 -11	Located within the investigation area associated with access road Alternative 3 and 4.	B/C (Few modifications/ Moderately modified)	Moderately Low	Marginal/ Moderate	RMO: C (Maintain) REC: C (Moderately modified) BAS: C

The area surrounding the identified watercourses is mainly natural, untransformed areas; however, the river was noted to have been historically cultivated. Trampling and grazing of livestock was identified within almost all the watercourses. Sand mining and various informal roads were the only identified anthropogenic activities occurring within the local catchment of these watercourses.

Based on the outcome of the impact assessment, the proposed surface infrastructure and internal access roads located in the development area and the proposed water purification plant was determined to pose a Low impact significance to the watercourses. Due to these infrastructure components located outside of the 100m/500m GN509 ZoR of the watercourses, they are considered not to pose any legislative nor freshwater conservation constraints. Consideration must be given to GN538 of 2016 with regards to the abstraction and storage of groundwater.

The layout of proposed access road Alternative 1 will directly traverse the Vlermuisleegte River. The impact of the construction of this road was determined to have a Medium impact significance during the construction thereof, and a Low impact significance during the operational phase, with the implementation of the recommended mitigation measures. Although the impacts associated with the construction of access road Alternative 1 can be considered acceptable, if all the proposed mitigation measures as stipulated in this report are implemented, it is not considered the preferred route from a freshwater ecological perspective.

Proposed access road Alternatives 3 and 4 do not traverse any of the identified pan wetlands, but they are located within the 500m GN509 Zone of Regulation. Based on the outcome of the impact assessment, the proposed access roads would pose a Low impact significance to these pans during both the construction and operational phases. This can primarily be attributed to the distance these pans are from the proposed access roads.
It is the opinion of the freshwater ecologist that access road Alternative 4 should be recommended for authorisation, as from a freshwater conservation perspective, it would pose the least impact to any

watercourses. This is mainly attributed to the single watercourse (Pan Wetland 11) identified within its investigation area, located approximately 245m from the proposed road.

Notwithstanding the fact that a clear preference has emerged in respect of the various access road alternatives, this is not compelling in that the impacts along all access road alternatives can be mitigated to acceptable levels (with the implementation of the provided mitigation measures). Consequently, the preference can be overridden by either technical and/or biodiversity requirements if these requirements are compelling.

Based on the outcome of the impact assessment, the proposed Hyperion Solar Development 2 will have an overall low impact on the various aspects of freshwater ecology (i.e. habitat and ecology, ecological and socio-cultural service provision and hydrological function and sediment balance) during the construction and operation phases, provided that well-conceived, strictly implemented and managed impact minimisation takes place.

After the conclusion of the assessment, it is the opinion of the freshwater ecologist that the proposed development be considered acceptable, provided that the essential mitigation measures as listed in this report are strictly adhered to.

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APPENDIX A: INDEMNITY AND TERMS OF USE OF THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

APPENDIX B: LEGISLATIVE REQUIREMENTS

National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i). A watercourse is defined as: a) A river or spring; b) A natural channel in which water flows regularly or intermittently; c) A wetland, lake or dam into which, or from which water flows; and d) Any collection of water which the minister may, by notice in the Gazette, declare a watercourse.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21(c) and 21(i) of the NWA, 1998 is defined as: ➢ The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; ➢ In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or ➢ A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and storm water management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C: WATERCOURSE ASSESSMENT APPROACH

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the watercourses present in the development area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), Department of Water Affairs (DWA), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland feature present within the area of interest.

1.2 Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the watercourse traversed by the proposed linear development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

The river encountered during site assessment was assessed using the "Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis *et. al*., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3:LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the classification system, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[2] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

[2] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et. al.,* 2013):

- Slope: an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- Valley floor: The base of a valley, situated between two distinct valley side-slopes;
- Plain: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- Bench (hilltop/saddle/shelf): an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table C2), on the basis of hydrology and geomorphology (Ollis *et. al*., 2013), namely:

- River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it;
- Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it;
- Floodplain wetland: the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- Depression: a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- Wetland Flat: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- Seep: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008) and WET-EcoServices (Kotze *et. al*., 2009).

3. Index of Habitat integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans et al. 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in the table below.

Table C3: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans et al. 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
0	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
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.	0 - 19

4. Riparian Vegetation Response Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

The Riparian Vegetation Response Assessment Index (VEGRAI) is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results[3]. Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Table C4: Descriptions of the A-F ecological categories.

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

[3] Kleynhans et al, 2007

5. WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores, and Present State categories are provided in the table below.

Table C5: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

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

Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C6: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole need to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

6. Freshwater Function Assessment (Wet-Ecoservices (2009))

"The importance of a water resource, in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table C6: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

7. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (see table below) of the wetland system being assessed.

Table C7: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and =4	A
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

8. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

“A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure” (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the watercourse (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C8: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

PES			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

*PES Categories E and F are considered ecologically unnacceptable (Malan and Day, 2012) and therefore, should a freshwater resource fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.

A watercourse may receive the same class for the REC as the PES if the watercourse is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the freshwater resource.

Table C9: Description of Recommended Ecological Category (REC) classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

9. Wetland and Riparian Delineation

The watercourse delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators and can accordingly be classified as both. If you are adjacent to a watercourse, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

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

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

Ecological Impact Assessment Method of assessment

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/ impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/ impacts have been assessed. The method to be used for assessing risks/ impacts is outlined in the sections below.

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **magnitude**, quantified on a scale from0-10, where a score is assigned:
  - 0 is small and will have no effect on the environment
  - 2 is minor and will not result in an impact on processes
  - 4 is low and will cause a slight impact on processes
  - 6 is moderate and will result in processes continuing but in a modified way
  - 8 is high (processes are altered to the extent that they temporarily cease)
  - 10 is very high and results in complete destruction of patterns and permanent cessation of processes
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:
S= (E+D+M) x P
S = Significance weighting
E = Extent
D = Duration
M =Magnitude
P = Probability

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

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of Cumulative Impacts

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[4].

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

» Unacceptable risk
» Unacceptable loss
» Complete or whole-scale changes to the environment or sense of place
» Unacceptable increase in impact

The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area.

Mitigation Measure Development

The following points present the key concepts considered in the development of mitigation measures for the proposed construction.

- Mitigation and performance improvement measures and actions that address the risks and impacts[5] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

[4] Unless otherwise stated, all definitions are from the 2014 EIA Regulations, GNR 982
[5] Mitigation measures should address both positive and negative impacts

APPENDIX D: RESULTS TABLES

1. PRESENT ECOLOGICAL STATE ASSESSMENT

PES as determined by the IHI method for the Vlermuisleegte River

RIPARIAN IHI	
Base Flows	-1,0
Zero Flows	0,0
Moderate Floods	2,5
Large Floods	1,5
HYDROLOGY RATING	**1,3**
Substrate Exposure (marginal)	2,5
Substrate Exposure (non-marginal)	2,0
Invasive Alien Vegetation (marginal)	1,5
Invasive Alien Vegetation (non-marginal)	1,0
Erosion (marginal)	1,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	1,0
Physico-Chemical (non-marginal)	1,0
Marginal	2,5
Non-marginal	2,0
BANK STRUCTURE RATING	**2,3**
Longitudinal Connectivity	2,0
Lateral Connectivity	2,0
CONNECTIVITY RATING	**2,0**
RIPARIAN IHI %	**61,9**
RIPARIAN IHI EC	**C/D**
RIPARIAN CONFIDENCE	**3,0**

VEGRAI Classification as determined for the Vlermuisleegte River.

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	60,0	40,0	2,5	1,0	100,0
NON MARGINAL	54,5	18,2	2,5	2,0	50,0
2,0					150,0
LEVEL 3 VEGRAI (%)				58,2	
VEGRAI EC				**C/D**	
AVERAGE CONFIDENCE				2,5	

PES as determined by the WET-Health for the perched depression wetland.

Resource	Hydrology		Geomorphology		Vegetation		Overall PES Category of the resource
	PES category	Trajectory of change	PES category	Trajectory of change	Impact Score	Trajectory of change	
Depression wetland	1,0	-1,0	1,0	-1,0	1,5	-1,0	B
	B	↓	B	↓	B	↓	

PES as determined by the WET-Health for the pan wetlands

Resource	Hydrology		Geomorphology		Vegetation		Overall PES Category of the resource
	PES category	Trajectory of change	PES category	Trajectory of change	Impact Score	Trajectory of change	
Depression wetland	1,5	-1,0	1,6	-1,0	2,7	-1,0	B
	B	↓	B	↓	C	↓	

2. ECOSERVICE PROVISION

Ecosystem functions and service provision scores calculated for the watercourses.

Ecosystem service	Vlermuisleegte River	Depression	Pans
Flood attenuation	1,5	1,2	1,2
Streamflow regulation	1,8	1,0	1,0
Sediment trapping	1,6	0,8	0,8
Phosphate assimilation	2,0	1,7	1,7
Nitrate assimilation	1,6	1,6	1,6
Toxicant assimilation	1,8	1,5	1,5
Erosion control	1,5	1,4	1,4
Carbon Storage	0,8	0,8	0,8
Biodiversity maintenance	2,0	1,8	2,0
Water Supply	0,3	0,2	0,2
Harvestable resources	0,4	0,4	0,4
Cultivated foods	0,4	0,4	0,4
Cultural value	0,5	0,5	0,5
Tourism and recreation	0,9	0,8	0,8
Education and research	0,8	0,8	0,8
SUM	**17,7**	**14,7**	**14,8**
Average score	**1,2**	**1,0**	**1,0**

3. EIS DETERMINATION

EIS determination for the calculated for the watercourses.

			Vlermuisleegte River	Perched Depression Wetland	Pan Wetlands
Ecological Importance and Sensitivity			Score (0-4)		
Biodiversity support			**A (average)**		
			1,33	1,00	1,33
Presence of Red Data species			1	1	0
Populations of unique species			1	1	1
Migration/breeding/feeding sites			2	1	3
Landscape scale			**B (average)**		
			1,40	1,40	1,40
Protection status of the wetland			1	1	1
Protection status of the vegetation type			1	1	1
Regional context of the ecological integrity			1	1	1
Size and rarity of the wetland type/s present			1	1	1
Diversity of habitat types			3	3	3
Sensitivity of the wetland			**C (average)**		
			1,00	1,00	1,00
Sensitivity to changes in floods			1	1	1
Sensitivity to changes in low flows/dry season			1	1	1
Sensitivity to changes in water quality			1	1	1
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)			**B**	**B**	**B**
Hydro-Functional Importance			**Score (0-4)**		
Regulating & supporting benefits	**Flood attenuation**		2	1	1
	Streamflow regulation		2	1	1
	Water Quality Enhancement	***Sediment trapping***	2	1	1
		Phosphate assimilation	2	1	1
		Nitrate assimilation	2	1	2
		Toxicant assimilation	1	1	2
		Erosion control	1	1	2
	Carbon storage		1	1	1
HYDRO-FUNCTIONAL IMPORTANCE (average score)			2	1	1
Direct Human Benefits			**Score (0-4)**		
Subsistence benefits	***Water for human use***		0	0	0
	Harvestable resources		0	0	0
	Cultivated foods		0	0	0
Cultural benefits	***Cultural heritage***		0	0	0
	Tourism and recreation		1	0	1
	Education and research		1	0	0
DIRECT HUMAN BENEFITS (average score)			0,33	0,00	0,17

APPENDIX E: ADDITIONAL GOOD HOUSEKEEPING MITIGATION MEASURES

General management and good housekeeping practices

The following essential mitigation measures are considered to be standard best practice measures applicable to a development of this nature and must be implemented during all phases of the proposed SEF development.

Development and operational footprint

- Sensitivity maps have been developed for the study area, indicating the freshwater environments, their relevant buffer zones and regulatory zones in accordance with the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA) and National Water Act, 1998 (Act No. 36 of 1998) (NWA), as shown in Section 6 It is recommended that these sensitivity maps be considered during all phases of the development and with special mention of the planning of infrastructure layout, to aid in the conservation of the freshwater habitats and environmental resources within the investigation area;
- All development footprint areas should remain as small as possible and should not encroach onto surrounding more sensitive areas. It must be ensured that the freshwater resources, and their associated buffer zones are off-limits to construction vehicles and personnel;
- The boundaries of footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised;
- All areas of increased ecological sensitivity should be marked as such and be off limits to all unauthorised construction and maintenance vehicles and personnel;
- Appropriate sanitary facilities must be provided for the life of the development and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored on bunded surfaces and no storage of such chemicals should be permitted within the freshwater buffer zones;
- Access to the construction site(s) should be limited to a single entry point as much as feasible to minimise compaction of soils, loss of vegetation and increased erosion;
- No informal fires should be permitted in or near the construction areas;
- Ensuring that an adequate number of rubbish and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills; and
- Edge effects of activities, particularly erosion and alien/weed control need to be strictly managed.

Vehicle access

- All areas of increased ecological sensitivity should be marked as such and kept off limits to all unauthorised construction and maintenance vehicles as well as personnel;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil;
- All spills, should they occur, should be immediately cleaned up and treated accordingly; and
- During maintenance activities, vehicles must only be driven on existing, maintained access roads and not drive indiscriminately through natural areas.

Alien plant species

- Proliferation of alien and invasive species is expected within any disturbed area, even though there were only a few areas where alien and invasive species were identified within the investigation area at the time of the assessment. These species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, must be controlled;

- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases; and
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species; and
  - No vehicles should be allowed to drive through designated sensitive areas during the eradication of alien and weed species.

Freshwater feature habitat

- Ensure that as far as possible all infrastructure is placed outside of freshwater resource areas and their respective buffer zones. If these measures cannot be adhered to, strict mitigation measures, will be required to minimize the impact on the receiving watercourses;
- Permit only essential construction personnel within 32 m of the freshwater habitat, if absolutely necessary that they enter the regulatory zone;
- Limit the footprint area of the construction activities to what is only essential in order to minimise environmental damage;
- During the construction phase, no vehicles should be allowed to indiscriminately drive through the freshwater resource areas; and
- Implement effective waste management in order to prevent construction related waste from entering the freshwater environments.

Soils

- The duration in which soils are exposed during construction activities should remain as short as possible, and all disturbed areas are to be monitored throughout the construction phase for incision and erosion;
- No soil stockpiling is to take place within freshwater habitat or associated buffer zones, and all soil stockpiles must be suitably protected with geotextiles;
- To prevent the erosion of soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas particularly susceptible to erosion;
- Install erosion berms during construction to prevent gully formation. Berms every 50 m should be installed where any disturbed soils have a slope of less than 2%, every 25 m where the track slopes between 2% and 10%, every 20 m where the track slopes between 10% and 15% and every 10 m where the track slope is greater than 15%;
- Sheet runoff from access roads and internal roads to be constructed, should be slowed down by the strategic placement of berms and sandbags;
- Maintain topsoil stockpiles below 2 m in height;
- All soils compacted as a result of construction activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Monitor all areas for erosion and incision, particularly any freshwater resource crossings. Any areas where erosion is occurring excessively quickly should be rehabilitated as quickly as possible and in conjunction with other role players in the catchment.

Rehabilitation

- All soils compacted as a result of construction activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive vegetation control within these areas. Alien and invasive vegetation control should take place throughout all construction and rehabilitation phases to prevent loss of floral habitat to the freshwater features that would possibly be impacted on by the proposed wind farm construction;
- Rehabilitate all freshwater feature areas possibly affected by the proposed development to ensure that the ecology of these areas is re-instated during all phases.
- Edge effects of activities including erosion and alien/ weed control need to be strictly managed in these areas;

- As far as possible, all rehabilitation activities should occur in the low flow season, during the drier summer months.
- As much vegetation growth as possible should be promoted within the proposed development in order to protect soils;
- All alien vegetation identified should be removed from rehabilitated areas and reseeded with indigenous vegetation as specified by a suitably qualified specialist (ecologist);
- All areas affected by the proposed development should be rehabilitated upon completion of all activities.

APPENDIX F: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Kim Dalhuijsen	Bsc Hons (Zoology) (University of the Witwatersrand)
Christel Pretorius	BSc (Environmental Sciences) (North West University)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, 2007		
Postal code:	1401	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1.(b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Kim Marais, 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 relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, 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

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Consultant
Date of Birth	28 August 1989
Nationality	The Netherlands
Languages	English, Afrikaans
Joined SAS	2015 – Present

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Natural Scientist with the South African Council for Natural Scientific Professions
Member of the South African Wetlands Society

EDUCATION

Qualifications

Short course in the identification of Aquatic and wetland plants	2019
Short course in Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013
BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)	2012
BSc (Zoology and Environment, Ecology and Conservation) (University of Witwatersrand)	2011

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
West Africa – Uganda

PREVIOUS EMPLOYMENT

Position	Junior Environmental Scientist
Company	ILISO Consulting (Pty) Ltd
Employment	2013 - 2015

SELECTED PROJECT EXAMPLES

Wetland Delineation and Wetland Function Assessment

Various **Freshwater Assessments**, including:

- Wetland Offset Plan for the Cape Town International Airport, Cape Town.
- Wetland offset investigation for the proposed Idas Valley residential development, Stellenbosch, Western Cape.
- Freshwater Assessment for the Swartklip Site as part of the Cape Town International Airport Wetland Offset requirements, Cape Town.
- Freshwater Assessment for the proposed road upgrades to Protea and Waarburgh Roads, Joostenbergvlakte, Western Cape.
- Freshwater Verification and Risk Assessment for the proposed upgrading of road culverts associated with the Main Road 287, 288 and trunk road 32/1, Bonnievale, Western Cape.
- Freshwater Assessment for the installation of a side cut drain north of the existing Kleinmond cemetery, Kleinmond, Western Cape.
- Freshwater Assessment for the proposed Melkhoutfontein residential development and associated services, Stillbaai, Western Cape.
- Freshwater Assessment associated with the Section 24G rectification process for the unauthorised dams within Tierhoek, Citrusdal, Western Cape.
- Freshwater Assessment associated with the Section 24G rectification process for the unauthorised Kleinberg dams, Citrusdal, Western Cape.
- Freshwater Assessment for the proposed sediment removal from an existing irrigation dam and installation of a sediment containment system at the Boschenmeer Golf Estate, Paarl, Western Cape.
- Freshwater Assessment for the proposed Heuningklip Solar Farm, Vredenburg, Western Cape.
- Freshwater screening for the proposed Doornfontein Solar Farm, Velddrift, Western Cape.
- Freshwater Screening for the proposed Valentia underground shooting range, Paarl, Western Cape.
- Freshwater Assessment for the proposed Baden Powell Industrial development, Western Cape.
- Freshwater Assessment for the decommissioning of five landfill sites within the Drakenstein Municipality, Western Cape.
- Freshwater Assessment for the proposed De Hoop Residential Development, southern Paarl, Western Cape.
- Freshwater assessment for the proposed Vredenburg Wind Energy Facility, Vredenburg, Western Cape.
- Wetland Assessment for the proposed Excelsior Wind Energy Farm and associated powerline infrastructure, Swellendam, Western Cape.
- Wetland Assessment for the sewage Bulk Service System for the Drakenstein Municipality, Paarl, Western Cape.
- Freshwater screening for the proposed Vendome residential Development, Paarl, Western Cape.
- Wetland Assessment for the Riverclub Development for the Val de Vie development, Paarl, Western Cape.
- Wetland Assessment for the Riverfarm Development for the Val de Vie development, Paarl, Western Cape.
- Wetland Assessment for the development of three agricultural dams for irrigation of crops, Cape Farms, Western Cape.
- Wetland Assessment for the Willow Wood Estate Sewage pipeline upgrade, D'Urbanvale, Western Cape.
- Wetland Assessment for the rectification of infilling of a freshwater feature, D'Urbanvale, Western Cape.
- Freshwater Assessment for the stabilisation of the Franschhoek River embankment, Leeu Estates, Franschhoek, Western Cape.
- Freshwater Assessment for the proposed Helderburg Hospital, Somerset West, Western Cape.
- Freshwater Assessment for the Vergenoegd Wine Estate, Cryodon, Western Cape.
- Freshwater assessment for the proposed upgrade of the community school, Elandsdift farm, Sir Lowry's Pass, Western Cape.

Various **Freshwater Rehabilitation and Management Plans**, including:

- Detailed Method Statement for the rehabilitation and Maintenance of the wetland associated with the Gentleman's Estate Plots, Val de Vie, Paarl, Western Cape.
- Detailed method statement for the rectification and rehabilitation of a storm water system, D'Urbanvale, Western Cape.
- Rehabilitation Plan for the proposed de Hoop Residential Development, Paarl, Western Cape.
- Rehabilitation Plan for the proposed abstraction and storage of water from the Diep River in a 500,000m^3 dam, Durbanville, Western Cape.
- Rehabilitation Plan for the proposed bulk water pipeline over the Kuils River, Belhar, Western Cape.
- Rehabilitation and implementation plan for the proposed IDas Valley residential development offset requirements, Stellenbosch, Western Cape.

Water Use Authorisations and ECO input

- WUA for the SANRAL N3 De Beers Pass Section within the Free State and KwaZulu-Natal.

- Assistance with the WULA for the Mzimvubu Water Project, Eastern Cape.
- WUA for the Excelsior Wind Energy Farm and associated powerline infrastructure, Swellendam, Western Cape.
- WUA for the Golden Valley Phase II Wind Energy Facility, Eastern Cape.
- WUA for the Sewage Bulk Service system for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Riverfarm Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Pearl Valley II Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Levendal Village for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for a residential Development, Klapmuts, Western Cape.
- WUA for the Riverclub Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the proposed Copperton Wind Energy Facility, Northern Cape.
- WUA for the proposed bulk water pipeline crossing over the Kuils River, Bellville, Western Cape.
- WUA for the proposed Vergenoegd Village residential development near Crydon, Western Cape.
- Validation and Verification process of three farms in Franschhoek, Western Cape.
- Validation and Verification process for Farm 1165 in Durbanville, Western Cape.
- WUA for the De Hoop Lifestyle Estate, Paarl, Western Cape.
- WUA for the proposed Platrug Dam with storage capacity of 500,000m^3, Western Cape.
- WUA for the proposed Boland Park residential development, Western Cape.
- WUA for the proposed Symphony Way residential development, Delft, Western Cape.
- WUA for the proposed abstraction and storage of groundwater on erf 3239 and Farm Watervliet 1224, Paarl, Western Cape.
- WUA for the proposed abstraction of groundwater as part of the Belhar development, Belhar, Western Cape.

Specialist **Environmental Control Work**

- ECO of WUL conditions for the proposed bridge and access road over the Berg River, Val de Vie Estate, Paarl.
- ECO of WUL conditions for the proposed bulk water pipeline over the Kuils River, City of Cape Town, Belhar, Western Cape.
- ECO of WUL conditions for the proposed Riverclub residential development, Paarl, Western Cape.
- Various specialist freshwater input into EMP's and landscape plans, Western Cape.

Public Participation and Environmental Impact Assessments

- Public Participation for the Environmental Impact Assessment for the Eskom Photovoltaic Plant at Arnot and Duvha Power Station.
- Eskom Hendrina to Gumeni sub-stations 400 kV Powerline. Co-ordination of Heritage and Ecological Assessment and updating the Construction and Operation Environmental Management Plan.
- Public Participation Team Leader for the Mzimvubu Dam Environmental Impact Assessment.
- Public Participation Process for Eskom Exemption from and Postponement of Air Emission Licence Applications.
- EIA for Eskom Vierfontien to Wawielpark 22 kV Transmission line refurbishing.
- Junior Environmental Scientist for the Hartbeespoort Waste Charge Discharge System.
- Public Participation Process for City of Tshwane's Bus Rapid Transit from Pretoria Station to Rainbow Junction.
- EIA for the Rwengaaju Model Village Irrigation Scheme in Kabarole District, Uganda.
- EIA for tte Water supply and Sanitation system in Moroto, Bugaddem Kacheri-Lokona, Nakapelimoru and Kotido, Uganda.
- EIA for the Farm Income Enhancement and Forestry Conservation Project: Irrigation Scheme for Katete, Kibimba and Mubuku II, Uganda.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF CHRISTEL DU PREEZ

PERSONAL DETAILS

Position in Company	Wetland Ecologist
Date of Birth	22 March 1990
Nationality	South African
Languages	English, Afrikaans
Joined SAS	January 2016

EDUCATION

Qualifications

MSc Environmental Sciences (North West University)	2017
BSc (Hons) Environmental Sciences (North West University)	2012
BSc Environmental and Biological Sciences (North West University)	2011

COUNTRIES OF WORK EXPERIENCE

South Africa – KwaZulu Natal, Northern Cape, Gauteng, Mpumalanga, Free State, Eastern Cape

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Baseline freshwater assessment as part of the environmental assessment and authorisation process for the proposed National Route 3 (N3) Van Reenen Village Caltex Interchange, KwaZulu Natal.
- Basic assessment for the proposed construction of supporting electrical infrastructure for the Victoria West Wind Farm, Victoria West, Northern Cape Province.
- Freshwater Ecological Assessment in Support of the WULA Associated with the Rehabilitation of the Wetland Resources in Ecopark, Centurion, and Gauteng.
- Wetland Ecological Assessment for the Proposed Mixed Land Use Development (Kosmosdal Extension 92) on the remainder of Portion 2 of the farm Olievenhoutbosch 389 Jr, City of Tshwane Metropolitan Municipality, Gauteng Province.
- Freshwater Ecological Assessment for the Mokate Pig Production and Chicken Broiler Facility on the farm Rietvalei Portion 1 and 6 near Delmas, Mpumalanga.
- Wetland Ecological Assessment as part of the Environmental Assessment and Authorisation Process for the Proposed Relocation of a Dragline from the Kromdraai Section to Navigation Section of the Anglo American Landau Colliery in Mpumalanga.
- Freshwater Assessment as part of the Environmental Assessment and Authorisation Process for a proposed 132kv powerline and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces.
- Freshwater Ecological Assessment of the Freshwater Prospect Stream in the AEL Operational Area, Modderfontein, Gauteng.
- Specialist Freshwater Scoping and Environmental Impact Assessment for the Proposed Development of the Platberg and Teekloof Wind Energy Facility and Supporting Electrical Infrastructure near Victoria West, Northern Cape Province.
- Wetland Ecological Assessment as part of the Environmental Assessment and Authorisation Process for the Proposed Development of Wilgedraai, Vaaldam Settlement 1777, Free State Province.
- Freshwater Resource Delineation and Assessment as part of the consolidation of four Environmental Management Plans at the Graspan Colliery, in Middelburg, Mpumalanga Province.
- Freshwater Assessment as part of the Water Use Authorisation for the proposed Copperton Wind Energy Facility, Northern Cape.
- Freshwater Resource and Water Quality Ecological Assessment for the Lakefield Manor Residential project, Boksburg, Gauteng Province.