PROPOSED UPGRADE OF THE MUNICIPAL ACCESS ROADS TO THE N2 SECTION 18 BETWEEN MTHATHA AND VIEDGESVILLE, KING SABATA DALINDYEBO LOCAL MUNICIPALITY, EASTERN CAPE

Specialist Freshwater Ecosystem Impact Assessment Report





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SPECIALIST REPORT DETAILS AND DECLARATION

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (Act No. 107 OF 1998) ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014 as per Government Notice No. 38282 GOVERNMENT GAZETTE, 4 DECEMBER 2014 (as amended).
- The Department of Water & Sanitation for Water Use Licensing and wetland/aquatic assessment, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017.

Document Title:	Specialist Freshwater Ecosystem Impact Assessment
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EXECUTIVE SUMMARY

The South African National Roads Agency State Owned Company Limited (SANRAL) has been approached by the King Sabata Dalindyebo Local Municipality to upgrade the existing local road network to tie in with the National Road Route 2 interchange Section 18 between Mthatha and Viedgesville in the Eastern Cape, with the purpose of the assessment being to provide the relevant information to assist with the application for a Water Use License in terms of Section 21 of the National Water Act No. 36 of 1998. The main findings of this report have been summarized below as follows:

Baseline Aquatic Assessment:

The study area and watercourses are located within DWS Quaternary Catchment T20C and T20D, which are drained by the perennial Centuli River (T20C) to the west and the perennial Zimbane and Mthatha River (T20D) to the east, situated in the Mzimvuba – Tsitsikamma Water Management Area (WMA). The site is drained by both wetlands and ephemeral drainage lines (preferential flow paths) which flow in a westerly direction and join the Centuli River (T20C) located some 6000m east of the road alignment. Whilst both wetlands and ephemeral drainage lines located in T20D flow in an easterly direction into the Zimbane and Mthatha located some 1200m and 3500m east of the road alignment, respectively.

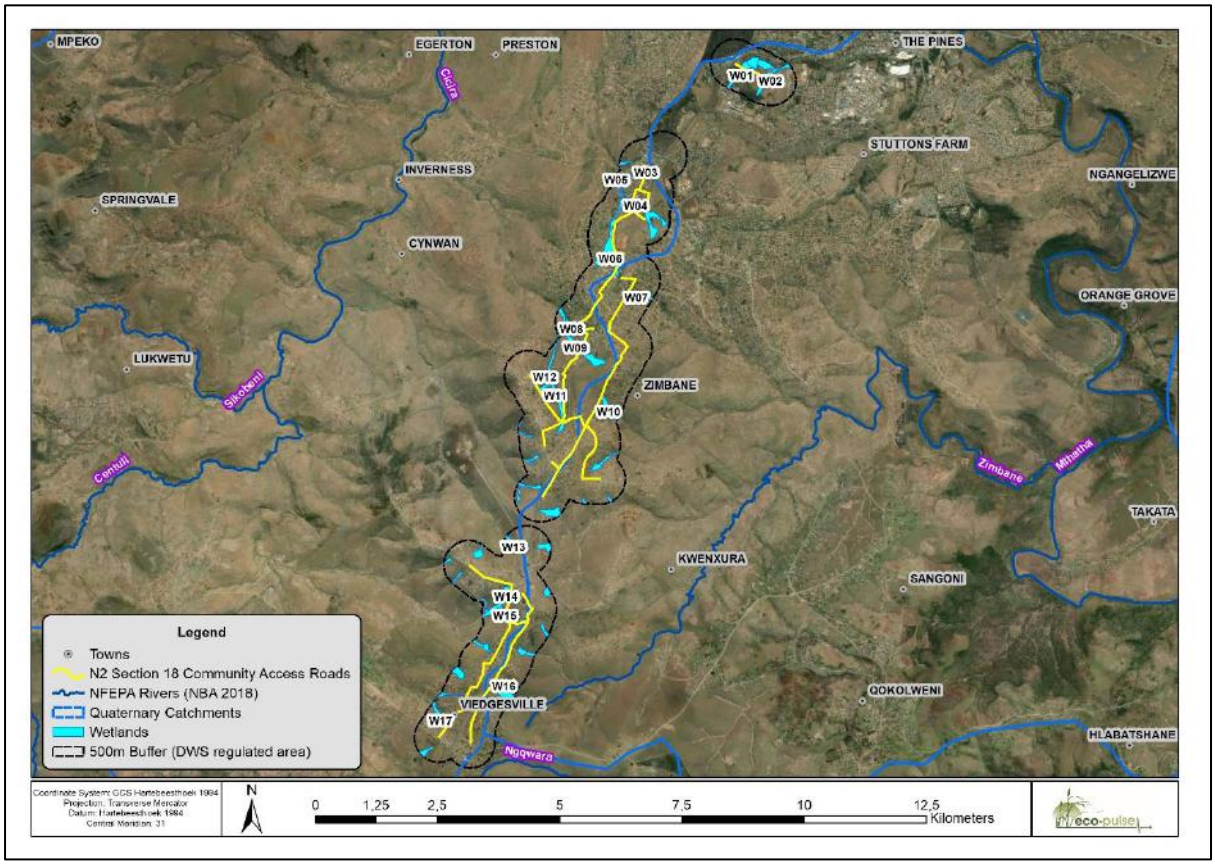
A total of **17** watercourse units were found to be crossed and/or within 32m of the proposed development footprint (i.e. units considered to be potentially negatively affected). The dominant watercourse type to be crossed are seeps (65%) followed by channelled valley bottom wetlands (24%) and un-channelled valley bottom wetlands (12%). Based on the combined desktop assessment and field verification exercise, **NO RIVERS WERE IDENTIFIED** within the area of study and downstream as being at risk of potential impact by the proposed road upgrade.

A summary of the PES (Present Ecological State) and EIS (Ecological Importance & Sensitivity) assessment results are as follows:

WETLANDS CROSSED BY THE ROAD ALIGNMENT OR DOWNSTREAM AND AT HIGH RISK OF BEING DIRECTLY OR INDIRECTLY IMPACTED			
Wetland Reference	**PES**	**EIS**	**Recommended Management Objective**
W01	**E: Seriously Modified**	**Moderately-Low**	*Maintain PES/EIS*
W02	**D: Largely Modified**	**Moderate**	*Maintain PES/EIS*
W03	**E: Seriously Modified**	**Moderately-Low**	*Maintain PES/EIS*
W04	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W05	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W06	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W07	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W08	**E: Seriously Modified**	**Moderately-Low**	*Maintain PES/EIS*
W09	**E: Seriously Modified**	**Moderately-Low**	*Maintain PES/EIS*
W10	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W11	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*

WETLANDS CROSSED BY THE ROAD ALIGNMENT OR DOWNSTREAM AND AT HIGH RISK OF BEING DIRECTLY OR INDIRECTLY IMPACTED			
Wetland Reference	**PES**	**EIS**	**Recommended Management Objective**
W12	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W13	**F: Critically Modified**	**Low**	*Maintain PES/EIS*
W14	**F: Critically Modified**	**Low**	*Maintain PES/EIS*
W15	**E: Seriously Modified**	**Low**	*Maintain PES/EIS*
W16	**D: Largely Modified**	**Low**	*Maintain PES/EIS*
W17	**D: Largely Modified**	**Low**	*Maintain PES/EIS*

Map showing the mapped watercourses (wetlands)



Resource Management Objectives & Recommendations:

The RMO (Recommended Management Objective) for wetlands assessed is to 'Maintain' current PES through water resource management measures that do not lead to a reduction in PES.

Project Planning and Design Recommendations:

As some of the community access roads already exist and cross freshwater ecosystems, direct and indirect impacts to these systems cannot be avoided and freshwater habitat loss is inevitable. The focus of planning and design recommendations should therefore be on the second step of the mitigation hierarchy – minimisation. However, several new roads are also proposed, and it is assumed that these

roads can potentially be shifted to avoid sensitive freshwater areas currently unimpacted by existing road alignments.

In this regard, it is recommended that the proposed crossing and infilling of Unit W03 (a hillslope seep characterized by hygrophilous grasses and sedges) along the northernmost section of the road alignment (Road 12A, also referred to as P1), and the crossing of Unit W08 (a hillslope seep, characterized by hygrophilous grassland) which is associated with a new road crossing and road underpass (Road 10 and Road-Class 4-R2r1[1], also referred to as P2), be avoided or minimised as far as practically possible.

Following the submission of these re-alignment recommendations to the EAP and project team, the project engineers were able to shift the P2 southwards to reduce the extent of Unit W08 which stands to be infilled and impacted. The realignment resulted in a reduction in wetland loss, which is a measurable reduction in wetland habitat loss and impact significance. However, the EAP confirmed that P1, which will adversely impact upon Unit W03 is still under discussion. It is suggested the road alignment is shifted to the west to align with an existing road crossing which has already impacted upon the lower end of a channelled valley bottom wetland (situated to the west of Unit W03). In doing so, the realignment is expected to result in a reduction in wetland habitat loss and impact significance.

Impact Assessment:

The impact significance and risk assessment undertaken for the project reveal that three key potential impacts are noteworthy, namely:

- Impact C1 – Threatened freshwater habitat loss / destruction and modification (**Moderately-Low significance**).
- Impact C2 – Indirect impacts of land clearing and construction activities within or near the watercourses (**Moderately-Low significance**).
- Impact O2 – Indirect impacts of flow concentration and associated erosion and sedimentation resulting from diversion of flows through road crossings (**Moderate significance**).

With the effective implementation of the mitigation measures recommended in Section 6 below, the significance of all the impacts can be reduced.

DWS Risk Matrix Assessment:

The impact significance assessment findings indicate that Impacts C1, C2 and O2 are the most significant impacts and should pose the highest risks to freshwater ecosystem integrity and biodiversity. This is confirmed by the risk assessment results that indicate that Impact **C1 poses a moderate risk** to wetland ecosystem functioning due to permanent freshwater habitat infilling, and Impacts **C2 and O2 likewise pose a moderate level of risk** to the wetlands assessed. After careful consideration of best practical mitigation measures (design and operational mitigation measures recommended by Eco-

[1] The road references are extracted from the road alignment provided (2020-06-02) N2 18 Access Roads.

Pulse in this specialist report), **the risk scores for borderline low/moderate cases were manually reduced from Moderate to a Low Risk class.**

The recent GA also includes a number of activities that are generally authorized for State Owned Companies (SOC's) and institutions that are then subject only to compliance with the conditions of the GA (summarised below under Section 6.5.2). **This essentially replaces the need for SANRAL to apply for a full water use license for the upgrades to the existing N2 community access roads, and those activities and water uses could then potentially be authorised under the provisions of the GA subject to compliance with the conditions of the GA.**

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Background to the assessment, area of study and proposed development activity

The South African National Roads Agency State Owned Company Limited (SANRAL) has been approached by the King Sabata Dalindyebo Local Municipality to upgrade the existing local road network to tie in with the National Road Route 2 interchange Section 18 between Mthatha and Viedgesville in the Eastern Cape. The sections of road to be upgraded as part of the proposed project are shown in Figure 1 below.

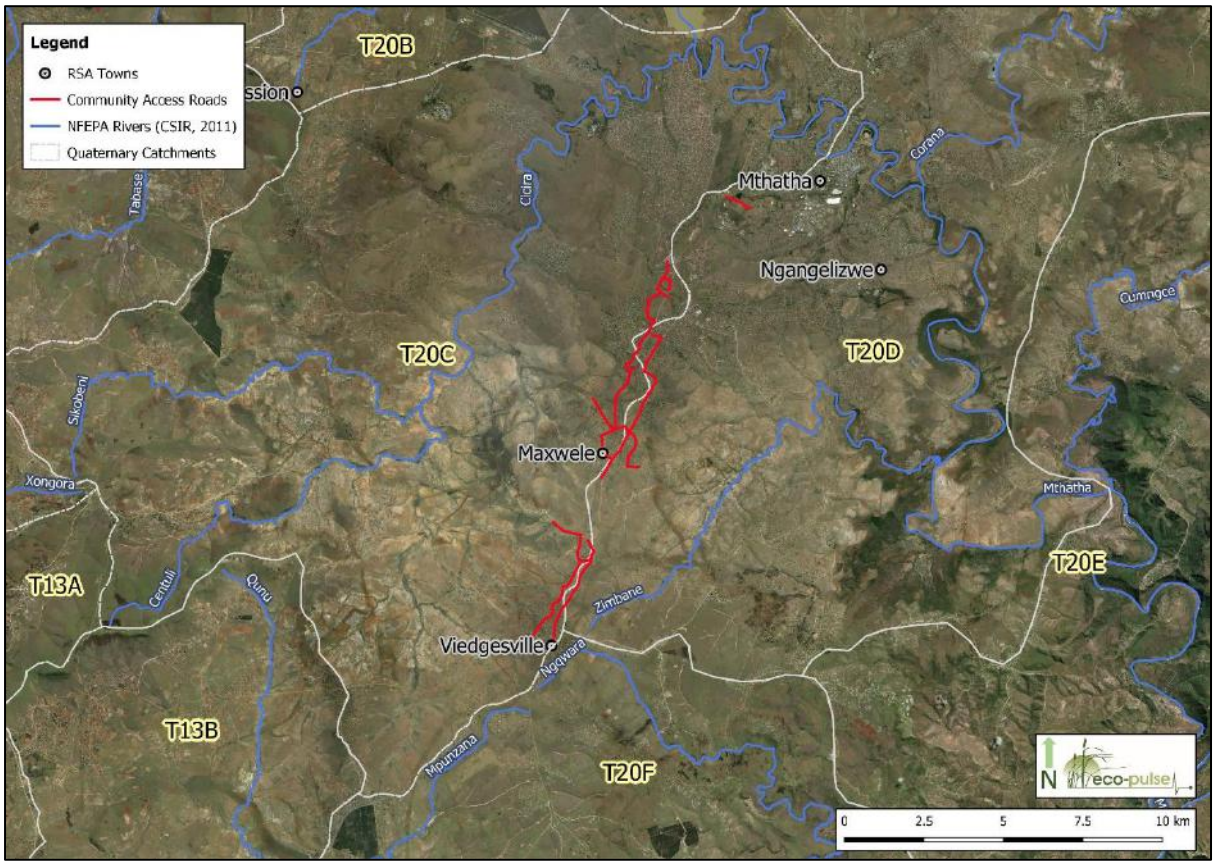


Figure 1 Proposed community access roads to be upgraded along the N2 Section 18 between Mthatha and Viedgesville.

The proposed development constitutes a number of listed activities under the National Environmental Management Act (No. 107 of 4998) ('NEMA') that require Environmental Authorization (EA) and constitutes a few water uses under the National Water Act (No. 36 of 1998) ('NWA') that require Water Use authorisation/registration. In response to these requirements, the need for this specialist assessment to inform both the EA and Water Use authorisation/registration was identified. In this regard, Eco-Pulse Environmental Consulting Services was appointed by SLR Consulting, the appointed Environmental Assessment Practitioner (EAP), to undertake a specialist freshwater ecosystem / habitat (rivers and wetlands) impact assessment for the project.

1.2 Scope of work

This report was generated in response to the need to undertake a specialist assessment of water resources potentially impacted by the proposed upgrade of The Municipal Access Roads to The N2 Section 18 Between Mthatha and Viedgesville. The scope of work addressed in this report is briefly summarized below whilst details of the approach and methodology followed are included in Chapter 2.

- Desktop review and consolidation of available information on freshwater ecosystems in the study area.
- Desktop mapping of all watercourses (rivers, streams & wetlands) within a 500m radius of the proposed activities.
- Undertaking a site visit to delineate and assess the freshwater ecosystems. Due to the nature of the project, with a considerable number of existing watercourse crossings and watercourses being in close proximity to the proposed upgrade activities, as well as indirect impacts of the road operation already being realized, detailed delineation was focused on those watercourses to be directly impacted by the developments. Desktop delineation with some infield verification was undertaken for the remaining areas within 32m of the proposed activities. The freshwater habitats were delineated according to the methods contained in the manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
- Rapid assessment of the Present Ecological State (PES) of the river and wetland units based on professional opinion with substantiation and onsite observations of the study area only. No formal assessments using available PES tools / methods were used, although the rapid assessment was used and the frameworks of available PES assessment methods. Health scores for each of the key ecosystem components were rated i.e. hydrology, geomorphology, vegetation, water quality.
- Rapid assessment of the Importance and Sensitivity of the delineated river and wetland units based on professional opinion with substantiation and onsite observations of the study area only. No formal assessments using available Ecological Importance & Sensitivity (EIS) and functional assessment tools / methods were used, although the rapid assessment was used and the frameworks of available assessment methods. Ratings were provided for:
    a) biodiversity importance based on habitats and species of conservation concern; and
    b) functional importance based on HGM type and hydrological condition.
- An EIS map was prepared to assist in evaluating the alternative alignment and project design options and an opinion on the preferred options from a wetland management perspective has been outlined as part of the reporting process.
- Project design recommendations related to road alignments, interchange alignments, road watercourse crossing designs and road stormwater designs have been prepared to inform layout planning and finalization prior to impact assessment.

- Furthermore, given that the nature of the project is linear, with a large number of crossings, and the project involves the upgrade of existing roads, rapid visual habitat assessments were considered satisfactory in this case.
- Identification, description and assessment of the potential impacts of the proposed activity on onsite and local freshwater ecosystems. Please note, that the predicted change in the state and level of ecosystem services provided by the delineated freshwater habitats was qualitatively described based on professional opinion and not using formal post-development assessment tools.
- A DWS Risk assessment was undertaken to inform the need for a General Authorisation with regards to Section 21 (c) and (i) water uses.
- Construction and operational impact mitigation / recommendations to avoid and minimise direct and indirect impacts have been provided and can be easily integrated into the Environmental Management Programme (EMPr).
- A conceptual rehabilitation and management plan / strategy for freshwater ecosystems has been compiled.
- Where relevant, a brief discussion of the need for wetland offsets has been provided.
- An opinion on the legislative requirements of the proposed activities in terms of all environmental and water legislation has been included.

1.3 Project team

Details of project team members involved in the project are indicated below in Table 1:

Table 1. Details of team members.

Specialist	Role	Details
Ryan Kok *Pr.Sci.Nat.* Scientist & Ecologist	Project leader, Author & fieldwork	Ryan holds a BSc degree in Environmental Science; BSc Honours and MSc degree in Biological & Ecological Sciences. His MSc thesis focused primarily on the impacts of climate change and human land use on the species distribution of Malagasy bats (past-present-future). Ryan has 7 years' experience in GIS and environmental modelling, with extensive field experience in monitoring and analysing data. Since being part of Eco-Pulse Ryan has utilized his GIS skills in Environmental Management Frameworks, Wetland Inventories and Prioritization Assessments for major Municipalities. Ryan also has experience in wetland and riparian delineations, functional and impact assessments. He has also been involved in numerous freshwater ecosystem assessments and has experience in the compilation and management of Water Use Licence Applications.
Adam Teixeira-Leite *Pr.Sci.Nat.* Principal Scientist & Ecologist	Technical Support	Adam is a Principal Scientist and Wetland / Aquatic Ecologist at Eco-Pulse with a BSc. Honours degree in *Environmental Science: Earth Sciences*, research Msc (Water & Environmental Management: *in prep)*. He is a registered Professional Natural Scientist (Pr. Sci. Nat.) with >12 years' experience, having worked extensively on numerous specialist ecological assessment projects, both for wetland/aquatic and terrestrial (grasslands and forests) habitats and ecosystems in KZN, the Free State, Gauteng, Eastern Cape, Western Cape, Lesotho and Mozambique. He is also experienced in undertaking alien plant surveys and developing ecological rehabilitation and management plans, ecological monitoring programmes and biodiversity offset plans.
Juliette Lagesse Junior Scientist	Fieldwork	Juliette Lagesse is a Junior Environmental Scientist at Eco-Pulse with a BSc degree in Environmental Science; BSc Honours and MSc degree in Geography. Her MSc thesis focused primarily on gully erosion as a mechanism for wetland formation. Juliette is currently involved in wetland delineation, background research and undertaking wetland and terrestrial assessments.

1.4 Introduction to Wetlands and Rivers

1.4.1 Key Definitions and Concepts

An ecosystem is a group of plants, animals and other organisms interacting with each other and with non-living (abiotic) components of their environment. Ecosystems can be classified broadly into terrestrial and aquatic ecosystems. Terrestrial ecosystems occur on land where water is a limiting factor, whereas aquatic ecosystems occur within landforms that are permanently or periodically inundated with flowing or standing water (Ollis *et al*., 2013). Freshwater ecosystems are a subset of the Earth's aquatic ecosystems and include all inland freshwater rivers, streams, wetlands, lakes, ponds and springs. This broad range of freshwater ecosystem types contains a multitude of habitats of varying ecological complexity and diversity (Wrona *et al*., 2016). Wetlands, streams and rivers fall under the umbrella term of 'freshwater ecosystems'.

Under Section 1(1)(xxiv) of the National Water Act (Act No. 36 of 1998) (NWA), 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 to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

This assessment focusses on the assessment of all natural watercourses and their associated habitats / ecosystems likely to be measurably affected by the proposed development, focussing specifically on wetlands, streams and rivers. For the purposes of this assessment, wetlands, streams and rivers are defined as follows:

- **Wetlands** are areas that have water on the surface or within the root zone for extended periods throughout the year such that anaerobic soil conditions develop which favour the growth and regeneration of hydrophytic vegetation (plants which are adapted to saturated and anaerobic soil conditions). In terms of Section 1 of the NWA, wetlands are legally defined as: (1) "…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."
- **Rivers and streams** are natural channels that are permanent, seasonal or temporary conduits of freshwater. In terms of ecological habitats, rivers and streams comprise in-stream aquatic habitat and riparian habitat. Generally, riparian zones mark the outer edge of stream and river systems. Streams and rivers are differentiated in terms of channel dimensions and generally fall within the broad category of rivers / riverine ecosystems in this report.
- **Instream habitat** is the aquatic habitat (or alluvial in the case of intermittent / ephemeral watercourses) within the active channel that includes the water column, river bed and the

inundated active channel margins, and associated vegetation. In terms of Section 1 of the NWA, instream habitat is legally defined as habitat that includes "…the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse."

- A **riparian zone** is a habitat, comprising bare soil, rock and/or vegetation that is: (i) associated with a watercourse; (ii) commonly characterised by alluvial soils; and (iii) inundated or flooded to an extent and with a frequency sufficient to support vegetation species with a composition and physical structure distinct from those of adjacent land areas (DWAF, 2005). In terms of Section 1 of the NWA, riparian habitat is legally defined as: 'habitat that "…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."

1.4.2 Importance of Freshwater Ecosystems

Freshwater ecosystems provide a wide range of ecosystem goods and services critical to human development, referred to as ecosystem services, and are increasingly being recognised as critical ecological infrastructure in the landscape. Ecosystem services are the benefits that people, society and the economy receive from nature (Russi *et al*., 2013). Key ecosystem services and benefits provided by freshwater ecosystems include:

- Firstly, freshwater ecosystems are conduits, regulators, filters and ultimately suppliers of freshwater water. South Africa is a water-stressed country whose socio-economic development places enormous pressure on water resources. With predicted population growth and associated urban and agricultural expansion, in conjunction with the predicted effects of climate change, pressure on water resources is going to continue to increase, and with this the value of water resources and the ecosystems that sustain them. The proper protection and management of water resources associated with and provided by freshwater ecosystems is thus critical to all current and future levels of human development. Wetlands in particular are known to provide important regulating services to society in support of water resource management, namely streamflow regulation, water quality enhancement services and carbon storage / sequestration services.
- Secondly, being conduits, regulators and filters of freshwater water, freshwater ecosystems provide key streamflow regulation services that contribute to disaster risk management and climate change reliance / adaptation e.g. reducing the impact of floods and droughts. Linked to climate resilience and adaptation, permanently and seasonally saturated wetlands are also known to provide relatively high levels of carbon storage / sequestration benefits, which is important considering the global need to reduce the amount of carbon dioxide in the atmosphere.
- Thirdly, freshwater ecosystems provide critical habitat for aquatic and wetland specific species uniquely adapted to take advantage and thrive in such conditions. Being spatially and geographically restricted ecosystem types associated with particular and varied hydro-geomorphic landforms, and with South Africa having a high level of climate variability,

freshwater ecosystems typically support a comparatively large number of rare and endemic species, and in some circumstances can support uniquely large populations of resident and migratory animals like birds, a phenomenon that is linked to their high productivity and refuge value.

- Fourthly, freshwater ecosystems provide a number of direct goods to communities (provisioning services), particularly rural and/or un-serviced communities that often relay directly on freshwater ecosystems for meeting basic human needs and supporting livelihoods[2]. Typical ecosystem goods capitalized on in South Africa include: (i) the supply of fresh water for domestic and agricultural uses; (ii) harvestable resources for food, combustion (cooking and heating), building materials, medicinal materials and crafts for exchange; and (iii) cultivated food and grazing benefits, especially in arid regions. These direct goods and services can be life-saving 'safety nets' in arid and semiarid regions, often being the only source of water and food in the dry season.
- Fifthly, freshwater ecosystems can also deliver significant non-material benefits. In South Africa, rivers and wetlands are recognized as having cultural significance for an array of different local cultures. Rivers and wetlands not only provide several culturally significant plants species (for medicine, food and craft) significant for cultural ceremonies but they also act as places of special cultural significance in of themselves (e.g. where baptisms or cleansing ceremonies take place). Rivers and wetlands also have value as sites for tourism and recreation as they are generally visually appealing and usually have an abundance of wildlife. In urban settings in particular, the preservation of river and wetland corridors can improve the aesthetics and amenity value of urban areas and contribute to improving the livability of urban spaces.

1.4.3 The State of Freshwater Ecosystems in South Africa

South Africa's freshwater ecosystems are diverse, ranging from subtropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the Western Cape. South Africa's freshwater ecosystems have been mapped and classified into National Freshwater Ecosystem Priority Areas (NFEPAs). This work shows that 60% of our river ecosystems are threatened and 23% are critically endangered. The situation for wetlands is even worse: 65% of our wetland types are threatened, and 48% are critically endangered (Driver et al., 2011*)*. Recent studies reveal that less than one third of South Africa's main rivers are considered to be in an ecologically 'natural' state, with the principal threat to freshwater systems being human activities, including river regulation, followed by catchment transformation (Rivers-Moore & Goodman, 2009). South Africa's freshwater fauna also display high levels of threat: at least one third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fish, molluscs, dragonflies, crabs and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region (Darwall *et al*., 2009).

[2] "A person's livelihood refers to their "means of securing the basic necessities -food, water, shelter and clothing- of life". Livelihood is defined as a set of activities, involving securing water, food, fodder, medicine, shelter, clothing and the capacity to acquire above necessities working either individually or as a group by using endowments (both human and material) for meeting the requirements of the self and his/her household on a sustainable basis with dignity." (Wikipedia - https://en.wikipedia.org/wiki/Livelihood)

Clearly, urgent attention is required to ensure that representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations to come. The degradation of South African rivers and wetlands s is a concern now recognized by Government as requiring urgent action and the protection of freshwater resources, including rivers and wetlands, is considered fundamental to the sustainable management of South Africa's water resources in the context of the development of the country.

1.5 Relevant Environmental Legislation related to Freshwater Ecosystems

Rivers and wetlands as ecosystem types are not formally protected by law but their alteration is regulated by the water use licensing process of the National Water Act (No. 36 of 1998) ('NWA'), the environmental authorization process of the National Environmental Management Act (No. 107 of 1998) ('NEMA') and the regulated activity permission process of the Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA'). The reader is referred to **Annexure A** of this report for further details on the legislation relevant to wetlands and rivers in South Africa.

2 APPROACH AND METHODOLOGY FOLLOWED

2.1 Approach to the Assessment

The approach to the assessment involved four phases:

1. Desktop assessment, including:

- Review of the freshwater ecosystem and conservation setting of the project area using available spatial datasets (see Table 2, below) in a Geographical Information System (GIS).
- Mapping of all aquatic ecosystems (wetlands and rivers) within 500m of the road footprint using aerial photography, 5m contours and available spatial datasets (see Table 2, below) in a Geographical Information System (GIS).
- Flagging of aquatic (river and wetland) ecosystems for field verification/delineation based on potential impact and sensitivity of the receiving environment.

2. Baseline assessment, including field verification of:

- The location and extent of wetland and riparian habitat;
- Condition of wetland and river ecosystems; and
- Ecological importance and sensitivity (including the level of supply of ecosystem services).

3. The identification, description and assessment of potential impacts, including an assessment of potential ecological impacts was undertaken based on the development information and informed by an understanding of the sensitivity of the receiving environment.

4. Recommendations for mitigation: management and mitigation recommendations were compiled to assist with addressing the range of impacts identified and other ecological concerns related to project activities, these include:

- Project design mitigation measures
- Generic construction and operation mitigation measures
- Specific construction and operation mitigation measures
- Monitoring and implementation requirements
- The need and desirability for offsets

2.2 Data Sources Consulted

The following data sources and GIS spatial information provided in Table 2 below was consulted to inform the freshwater ecosystem assessment. The data type, relevance to the project and source of the information has been provided.

Table 2. Information and data coverages used to inform the aquatic assessment.

	DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Biophysical Context	**2009 Colour aerial photography**	*Desktop mapping of wetlands*	National Geo-Spatial Information (NGI)
	Latest Google Earth ™ imagery	*To supplement available aerial photography where needed*	Google Earth™ On-line
	Proposed road infrastructure GIS coverage	*Shows location and layout of the proposed water pipeline*	Client
	5m Elevation Contours	*To assist with desktop mapping of wetlands*	Surveyor General
	DWA Eco-regions	*Classification of ecoregions*	DWA (2005)
	Geology	*Assessment of underlying geology controlling soil formation and aspects of wetland/river geomorphology*	1: 1000 000 Geological Map of South Africa (Council for Geosciences)
	South African Vegetation Map (GIS Coverage)	*Classify vegetation types and understand threat status*	Mucina & Rutherford (2006)
	Geomorphological Provinces of South Africa	*Understand regional geomorphology controlling the physical environment*	Partridge *et al.* (2010)
Conservation Context	**NFEPA rivers and wetlands coverage**	*Shows location of FEPA river and wetland sites*	CSIR (2011)
	Freshwater Systematic Conservation Plan for the Eastern Cape	*Used to identify and interrogate aquatic biodiversity concerns at a desktop level*	Berliner & Desmet (2007)
	National Land cover 2014	*Used to identify land use in the broader area*	SANBI BGIS
	Desktop PES/EIS of rivers	*Used as a basis for PES/EIS assessments of large rivers*	DWA (2014)
	Threatened Ecosystems	*Location and extent of threatened ecosystems*	SANBI (2011)
	Protected Areas and Protected Areas Expansion Strategy	*Location and extent of existing Protected Areas and focal areas for expansion*	DEA

2.3 Methods Used

A brief summary of the methods used in this assessment has been included below. For further details on the individual assessment methods applied in this study, refer to **Annexure B** at the back of this report.

2.3.1 Desktop mapping and classification of water resources

This involved detailed mapping and preliminary classification of all freshwater ecosystems (river and wetlands) within a 500m buffer of the proposed route alignment. See **Annexure B1** for the detailed methodology followed.

2.3.2 Flagging of water resources to inform field assessments

Due to the scale of the assessment area and number of aquatic resources, a flagging process was adopted in order to direct field efforts and prioritise areas for detailed field delineation and PES/EIS assessments. Water resources were assessed based on their classification, impact potential (proximity and vulnerability to development activities) and the sensitivity of the receiving environment (based on a desktop PES rating and available conservation datasets). Table 3 below describes the various' 'Flags' assigned to water resources and indicates the level of field assessment required. See ***Annexure A1*** for the detailed methodology followed.

Table 3. Flags assigned to water resources.

FLAG STATUS SYMBOL IN GIS		FLAG STATUS DESCRIPTION	LEVEL OF FIELD ASSESSMENT
	"Green" Flag	Given the status of the receiving environment and the nature or proximity of the proposed activity, the potential impacts on the receiving system are negligible. Collection of basic site-level information should be collected where feasible to improve desktop information.	Largely desktop with very limited field verification
	"Orange" Flag	Given the status of the receiving environment and/or the nature or proximity of the proposed activity, the potential impacts on the receiving system are likely to be limited. Impacts within these areas are likely to be successfully mitigated through the application of generic mitigation measures. **Limited field verification should be undertaken to verify desktop information (including delineation) and to collect site-specific information to inform the PES & EIS assessments where possible.**	Largely desktop with some field verification where accessibility allows
	"Red" Flag	Given the status of the receiving environment and/or the nature or proximity of the proposed activity, the potential impacts are likely to be significant and generic mitigation measures may not be sufficient. Such areas **require further specialist investigation to determine the extent of features that will be impacted, to collect more detailed information on PES/EIS and to identify potential site-specific options for mitigation**.	Desktop assessment and mapping refined through onsite delineation and assessment where accessibility allows.

2.3.3 Wetland and riparian area delineation

The outer boundary of wetlands and riparian areas occurring within the study area was identified and delineated according to the Department of Water Affairs wetland delineation manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (*DWAF, 2005a). Three specific wetland indicators were used: terrain unit indicator, vegetation indicator and soil wetness indicator and three specific riparian indicators were used: topography, vegetation and alluvial soil and deposited material. The level of field sampling was tailored according to the desktop flag status and the accessibility of sites. A GPS (Global Positioning System) was used to capture the location of sampling points used to inform the delineation while additional information on plant and soil indicators was also captured (see ***Annexure B2*** for more details on the delineation methodology followed).

2.3.4 Classification of wetlands and channels

For the purposes of this study, wetlands were classified according to HGM (hydro geomorphic) type (Level 4A classification level) using the National Wetland Classification System which was developed for the South African National Biodiversity Institute (SANBI, 2009) (see **Annexure B3** for further details). Additional information was also captured on the dominant vegetation communities present within each wetland system. Rivers (channels) were classified according to the size of channels and nature of flows through these systems (see **Annexure B4** for further details).

2.3.5 Wetland assessments

Whilst a detailed assessment of wetland PES, functionality and EIS using tools such as WET-Health (Macfarlane *et al.* 2008) and WET-Ecoservices (Kotze *et.al.* 2007) would be ideal, these tools are too cumbersome for an assessment of this nature where numerous small wetlands, with typically small

catchments and similar characteristics need to be assessed. The following streamlined approach was therefore applied to assess wetlands along the route:

- **Assessment of Present Ecological State (PES):**

This assessment was based on the principles contained in the WET-Health but relied on expert judgment rather than the collection of detailed quantitative data. This information was captured in a GIS database for ease of data storage and interpretation. Refer to **Annexure B5** for further details.

- **Ecological Importance and Sensitivity (EIS) Assessment:**

This was based on the principles of WET-Ecoservices (Kotze et.al. 2007) and the EIS (Ecological Importance and Sensitivity) assessment tools (Rountree & Kotze, 2013). The EIS assessment of wetland resources will involve subjectively assessing (1) ecological importance, (2) hydrological/functional importance and (3) importance for direct human benefits. The final EIS was then determined based on the maximum score obtained for each of the different values assessed. Refer to **Annexure B6** for further details.

2.3.6 *Setting of management objectives for water resources*

This was informed by the management objective for the water resource which, in the absence of classification, is typically based on the Present Ecological State (PES) and the Ecological Importance and Sensitivity (EIS) of the water resource (DWAF, 2007). Further details of the method used are included in ***Annexure B7.***

2.3.7 *Assessment of ecological impacts and impact significance*

Impacts are best grouped into distinct impact pathways that roughly align with different impact-causing activities. In this regard, freshwater ecosystem impacts can typically be grouped into the following five (5) broad groups or categories:

1. **Direct transformation and modification of habitat**: This refers to any human activities that result in the direct physical destruction and/or disturbance of freshwater habitat and associated biota. Such impacts may be attributed to a range of activities including vegetation / habitat clearing (stripping / grubbing), earthworks (i.e. excavation and infilling) and deep flooding by impoundments.
2. **Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities within the watercourse:** This group of impacts refers specifically to all of the indirect impacts resulting from and associated with undertaking human activities within the watercourse that alter hydrological and geomorphological processes. This includes activities such as clearing, earthworks and cultivation that alter sediment dynamics, and the establishment of drains, diversions or impoundments that affect flow dynamics.
3. **Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of the watercourse:** This group of impacts refers to all of the indirect impacts resulting from and associated with human activities within close proximity to the watercourse

and the broader catchment that alter hydrological and geomorphological processes. This includes disturbance, modification and transformation of landcover characteristics (e.g. earthworks, surface hardening, alien plant encroachment, plantations) that alters the quantity and pattern of catchment runoff and sediment inputs. Also included are activities involving flow regulation, abstraction and augmentation (e.g. upstream dams, abstraction, discharge of treated waste water / effluent, mine water discharges & acid mine drainage).

4. **Water pollution impacts**: This impact refers to the alteration or deterioration in the physical, chemical and biological characteristics of water within watercourses and the associated ecological impacts resulting from human activities. In the context of this impact assessment, water quality is assessed in relation to changes to its fitness for use (e.g. for domestic, recreational or agricultural purposes) and ability to maintain the health of aquatic ecosystems. This impact includes a full spectrum of activities ranging from direct inputs (e.g. spillages / point source discharges) through to diffuse source inputs from landuse activities that affects the quality of water entering watercourses (e.g. hazardous substances handling, storage & transport; urban stormwater management; irrigation return flows and acid mine drainage).
5. **Habitat fragmentation, connectivity and disturbance impacts**: This impact refers to the alteration of ecological processes resulting from the transformation of land and disturbance within and/or surrounding a watercourse. Key ecological processes of relevance in this regard include edge effects and changes in connectivity as well as indirect (e.g. light & noise) and direct disturbance (e.g. human activities) that can affect habitat quality and the viability and persistence of biotic communities.

The significance of each impact group was assessed using an impact assessment method developed by Eco-Pulse. In this method the predicted changes in the state / condition of, and ecosystems services provided by, the relevant freshwater ecosystem units was interpreted in terms of the ultimate consequences or end-point impacts to resources of known societal value. In line with the National Wetland Offset Guidelines (SANBI & DWS, 2014), the freshwater resources against which each impact types was assessed included:

(i) **Impacts to water resource supply and quality**: This addresses impacts to the quantity and quality of water provided by water resources. Such impacts may be the result of more direct impacts like abstraction, regulation and/or return discharges, and/or the result of freshwater ecosystem loss or degradation that affects the ability of watercourses to provide supporting regulating and supporting services.

(ii) **Impacts to ecosystem and habitat conservation (ecosystem biodiversity):** This deals specifically with impacts to quality and condition of habitat and the ability to meet conservation targets for freshwater ecosystems. This therefore accounts for the loss or change in freshwater habitat, which is particularly important for highly threatened ecosystem types.

(iii) **Impacts to species of conservation concern (species biodiversity)**: This addresses impacts on freshwater biota, with a particular emphasis on species or populations of conservation concern and the ability to meet species conservation targets.

(iv) **Impacts to local communities**: This deals with impacts to local communities reliant on freshwater ecosystem goods and services, specifically impacts to provisioning (e.g. water supply & cultivated foods) and cultural services (e.g. cultural significance or recreational values) of direct value to local users and consequences for human health, safety and livelihood support.

The approach to impact conceptualisation is depicted by the diagram in Figure 2, below.

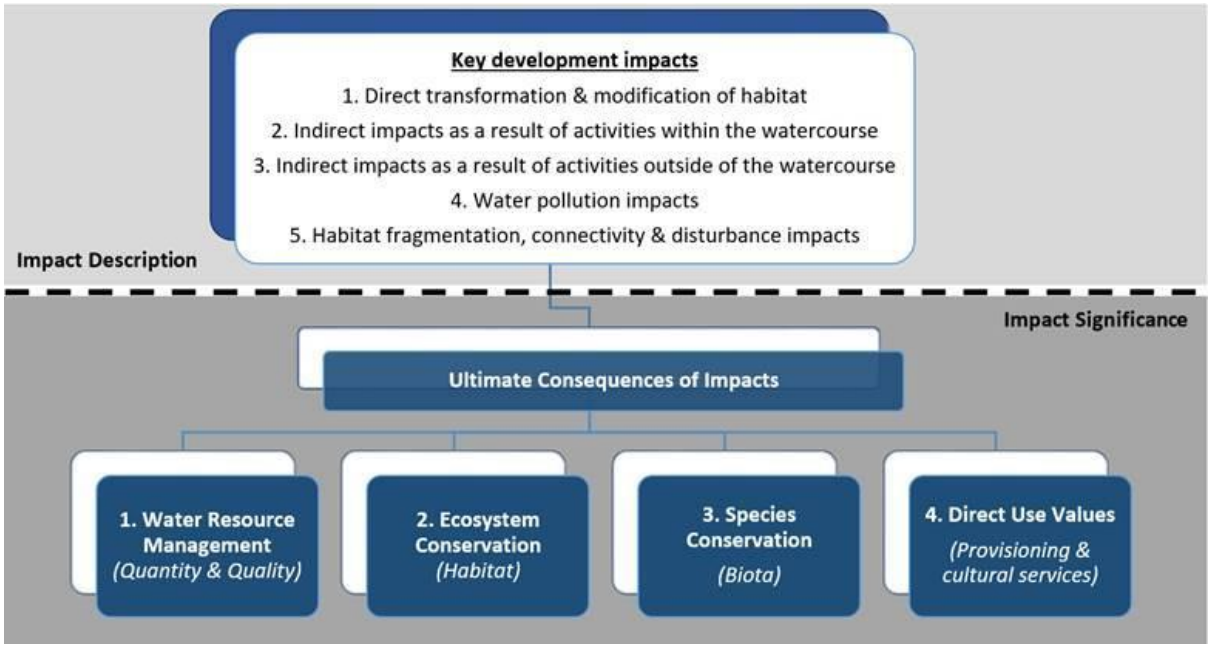


Figure 2 Diagram illustrating how the impact assessment framework is conceptualized.

Please note that due to the rapid nature of this study, impacts were only assessed in terms of the overall impacts to ecosystems and habitats (PES and EIS) and associated water resource management and ecosystem conservation objectives. The significance in terms of impacts to specific floral and faunal species of conservation and specific social impacts was not assessed as these aspects would require focussed botanical, zoological and social scientist input outside of our scope of work. This assessment is not a formal botanical or zoological assessment. Nevertheless, every effort was made to flag species of significance if encountered and flag the need for further studies. It is important to note that floral and faunal biota rescues will likely be required as part of mitigation anyway prior to intact freshwater habitat clearing.

The impact assessment was undertaken for the following mitigation scenarios only:

- **Realistic Poor Mitigation Scenario (or before mitigation)**: This scenario involves the implementation of the development plan and designs that are currently proposed with the associated poor implementation of standard construction and operational phase mitigation measures. In terms of implementation success, this scenario assumes a realistic / likely poor implementation scenario based on the author's experience with such developments. It is

important to note that it is our experience in similar development settings that contractor compliance with construction Environmental Management Programmes (EMPr) is poor and that operational maintenance is poor.

- **Realistic Good Mitigation Scenario (or after mitigation)**: This scenario involves the implementation of the development plan and designs that are currently proposed with the associated implementation of the construction and operational phase mitigation measure recommended by the author. In terms of implementation success, this scenario assumes a realistic best case scenario for implementation based on the author's experience with such developments.

A comprehensive description of the impact significance assessment method employed (Eco-Pulse, 2015) is included in **Annexure B8.**

2.3.8 Risk Assessment

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorisation of Section 21(c3) and 21(i4) water uses, key among which is that only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
- Use of water within the 'regulated area'[5] of a watercourse where the Risk Class is **Medium or High.**
- Where any other water use as defined in Section 21 of the NWA must be applied for.
- Where storage of water results from Section 21 (c) and/or (i) water use.
- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 (c) and (i) water use Risk Assessment Protocol') was applied to the proposed project. The tool uses the following approach to calculating risk:

[3] 21(c): Impeding or diverting the flow of water in a watercourse
[4] 21(i): Altering the bed, banks, course or characteristics of a watercourse
[5] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

i. The outer edge of the 1:100 yr flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.
ii. In the absence of a determined 1:100 yr flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).
iii. A 500m radius from the delineated boundary of any wetland or pan.

RISK = CONSEQUENCE X LIKELIHOOD

whereby:

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

At the WULA pre-application meeting for the project the DWS confirmed that a General Authorization in terms of Section 39 of the NWA would be applicable to the project irrespective of the risk posed by the proposed activities. Nevertheless, a risk assessment using the DWS risk matrix was still undertaken as per the DWS' requirements.

The key risk stressors[6] associated with each of the five (5) impact groups / types considered were:

1. Direct transformation and modification of habitat – **Physical disturbance**
2. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities within the watercourse – **Erosive surface runoff, sediment and increased and/or reduced water inputs**
3. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of the watercourse – **Erosive surface runoff, sediment and increased and/or reduced water inputs**
4. Water pollution impacts – **Chemical, organic and biological pollutants**
5. Habitat fragmentation, connectivity and disturbance impacts – **Alien invasive plants, noise pollution, dust pollution**

For each of the above stressors, risk was assessed qualitatively using the DWS risk matrix tool.

It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses was used to inform WUL requirements for the proposed development.

2.3.9 *Identification of mitigation measures*

Specialist working knowledge, best practice guidelines, available literature, consulting engineers and experience with other similar projects were used in compiling the recommended mitigation measures for this project **(*Annexure B9*).** Mitigation measures were recommended for the planning design, construction and operational phases of the project. It is important to note that the project design recommendations were provided to the EAP upfront for consideration of the project team. The layout plan was finalised thereafter. Construction and operational mitigation measures were then identified based on the final project design.

[6] A stressor is any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact (USA EPA - https://www.epa.gov/risk/about-risk-assessment#whatisrisk).

2.4 Assumptions and Limitations

The following limitations and assumptions apply to the study undertaken for this report:

Sampling:

- For the purposes of this assessment, only those watercourses that stand to be measurably negatively affected, which was assumed to be all watercourses located within the road footprint, road servitude, within 32m upslope or upstream of the road footprint, and within 50m downslope or downstream of the road footprint.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area. Considering the scale and nature of the project and the time constraints, sampling intensity was typically low and essentially involved the field verification of desktop analysis.
- Soil wetness indicators (i.e. soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas.
- The accuracy of the delineations are based solely on the recording of the onsite wetland indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points and therefore water resource boundaries, and an error of 1-5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin Montana™ Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Furthermore, only dominant and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- Although every effort was made to correctly identify the plant species encountered onsite, wetland plants, particularly the Cyperaceae (sedge) family, are notoriously difficult to identify to species level. Every effort was made to accurately identify plants species but where identification to species level could not be determined, such species were only identified to genus level.
- Seasonality can also influence the species of flora encountered at the site, with the flowering time of many species often posing a challenge in species identification. Since the wetland vegetation in the study area was found to be largely secondary/degraded with low native plant diversity, seasonality would not be as significant a limitation when compared with a vegetation community that is largely natural or high in native plant diversity.
- The location of the study area inland within the Eastern Cape province means that climate may have an effect on aquatic ecosystems and vegetation characteristics; as typical temperate inland systems are exposed to more extreme variations in temperatures between seasons. Thus, vegetation response, species structure and composition may vary between seasons.
- Due to the scale of the study area with a large network of freshwater ecosystems and drainage lines, field delineation focused on areas where the proposed road infrastructure either crossed or came in close proximity to wetlands and rivers. The broader network of wetland and rivers were

delineated largely at a desktop level (low confidence) using field data that was extrapolated to the broader areas as well as digital imagery and available topographic/contour data for the region.

- The classification of wetlands into HGM (Hydro-Geomorphic) units was based on dominant HGM type, as often wetland systems comprised a number of HGM units and it was not practically feasible to apportion all wetlands given the scale of the project area. In such instances it was up to the assessor to assign a dominant HGM type which was often influenced by the section of the wetland assessed (that closest to potential road impacts).

PES, EIS and Functional Assessments:

- The assessment of wetland condition was based on principles contained in the WET-HealthV2 tool (Macfarlane *et al.* 2020) but did not entail undertaking detailed assessments of wetland Present Ecological State (PES). Due to the rapid nature of theses assessments and the scale of the project area, the accuracy of these assessments is somewhat limited.
- The rating of Ecological importance was based on the principles of WET-EcoservicesV2 (Kotze *et.al.* 2020) and the EIS (Ecological Importance and Sensitivity) assessment tools (Rountree & Kotze, 2013), rather than detailed assessments. Due to the rapid nature of theses assessments and the scale of the project area, the broader accuracy of these assessments is somewhat limited.

Impact Assessment:

- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field surveys and based on the assessor's working knowledge and experience with similar projects as well as engineering input and available literature.
- Please note that due to the rapid nature of this study, impacts were only assessed in terms of the overall impacts to ecosystems and habitats (PES and EIS) and associated water resource management and ecosystem conservation objectives. The significance in terms of impacts to specific floral and faunal species of conservation concern and specific social impacts was not assessed as these aspects would require focused botanical, zoological and social scientist input outside of our scope of work. Nevertheless, every effort was made to flag species of significance if encountered and flag the need for further studies. It is important to note that floral and faunal biota rescues will likely be required as part of mitigation anyway prior to intact freshwater habitat clearing.
- The impact descriptions and assessment are based on the author's understanding of the proposed development based on the information provided.
- Evaluation of the significance of impacts with mitigation takes into account mitigation measures provided in this report and standard mitigation measures included in the Environmental Management Programme (EMPr).
- The significance of impacts on estuarine ecosystems was not assessed as part of this freshwater ecosystem assessment.
- The significance of the impact of the proposed river abstractions during the construction phase was not assessed as part of this freshwater ecosystem assessment.

Risk Assessment:

- Risks were assessed for the entire project only and separate risk assessments were undertaken for the most sensitive wetland and riverine ecosystem to be negatively impacted.
- All risk ratings generated by the DWS risk matrix are conditional on the effective implementation of the mitigation measures provided in the specialist freshwater habitat assessment report for the project.
- For the purposes of this study, the term 'stressor[7]' was favoured instead of the term 'aspect' referred to in the DWS risk matrix.
- For the purposes of this study, the criterion 'frequency of stressor occurrence' was favoured instead of the criterion 'frequency of activity' referred to in the DWS risk matrix.
- For the severity ratings, impacts to wetlands were assessed on their merits rather than automatically scoring impacts to wetlands as 'disastrous' as guided in the DWS risk matrix.
- The severity assessment for changes in flow regime and physico-chemical impacts were interpreted in terms of the changes to the local freshwater ecosystem represented by the potentially affected reaches.
- For the scoring of impact duration, the predicted change in PES was also considered which could override the actual duration of the impact where applicable e.g. if the impact duration was long term (typically a score of 4 out of 5) but the predicted change in PES is negligible, the impact duration was down-scored to a score of 2 in line with the duration criteria descriptions in the risk matrix tool.
- The risk of the proposed river abstractions during the construction phase was not assessed as part of this freshwater ecosystem assessment.

Despite the above-mentioned assumptions and limitations, the credibility of this study as a means through which the authorities can make informed decisions on the proposed development is not in any way compromised.

[7] Any physical, chemical or biological entity that can induce an adverse response to the structure and function of an ecosystem (Reference: USEPA (1998). Guidelines for Ecological Risk Assessment; Notice Fed. Reg. 6326846-26924. Environmental Monitoring Systems Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati, Ohio.

3 BACKGROUND TO THE STUDY AREA

3.1 Regional context

3.1.1 Climate

The region is located within the north-eastern part of the Eastern Cape, with altitudes ranging from 500 – 1700 m a.m.s.l. (Kleynhans *et al*., 2005). Most rainfall in the region takes place during the summer months (December to March) and the highest rainfall is typically experienced during March (http://www.saexplorer.co.za/south-africa/climate/). The mean annual precipitation is moderate to moderately-high (between 500mm to 1000mm/annum). High temperatures experienced during the summer season in particular, cause the potential for evaporation to be high across South Africa in general, which plays a significant role in reducing the volume of rainfall available for use by the environment. Average daily temperatures are moderate and range from 19.4 – 25.8^{0}C (http://www.saexplorer.co.za/south-africa/climate/).

3.1.2 Ecoregions

South Africa is a geologically, geomorphologically, climatically and ecologically complex country with a diverse range of ecosystems, including freshwater wetlands and rivers (Kleynhans *et al*., 2005). When investigating the ecology of any area it is important to understand the biophysical drivers that affect the characteristics of water resources in the region. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often not available to guide the assessment at this level. River eco-regional classification or 'typing' allows for the grouping of river systems according to similarities based on a top-down nested hierarchy, the purpose being to simplify and contextualise assessments and statements of aquatic ecological state. One of the advantages of such a system is the extrapolation of information from data rich rivers to data poor rivers within the same hierarchical typing context.

'Ecoregions' are essentially regions within which there is a relative similarity in the mosaic of ecosystems and ecosystem components such as physiography, climate, rainfall, geology and potential natural vegetation (DWAF: Ground Water Dictionary, online). The proposed road route traverses one ecoregion, the South Eastern Uplands ecoregion. A summary of the ecoregion is provided below in Table 4 with its location shown in Figure 3.

Table 4. Table providing a description of the DWA Ecoregion classified for the study area.

Ecoregion (level I)	Ecoregion (level II)	Description
16	16.06	**South Eastern Uplands:** characterized by a complex range of terrain morphological classes including plains with a moderate relief, lowlands with a low to high relief, open hills with low to high relief, closed hills with a moderate relief and low mountains with a high relief. Vegetation types are equally diverse and include a variety of Grassland types, Bushveld types, Thicket types and Afromontane Forest. The most prominent amongst these are Moist Upland Grassland. Drainage density is low-medium with stream frequency being generally low/medium to high.

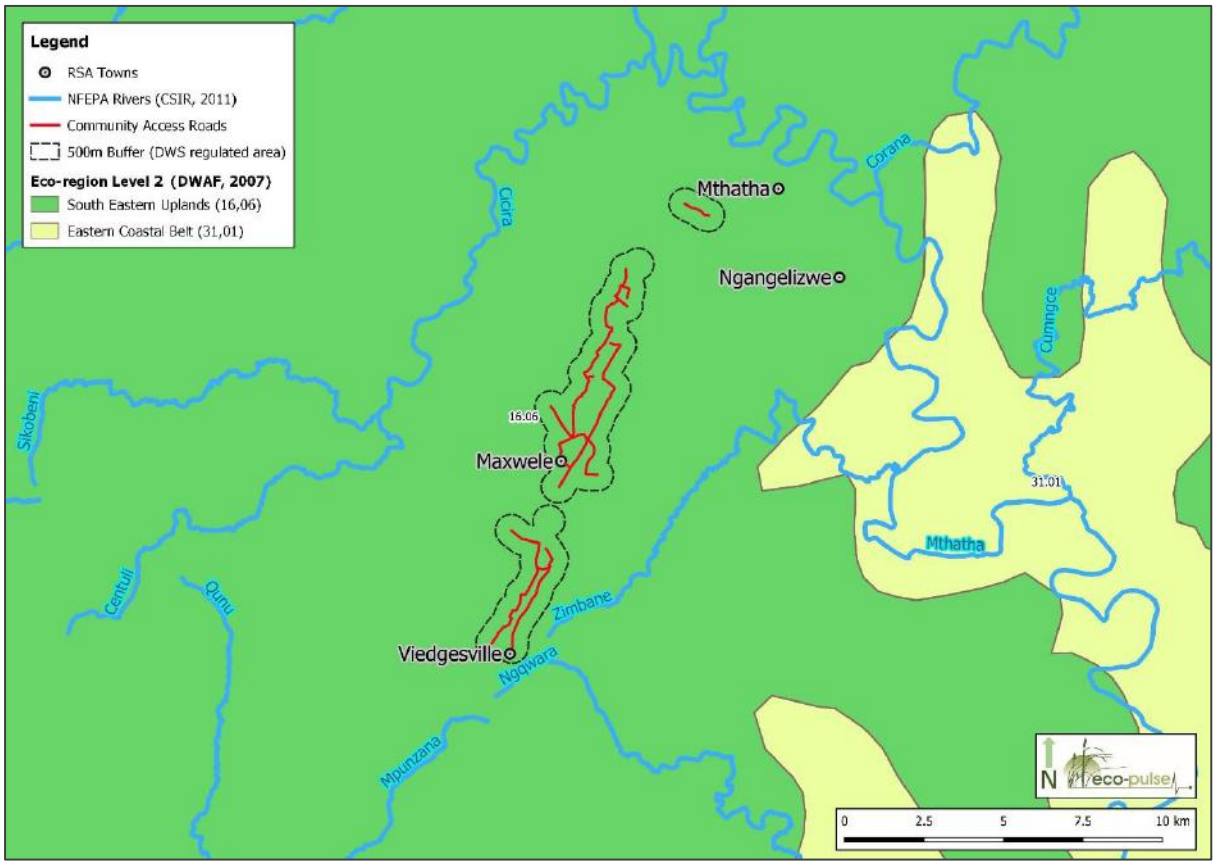


Figure 3 Map indicating the location and extent of Level II Eco-regions relevant to the study area.

3.1.3 Drainage and catchment setting

The study area and associated watercourses are located within DWS Quaternary Catchment T20C and T20D which are drained by the perennial Centuli River (T20C) to the west and the perennial Zimbane and Mthatha River (T20D) to the east, situated in the Mzimvuba – Tsitsikamma Water Management Area (WMA). The Site is drained by both wetlands and ephemeral drainage lines (preferential flow paths) which flow in a westerly direction and join the Centuli River (T20C) located some 6000m east of the road alignment. Whilst both wetlands and ephemeral drainage lines located in T20D flow in an easterly direction into the Zimbane and Mthatha located some 1200m and 3500m east of the road alignment, respectively.

3.1.4 Regional geology and geomorphology

Partridge et al. (2010) recently undertook a physiographic subdivision of South Africa, Swaziland and Lesotho in order to define "geomorphic provinces" (regions of relatively uniform physiography) based on recent work on the geological and geomorphological evolution of the southern African fluvial systems. The study area falls within the South-Eastern Coastal Hinterland geomorphic province, which extends from the Great Kei River in the Eastern Cape to northern Swaziland (Partridge et al., 2010). Nineteen major river systems cross this province, from the Sabie River in the northeast to the Great Kei River in the southwest. Rivers flowing off the Great Escarpment traverse the South-Eastern Coastal Hinterland towards the Indian Ocean in precipitous valleys. An important feature to note about the rivers in this province is that their flow is orthogonal to many valley and ridge features and are consequently transverse to the structural and tectonic grain of the topography. The most significant events that influenced the character of the rivers within this province are the two epeirogenic uplift episodes which took place ~5 Ma and ~20 Ma respectively. These uplift events resulted in widespread asymmetrical arching and steepening of the lower courses of rivers; while marginal reverse warping in the upper reaches of these rivers produced ponding. Thus, most of the rivers in this province are highly incised in their middle and lower reaches.

The South-eastern Coastal Hinterland is underlain mainly by clastic sedimentary rocks that form a platform sequence of sediments deposited in shallow marine to continental shelf environments and include sandstones, shales and quartzite's of Palaeozoic age (300 - 250Ma old). The location of the different lithostratigraphic units (underlying geology) occurring within the general area of study, their extent and the orientation of dolerite dykes is shown in the geological map in Figure 4.

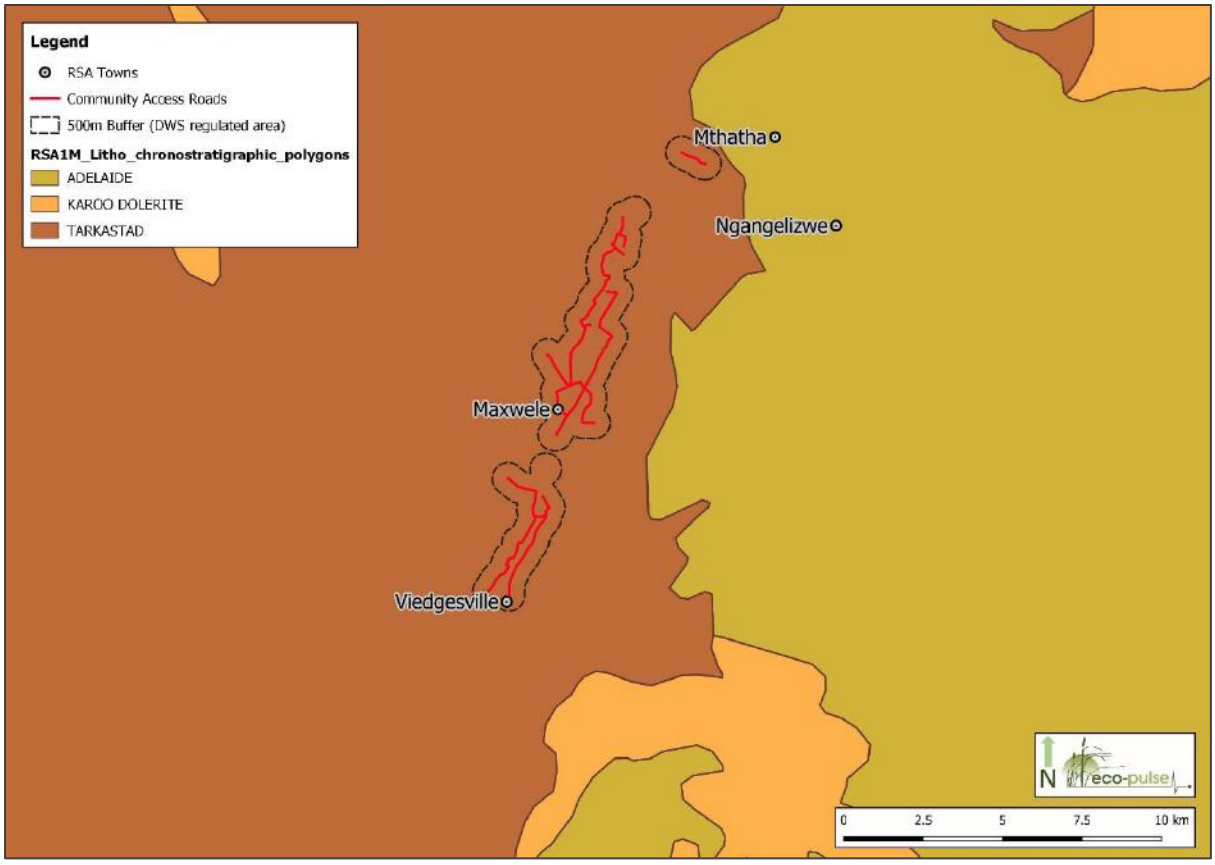


Figure 4 Map showing the regional geology associated with the study area, including different broad lithostratigraphic units and the location of dolerite dykes (Source: 1: 1000 000 Geological Map of South Africa).

3.1.5 Vegetation

The Eastern Cape shows the highest biome diversity of any province, with no less than seven biomes, including Forest, Fynbos, Grassland, Nama Karoo, Savanna, Succulent Karoo and Thicket (Berliner & Desmet, 2007). The study area extends across only one of these biomes: (i) the Grassland biome. Biomes are broad ecological units that represent major life zones extending over large natural areas which are further sub-divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. The project area is located within the Sub-Escarpment Grassland Bioregions (Mucina & Rutherford, 2006).

The vegetation of the region is as described by Mucina and Rutherford (2006) and is summarised in Table 5 (below), with the location and approximate extent of the different vegetation types shown spatially in Figure 5. Mthatha Moist Grassland dominates the vegetation for the area associated with the project.

Table 5. Summary of the different vegetation types occurring in the region and associated with the proposed road development (Mucina & Rutherford, 2006).

Vegetation Type	Threat Status	Protection Status
Mthatha Moist Grassland	Endangered	Hardly Protected

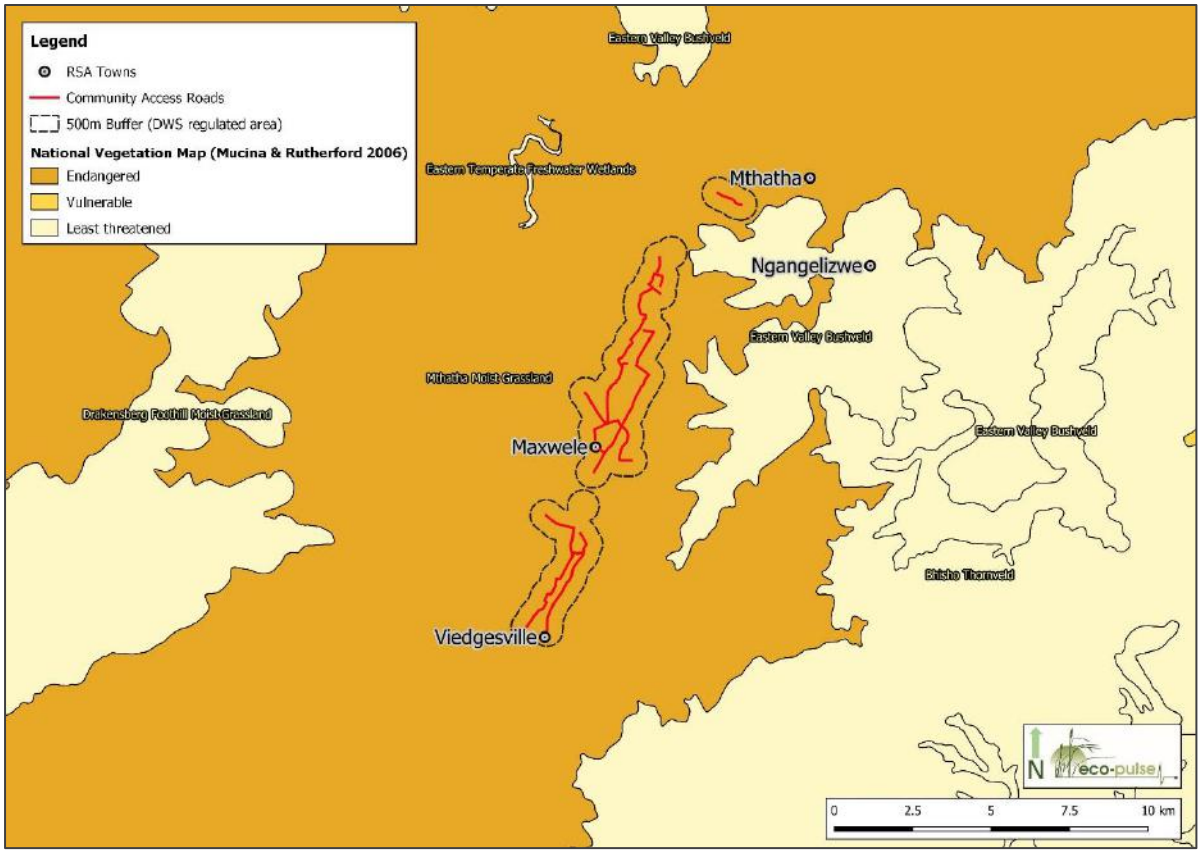


Figure 5 Location and extent of the different broad vegetation types occurring in the region according to Mucina & Rutherford (2006).

3.2 Conservation context

3.2.1 International conservation priorities

Conservation International (CI), a member of the Critical Ecosystem Partnership Fund (CEPF) has identified 34 'hotspots' or regions worldwide where 75% of the planet's most threatened mammals, birds, and amphibians survive within habitat covering just 2.3% of the Earth's surface. They are chosen for their species richness, endemism, taxonomic uniqueness, unusual ecological or evolutionary phenomena, and global rarity (www.CEPF.net). South Africa is one of the few countries to have three global hotspots, each of which overlaps to a greater or lesser degree with the Eastern Cape province, including the Maputaland-Pondoland-Albany hotspot, the Succulent Karoo hotspot and the Cape Floristic Region.

The N2 community access roads along section 18 project area is located within the **Maputaland-Pondoland-Albany hotspot** (Figure 6, below) which stretches along the east coast of southern Africa below the Great Escarpment extending from extreme southern Mozambique (south of the Limpopo River, where it adjuts on the Coastal Forests of the Eastern Africa Hotspot) and Mpumalanga province in South Africa (south of the Olifants River) in the north, through eastern Swaziland to the Eastern Cape Province in the south.

According to the Critical Ecosystem Partnership Fund (CEPF) Ecosystem Profile Summary (CEPF, 2011), the region associated with the Maputaland-Pondoland-Albany hotspot is floristically, climatologically and geologically complex and is an important center of plant endemism. There are at least three clear foci of high endemism and high diversity in the area, the names of which have been amalgamated as the name of this hotspot: Maputaland (Tongaland) in the north, Pondoland further south, and Albany in the southwest. The hotspot's vegetation is comprised mainly of forests, thickets, bushveld and grasslands. About 80 percent of South Africa's remaining forests fall within this hotspot. These warm temperate forests, which are home to nearly 600 tree species, have the highest tree diversity of any of the world's temperate forests and is the second richest floristic region in Africa after the Cape Floristic Region (In total, about 8,100 species of plants from 243 families occur within this hotspot, and nearly a quarter of these are found nowhere else). In addition to its floristic diversity, the region is also important for the following:

- Birds are the most diverse group of vertebrates in the hotspot, with more than 540 regularly occurring species;
- Of the nearly 200 mammal species found in the hotspot, only four are endemic;
- More than 200 reptile species are found in the hotspot, and roughly 30 are endemic;
- All 72 of the hotspot's amphibian species are frogs, eleven of which are endemic (includes 8 threatened species that represent monotypic endemic genera);
- Of the more than 70 freshwater fish species native to the hotspot, about 20 are endemic; and
- The hotspot has an exceptionally rich and diverse invertebrate fauna.

As a result of human impacts, much of the once expansive grasslands and forests of this region face increased threats from urbanisation, industrial activities, afforestation, local farming, illegal wildlife harvesting for medicines and trade, bush encroachment, grazing pressures and invasive alien plants (CEPF, 2011).

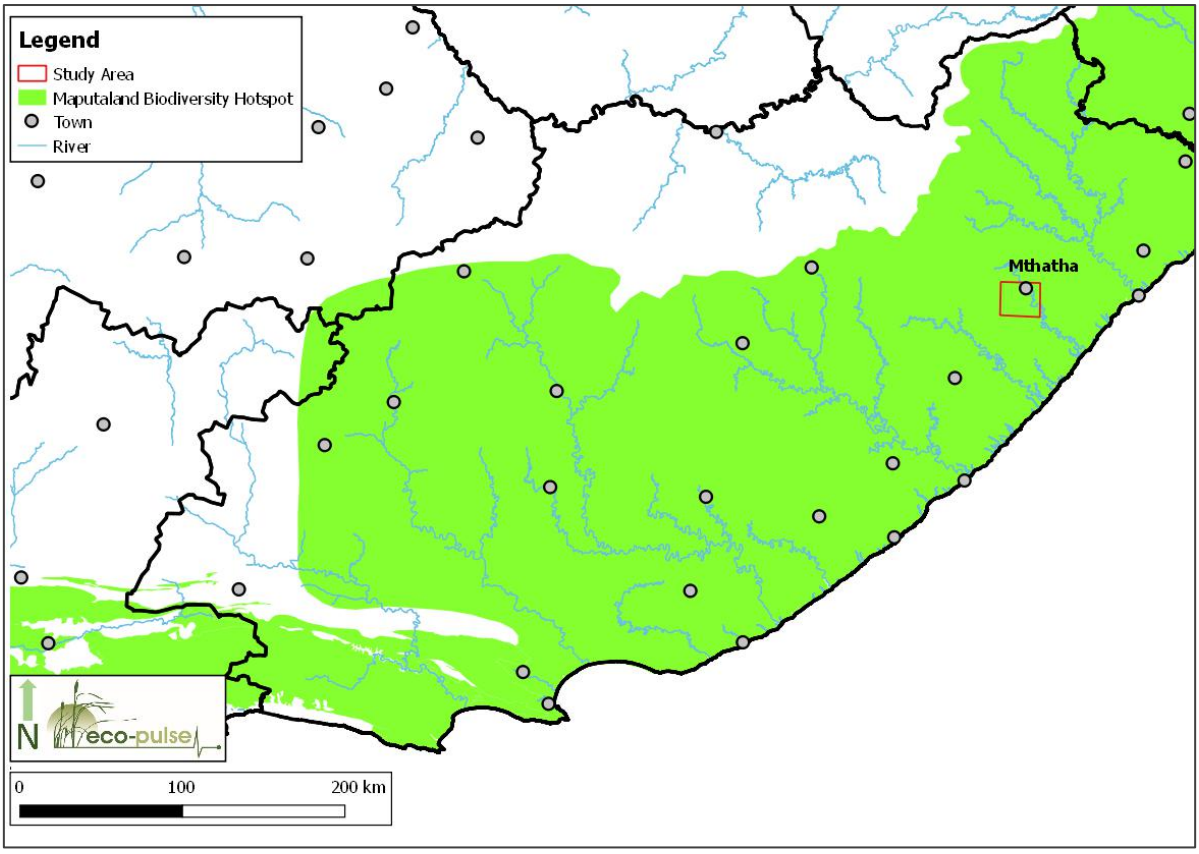


Figure 6 Map showing the location and extent of the Maputaland-Pondoland-Albany biodiversity hotspot (Conservation International, 2011).

3.2.2 *National conservation priorities*

3.2.2.1 *National Threatened Ecosystems*

A national process has been undertaken to identify and list threatened ecosystems that are currently under threat of being transformed by other land uses. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (National Environmental Management: Biodiversity Act or NEMBA: National list of ecosystems that are threatened and in need of protection, G34809, GN 1002, 9 December 2011). The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI, 2011). The NEMBA provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. There are four main types of implications of listing ecosystems:

- Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
- Environmental authorisation implications in terms of NEMA and the EIA regulations;
- Proactive management implications in terms of the National Biodiversity Act; and
- Monitoring and reporting implications in terms of the Biodiversity Act.

Figure 7 (below) shows the remaining extent (after transformation) of Threatened Ecosystems in the region relevant to the project area. Significant portions of untransformed land are shown mapped within the category of ***Vulnerable (VU)*** ecosystems, shown shaded in Figure 7, and are particularly extensive in the project area.

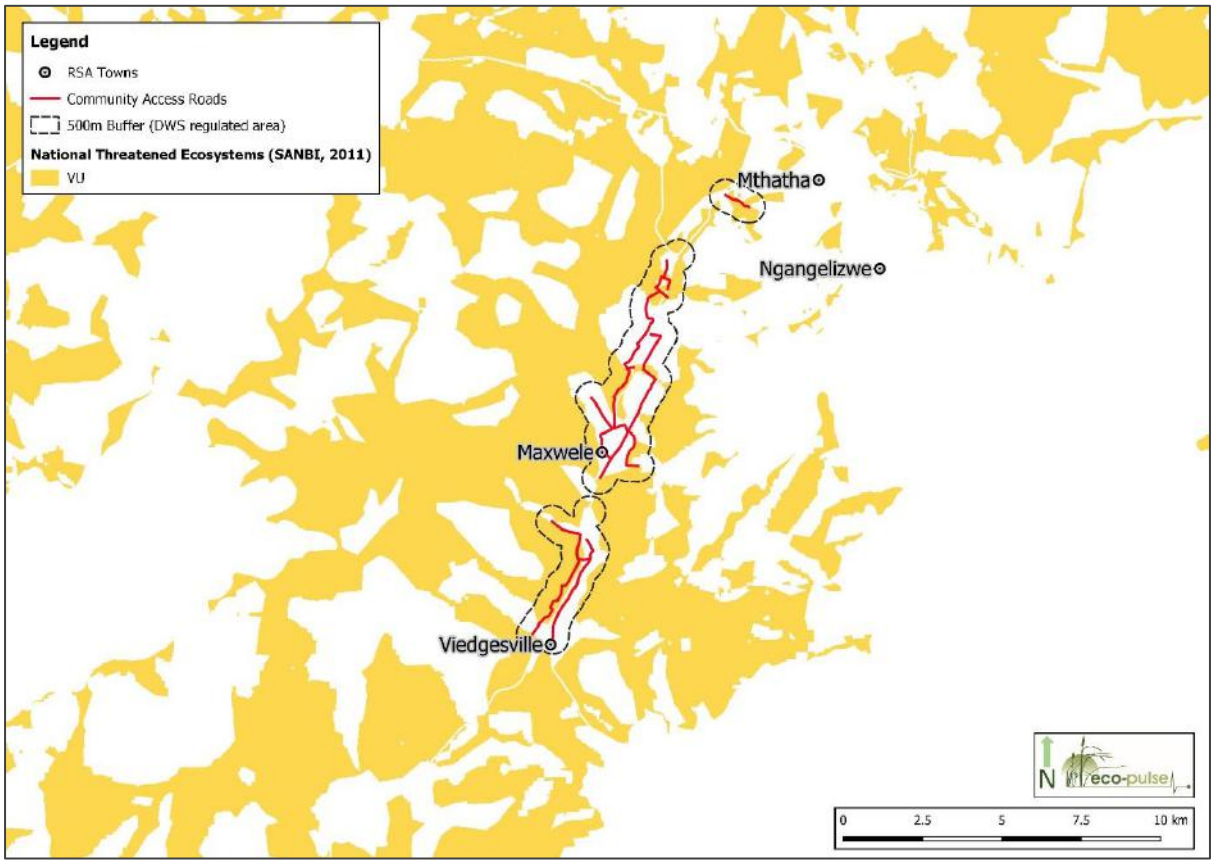


Figure 7 Map showing the location of the project area in relation to the estimated remaining extent of identified Threatened Ecosystems (SANBI, 2011).

3.2.2.2 *National Freshwater Ecosystem Priority Areas (NFEPA)*

National level conservation priorities are highlighted for water resources (including wetlands and rivers) in terms of the NFEPA (National Freshwater Ecosystem Priority Areas) Project (CSIR, 2011). FEPAs or Freshwater Priority Areas need to remain in a good condition in order to achieve biodiversity goals and protect water resources from human use. This does not necessarily mean that they need to be locked away from human use, but rather that they should be supported by good planning and catchment management (Driver *et al.,* 2011). The NFEPA wetlands and rivers coverage for the region is shown in Figure 8 (below), which identifies a number of river/wetland Freshwater Ecosystem Priorities. These are discussed in further detail below, according to the descriptions of FEPA map categories provided in the Implementation Manual for FEPAs (Driver *et al.,* 2011).

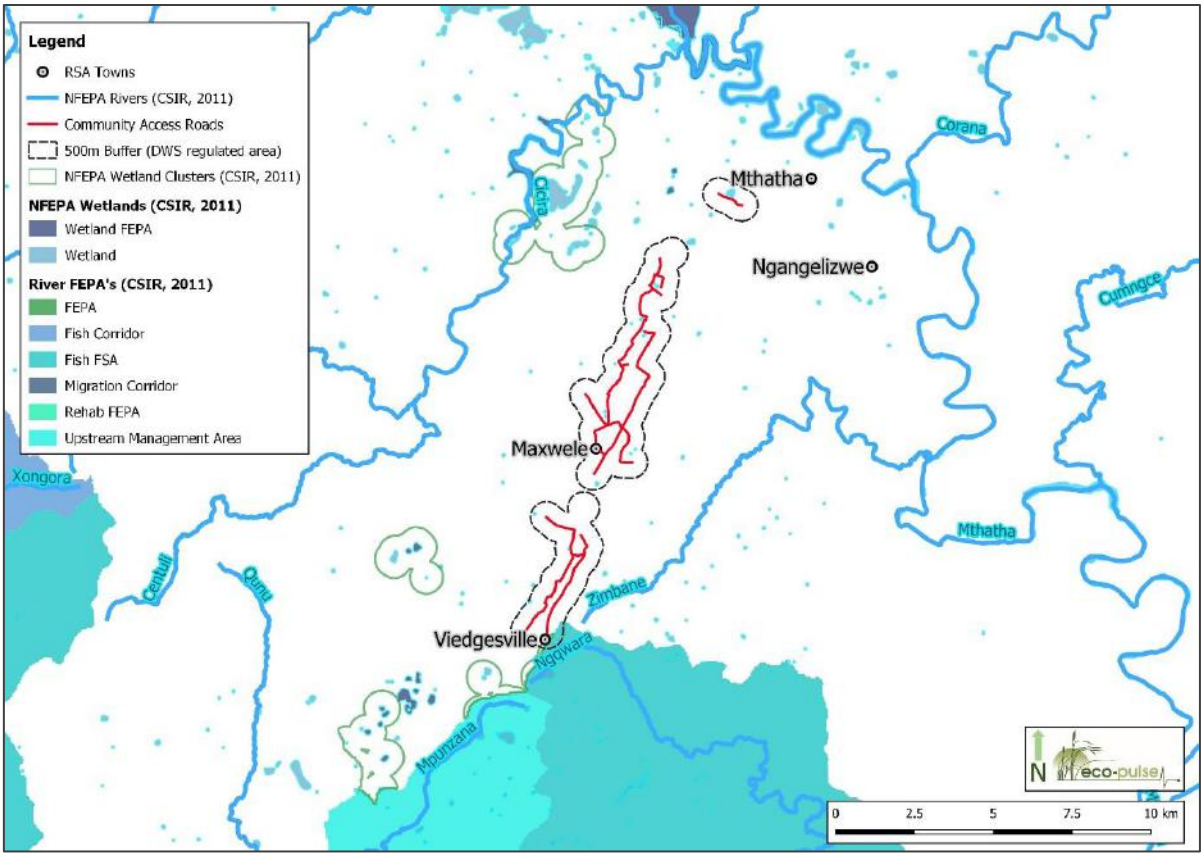


Figure 8 Map showing the project area and proposed N2 re-alignment/widening relative to identified river and wetland FEPAs as part of the NFEPA project (CSIR, 2011).

- **River FEPAs:**

"Fish sanctuaries" have been identified, representing sub-quaternary catchments that are essential for protecting threatened and near threatened freshwater fish that are indigenous to South Africa. A goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened from becoming extinct. In order to achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking alien invasive alien fish in farm dams within fish sanctuaries. Fish management plans need to be developed in all fish sanctuaries to protect the fish they contain, with an urgency given to those fish sanctuaries containing critically endangered or endangered fish species.

- **Wetland FEPAs:**

Some small wetland FEPAS have been identified at an immediate project scale level. Wetland FEPAs that are currently in a good ecological condition should be managed to maintain this condition. Those currently not in a good condition should be rehabilitated to the best attainable ecological condition. "Wetland clusters" have also been mapped ("green" outline), which refer to groups of wetlands within 1 km of each other and embedded in a relatively natural landscape that are considered important for allowing for important ecological processes such as migration of frogs and insects between wetlands. Note that wetlands do not have to have FEPA status to belong to a wetland cluster. Wetland clusters identified in the region are linked to the Cicira River. It is important to note that wetlands in the Eastern

Cape and relevant to the study area have been very poorly mapped to date. The need to improve mapping in this region has been flagged by SANBI and will hopefully be addressed in future updates of the Provincial and National wetland coverage's (used to inform the NFEPA project).

The NFEPA project also maps and classifies a number of "Wetland Vegetation Groups" that are based on groupings of national vegetation types (Mucina & Rutherford, 2006) expected to share similar types of wetlands and used in combination with the landform map to identify wetland ecosystem types (Driver *et al.,* 2011). The assumption here is that wetlands in a particular vegetation group are likely to be more similar to one another than to wetlands in other vegetation groups (since broad vegetation groupings reflect differences in geology, soils and climate, which in turn affect the ecological characteristics and functionality of wetlands). The "Wetland Vegetation Group" GIS layer (CSIR, 2011) identifies one general group of wetlands based on wetland vegetation, i.e. 'Sub-Escarpment Grassland Group 7' (Figure 9). The extent and location of Wetland Vegetation Groups is shown in Figure 9, below. Ecosystem Threat Status and Protection Status is defined for wetlands based on Vegetation Group and wetland HGM (Hydro-Geomorphic) type, and is summarised below in Table 6.

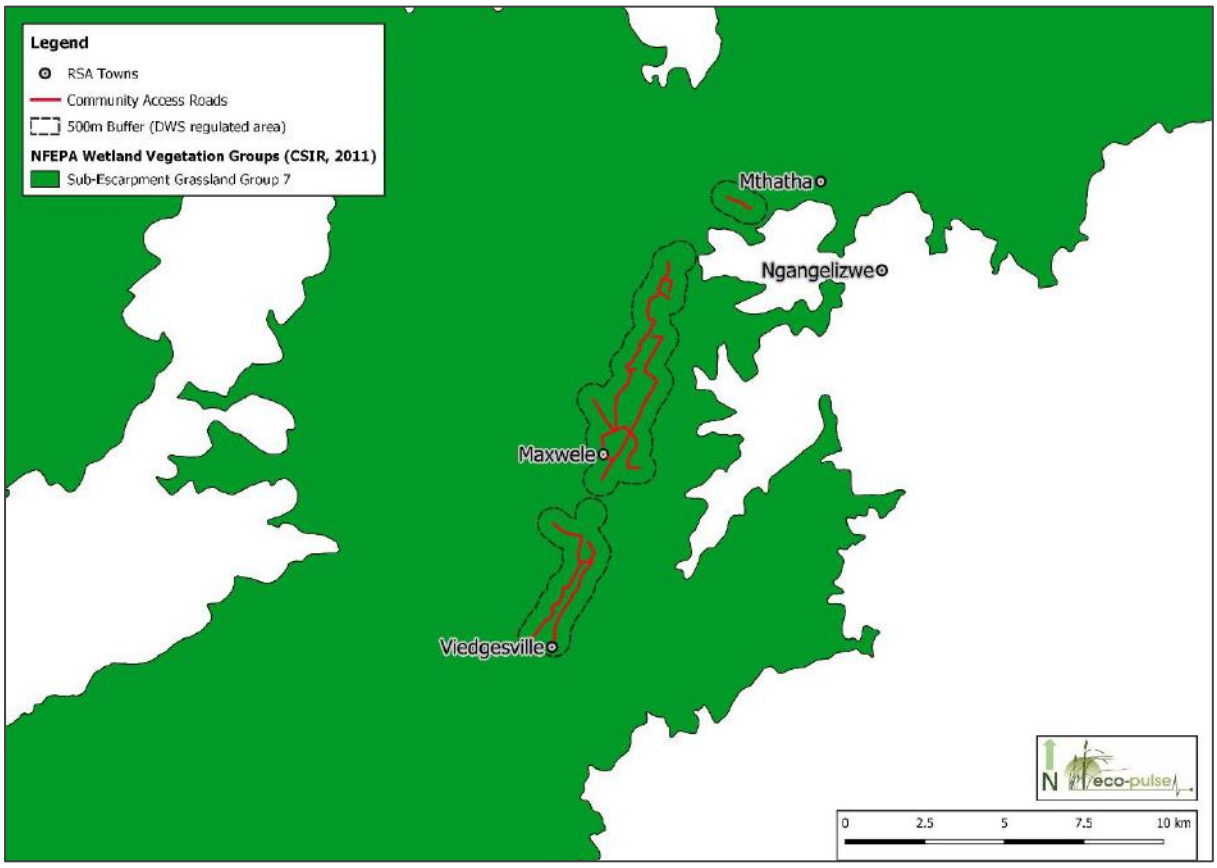


Figure 9 Map showing the project area and proposed community access roads to be upgraded relative to Wetland Vegetation Groups identified in the NFEPA project (CSIR, 2011).

Table 6. Summary of the different Wetland Vegetation Groups for the project area, indicating ecosystem threat status[8] and protection status for different wetland HGM types (CSIR, 2011).

Wetland HGM Type	**NFEPA Vegetation Group** (including threat status and protection status)
	Sub-Escarpment Grassland Group 7
Channelled valley-bottom	CR, Zero protection
Unchannelled valley-bottom	EN, Zero protection
Depression	CR, Zero protection
Seep	EN, Zero protection
Valleyhead seep	CR, Zero protection
Floodplain	CR, Zero protection
Flat	EN, Zero protection

3.2.2.3 *Strategic Water Source Areas (SWSAs)*

Strategic Water Source Areas or SWSA's are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest (Nel *et al.,* 2013). SWSA's are considered national assets vital for South Africa's water security as they have the potential to contribute significantly to overall water quality and supply, supporting growth and development needs and forming the foundational ecological infrastructure on which a great deal of built infrastructure for water services depends (Nel *et al.,* 2013). The importance of managing this small fraction of land that contributes so vitally to our water security should be acknowledged at the highest level across all sectors as the deterioration of water quality and quantity in these areas can have a disproportionately large negative effect on the functioning of downstream ecosystems and the overall sustainability of growth and development in the regions they support. This is particularly important in the South African context, where not only are the country's surface water resources extremely limited, but the country also has a growing water quality problem which represents a major challenge to water security in the near future. Water management in the country is inevitably faced with finding new and innovative ways of improving both water quality and quantity to meet the increasing water demands of the country and managing Strategic Water Source Areas is one such opportunity. Investing in SWSA's is also an important mechanism for long-term adaptation to the effects of climate change on water provision, growth and development. According to Nel *et al.* (2013), appropriate management of these areas should include:

- maintaining healthy functioning riparian zones and wetlands;
- ensuring good agricultural management leads to soil conservation that supports the water cycle;
- avoiding activities that reduce stream flow (e.g. irrigated agriculture and forestry plantations) and where this is not possible ensuring careful regulation of these activities;
- minimizing ground water abstraction;
- clearing invasive alien plants; and
- restoring the hydrological functioning of degraded landscapes.

[8] **Key to threat status**: **CR** – Critically Endangered, **EN** – Endangered, **VU** – Vulnerable, **LT** – Least Threatened

SWSA's for South Africa have recently been mapped and reviewed through an extensive stakeholder process. The spatial data outputs for the project area region are shown below in Figure 10. A portion of the study area along the proposed upgrade of the community access roads along the N2 contains Category 3 Strategic Water Source Areas (high MAR) which are collectively responsible for >50% of water supply.

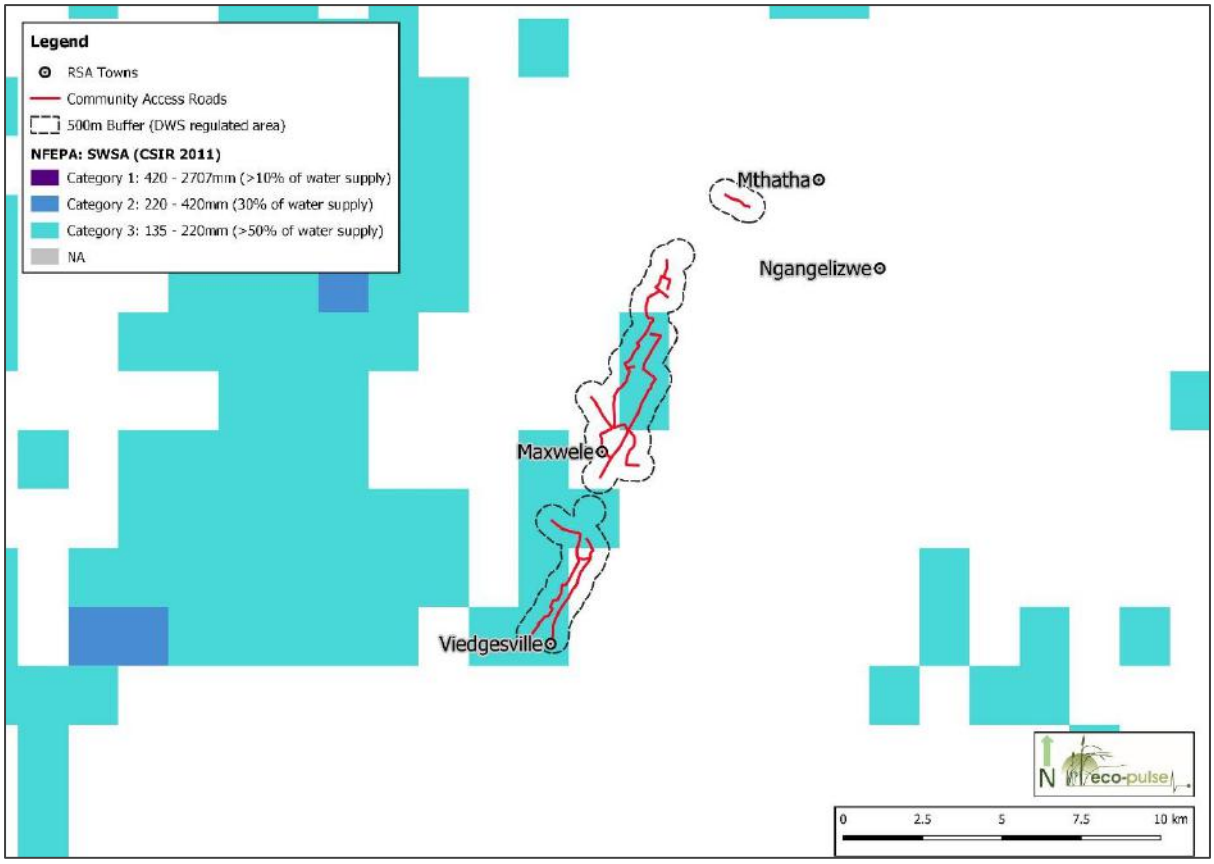


Figure 10 Map indicating the location of Strategic Water Source Areas (SWSAs) relative to the project area.

3.2.3 Regional conservation priorities

At a Provincial level, terrestrial and aquatic biodiversity conservation priorities are highlighted in the Eastern Cape Biodiversity Conservation Plan or 'CPLAN' (Berliner & Desmet, 2007). The CPLAN for the Eastern Cape Province identifies Critical Biodiversity Areas (CBAs) which refer to terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning (Hayes *et al.,* 2007). These form the key output of the conservation plan and are used to guide protected area selection and should remain in their natural state as far as possible (Berliner & Desmet, 2007). Aquatic CBAs for the project area are shown mapped below in Figure 11. This indicates that the project area falls within an **Aquatic Critical Biodiversity Area (Aquatic CBA 2)** which represent sub-quaternary catchment areas in a near natural state that are important as a whole, or they are sub-catchments that either contain free-flowing rivers important for fish migration or support important estuaries (Hayes *et al.*, 2007).

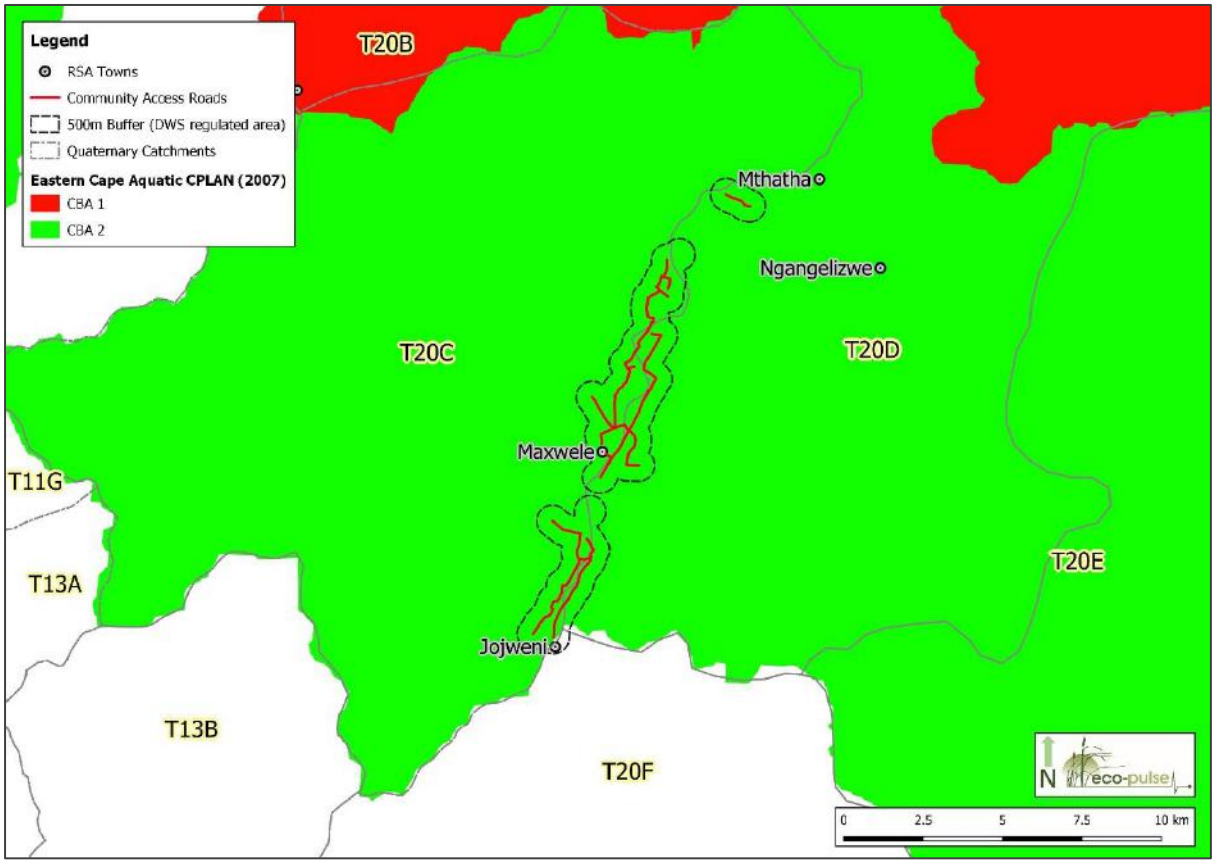


Figure 11 Map showing the location of the study area relative to freshwater conservation priorities highlighted in the Aquatic Plan for the Province (Hayes *et al.* 2007).

4 BASELINE ASSESSMENT FINDINGS

The findings of the specialist freshwater ecosystem baseline assessment are presented in this section of the report. The section first gives an overview of the entire project.

For the purposes of this assessment, only those watercourses that stand to be measurably negatively affected, which was assumed to be all watercourses located within the road footprint, road servitude, within 32m upslope or upstream of the road footprint, and within 50m downslope or downstream of the road footprint.

4.1 Review of available information

4.1.1 Available wetland information

While the NFEPA (National Freshwater Ecosystem Priority Areas) wetland datasets were consulted, little information was available on the wetlands within the study area in terms of their extent, classification, condition or functionality.

Eco-Pulse Consulting has been involved in undertaking similar freshwater ecosystem assessments for the N2 upgrade Section 18 (EP350-01, 2019) as well as the proposed Errol Sprigg Road extension (EP389-01, 2018). Although a number of wetlands within the study area have already been assessed, where the proposed road upgrades intend to cross a watercourse, the watercourse in question was selected for assessment/or re-assessment (in the case of watercourse units previously assessed) in this report.

4.1.2 Available River information

Information on river systems in the study area was limited, with only PES and EIS ratings available (DWS 2014) for three major rivers near the study site namely the Centuli, Mthatha and Zimbane Rivers. Although these rivers do not fall within the 500 m buffer zone for the development footprint and they are unlikely to be affected, relevant information available on these systems is presented below.

Table 7. Summary of NFEPA and Desktop PES/EIS information for major rivers in the study area

General details			FEPA (CSIR 2011)		Desktop PES/EIS (DWS 2014)		
Quaternary Catchment	Reach Code	River Name	FEPA Catchment	River FEPA	PES (present ecological state)	EI (ecological importance)	ES (ecological sensitivity)
T20C	6511	Centuli	N/A	N/A	D	Moderate	Moderate
T20C/T20D	6527	Mthatha	N/A	N/A	E	Low	Moderate
T20D	6606	Zimbane	N/A	N/A	C	Moderate	Moderate

4.2 Ecological findings

4.2.1 Description of the study area

A total of **17** watercourse units were found to be crossed and/or within 32m of the proposed development footprint (i.e. units considered to be potentially negatively affected). A detailed summary of the different watercourse types within the study area assessed is provided in Table 8 below. The dominant watercourse type to be crossed is the hillslope seep wetland HGM (65%) followed by channelled valley bottom wetlands (24%) and un-channelled valley bottom wetlands (12%). The current proposed roads to be upgraded do not cross any minor or major rivers.

Table 8. Summary of assessed watercourses units for the entire project.

Water Resource Type	Resource Classification	Total Number of Watercourses	% of Entire Project
Wetlands	Seeps	**11**	65%
	Channelled Valley Bottoms	**4**	24%
	Unchannelled Valley Bottoms	**2**	12%
Totals		**17**	**100%**

A series of maps showing all watercourses within 500m of the proposed road footprint is provided in **Annexure D**. Only those watercourses that have been labelled were formally assessed and those labelled with "N/A" were not formally assessed. The maps within **Annexure D** also show the watercourse type classification.

A description of each of the different watercourse types encountered is summarised in table 9 below.

Table 9. Classification and description of aquatic resources in the study area.

Classification	Photo Example	Description
Wetlands		
Seeps		Wetlands located on gently to steep sloping land fed primarily by subsurface water inputs from an upslope direction. Water movement and through flow is generally as interflow with diffuse overland flow. Seeps were identified at the head of valleys, often terminating or transitioning into unchanneled, channelled/riverine habitat.
Unchannelled Valley Bottoms		Wetland systems located on the valley floor with channelled flow absent. Flows within these non-channelled systems are distinctly diffuse and confined to the valley sides. Given the topography of the study area, these systems were widespread and were most notable within quaternary catchment T40F.

Classification	Photo Example	Description
Channelled Valley Bottoms		Wetland systems characterised by their location on the valley floor with the presence of an active channel, but without typical floodplain features such as oxbows and heavy meandering channels. These systems were generally characterised by an active channel with a narrow wetland fringe. These systems were not widespread, with flows confined by moderately steep valley sides and located in a valley bottom setting.

Topography within the DWS regulated 500m buffer study area comprised of undulating hills that range from moderately steep to gently sloping. The majority of wetland habitat encountered along the development footprint was characterised by hillslope seeps of varying size at the heads of valleys. These hillslope seeps feed into either channelled or unchanneled valley bottoms further downstream, which flow into their respective tributaries.

4.2.2 Vegetation characteristics of wetland ecosystems

Vegetation characteristics of wetland habitat varied across the study area comprising overgrazed grasses with minimal facultative wetland grass species present, extensive areas dominated by erosion and occasional clumps of tall mixed sedges observed at some wetlands. A brief description of the different vegetation community types encountered during the field investigation is summarized in Table 10, below.

Table 10. Brief description of dominant wetland vegetation communities encountered during the field investigation.

TYPE	DESCRIPTION OF VEGETATION STRUCTURE	CHARACTERISITIC SPECIES
Tall sedge 	Characteristically dense and 0.5 - 1 m tall	Generally dominated by *Typha Capensis*, *Juncus effusus* and/or other *Cyperus* species.
Mixed grass community with gullies 	Mixed grass community, heavily grazed, frequently burnt and primarily cropped short (~0.1 m), with extensive erosion present.	The vegetation cover in this community was characterised by the co-dominance of *Sporobolus africanus* and *Hyparrhenia hirta* with lower abundances of *Aristida junciformis* present. Species that were encountered less frequently included *Eragrostis plana* and *Chloris gayana*.
Mixed grass community	Mixed grass community, heavily grazed, frequently burnt and primarily cropped short (~0.1 m).	This community was characterised by the co-dominance of *Sporobolus africanus* and *Hyparrhenia hirta* with lower abundances of *Aristida junciformis*. Species that were encountered less frequently included *Eragrostis plana* and *Chloris gayana*.

TYPE	DESCRIPTION OF VEGETATION STRUCTURE	CHARACTERISITIC SPECIES
		

4.2.3 *Present Ecological State (PES) of water resources*

The Present Ecological State (PES) of the water resources assessed reflects the present condition or integrity of aquatic ecosystems. PES for aquatic resources, including wetlands is reported in this section.

4.2.3.1 *PES: Wetland Ecosystems*

The wetland PES ratings range from **Largely Modified** (D PES Class) to **Critically Modified** (F PES Class) (Table 11). Most of the wetland units assessed are seriously modified (PES Class E). The dominant impacts affecting wetland hydrological drivers are associated with altered storm water run-off regimes caused by degraded land cover in the catchments, which has resulted in an increase in flood peaks with erosion and deposition features manifesting within the wetlands as a result (indirect indicators of altered catchment hydrology). Other catchment impacts include a minor reduction in water inputs as a result of alien vegetation in the catchment. Hydrological impacts within wetlands include severe levels of erosion and deposition, cultivation, channel incision and alien vegetation. Impacts to wetland **geomorphological condition** are driven largely by catchment alteration in terms of increased flood peaks and the resultant increase in erosion and sediment delivery to wetlands. Key impacts driving the **current state of wetland vegetation** include cultivation, alien vegetation and artificial impoundment, wetland desiccation (drying-out of wetland areas which is linked to erosion and its impact on the local water table) with overgrazing and frequent burning of grassland being the most pervasive impacts. PES maps are provided in **Annexure E**.

Table 11. Summary of PES of wetlands linked to the proposed community access roads upgrade.

Quaternary catchment	Wetland Reference	HGM	Area (ha)	Proposed Impact Feature	PES Ecological Class Overall Class
T20D	W01	Seep	5.5	Road Upgrade and Crossing	E
T20D	W02	Seep	3.1	Road Upgrade and Crossing	D
T20C	W03	Seep	0.9	Road Upgrade and Crossing	E
T20C	W04	Channelled Valley Bottom	2.6	Road Upgrade and Crossing	E
T20C	W05	Channelled Valley Bottom	5.2	Road Upgrade and Crossing	E
T20C	W06	Seep	16.3	Road Upgrade and Crossing	E
T20D	W07	Channelled Valley Bottom	4.1	Road Upgrade and Crossing	E
T20C	W08	Seep	3.2	Road Upgrade and Crossing	E
T20C	W09	Channelled Valley Bottom	4.0	Road Upgrade and Crossing	E
T20D	W10	Seep	5.1	Road Upgrades	E
T20C	W11	Un-Channelled Valley Bottom	10.7	Road Upgrade and Crossing	E
T20C	W12	Seep	1.4	Road Upgrades	E
T20C	W13	Seep	2.8	Road Upgrades	F
T20C	W14	Seep	2.6	Road Upgrades	F
T20C	W15	Seep	3.3	Road Upgrade and Crossing	E
T20D	W16	Seep	7.8	Road Upgrades	D
T20C	W17	Un-Channelled Valley Bottom	4.4	Road Upgrade and Crossing	D

Photo 1: View of a seep, with extensive erosion.

Photo 2: View of a wetland that has been affected by housing development within the wetland and drained.

Photo3: View of development near/in a wetland impacted by alien plants.

Photo 4: View of erosion and subsistence cultivation in a wetland.

4.2.4 Ecological Importance and Sensitivity (EIS) of water resources

Ecological Importance is an expression of the importance of the aquatic resources for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). Ecological importance is critically important in informing the significance of the impacts of the proposed road upgrade activities and sensitivity is important in informing the predicted degree of change to the watercourses and risk. The EIS scores and ratings for the wetland ecosystems to be impacted are discussed in the following sections.

4.2.4.1 *EIS: Wetlands*

With regards to their Ecological Importance & Sensitivity wetlands in the study area range between the **Low to Moderate EIS** class, which is driven primarily by the hydrological and social importance of these systems in terms of direct ecosystem use and benefits supplied by these wetlands (Table 12).

Table 12. Summary of EIS for wetlands within catchments T20C, T20D, T20E and T20F.

Quaternary catchment	Wetland Reference	HGM	EIS Class
T20D	W01	Seep	**Moderately-Low**
T20D	W02	Seep	**Moderate**
T20C	W03	Seep	**Moderately-Low**
T20C	W04	Channelled Valley Bottom	**Low**
T20C	W05	Channelled Valley Bottom	**Low**
T20C	W06	Seep	**Low**
T20D	W07	Channelled Valley Bottom	**Low**
T20C	W08	Seep	**Moderately-Low**
T20C	W09	Channelled Valley Bottom	**Moderately-Low**
T20D	W10	Seep	**Low**
T20C	W11	Un-Channelled Valley Bottom	**Low**
T20C	W12	Seep	**Low**

Quaternary catchment	Wetland Reference	HGM	EIS Class
T20C	W13	Seep	**Low**
T20C	W14	Seep	**Low**
T20C	W15	Seep	**Low**
T20D	W16	Seep	**Low**
T20C	W17	Un-Channelled Valley Bottom	**Low**

Key direct benefits provided by wetlands include: livestock grazing and water supply. The important regulating and supporting services provided by wetlands within the study area include nutrient and toxicant removal and stream flow regulation. The most notable service is deemed to be toxicant removal which is driven by local demand linked to increased sediment from catchment impacts and toxicants associated with road run-off. A selection of photos has been provided below to illustrate some of the important direct services provided by wetlands in the study area.

View of a wetland system being used for water supply.

View of livestock grazing occurring in a seep wetland.

4.2.5 Recommended Ecological Category (REC) & Management Objectives (RMOs)

The recommended ecological category (REC) is the target or desired state of resource units required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES that is driven by the context / setting. The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the river (Kleynhans & Louw, 2007). However, the causes related to a particular PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs and RMOs for water resources is shown in Table 13 below.

Table 13. Generic matrix for the determination of REC and RMO for water resources.

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good - Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Maintain	E/F Maintain

Future management of the freshwater ecosystems identified for the project area should be informed by recommended management objectives for the water resource which, in the absence of classification, is generally based on the current status of the water resource or PES (Present Ecological State) and the EIS (Ecological Importance and Sensitivity) for the water resource type (DWAF, 2007). Based on an assessment of PES & EIS, preliminary management objectives were defined for water resources in the study area. The outcomes of the assessment suggest that the recommended management objective is that ***all freshwater resources, (including rivers and wetlands) should be maintained in their current state without any further loss of integrity/functioning.*** It is the responsibility of the developer to ensure that these objectives are achieved, the assessment provides an indication of which systems ideally require rehabilitation in order to secure existing values.

5 IMPACT & RISK ASSESSMENT

This section deals with the prediction, description and assessment of the potential construction and operational impacts and risks of the proposed activities as described in the introduction (Section 1). Each one of the potential impact types are discussed and assessed separately for the construction and operational phases.

5.1 Description of construction activities

The proposed construction will involve the upgrade of the existing local road network to tie in with the National Road Route 2 interchange Section 18 between Mthatha and Viedgiesville in the Eastern Cape. Specialist working knowledge and experience with other linear projects (roads/pipelines), along with a review of available literature was used in identifying and describing potential impacts to aquatic ecosystems for this assessment. While much of the proposed development will be an upgrade of existing infrastructure, some new road sections will be constructed and will include many of the typical activities described in Table 14 (below), taken from the South African pavement engineering manual, Chapter 12: *Construction Equipment and Method Guidelines* (SANRAL).

Table 14. Typical activities associated with construction and maintenance of roads in South Africa (SANRAL).

Construction activity	General description
Roadbed preparation	Clearing of vegetation and associated organic **material** (roughly 200 mm) below the natural ground level. • Where necessary, and possible, **subsurface drainage** is provided to drain the roadbed and ensure that dry conditions prevail. • The **quality of the in-situ soils** are assessed to ensure compliance with the minimum requirements. Any unsuitable material is removed and replaced or treated to facilitate compaction of the pavement layers over this layer. • The roadbed must be **effectively compacted** to achieve the required density and in-situ shear strength.
Fills	Construction of fill embankments, either earth or rock fills will be required.
Cuts	Cutting back and stabilization of steep banks to prevent erosion.
Borrow Pit Establishment	Excavation, crushing and processing of appropriate stone materials required for construction.
Crushed stone base	This involves the construction of crushed stone and crushed slag-based layers. A crushed stone base is the most popular base in pavements constructed in South Africa.
Compaction of soils and gravels	Compaction of material layers is one of the most important determinants of the performance of a constructed fill or pavement structure. The effect of compaction on a material is to improve particle interlock and to reduce the voids between the particles.
Cementitious stabilisation	Stabilising road building material with cementitious agents such as cement and lime, or blends of cement with mineral components such as fly ash, ground granulated blast furnace slag and limestone is common practice in South Africa.
Bitumen stabilisation	Bitumen is becoming increasingly popular as a stabilising agent, primarily due to technological advances. The bitumen is applied in either an emulsified or a foamed form. Stabilising with bitumen is a cost-effective way to improve the strength of a material, while reducing the detrimental effects of water. Bitumen stabilisation produces a relatively flexible layer, compared to the same material treated with cement.
Modification of materials	In many situations, the available gravels do not meet the necessary requirements for the pavement layer. In these cases, the materials can be modified. Several physical or natural methods of modification are available, which are used depending on the availability of materials. Should the necessary material not be available, then chemical modification may be used.
Primes and tack coats	A prime is a coat of suitable bituminous binder applied to a non-bituminous granular pavement layer as a preliminary treatment, prior to the application of a bituminous base or surfacing. The main function of a prime is to penetrate the layer to which it is applied, while leaving a small residual amount of binder on the surface. A tack coat is applied to a primed surface or

Construction activity	General description
	bituminous surface to promote adhesion between the existing and new asphalt layer. The function of a tack coat is to ensure bonding between the new asphalt layer and the primed surface or old asphalt layer.
Surfacing seals	Surfacing seals are a relatively simple and inexpensive road treatment, which are highly effective as a final surfacing.
Hot mix asphalt	The term "hot mix asphalt" (HMA) is generically used to include many different types of mixes of aggregate and bitumen that are produced at an elevated temperature in an asphalt plant.
Concrete pavements	Concrete pavements are rigid pavement structures that are generally constructed using slipform or side form pavers.
Proprietary products	The construction of layers using proprietary products is essentially the same as the construction of granular layers. The products are typically used as a compaction aid for granular materials. The manufacturer may, however, have special requirements that should be followed.
Construction of watercourse crossings	This includes the construction of culverts and bridges where the road crosses watercourses. These crossings are designed according to SANRAL's Drainage manual with a key focus on limiting the risk of damage to the road from flooding.
Installation of road drainage	Surface drainage involves the installation of a drainage system to effectively remove water from the road surface in order to limit risks to road users. This includes the construction of surface drainage, minor culverts and discharge points to deflect flows away from the road surface and sensitive embankments.
Abstraction	This includes the abstraction of water from local water resources for use in construction activities.
Cold recycling	**Recovery and reuse of material from an existing pavement without the addition of heat.** The cold recycling process, which has become a very popular construction method since the introduction of in-situ recycling machines. The shortage of construction material, especially in built-up areas, has resulted in the process becoming very popular as a rehabilitation option for strengthening pavement layers.

5.2 Impact Identification and Description

When making inferences on the impact of road construction and operation on aquatic ecosystems it is important to understand that these impacts speak specifically to their effect on the Present Ecological State (PES), ecological processes and functions and ecosystem functions and services. All of these are linked to the physical components and processes of aquatic ecosystems, including hydrology, geomorphology and vegetation as well as the biota that inhabit these ecosystems. Impacts will vary across water resource types depending on natural site attributes that affect local sensitivity including aspects such as:

- the source of water inputs to the system;
- the patterns of flows within the system;
- existing water quality characteristics;
- the vulnerability of the site to erosion;
- natural biotic characteristics including the presence of important species;
- the importance of existing functional values; and
- the nature and design of the proposed road infrastructure.

Physical alteration of water resources brought about by the road upgrades may result in a decline in the condition and functional value of affected ecosystems. Impacts to aquatic ecosystems are not necessarily limited to the road footprint however and often have more far-reaching implications on downstream environments. For the purposes of this assessment, impacts have been grouped according to whether impacts are linked to construction or operational phases. While an attempt has been

made to clearly separate out different impacts, there is invariably some overlap due to the inter-relatedness of the different components of water resources.

5.2.1 Construction-Phase Impacts

C1. Direct transformation and modification of habitat

This refers to the direct destruction and/or disturbance of aquatic habitat (affecting functionality and biota) during the construction phase and includes:

- Vegetation clearing (direct alteration / loss of aquatic habitat);
- Habitat infilling for road fill embankments;
- Direct disturbance adjacent to the construction zone e.g. haulage / access routes;
- Alteration of profiles where water resources are crossed (including bed and banks).

The preparation of the roadbed involves the complete removal of all existing indigenous vegetation and topsoil within the road footprint. The impact from clearing and disturbance is not limited to the construction zone however and will include areas used by machinery and workers to access the site and to construct ancillary infrastructure such as road drainage and erosion control measures. The result is either the complete loss (within the road bed and embankment footprint) or the disturbance and partial loss of indigenous vegetation communities (broader road reserve), impacting directly on the ecological condition and functionality of these ecosystems.

Physical disturbance of cross-sectional and longitudinal profiles of wetlands and rivers may also result in indirect impacts that alter the composition and structure of the aquatic habitat. Key concerns include physical alterations in the bed and banks of water courses that either alters the cross-sectional profile or longitudinal profile of the watercourse. These impacts can stimulate erosion, resulting in direct impacts to affected areas, potential sedimentation of downstream habitats and a change to water regimes of adjoining wetland and riparian habitat.

C2. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of and within the watercourse

This refers to the indirect impacts of the alteration in the quantity, timing and distribution of water inputs (catchment hydrology) and through flows (watercourse hydraulics and flows) and the associated alteration in rates of erosion and sedimentation.

Watercourse impacts considered as part of this impact group include:

- Wetland and/or river channel erosion (e.g. rill and gully formation or existing channel incision and widening) and resultant changes in soil wetness / moisture as a result of the following:
    - Increased velocity of water inputs / flood peaks through catchment land cover alteration.
    - The modification of the distribution of through-flows e.g. flow concentration through culverts, temporary flow diversion and/or working area dewatering discharges.

  - Alteration of established artificial base levels and knickpoints (longitudinal profile) at existing crossings e.g. if the base of the culverts were to be lowered at the culvert inlet or raised at the culvert outlet relative to the current valley bottom or bed surfaces.
- Increased sediment inputs and associated habitat smothering and burial or increased water column turbidity, as a result of erosion along the construction corridor (i.e. construction activities outside and within watercourses). Temporary reductions in sediment loads may also occur during flow impoundment to gain access to working areas within the watercourses.
- Temporary flow reduction, as a result of the temporary damming and/or diversion of flow upstream of the construction corridor, and as a result of flow abstraction. Wetlands and small streams are particularly sensitive to such impacts as they are typically characterized by low flow volumes.

All the above-mentioned impacts will result in changes to the vegetation and habitat quality of the affected watercourses, which may cause biotic fatalities and/or stresses that alter the present composition of the various plant and animal communities in favour of more generalist, hardy, opportunistic, weedy and invasive species.

Of all the above-mentioned impacts within this group, increased sedimentation during the construction phase is likely going to be the most intense impact. Some of the key biological effects related to the deposition of sediment and suspension of fine sediment within the water column of rivers/wetlands includes:

- Habitat alteration downstream of crossing points due to increased sediment deposition (degradation of coarse streambed habitats by the infilling of interstitial spaces and the reduction of inter-granular flow for example);
- Reductions in photosynthetic activity and primary production caused by sediments impeding light penetration;
- Reduced density and diversity in benthic invertebrate communities, as a result of habitat degradation, blanketing of fish spawning sites and the establishment of more tolerant taxa or exotic species; and
- Changes to the behaviour and feeding ability of fish at low levels of suspended sediments, while physiological damage and mortality can occur at very high concentrations of suspended sediment (e.g. as a result of clogging of fish gills, interference in embryogenesis and larval development of amphibians and mortality of filter-feeding macro-invertebrates).

C3. Water pollution impacts

This refers to the alteration/deterioration in physical, chemical and biological characteristics of water resources (as defined by the National Water Act (Act No. 36 of 1998)).

The term 'water quality' must be viewed in terms of its fitness for a specific use (DWAF, 2001). In the context of this impact assessment, water quality refers to its fitness for maintaining the health of aquatic

ecosystems and for direct human use, with most rural communities being directly reliant on natural watercourses for domestic water supply.

Contaminants such as hydrocarbons, solids and pathogens may be generated during the construction phase from a number of sources. These contaminants have the capacity to negatively affect aquatic ecosystems including sensitive or intolerant species. Where significant, changes in water quality will ultimately cause a shift in aquatic species composition, favouring tolerant species, and potentially resulting in the localised exclusion of sensitive species. Sudden drastic changes in water quality can also have chronic effects on aquatic biota leading to localised extinction. Deterioration in water quality could also affect the fitness for human use and so have far reaching impacts to rural or semi-urban communities who already often have to walk long distances to access suitable sites to meet their daily water requirements.

C4. Habitat fragmentation, connectivity and disturbance impacts

This refers to indirect ecological impacts to aquatic habitat and biota during the construction phase.
This includes the following:

- Fragmentation of habitat and reduced ecological connectivity - Alteration of natural plant species propagule movement corridors and routes and/or interruption of faunal movement corridors to and from the watercourses and increased mortality risk. This can reduce natural plant species recruitment within freshwater habitats.
- Reduced habitat patch size and core to edge ratio – Increased stress to sensitive habitats and species, alteration of the composition of communities and the displacement of sensitive species.
- Increased intensity of edge disturbances, as a result of construction activities (e.g. noise, dust and light pollution) – Alteration of the composition of communities and the displacement of freshwater fauna sensitive to human presence, noise pollution and light pollution. Increased intensity of dust pollution, smothering of vegetation with dust, increased plant stress and mortality, alteration of plant species composition, degradation in habitat condition.
- Invasion of construction corridor with alien invasive species and increased alien invasive propagule sources within proximity to the freshwater habitats. Increased alien invasive plant invasion, alteration of plant species composition, degradation of freshwater habitat.
- Illegal harvesting of indigenous species – An increase in the hunting/poaching/trapping of fauna, as well as the harvesting of indigenous wetland plants for various uses such as firewood/medicinal use may also be associated with large construction projects of this nature.

5.2.2 Operational-Phase Impacts

O1. Direct transformation and modification of habitat

This refers to the direct destruction and/or disturbance of aquatic habitat (affecting functionality and biota) during the operational phase. Such direct impacts include vegetation clearing and direct habitat modification during the maintenance and repair of the community access roads and their associated infrastructure.

O2. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of and within the watercourse

This refers to the indirect impacts of the alteration in the quantity, timing and distribution of water inputs (catchment hydrology) and through flows (watercourse hydraulics and flows) and the associated alteration in rates of erosion and sedimentation.

There will be a measurable increase in the extent of road surface area with widening of the existing community access roads, which will increase surface runoff / stormwater discharges to the freshwater environment. Roads are designed to avoid the accumulation of water and discharge it to areas adjacent to the road surface. This is an important safety feature for road users and aims to reduce road accident incidents. The consequence, however, is that road networks intercept, direct and concentrate flows which essentially changes volume and timing of peak flows reaching aquatic ecosystems. This increase in peak discharge may significantly increase the stream power, thereby increasing the risk of erosion and channel incision. In addition, the diversion of flow through culverts at road crossings will narrow the width of the flow / concentrate flows and increase the velocity of flows at the culvert outlets. These impacts may result in the following consequences:

- Stream bed and bank erosion (incision and widening) within channeled valley bottom wetlands, rivers and streams, and gully erosion in un-channeled valley bottom wetlands and seeps. The result of such erosion and scour would be instream biotope alteration and modification and flow concentration within wetlands that will reduce levels of soil saturation and alter plant communities.
- Increased sediment inputs to downstream freshwater ecosystems and associated habitat smothering and burial or increased water column turbidity. Deposition of large masses of sediment downstream causing localized channel braiding, instability of stream banks and alterations in water distribution and retention patterns in wetlands.

In particular, road run-off points may cause localised scour at the point of discharge resulting in the deposition of material into wetland and riverine habitat. Sedimentation alters the structure and composition of the aquatic habitat (covered in impacts to aquatic habitat), affects the movement of water and increases water turbidity (covered in impacts on water quality). These impacts are linked to hydrological impacts and associated erosion as discussed above.

For the majority of the project area, impacts to the hydrological functioning of aquatic resources from road run-off are already prevalent and will likely increase as a result of increased impermeable surface area. However, new impacts are expected for those systems to be crossed by new alignments.

O3. Water pollution impacts

This refers to the alteration/deterioration in physical, chemical and biological characteristics of water resources as a result of contaminated road runoff entering aquatic ecosystems during the operational phase.

Highway run-off has been identified as a significant source of diffuse pollution contaminating receiving water resources. It may contain significant loads of nutrients, heavy metals, polycyclic aromatic hydrocarbons (PAHs), Volatile Organic Compounds (VOCs) such as benzene, toluene, ethylbenzene, xylene, and methyl tert-butyl ether (MTBE). Table 15 (below) outlines typical sources of pollution and impacts on water quality associated with road run-off.

Table 15. Typical water quality concerns associated with road run-off

Type	Consistent Source	Impact to aquatic ecosystems
Heavy metals (Lead, Cadmium, Copper, Aluminium, Iron, Nickel, Zinc, Chromium and Manganese)	**Engine wear and fluid leakage** - Aluminium, Copper, Nickel and Chromium) **Tire wear** - Zinc and Cadmium **Break wear** - Copper, Lead, Chromium and Manganese **Vehicle component wear** - Iron, Aluminium, Chromium and Zinc	Heavy metals are Toxic to aquatic life. Toxicity does depend on species-specific tolerance and lifecycle. Lead, among other compounds is bio-accumulated by benthic bacteria, freshwater plants, invertebrates and fish and is passed along trophic levels.
Polycyclic Aromatic Hydrocarbons (PAHs) (Fluoranthene, Pyrene, and Phenanthrene)	Incomplete combustion of oils and fuels	PAHs are of major concern because they are responsible for the larger percentage of toxicity to freshwater organisms. Toxicity does depend on species-specific tolerance and lifecycle.
The Fuel Oxygenate Methyl-Tert-Butyl Ether (MTBE)	Since the phasing out of leaded octanes MTBE has been widely adopted as a cost-effective octane enhancer achieving the required octane level and cleaner-burning petrol	Most commonly observed concentrations unlikely to cause harmful, acute or developmental effects in a variety of freshwater organisms. Taste and odour impacts are more prominent.
Other pollutants (solids, organic compounds and nutrients)	Organic matter, solid waste, nutrients bound to sediment, nitrogenous waste from vehicle engines	Impacts the quality and integrity of the aquatic environment. Major impacts associated with organic matter are colour, taste, odour and oxygen depletion.

The use of nutrient rich, non-native bedding material can also increase nutrient concentrations in the aquatic environment, as these compounds leach out over time. The magnitude of this impact is especially high in nutrient poor environments. This can cause localised increases in available nutrients, the onset of algal blooms and shifts in dissolved oxygen concentrations. In this case, these pollution impacts are already present with the road upgrades likely to increase the amount and concentration of pollutants to the degree that the hardened surfaces are increased.

O4. Habitat fragmentation, connectivity and disturbance impacts

This refers to indirect ecological impacts to aquatic habitat and biota during the operational phase. This includes the following:

- Fragmentation of habitat and reduced ecological connectivity - Alteration of natural plant species propagule movement corridors and routes and/or interruption of faunal movement corridors to and from the watercourses and increased mortality risk. This can reduce natural plant species recruitment within freshwater habitats. The lengthening of culverts could also decrease the connectivity of the watercourses for aquatic and wetland biota. Fauna road kills are inevitable, but the number of fatalities should not increase measurably from the present situation.
- Reduced habitat patch size and core to edge ratio – Increased stress to sensitive habitats and species, alteration of the composition of communities and the displacement of sensitive species.
- Increased intensity of edge disturbances (e.g. noise, dust and light pollution) - Alteration of the composition of communities and the displacement of freshwater fauna sensitive to human presence, noise pollution and light pollution. Increased intensity of dust pollution, smothering of vegetation with dust, increased plant stress and mortality, alteration of plant species composition, degradation in habitat condition.
- Invasion of the road servitude with alien invasive plant species due to poor management and increased alien invasive propagule sources within proximity to the freshwater habitats. Increased alien invasive plant invasion, alteration of plant species composition, degradation of freshwater habitat.

In this case, the fragmentation and ecological disturbance impacts are already present with the operation of the existing community access roads. The road upgrades will likely lead to an increase in the intensity of indirect ecological impacts during the construction phases, thereafter, the intensity of the impacts should return to pre-development/current levels. The only exception to this is where road widening has resulted in the reduction of buffers and/or encroachment into core intact habitats and where new roads are proposed.

5.3 Impact significance assessment for WULA

Construction Phase:

The direct transformation and modification of habitat (**Impact C1**) is inevitable at all existing watercourse road crossings, as well as areas where road re-alignment resulting in new crossings and

widening of roads across watercourses (wetlands and rivers) will be required. Therefore, Impact C1 was assessed as being of **moderately-low significance and generally acceptable** for both the poor and good mitigation scenarios. The process will involve vegetation clearing, excavation and infilling to facilitate the road upgrade (widening and realignment of road sections). Permanent transformation and the direct loss of aquatic (wetland/riparian) habitat is expected where new culverts will be constructed at new locations (associated with road realignment). Most watercourses are characterised by degraded vegetation and habitat (moderately to largely modified) of low ecological importance and sensitivity, therefore the magnitude of the impact on the general wetland/riverine vegetation and associated habitat is likely to be relatively low as indigenous plants that stand to be lost include mainly common indigenous species and alien plants that are of minimal to no conservation importance respectively.

Impact C2 (Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of and within the watercourse) was assessed as being of **moderately-low significance and generally acceptable** under the poor mitigation scenario for the ecosystem conservation component because of the predicted high intensity of construction related sedimentation and erosion impacts if mitigation measures are poorly implemented. The extent of habitat to be affected across the entire project is relatively small. With the effective implementation of the erosion and sediment control measures recommended in this report, the significance of Impact C2 can be reduced **to low and generally acceptable**. *It is important to note however, that the author's experience with working on large SANRAL road upgrade projects indicates that appropriate and proper erosion and sediment control measures are often not effectively implemented and that road footprint and servitude clearing often occurs with little implementation of such measures. It is thus recommended in the mitigation section below that all erosion control and sediment measures are approved by an independent Environmental Control Officer (ECO) prior to any clearing within or in close proximity to watercourses. This should be a strict condition of all authorisations and licenses failing which the applicant and/or contractors should be heavily fined in addition to undertaking the required rehabilitation.*

The rest of the impacts assessed were all assessed as being of moderately-low or low significance under a poor mitigation scenario and of low significance under a good mitigation scenario indicating that these impacts are not significant, and duty of care should be applied to effectively mitigate these impacts.

Table 16. Summary of the impact significance ratings for the construction phase impacts for the entire project.

Construction Phase Impact Significance Assessment Summary				
No.	**Impact Type**	**Status**	**Significance**	
			Poor' Mitigation	**Good' Mitigation**
C1	Direct physical loss or modification of freshwater habitat	Negative	Moderately-Low	Moderately-Low
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Moderately-Low	Moderately-Low
C3	Impacts to water quality	Negative	Moderately-Low	Low
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Low	Low

Operational Phase:

The most significant operational impact assessed was **Impact O2** (Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of and within the watercourse), which was assessed as being of **moderately-low significance and generally acceptable** under a poor mitigation scenario in terms of both impacts to water resource quality and management and ecosystem conservation. This moderate score was primarily driven by the unintended erosion of freshwater ecosystems that may occur if flow is unnecessarily concentrated at sensitive crossings and erosion protection is not appropriately designed or implemented. The significance of this impact will remain at **moderately-low/low significance** under a good mitigation scenario that assumes most of the design measures provided in **Section 6** are adhered to.

The rest of the impacts assessed were all assessed as being of low significance under a poor mitigation scenario. With the effective implementation of the mitigation measures recommended in **Section 6** below, the significance of all the impacts can be reduced. It is also important to note that mitigation measures recommended for **Impact O3** (Water pollution impacts), favour the use of open vegetated stormwater conveyance systems over concrete and piped ones.

Table 17. Summary of the impact significance ratings for the operational phase impacts for the entire project.

Operational Phase Impact Significance Assessment Summary				
No.	**Impact Type**	**Status**	**Significance**	
			Poor' Mitigation	**Good' Mitigation**
O1	Direct physical loss or modification of freshwater habitat	Negative	Low	Low
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Moderately-Low	Moderately-Low
O3	Impacts to water quality	Negative	Moderately-Low	Low
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Low	Low

6 PRELIMINARY RISK ASSESSMENT (DWS RISK MATRIX) (ONLY APPLICABLE TO WULA)

It is our understanding that the purpose of the risk matrix tool developed by the DWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) to local and regional water resource quality. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services. Unlike the significance assessment section, risks were assessed for the entire project only and was undertaken for the most sensitive wetland and riverine ecosystem to be negatively impacted.

The impact significance assessment findings in the section above clearly indicate that Impacts C1, C2 and O2 are the most significant impacts and should pose the highest risks to freshwater ecosystem integrity and biodiversity. This is confirmed by the risk assessment results in Table 18 below that indicates that Impact C1 poses a moderate level of risk to freshwater ecosystem functioning due to permanent freshwater habitat infilling, and likewise Impact C2 also poses a moderate level of risk, but can be reduced to a low level of risk. The risks of Impact O2 could be reduced to a low risk if the design recommendations provided in this report are adhered to. For the full risk matrix please refer to **ANNEXURE B**.

Table 18. Summary of the DWS risk scores and ratings for wetlands.

Impact No.	Consequence Score (0-15)	Probability Score (0-20)	Risk Score (0-300)	Risk Matrix Rating	Specialist Revised Rating
Wetland Ecosystems					
C1	6.5	14	**77**	Moderate	Low
C2	6.5	11	**71.5**	Moderate	Low
C3	4	13	**52**	Low	Low
C4	3	11	**33**	Low	Low
O1	6.5	8	**52**	Low	Low
O2	6.5	12	**78**	Moderate	Low
O3	5	11	**55**	Low	Low
O4	4	13	**52**	Low	Low

7 IMPACT MITIGATION & MANAGEMENT GUIDELINES

A strong legislative framework which backs up South Africa's obligations to numerous international conservation agreements creates the necessary enabling legal framework for the protection and management of freshwater resources in the country. Given the value of wetlands and other aquatic ecosystems (such as rivers and estuaries) and the fact that humans depend on aquatic resources, it is against the law to deliberately damage wetlands and rivers. The law therefore places, directly and indirectly, the responsibility on landowners and other responsible parties, to manage and restore wetlands where relevant.

According to the National Environmental Management Act No. 107 of 1998 (NEMA), sensitive,

vulnerable, highly dynamic or stressed ecosystems, such as wetlands, rivers and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. NEMA also requires "a risk-averse and cautious approach which takes into account the limits of current knowledge about the consequences of decisions and actions". The 'precautionary principle' therefore applies and cost-effective measures must be implemented to pro-actively prevent degradation of the region's water resources and the social systems that depend on it. ***Ultimately, the risk of water resource degradation and biodiversity reduction/loss must drive sustainability in development design.***

Of particular importance is the requirement of 'duty of care' with regards to environmental remediation stipulated in Section 28 of NEMA (National Environmental Management Act No.107 of 1998):

> **Duty of care and remediation of environmental damage**: "(1) *Every person who causes has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot be reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.*"

7.1 The 'Mitigation Hierarchy' Best Practice Environmental Planning Framework

The protection of water resources (wetlands & rivers/streams) begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces such impacts. Driver *et al.* (2011) recommend that the management of freshwater ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging (e.g. as a result of sedimentation and pollution). 'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on aquatic resources is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. This generally follows some form of 'mitigation hierarchy' (see Figure 12, below) which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts.

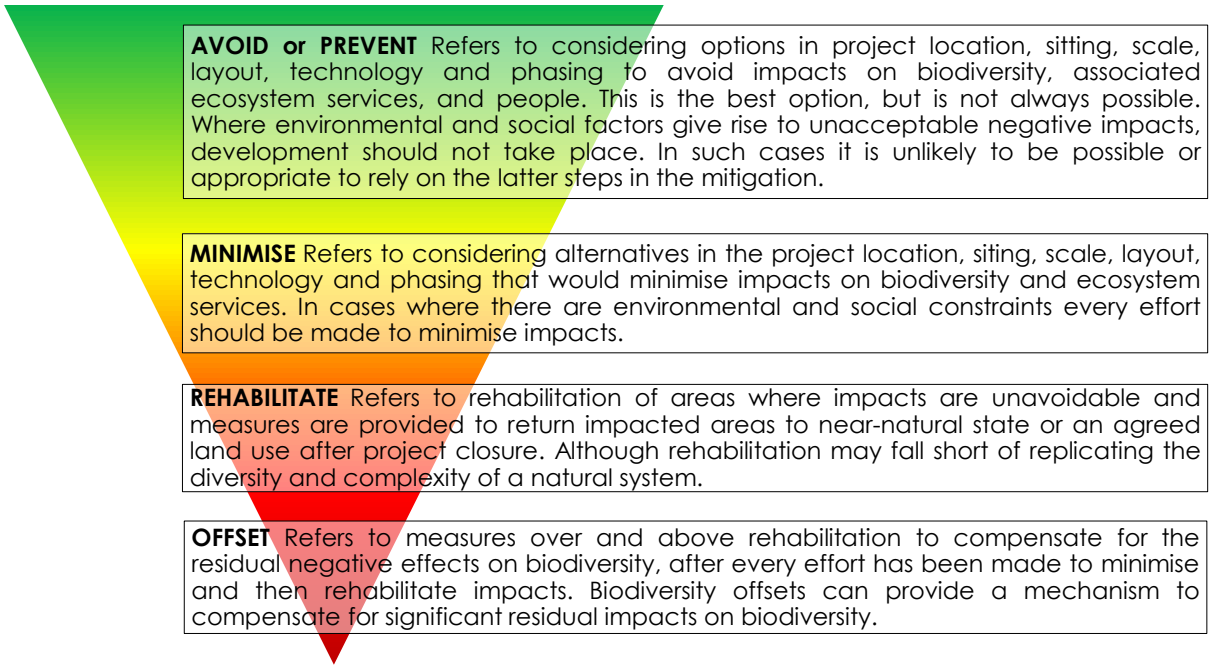


Figure 12 Diagram illustrating the 'mitigation hierarchy' (after DEA et al., 2013).

7.2 Project Planning & Design Recommendations

The following planning and design recommendations are relevant to the entire municipal community access roads upgrade project activities to be submitted for the WULA. It is important to note however that some of these recommendations may not be applicable to the project activities currently included in the NEMA EA application for the same project. We have indicated which recommendations may not be applicable to the EA application in the text.

7.2.1 Road alignment recommendations

As some of the community access roads already exist and cross various freshwater ecosystems, direct and indirect impacts to these systems cannot be avoided and freshwater habitat loss is inevitable. The focus of planning and design recommendations should thus be on the second step of the mitigation hierarchy – minimisation. However, several new roads are also proposed, and it is assumed that these roads can potentially be shifted to avoid more intact freshwater ecosystems which are as yet unaffected by existing road crossings.

In this regard, it is recommended that the proposed crossing and infilling of Unit W03 (a hillslope seep wetland characterized by hygrophilous grasses and sedges) along the northernmost section of the road alignment (road 12A, also referred to as P1), and the crossing of Unit W08 (a hillslope seep wetland characterized by hygrophilous grassland) which intersects with a new proposed road crossing and road underpass (Road 10 and Road-Class 4-R2r1[9], also referred to as P2) according to the initial designs received, be avoided or minimised as far as practically possible.

[9] The road references are extracted from the road alignment provided (2020-06-02) N2 18 Access Roads.

Following the submission of these re-alignment recommendations to the EAP and project team, the project engineers were able to shift the P2 southwards to reduce the extent of Unit W08 which stands to be infilled and impacted. The realignment resulted in a reduction in wetland loss, which is a measurable reduction in wetland habitat loss and impact significance. However, the EAP confirmed that P1 that will adversely impact Unit W03 is still under discussion. It is suggested the road alignment is shifted to the west to align with an existing road crossing which has already impacted upon the lower end of a channelled valley bottom wetland (situated to the west of Unit W03). In doing so the realignment is expected to result in a reduction in wetland habitat loss and impact significance.

7.2.2 Watercourse Road Crossings

A. Proposed new road alignments and associated fill embankments:

- New watercourse road crossings should be minimised as far as practically possible and crossings of important systems should be avoided to avoid or minimize direct habitat impacts, hydrological impacts and ecological fragmentation impacts.
- All new road crossings should be aligned and designed to minimise the extent of wetland habitat directly impacted by construction activities and permanent structures.
- Culverts should be sized to transport not only water, but other materials that might be mobilized (i.e. debris) and cause blockages to flow.
- Flow through the road crossings should not be unnecessarily concentrated and appropriate erosion protection measures must be installed to reduce bed erosion / scour.
- The base (invert) of culverts must be aligned with the natural ground level of the wetland / bed of the channel to limit risks of erosion. Where necessary, additional measures such as drop-inlets or stepped inlet weirs must be constructed to address such risks.
- Designs of all new road crossings must be reviewed and refined in consultation with the freshwater specialist to ensure that recommended mitigation measures are adhered to as far as practically possible.

Note: Inadequate design and installation of culverts may result in culvert failure. Box 1 (below) summarises some key causes of culvert failure for consideration.

Box 1: Possible causes of culvert failure

Culvert failure can have far reaching impacts on aquatic resources, particularly those related to system hydrology, erosion/ sedimentation and aquatic biota. Attention should therefore be given to the following to mitigate against possible failure of installed culverts:

- Inadequate culvert capacity for the calculated stream flow.
- Structural failure due to excessive soil loading.
- Wash-out due to water overtopping the road.
- End scouring from poor end treatment and lack of erosion protection.
- Improper jointing resulting in water piping along the outside of the culvert.
- Erosion due to excessive water transport of sand and gravel, arising from the acceleration of flow through the culvert.
- Corrosion from acid or salt laden soils and water.
- Improper inlet and outlet structures, resulting in embankment failures.
- Improper alignment of the culvert relevant to the natural channel, resulting in scour of the embankment at the inlet.
- Poor installation and/or bedding condition resulting in settlement, joint separation, or structural failure of the culvert.

B. Upgrade of existing fill embankment crossings with culverts:

In the case of existing fill embankments, design will be constrained by existing crossing designs. The following mitigation measures must, however, be adhered to in order to limit impacts to watercourses:

- The base (invert) of culverts must be aligned with the natural ground level of the wetland / bed of the channel to limit risks of erosion. To achieve this, the following practical mitigation measures must be integrated into designs where possible:
    - drop-inlets or stepped inlet weirs should be installed at inlets to facilitate a change in grade; and
    - crossing outlets should be graded to tie back into natural ground level downstream.
- Appropriate erosion protection measures must be installed to reduce bed erosion / scour. This should include the installation of measures to dissipate energy and flow velocity and reno mattresses to reduce erosion risk where areas of high erosion risk are identified.

7.2.3 Road Stormwater Management

Stormwater management will be designed according to SANRALs Drainage Manual which seeks to minimise risks to road users. The following specific mitigation measures will however be adhered to, to reduce risks to receiving watercourses:

- Where possible grass-lined channels must be integrated into the stormwater drainage system to trap sediments and pollutants.
- Where erosion risks are a concern, stone pitching and/or gabion mattress must be used to line drains.
- Where space permits, inline weirs or detention ponds must be introduced to promote detention and infiltration.
- All stormwater outlets must be designed with energy dissipaters and appropriate erosion protection to limit erosion risks.

7.3 Construction Phase Mitigation Measures

These mitigation measures and management recommendations have been compiled based on specialist knowledge and experience in similar linear projects in EC as well as the latest available best-practice environmental management guidelines.

7.3.1 Method Statements for working in watercourses

A detailed method statement for working in watercourses / freshwater ecosystems must be compiled and appended to the construction (EMPr) prior to construction commencing. Detailed method statements should be compiled by a freshwater ecological specialist in conjunction with the project engineer / civil contractor, prior to any construction commencing.

Separate statements must be compiled for the following watercourses types:

- Rivers and streams
- Channelled valley bottoms wetlands
- Un-channelled valley bottom wetlands and seeps

7.3.2 No-go area / working area demarcations

- The construction corridor width at all watercourse crossings must be minimised as far as practically possible and must include the road footprint and an access and/or haulage corridor along both sides of the road footprint with a maximum width of 5m.
- Before any work commences within 32m of a watercourse, the outer edge of the construction corridor within or in close proximity to watercourses must be marked out and clearly demarcated using highly visible material, preferably brightly coloured shade cloth.
- All demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- Demarcations are to remain until construction and rehabilitation is complete.
- All areas outside of this demarcated working servitude must be considered no-go areas for the entire construction phase.
- Access to and from the development area should be either via existing roads or within the construction servitude.
- Temporary access routes should be designed to avoid watercourses as far as possible and to limit their potential impact on the environment (existing access roads to be used where possible).
- Prevent access at the approach and departure points to wetlands and river channels to prevent vehicles crossing these areas upstream or downstream of designated areas.
- Any contractors found working inside the 'No-Go' wetland/river areas (areas outside the construction/ working servitude) should be fined as per a fining schedule/system setup for the project.

7.3.3 Plant rescue plan and protected plant permits

- All intact wetland and riparian vegetation within the construction corridor (working area) that can be practically transplanted and used in rehabilitation must be rescued and temporarily stored onsite for later rehabilitation.
- All protected and threatened plants that can be practically transplanted and used in rehabilitation must be rescued and temporarily stored onsite for later rehabilitation.
- A suitably qualified botanist or horticulturalist must be appointed to compile a detailed plant rescue plan prior to construction commencing. This plan must include arrangements to store and/or relocate any such species into suitable onsite or offsite habitats or, in the case of rescued plants which are suitable for rehabilitation maintain them in a nursery until they are required.
- Protected plant destruction or relocation permits must be acquired prior to construction commencing.

7.3.4 Fauna rescue and relocation plan

- If threatened fauna are likely to be present within certain freshwater habitats to be infilled and/ or cleared, a search and rescue plan for fauna of conservation concern must be undertaken by a qualified zoologist prior to habitat clearing and destruction.
- All fauna encountered during vegetation cutting and clearing must be rescued and relocated to suitable intact habitat(s) that have been identified and made known to the ECO before clearing commences.

7.3.5 Temporary diversions and impoundments

- Under no circumstances should temporary diversion channels be established. If the isolation of working areas from flow is required, temporary coffer dams should be constructed, the details of which should be included in the detailed method statements.
- Under no circumstance should the damming of rivers that totally restrict / impound flow occur. Water impoundments and barriers must be temporary and lows flows to downstream areas must be maintained.

7.3.6 Running tracks / haulage routes / access routes establishment within watercourses

- Wherever possible the establishment of construction corridor running tracks across watercourses should be avoided.
- The crossing of channels by temporary running tracks must be minimised.
  - Use low-ground-weight construction equipment, or operate normal equipment on timber riprap, prefabricated equipment mats, terra mats or bog mats to avoid rutting and limit impacts to aquatic habitats.
  - For permanent and seasonal wetlands, the vegetation and topsoil must not be stripped. Rather the vegetation should be cut and bog mats or other load spreading mats that reduce compaction must be laid down for the running track.
  - No excavator or heavy machinery must enter a semi-permanent to permanent wetland zone prior to the establishment of bog-mats.
  - For temporary wetlands and riparian areas, the vegetation along the running track will need to be stripped after the plant rescue process has been completed.
  - Geotextile/geofabric must be laid down along running track corridors. Thereafter, crusher run/stone/rock material laid down on top of the geofabric. This is to avoid mixing of foreign material with the wetland soils.
  - Where applicable, the macro and active channel banks along the running track should be re-graded to a slope that will allow for safe access by heavy machinery to the channel bed.

7.3.7 Runoff, erosion and sediment control

Outside of the watercourses:

- Wherever possible, existing vegetation cover on the development site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2-4m) to break the energy of surface flows.
- No bare slopes should be left unprotected for more than a week. During the wet season, no bare slopes should be left unprotected for more than 2 days.
- For work to be undertaken immediately upslope / adjacent to the watercourse units, a row of sand bags must be installed along the outer edge of the construction corridor as a last line of defence. This should be in addition to the rows of erosion / sediment control measures spaced at 2 m intervals. The watercourses of importance to consider for these measures are:
    - **Wetland Units: W10, W12, W14 & W16**
- Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
- If re-vegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.

Measures specific to working within watercourses:

- The duration of construction work within the watercourses must be minimised as far as practically possible through proper planning and phasing.
- Construction work within the watercourses should be limited to the dry winter season wherever possible.
- When working within watercourses, downstream silt traps / curtains should be installed to capture sediment eroded from the working area prior to construction activities commencing within the watercourses. These silt traps must be regularly monitored and maintained and replaced / repaired immediately as and when required. These measures should be regularly

checked, maintained and repaired when required to ensure that they are effective. The ECO must sign-off on these measures prior to construction activities within the watercourses commencing.

- For work to be undertaken within the watercourse units, a row of sand bags must be installed along the outer edge of the construction corridor as a last line of defence. This should be in addition to the rows of erosion / sediment control measures spaced at 2 m intervals. The watercourses of importance to consider for these measures are:
    - **Wetland Units: W03, W04, W06, W07, W08, W09, W11, W15, W17**
- Under no circumstances must new channels be created for flow diversion and conveyance purposes unless approved as part of an EA or WUL.
- If dewatering is required, pumped water must be discharged back into the watercourses in a manner that does not cause erosion or elevated levels of sedimentation. In this regard, pumped water should be discharged into an erosion control and sediment trap structure designed for such a purpose. Such a structure should not be located near steep banks or slopes where water re-entering the watercourses could cause erosion.

With regards to the above measures, it is important that the costs of the implementation of such measures are factored into the tender specification and awarded contract. Quantities and costs of measures must be determined by the project engineer in conjunction with the appointed contractor and ECO. In addition, the ECO should perform periodic visual inspections of on-site habitat and water quality, identifying the source of any rapid increases in sediment deposits and turbidity of surface waters and remedying this where necessary.

7.3.8 Soil management

- Soil stockpiles must be established on flat ground at least 15m away from all watercourses.
- Erosion/sediment control measures such as silt fences, low soil berms or wooden shutter boards must be placed around the stockpiles to limit sediment runoff from stockpiles.
- Any topsoil removed from the road footprint must be stockpiled separately from subsoil material and be stored appropriately for use in rehabilitation activities.
- Stockpiles of construction materials must be clearly separated from soil stockpiles in order to limit any contamination of soils.
- The stockpiles may only be placed within demarcated stockpile areas, which must fall within the demarcated construction area. The contractor shall, where possible, avoid stockpiling materials in vegetated areas that will not be cleared.
- Stockpiled soils are to be kept free of weeds and are not to be compacted. The stockpiled soil must be kept moist using some form of spray irrigation on a regular basis as appropriate and according to weather conditions.
- If soil stockpiles are to be kept for more than 3 months they must be hydroseeded.

The slope and height of stockpiles must be limited to 1.5m and are not be sloped more than 1:2 to avoid collapse.

7.3.9 Invasive alien plant control

- All alien invasive vegetation that colonise the construction site must be removed, preferably by uprooting. The contactor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for IAPs every two weeks and IAPs removed by hand pulling/uprooting and adequately disposed.
- Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in wetlands by independent testing authority are to be used. The ECO must be consulted in this regard.

7.3.10 Establishment and management of construction camp, storage and laydown areas

Location:

- When locating the construction camp and equipment yard, watercourses and areas susceptible to soil erosion and/or water contamination must be avoided. The camp must be situated at least 32m away from the edge of the nearest watercourse.
- The camp should be established on level ground.
- The location of the camp site should be approved by the appointed Environmental Control Officer (ECO).

Camp Site Ablutions:

- The Contractor shall make adequate provision for temporary chemical toilets for the use of their employees during the Construction Phase. Such facilities, which shall comply with local authority regulations, shall be maintained in a clean and hygienic condition. Their use shall be strictly enforced.
- All chemical toilets must be situated at least 32m away from the edge of the nearest watercourse.
- The location of the toilets should be approved by the appointed ECO.
- An adequate number of self-contained chemical toilets must be established on site – at least one toilet for every 15 workers.
- Weekly servicing of the chemical toilets on site needs to be practiced by the supplier and service records are to be submitted to the ECO on a monthly basis. Toilets on site need to be kept in a clean and hygienic state.
- Contractors must ensure that no spillage occurs when chemical toilets are cleaned and that the contents are properly stored and removed off-site.

7.3.11 Hazardous substances / materials management

- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 15m of the artificial wetland.
- No vehicles transporting concrete, asphalt or any other bituminous product may be washed on site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period following the appropriate SANS codes. The bund wall should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- Sanitation - portable toilets (1 toilet per 10 users) to be provided where construction is occurring. Workers need to be encouraged to use these facilities and not the natural environment. Toilets must not be located within the 1:100yr flood line of a watercourse or within the buffer of any natural watercourses. Waste from chemical toilets must be disposed of regularly (at least once a week) and in a responsible manner by a registered waste contractor. Toilet facilities must be serviced weekly and in a responsible manner by a registered waste contractor to prevent pollution and improper hygiene conditions.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- An emergency spill response procedure must be formulated and staff are to be trained in spill response. All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- 44-gallon drums must be kept on site to collect contaminated soil. These should be disposed of at a registered hazardous waste site.
- Provide adequate rubbish bins and waste disposal facilities on-site and educate/encourage workers not to litter or dispose of solid waste in the natural environment but to use available facilities for waste disposal.
- Clear and completely remove from site all general waste, constructional plant, equipment, surplus rock and other foreign materials once construction has been completed.

- Litter generated by the construction crew must be collected in rubbish bins and disposed of at registered landfill sites.
- Litter bins must be equipped with a closing mechanism to prevent their contents from blowing out or wild animals from accessing the contents.

7.3.12 Solid waste management

- Eating areas must not be located within 30m of the wetland/aquatic habitats.
- Waste bins must be provided at the eating areas.
- Bins and/or skips need to be supplied at convenient intervals on site for disposal of waste within the construction camp. The bins should have liner bags for easy control and safe disposal of waste.
- Bins should be provided to all areas that generate waste e.g. worker eating and resting areas and the camp site. General refuse and construction material refuse should not be mixed.
- Regular clearing/maintenance of bins is required.

7.3.13 Noise, dust and light pollution minimisation

- Temporary noise pollution due to construction works should be minimized by ensuring the proper maintenance of equipment and vehicles and tuning of engines and mufflers as well as employing low noise equipment where possible.
- A water truck may be required to suppress dust by spraying water on affected areas producing dust.
- No lights must be established within the constriction corridor within or in close proximity to important and sensitive freshwater habitats.

7.3.14 Prohibitions related to the Illegal harvesting of plants and hunting of wildlife

Appropriate environmental awareness talks must be given to workers. This must include training on the need to protect indigenous biodiversity. Key messages should include:

- No firewood or medicinal plants may be harvested from natural areas;
- No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way or removed from the site. This includes animals perceived to be vermin.
- Access to sensitive habitat types (e.g. riparian and swamp forest habitat) outside of the construction zone is not permitted.
- Any fauna that are found within the construction corridor should be moved to the closest point of natural or semi-natural vegetation outside the construction servitude.

7.3.15 Preliminary rehabilitation strategy (conceptual plan)

For those watercourses to be directly affected by the project activities, the developer / applicant is responsible for rehabilitation all construction impacts after which they are responsible for the

maintenance of the road servitude. Construction phase rehabilitation guidelines are provided in this section.

All construction phase impacts to freshwater habitats, both planned and unplanned, need to be rehabilitated successfully before the contractor's scope of work and responsibilities can be considered completed. The desired state for the areas to be rehabilitated is to rehabilitate all physical disturbances and establish an indigenous plant cover that effectively stabilises the soil, minimises long-term erosion, and minimises long-term alien pant invasion. The key rehabilitation interventions should be to:

1. Reshape all physically disturbed and modified freshwater habitat and repair all potential erosion damage to more-or-less similar slope and morphological characteristics that existed prior to construction commencing.
2. Revegetate the affected habitats with suitable indigenous vegetation with the aim of achieving an adequate cover in the shortest time that is financially practical. In this regard it is recommend that re-vegetation be undertaken as follows:
   a. **For important and sensitive vegetation communities:**
      i. Herbaceous wetlands: Actively re-vegetate with rescued sods. For the permanent wetlands, gaps are likely to fill up over time without much active intervention. For seasonal wetlands, additional sods may need to be sourced to increase the planting densities. Suitable donor sites must be identified by a wetland ecologist and transplanting / translocation undertaken by a suitably qualified and experienced planting contractor.
      ii. Swamp forest and riverine forest: Trees will need to be sourced from a local nursery as tree translocation is costly. The costs of sourcing new saplings versus translocating saplings from donor sites will need to be investigated. Understorey plants and groundcover will need to either be rescued for re-vegetation or sourced from donor sites. Suitable donor sites must be identified by a wetland ecologist and transplanting / translocation undertaken by a suitably qualified and experienced planting contractor.
      iii. Marginal riparian zones: The active channel banks and marginal riparian zones must be re-vegetated with rescued sods or re-vegetated by translocating plants from donor sites. Suitable donor sites must be identified by a wetland or aquatic ecologist and transplanting / translocation undertaken by a suitably qualified and experienced planting contractor.
      iv. Non-marginal riparian zones - Banks: The channel banks must be re-vegetated with rescued sods. Suitable donor sites must be identified by a wetland or aquatic ecologist and transplanting / translocation undertaken by a suitably qualified and experienced planting contractor.
      v. Non-marginal riparian zones - Flood benches, floodplains and terraces: The channel banks must be re-vegetated with rescued sods. Suitable donor sites must be identified by a wetland or aquatic ecologist and transplanting / translocation undertaken by a suitably qualified and experienced planting contractor.

b. **For degraded and transformed vegetation communities:** Re-vegetation by hydroseeding with suitable indigenous grass seed mixes tailored to the prevailing soil moisture conditions will be sufficient.

c. **Dryland buffer zones:** Hydroseeding with an indigenous seed mix will be sufficient.

Although hydroseeding does not offer instant protection like sodding or relatively quick cover establishment like plugs, it provides protection within a few months and is a lot cheaper than sods.

Table 19 outlines the recommended rehabilitation measures specific to this project that will need to be included in a detailed construction phase rehabilitation plan and a detailed method statement for working within the watercourses. As part of the approval of the final construction EMPr, a detailed construction phase rehabilitation plan should be compiled and appended to the EMPr.

Table 19. Post construction rehabilitation guidelines disturbed freshwater habitats.

Rehabilitation Step	Rehabilitation Guidelines
STEP 1: Planning, timing and sourcing of materials	• The reshaping and general soil preparation can be undertaken by the appointed civil contractor, but the re-vegetation and associated specific soil preparation should be undertaken by a suitably qualified and experienced planting contractor. • The planting contractor will need to plant the rescued plants within the correct locations at the appropriate densities as per the detailed -re-vegetation plan in the rehabilitation plan. It is assumed that the planting contractor will be responsible for setting up and maintaining the temporary rescue plant storage facility. • If additional plant material is required, the planting contractor will need to harvest plant material from donor sites identified in the detailed rehabilitation plan. If such detail is not included in the rehabilitation plan, donor sites and harvesting densities will need to be confirmed by the planting contractor in conjunction with a wetland or aquatic ecologist. • For hydroseeding, the planting contractor will need to confirm the seed mix ratios as well as other required materials including fertiliser, mulch and geofabric. • All seed must be sourced from the closest nurseries which obtain their plant material from local genetic stock. • The germinability of the seeds must be confirmed prior to acceptance of seeds by the planting contractor. • Hydroseeding should ideally be undertaken early in summer. Irrigation will likely not be required during the wettest four months. Irrigation will be required outside of the optimal growing season period. Alternatively, the use of hygroscopic gels and similar products should also be investigated if replanting is undertaken in less than optimal seasonal conditions. • Where a rapid cover is required in the drier areas, the bare areas should be seeded with *Eragrostis tef* in addition to translocation planting. This will need to be done under the instruction and guidance of a wetland specialist or plant ecologist.
STEP 2: Remove any	• All waste products (spoil, construction materials, hazardous substances, and general litter) need to be removed from the site and disposed of at an

waste products	appropriate landfill site. • Minimise additional disturbance by limiting the use of heavy vehicles and personnel during clean-up operations. • Any large plumes of sediment collected in temporary stormwater infrastructure must be removed, taking care not to remove or disturb the natural soil profile. • Coffer dams and running tracks within the watercourse must be removed systematically moving backwards out of the wettest areas. All foreign material (e.g. sand bags, rock fill, imported soils, aggregate, geofabric etc.) must be removed from the watercourse, taking care not to remove natural sediment/rock from the watercourse.
STEP 3: Remove/control invasive alien plants	• All exotic/alien plants and weeds to be removed and properly disposed of prior to the implementation of rehabilitation measures. • Note that frequent hand removal is the most preferred option and only in the event that this is not a viable means of control, should chemical means be considered. • Herbicides which have been certified safe for use in aquatic environments by an independent testing authority must be given preference. The ECO must be consulted in this regard.
STEP 4: Stabilise, reshape and prepare soil profiles	• Exposed slopes are to be stabilized and re-vegetated as soon as practically possible. • Erosion control and soil protection measures such as geofabric, eco-logs and biodegradable silt fences must generally be installed prior to revegetation. • All riverbanks must be protected with a biodegradable geofabric such as Biojute® or other similar products. Temporary measures to prevent soil loss on the banks must be implemented which may include laying rows of sandbags/silt fences and silt fences at the water's edge. • Rip and / or scarify all disturbed and compacted areas of the construction site. The ECO with the assistance of the engineer will specify whether ripping and / or scarifying is necessary, based on the site conditions. • Do not rip and / or scarify areas that are saturated with water, as the soil will not break up. • If required, topsoil must be imported. Imported or stored topsoil must be re-spread across the reshaped surfaces prior to revegetation. • For the hydroseeding the soil will need to be prepared to optimise germination. Such preparation may be undertaken by racking. The soil in the seedbed should be loosened to facilitate good contact between the seeds and the soil. • No fertilizers should be applied. The need for mulch will need to be determined.
STEP 5: Re-vegetation of disturbed areas	• The soil which is to be planted should be watered to within 10% of field capacity the day before planting. 'Field Capacity' is the amount of soil moisture or water content held in soil after excess water has drained away and the rate of downward movement has materially decreased, which usually takes place within 2–3 days after a rain or irrigation in pervious soils of uniform structure and texture. • The re-vegetation should be timed to occur before the wet season (ideally at the onset of the wet season in early spring – August to October) so that watering requirements are minimized and plant growth is most vigorous. • Watering should be gentle so that rill erosion is avoided and minimised. • Any erosion damage resulting from watering/irrigation must be repaired immediately. • Alien and weed vegetation that colonize the rehabilitation areas must be removed and eradicated immediately via hand pulling and should be

	adequately disposed of.
STEP 6: Monitor re-vegetation progress and administer alien plant control	• It is the responsibility of the appointed planting contractor to ensure successful vegetation establishment and to undertake regular maintenance for 6 months after successful establishment. • The first 8 weeks after re-vegetation are the most critical in terms of maintenance and monitoring and weekly audits by an ECO with the planting contractor must be undertaken to monitor re-vegetation success. Only once an adequate ground cover is established (>80%) should the ECO sign-off on the completion re-vegetation. Targets for re-vegetation success include: o Low levels of Invasive Alien Plants (<10% IAP cover). o >80% indigenous vegetation cover. • Thereafter, monitoring visits by the ECO and contractor should be undertaken every 3 months for the first 6 months (two monitoring visits) after the completion of construction. At such visits the need for further re-vegetation, IAP clearing and erosion control / damage repair must be addressed where necessary. If problems persist, further maintenance and monitoring may be required as instructed by the ECO. • Implement IAP control for the first 12 months post-construction to ensure that alien plants are actively managed and eradicated from the site, with adequate monitoring and follow-up measures. This will need to include any disturbed areas created during construction. • The ECO should assess the need / desirability for further monitoring and control after the first 12 months and include any recommendations for further action to the relevant environmental authority. • The use of herbicides in IAP control will require an investigation into the necessity, type to be used, effectiveness and impacts of the agent on aquatic biota. • Any soil erosion in rehabilitated areas must also be addressed through appropriate actions.

7.3.16 Construction Phase - Monitoring Measures

- Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EO's (Environmental Officers) having the required competency skills and experience to ensure that monitoring is undertaken effectively and appropriately.
- Where required, inputs from a freshwater specialist must be obtained prior to construction to ensure that new crossings and bridge designs are reviewed and amended to limit environmental impacts.
- A photographic record of the state of the watercourse prior to the commencement of clearing/construction must be kept for reference and rehabilitation monitoring purposes.
- The ECO must undertake weekly compliance monitoring audits. Freshwater ecosystem aspects that must be monitored related to monitoring freshwater ecosystem impacts include:
    - The condition of the demarcation fence.
    - Evidence of any no-go area incursions.
    - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures or sediment deposits within watercourses.
    - Evidence of elevated river / stream turbidity levels.

  - Evidence of gully or bed/bank erosion.
  - Visual assessment of stormwater quality and instream water quality.
  - The condition of waste bins and the presence of litter within the working area.
  - Evidence of solid waste within the no-go areas.
  - Evidence of hazardous materials spills and soil contamination.
  - Presence of alien invasive and weedy vegetation within the working area.
  - Rehabilitation and re-vegetation methods and success.
- During the construction and rehabilitation phases, the ECO should conduct weekly site visits to ensure that the mitigation measures in the final method statements and EMPr are being adhered to.
- Once the construction and rehabilitation has been completed, the wetland specialist must conduct a close out site audit to assess compliance with recommended rehabilitation measures and to identify any additional actions required. These actions will then need to be checked and signed off by the ECO.

7.4 Operational Phase Mitigation Measures

7.4.1 Incorporation of watercourses into servitude maintenance

- Where watercourses occur within the road servitude but outside of road embankments (the proposed road footprint), these areas must not be subjected to typical servitude maintenance like mowing, cutting and burning. Wetland and riverine vegetation must be left alone.
- The applicant is responsible for ensuring that road embankments and servitudes within and adjacent to the watercourses are maintained in perpetuity so that long-term erosion and sedimentation risks are reduced.
- The applicant is responsible for the periodic monitoring of the road embankment and servitude vegetation cover and taking corrective action where necessary.

7.4.2 Incorporation of watercourses into maintenance and repair plans

- The location and extent of the delineated watercourses as well as the relevant mitigation measures within **Section 6** of this report, must be incorporated into all formal maintenance and repair plans for the road and associated infrastructure.

7.4.3 Road Embankment Re-vegetation

It is recommended that landscaping promote the use of indigenous species common to the region and that as much natural ground cover is established (naturally) on the site to help with binding soils and encouraging water infiltration, thus reducing overland flows and the pressure on stormwater management infrastructure.

7.4.4 Operational Phase Monitoring Measures

This involves annual monitoring of water resources in the road reserve (either crossed or impinged on) in order to ensure that operational impacts identified are being effectively managed. This can also be achieved through basic visual inspections documenting issues such as:

- Headcut advancement.
- Channel incision upstream and/or downstream of road crossings.
- Scouring and deposition associated with road run-off points.
- Scouring around or under road infrastructure at crossings (including bridge and culvert structures).
- Failure of drainage infrastructure such as culverts to maintain base levels within a water resourcing.
- Bank erosion within channels.

7.5 Additional Requirements

7.5.1 Water Use Authorisation/Registration Requirements

Section 21 of the National Water Act (No 36 of 1998) lists certain activities for which water uses must be licensed, unless its use is excluded. There are several reasons why water users are required to register and license their water use with the Department of Water & Sanitation (DWS), the most important being: (i) to manage and control water resources for planning and development; (ii) to protect water resources against over-use, damage and impacts and (iii) to ensure fair allocation of water among users. Depending on the nature of the development and water use, Section 21 (c) and (i) water uses could potentially be triggered by the development (and associated activities) and would then require a Water Use Licence (WUL) from the DWS. The potential for the Road Upgrades to trigger these water uses has been investigated by considering the proximity of the activity to the watercourses assessed in the specialist report and the risk of any related activities resulting in impacts to the resource quality of the water course, as specified under Chapter 4, Section 21 of the National Water Act No. 36 of 1998 (see Table 20, below).

Table 20. Water Uses applicable to the proposed development.

NWA Section 21 Water Use	Description (DWAF, 2009)	Relevance to the site
21(c): Impeding or diverting the flow of water in a watercourse	This water use includes the temporary or permanent obstruction or hindrance to the flow of water into watercourse by structures built either fully or partially in or across a watercourse; or a temporary or permanent structure causing the flow of water to be re-routed in a watercourse for any purpose.	*Instream works will likely require temporary flow diversion and impedance depending on the nature of flows at the time of construction and as such will constitute a water use.*
21(i): Altering the bed, banks, course or characteristics of a watercourse	This water use relates to any change affecting the resource quality of the watercourse (the area within the riparian habitat or 1:100 year floodline, whichever is the greatest).	*Instream works will likely result in alterations to the bed and banks of the watercourses.*

The recent General Authorisation (GA) in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (c) or Section 21 (i), (as contained in Government Gazette No. 40229, 26 August 2016) replaces the need for a water user to apply for a license in terms of the National Water Act No. 36 of 1998, 'provided that the water use is within the limits and conditions of the GA'. Note that the GA does not apply to:

1. Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
2. Use of water within the 'regulated area' [10] of a watercourse where the Risk Class is Medium or High.
3. Where any other water use as defined in Section 21 of the NWA must be applied for.
4. Where storage of water results from Section 21 (c) and/or (i) water use.
5. Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

The recent GA also includes a number of activities that are generally authorized for State Owned Companies (SOC's) and institutions that are then subject only to compliance with the conditions of the GA (summarised below under Section 6.5.2). Under Appendix D2 of the GA, for SANRAL and the Provincial Departments of Transport or municipalities, the following activities can be authorized under the GA:

- All maintenance of roads/bridges over rivers, streams and wetlands and the new construction of roads/bridges done according to the SANRAL Drainage Manual or similar norms and standards.

[10] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

iv. The outer edge of the 1:100 year flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.
v. In the absence of a determined 1:100 year flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).
vi. A 500m radius from the delineated boundary of any wetland or pan.

This essentially replaces the need for SANRAL to apply for a full water use license for the upgrades to the existing N2 community access roads, and those activities and water uses could then potentially be authorised under the provisions of the GA subject to compliance with the conditions of the GA.

7.5.2 Conditions of the GA

Note that conditions set for Section 21 (c) and (i) water use in terms of the GA specify that the water user must ensure that compliance with the following is achieved:

a. Impeding or diverting flow or altering the characteristics of a watercourse does not detrimentally affect other water users, property, health and safety of the general public or the resource quality.
b. The existing hydraulic, hydrologic, geomorphic and ecological functions of the watercourse in the vicinity of the structure is maintained or improved upon.
c. Full financial provision for the implementation of the management measures prescribed in the GA, including an annual financial provision for any future maintenance, monitoring, rehabilitation or restoration works (as may be applicable).
d. Construction camps, storage, washing and maintenance of equipment, storage of construction materials or chemical, sanitation and waste management facilities are located outside of the 1:100yr flood line or riparian habitat of a river, spring, lake, dam or outside any drainage feeding any wetland or pan and is removed within 30 days of completion of any works.
e. The site where water use will occur must not be located on a bend in the watercourse, must avoid high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs and seeps; avoid or minimise realignment of a watercourse, minimise the footprint of alteration and construction footprint.
f. A maximum impact footprint around the works must be established, clearly demarcated, no vegetation may be cleared or damaged beyond this demarcation and equipment/machinery should only be operated within the delineated impact footprint.
g. Minimise the duration of disturbance and the footprint of disturbance of the bed and banks of the watercourse.
h. Prevent the transfer of exotic biota to the site.
i. All works must start upstream and proceed in a downstream direction to ensure minimal impact on the water resource.
j. Excavated material from the bed or banks of a watercourse must be stored appropriately and returned to the original locations upon completion of the works.
k. Adequate erosion control measures are to be implemented at and near all alterations, with an emphasis on erosion control on steep slopes and drainage lines.
l. Alteration or hardened surfaces must be structurally stable, not induce sedimentation, erosion or flooding, not cause a detrimental change in the quantity, velocity, pattern, timing, water level, water quality, stability or geomorphological structure of a watercourse, or cause nuisance or health or safety hazards.
m. Measures are undertaken to protect the breeding, nesting or feeding patterns of aquatic biota (including migratory species), allow for the continued movement of biota up and downstream

and prevent a decline in the composition and diversity of indigenous and endemic aquatic biota.

n. Ensure that no substance or material that can potentially cause pollution of the water resource is being used in works.

o. Measures are undertaken to prevent increased turbidity, sedimentation and detrimental chemical changes to the composition of the water resource.

p. Instream water quality is to be measured on a weekly basis during construction (includes pH, EC/TDS, TSS/Turbidity, DO) both upstream and downstream of the works.

q. In-stream flow is to be measured on an on-going basis by means of instruments and devices certified by the SABS, with a baseline measurement at least one week prior to initiation of the works.

r. One or more photographs or video-recordings must be taken of the watercourse and its banks at least 20m upstream and 20m downstream from the structure/works. These must be taken on a daily basis, starting one week before commencement of any works and continuing of one month upon completion.

Furthermore:

- Rehabilitation authorized in terms of the GA (i.e where risk is deemed "Low") must be conducted in terms of a rehabilitation plan, with implementation overseen by a suitably qualified SACNASP registered *Pr.Sci.Nat*.
- Upon completion of construction activities, a systematic rehabilitation programme must be undertaken to restore the watercourse to its condition prior to the commencement of the water use. All disturbed areas must be re-vegetated with indigenous vegetation suitable to the area.
- Active alien invasive plant control measures must be implemented to prevent invasion by exotic and alien vegetation within the disturbed area.
- Upon completion of any works, during any annual inspection to determine the need for maintenance at any impeding or diverting structure, disturbed areas are to be cleared of construction debris/blockages, alien invasive vegetation, must be re-shaped to free-draining and non-erosive contours and re-vegetated with indigenous vegetation suitable to the area.
- Upon completion of any works, the hydrological functionality and integrity of the watercourse (bed, banks, riparian habitat and aquatic biota) must be equivalent or exceed that which existed before commencing with the works.
- The water user must establish and implement monitoring programmes to measure the impact on resource quality to ensure water use remains within the parameters in terms of water quality and quantity (maintaining instream flow).
- Baseline monitoring to be undertaken to determine 'present day values' for water resource quality before commencement of water use.
- Upon completion of construction activities, any Environmental Rehabilitation structures must be inspected regularly for the accumulation of debris, blockages, instabilities and erosion with remedial and maintenance actions implemented where required.
- An audit is to be undertaken annually for three years to ensure that the rehabilitation is stable.

8 CONCLUSION

The South African National Roads Agency State Owned Company Limited (SANRAL) plans to upgrade the existing local road network to tie in with the National Road Route 2 interchange upgrade Section 18 between Mthatha and Viedgiesville in the Eastern Cape. This assessment sets out the findings of a rapid assessment of freshwater ecosystems associated with the community access road upgrades.

A total of **17** watercourse units were found to be crossed and/or within 32m of the proposed development footprint (i.e. units considered to be potentially negatively affected). The dominant watercourse type to be crossed is the hillslope seep HGM (65%) followed by channelled valley bottom wetlands (24%) and un-channelled valley bottom wetlands (12%). The current proposed roads to be upgraded do not cross any minor or major rivers.

Extensive overgrazing, excessive burning and outright loss of grassland habitat to residential and infrastructure development in the upstream catchment has resulted in a number of cumulative impacts on the watercourses assessed. Thus, understandably their PES and EIS scores reflect their heavily degraded state. Most of the wetland units assessed are seriously modified (PES Class E). Nevertheless, although already seriously compromised, these systems will be impacted upon further by the community access roads upgrade project.

The significance and risk assessment undertaken for the project reveal that three impacts will be significant, namely:

For WULA Project Activities:

- Impact C1 – Threatened freshwater habitat loss / destruction and modification (**Moderately-Low significance**).
- Impact C2 – Indirect impacts of land clearing and construction activities within or near the watercourses (**Moderately-Low significance**).
- Impact O2 – Indirect impacts of flow concentration and associated erosion and sedimentation resulting from diversion of flows through road crossings (**Moderate-Low significance**).

The impact significance assessment findings indicate that Impacts C1, C2 and O2 are the most significant impacts and should pose the highest risks to freshwater ecosystem integrity and biodiversity. This is confirmed by the risk assessment results that indicate that Impact C1 poses a moderate risk to wetland ecosystem functioning due to permanent freshwater habitat infilling, and Impacts C2 and O2 likewise pose a moderate risk to wetland ecosystems. After careful consideration of the best practical mitigation measures (design revisions and operational mitigation measures recommended by Eco-Pulse in this specialist report), the risk scores for borderline low/moderate cases were manually reduced from Moderate to a Low Risk class.

A detailed suite of mitigation and management measures has been provided in this report to minimise the above-listed impacts. However, although the significance and risk of Impacts C2 and O2 can be

reduced to acceptable levels with the strict adoption and implementation of the mitigation measures provided, Impact C1 cannot be effectively mitigated as it involves the permanent loss of threatened freshwater habitat and thus remains a residual impact of moderately-low significance for the WULA.

Key measures such as best practise mitigation and rehabilitation as well as adequate and appropriate storm water management will aid in the reduction of impact significance to lower levels for these key impacts/risks. Proper implementation of an appropriate Environmental Management Programme, monitoring of construction impacts and rehabilitation effectiveness are considered critical in assuring the risk of loss of ecosystem state and functionality following construction is avoided or minimised. In addition, longer-term road maintenance and monitoring should be undertaken to address long-term impacts associated with road operation and ensure that operation-phase impacts are managed and rectified where possible.

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10 ANNEXURES

See separate document - Proposed Upgrade of the Municipal Access Roads to the N2 Section 18 between Mthatha and Viedgesville, King Sabata Dalindyebo Local Municipality, Eastern Cape *Freshwater Ecosystem Impact Assessment Report – Annexures.*

PROPOSED UPGRADE OF THE MUNICIPAL ACCESS ROADS TO THE N2 SECTION 18 BETWEEN MTHATHA AND VIEDGESVILLE, KING SABATA DALINDYEBO LOCAL MUNICIPALITY, EASTERN CAPE

Freshwater Ecosystem Impact Assessment Report

Annexures

Version 1

Date: 30 July 2020

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Report No: EP503-01

LIST OF ANNEXURES

A – Relevant Environmental Legislation related to Freshwater Ecosystems

B – Description of Assessment Methods

C – Extent and Classification Maps

D – PES and EIS Maps

E – Impact Significance Tables

F - DWS Risk Matrix Tables

Annexure A: Relevant Environmental Legislation related to Freshwater Ecosystems

National Water Act (Act No. 36 of 1998) ('NWA')

Section 21 of the National Water Act (No 36 of 1998) lists certain activities that constitute water uses that must be licensed prior to construction commencing, unless the use is excluded. There are several reasons why water users are required to register and license their water use with the Department of Water & Sanitation (DWS), the most important being: (i) to manage and control water resources for planning and development; (ii) to protect water resources against over-use, damage and impacts and (iii) to ensure fair allocation of water among users (NWA, 1998).

The water uses included in Section 1 are:

a) taking water from a water resource;
b) storing water;
c) impeding or diverting the flow of water in a watercourse;
d) engaging in a stream flow reduction activity contemplated in section 36;
e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) disposing of waste in a manner which may detrimentally impact on a water resource;
h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) altering the bed, banks, course or characteristics of a watercourse;
j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) using water for recreational purposes.

In general, Section 21(c) and 21(i) water uses are the most common water uses associated with development projects because they encapsulate impacts resulting from activities within or in close proximity to watercourses, and include both direct and indirect impacts.

The definitions of the particular terms within Section 21(c) and (i) of the NWA are included in Section 1 of the NWA and Section 2 of Government Notice 509 of 2016 dealing with provisions for general authorisations published under Section 39 of the NWA. The relevant definitions are as follows:

Section 1 of NWA (1998):

- 'Resource quality' means the quality of all the aspects of a water resource including -
    - (a) the quantity, pattern, timing, water level and assurance of instream flow;
    - (b) the water quality, including the physical, chemical and biological characteristics of the water;
    - (c) the character and condition of the instream and riparian habitat; and
    - (d) the characteristics, condition and distribution of the aquatic biota.

Section 2 of GN No. 509 (2016):

- 'Characteristics of a watercourse' means the resource quality of a watercourses within the extent of a watercourse.
- 'Diverting' means to, in any manner, cause the instream flow of water to be rerouted temporarily or permanently.
- 'Extent of a watercourses' means:
    - 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; and
    - Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.
- 'Flow altering' means to, in any manner, alter in the instream flow route, speed or quantity of water temporarily or permanently.
- 'Impeding' means to, in any manner, hinder or obstruct the instream flow of water temporarily or permanently, but excludes the damming of flow so as to cause storage of water.

The important implications of these definitions are:

- A section 21(i) water use is applicable if the characteristics of a watercourse are altered irrespective of whether the alteration is direct or indirect. This means that a development can be located some distance away from watercourses but could still negatively impact a watercourse e.g. alteration of catchment hydrology, pollution of runoff etc.
- If the 1:100 year floodline of a river / stream is larger than the delineated riparian zone, the 1:100 year floodline constitutes the outer extent of the watercourse that could be negatively affected.

If an activity is considered a Section 21(c) and/or 21(i) water use, a water use license to commence with the construction and operation of the activity is required from the DWS subject to a formal water use license application (WULA). However, Section 39 of the NWA makes provision for the general authorisation of a water use without a formal water use license. General authorisations are applicable in the following situations as stipulated in GN No. 509 (2016):

- Where the proposed use has a low risk class as determined using the risk matrix published with GN No. 509 (2016).
- The activity constitutes maintenance work associated with an existing lawful water use in terms Section 21(c) or (i) of the Act that has a low risk class as determined using the risk matrix.
- The activity constitutes river and stormwater management activities as contained in a river management plan.
- Rehabilitation of wetlands or rivers where such rehabilitation activities has a low risk class as determined using the risk matrix.
- 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.

It is important to note that Sections 9 – 17 of GN No. 209 (2016) provide a generic / standard set of conditions for GA's, some of which are particularly onerous.

If the DWS confirm that a water use licence is not required, the NWA still imposes 'duty of care' on all landowners / developers, to ensure that water resources are not negatively impacted, particularly pollution. The following Clause in terms of the National Water Act is applicable in this case:

> *19 (1) "An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring"*

A person who is responsible for an incident, or who owns a substance involved in an incident or who was in control of a substance involved in an incident, must take all reasonable measures to contain and minimise the effects of an incident and any other such measures that a Catchment Management Agency (CMA) may require.

National Environmental Management Act (No. 107 of 1998) ('NEMA')

Listed Activities that may negatively affect watercourses including wetlands have been published in Listing Notices of the EIA Regulations (2017) published under Section 24(5) and 44 the NEMA. The relevant listed activities are described in Table 1 below. The environmental authorisation of activities included in Listing Notices 1 and 3 must be subject to a basic assessment and those under Listing Notice 2 must be subject to a full Environmental Impact Assessment (EIA).

Table 1. Relevant NEMA listed activities related to watercourses.

Government Notice No.	Activity No.	Activity Description
R. 327 (Listing Notice 1)	12	The development of- (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more, (xiii)dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or (xiv) 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 exists, within 32 metres of a watercourse, measured from the edge of a watercourse; - excluding- (aa) the development of infrastructure or structures within existing ports or

Government Notice No.	Activity No.	Activity Description
		harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves. (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.
R. 327 (Listing Notice 1)	13	The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 16 in Listing Notice 2 of 2014.
R. 327 (Listing Notice 1)	19	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- (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing , dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies. (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.
R. 327 (Listing Notice 1)	48	The expansion of- . (i) canals where the canal is expanded by 100 square metres or more in size ; (ii) channels where the channel is expanded by 100 square metres or more in size ; (iii) bridges where the bridge is expanded by 100 square metres or more in size; (iv) dams, where the dam, including infrastructure and water surface area, is expanded by 100 square metres or more in size; (v) weirs, where the weir, including infrastructure and water surface area, is expanded by 100 square metres or more in size; (vi) bulk storm water outlet structures where the bulk storm water outlet structure is expanded by 100 square metres or more in size; or (vii) marinas where the marina is expanded by 100 square metres or more in size; (viii) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; or (viv) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 100 square metres or more; where such expansion or expansion and related operation occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding- (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such expansion occurs within an urban area; or (ee) where such expansion occurs within existing roads or road reserves and railway reserves.
R. 327 (Listing Notice 1)	49	The expansion of - (i) jetties by more than 100 square metres;

Government Notice No.	Activity No.	Activity Description
		(ii) slipways by more than 100 square metres; (iii) buildings by more than 100 square metres; (iv) boardwalks by more than 100 square metres; or (v) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; where such expansion or expansion and related operation occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding- (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such expansion occurs within an urban area; or (ee) where such expansion occurs within existing roads or road reserves.
R. 325 (Listing Notice 2)	15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for— (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.
R. 325 (Listing Notice 2)	16	The development of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the highwater mark of the dam covers an area of 10 hectares or more.
R. 325 (Listing Notice 2)	24	The extraction or removal of peat or peat soils, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils, but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a maintenance management plan.
R. 324 (Listing Notice 3)	5	The development of resorts, lodges, hotels, [and] tourism or hospitality facilities that sleep less than 15 people: For all areas outside of urban areas in the Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape: - Areas within a watercourse or wetland, or within 100 metres of a watercourse or wetland. For all areas of the North West Province: - Areas within a watercourse or wetland, or within 100 metres of a watercourse or wetland.
R. 324 (Listing Notice 3)	6	The development of resorts, lodges, hotels, [and] tourism or hospitality facilities that sleep 15 people or more: For all areas outside of urban areas in Eastern Cape: - Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined; or - A watercourse, For all areas outside of urban areas in Free State, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape: Areas within a watercourse or wetland, or within 100 metres of the edge of a watercourse or wetland; or For all areas of the North West Province: (vi) Areas within a watercourse or wetland, or within 100 metres of a watercourse or wetland.
R. 324 (Listing Notice 3)	7	The development of aircraft landing strips and runways 1,4 kilometres and shorter. For all areas outside of urban areas in Eastern Cape: - Areas on the watercourse side of the development setback line or within

Government Notice No.	Activity No.	Activity Description
		100 metres from the edge of a watercourse where no such setback line has been determined; - A watercourse. For all areas outside of urban areas in Free State, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape: - Areas within a watercourse or wetland, or within 100 metres of the edge of a watercourse or wetland.
R. 324 (Listing Notice 3)	8	The development and related operation of above ground cableways and funiculars. For all areas inside urban areas in Free State, Mpumalanga, Northern Cape and North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland. For all areas inside urban areas in KZN: - Areas within a watercourse or wetland.
R. 324 (Listing Notice 3)	9	The development and related operation of ziplines or foefieslides Exceeding 100 metres in length. All areas within the Free State and North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland. For all areas inside urban areas in KZN: - Areas within a watercourse or wetland. For all areas inside urban areas in Mpumalanga and Northern Cape: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland.
R. 324 (Listing Notice 3)	10	The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. For all areas outside of urban areas in Free state, KZN, Mpumalanga: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; or All areas within Northern Cape, North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland;
R. 324 (Listing Notice 3)	11	The development of tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles excluding conversion of existing tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles. For all areas inside urban areas in KZN: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; All areas within North West: - Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.
R. 324 (Listing Notice 3)	12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. All areas within Free State, North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland.
R. 324 (Listing	13	The development and related operation of facilities of any size for any form of

Government Notice No.	Activity No.	Activity Description
Notice 3)		aquaculture. All areas within Free State, Northern Cape, North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland. All areas within KZN: - Areas within a watercourse or wetland;
R. 324 (Listing Notice 3)	16	The expansion of reservoirs, [for bulk water supply] excluding dams, where the capacity will be increased by more than 250 cubic metres. Inside urban areas within KZN: - Areas within a watercourse or wetland;
R. 324 (Listing Notice 3)	17	The expansion of a resort, lodge, hotel, [and] tourism or hospitality facilities where the development footprint will be expanded and the expanded facility can accommodate an additional 15 people or more. Outside urban areas within KZN: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; All areas within North West: - Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.
R. 324 (Listing Notice 3)	18	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. Outside urban areas within Free State, Northern Cape: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; All areas within North West: - Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.
R. 324 (Listing Notice 3)	19	The expansion of runways or aircraft landing strips where the expanded runways or aircraft landing strips will be longer than 1,4 kilometres in length. Outside urban areas within Free State, KZN, Northern Cape: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland;
R. 324 (Listing Notice 3)	20	The expansion and related operation of above ground cableways and funiculars where the development footprint will be increased. Inside urban areas within Free State, Mpumalanga, Northern Cape: Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland. Inside urban areas within KZN: - Areas within a watercourse or wetland; All areas within North West: - Areas within a watercourse or wetland, or within 100 metres from the edge a watercourse or wetland.
R. 324 (Listing Notice 3)	21	The expansion of tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles excluding conversion of existing tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles, where the development footprint will be expanded. Inside urban areas within KZN: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; All areas within North West: - Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.

Government Notice No.	Activity No.	Activity Description
R. 324 (Listing Notice 3)	22	The expansion and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage facilities or infrastructure will be expanded by 30 cubic metres or more but no more than 80 cubic metres. Outside urban areas within Free State, KZN, Mpumalanga: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; Inside urban areas within Mpumalanga: - Areas within 100 metres of a watercourse or wetland. All areas within Northern Cape, North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland;
R. 324 (Listing Notice 3)	24	The expansion and related operation of facilities of any size for any form of aquaculture. All areas within Free State, Northern Cape, North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland. All areas within KZN: - Areas within a watercourse or wetland;
	25	The expansion and related operation of zip- lines or foefie-slides, where the zip-line or foefie-slide is expanded by 100 metres in length or more. All areas within Free State, North West: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland. Inside urban areas within KZN: Areas within a watercourse or wetland; Inside urban areas within Mpumalanga, Northern Cape: - Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland.

Where environmental authorisation is not required, Section 28 of NEMA still imposes 'duty of care' on all landowners / developers. According to Section 28:

(1) Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.

(3) The measures required in terms of subsection (1) may include measures to—

a. investigate, assess and evaluate the impact on the environment;

b. inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;

c. cease, modify or control any act, activity or process causing the pollution or degradation;

d. contain or prevent the movement of pollutants or the causant of degradation;

e. eliminate any source of the pollution or degradation; or

f. remedy the effects of the pollution or degradation.

Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA')

Regulated activities that may negatively affect watercourses including wetlands are included in the CARA Regulations as amended (2001) published under Section 29 the CARA. The relevant regulated activities are described in Table 2 below. Formal approval / permission from an executive officer is required before such regulated activities can take place.

Table 2. Relevant CARA regulations related to watercourses.

Government Notice No.	Regulation No.	Regulation Description
R280 (March 2001)	2	- Cultivation of virgin soil Except on the authority of a written permission by the executive officer, no land user shall cultivate* any virgin soil**. * Cultivation: In relation to land, means any act by means of which the topsoil is disturbed mechanically. ** Virgin soil: land, which in the opinion of the executive officer, has at no time during the preceding ten (10) years been cultivated.
R280 (March 2001)	7	Utilisation and protection of vleis, marshes, water sponges and water courses. 7(1) no land user shall utilise the vegetation in a vlei, marsh or water sponge or within the flood area of a water course or within 10 metres horizontally outside such flood area in a manner that causes or may cause the deterioration of or damage to the natural agricultural resources 7(3) Except on authority of a written permission by the exec. officer, no land user shall – – 7(3)(a) drain or cultivate any vlei, marsh or water sponge or a portion thereof on his farm unit; or – 7(3)(b) cultivate any land on his farm unit within the flood area of a water course or within 10 metres horizontally outside the flood area of a water course. * ***Watercourse***: a natural flow path in which water is concentrated and along which it is carried away.
R280 (March 2001)	8	Regulation of the flow pattern of run-off water 8(1) no land user shall in any manner whatsoever divert any run-off water from a water course on his farm unit to any other water course, except on authority of a written permission by the executive officer. 8(4) no land user shall effect an obstruction that will disturb the natural flow pattern of run-off water on his farm unit or permit the creation of such an obstruction unless the provision for the collection, passing through and flowing away of run-off water through, around or along that obstruction is sufficient to ensure that it will not be a cause for excessive soil loss due to erosion through the action of water or the deterioration of the natural agricultural resources.

Other Potentially Applicable Legislation

Other pieces of legislation that are not always applicable to development activities but which could be relevant in certain circumstances are:

- **National Environmental Management: Biodiversity Act (No. 57 of 2003) (NEM:BA)** - NEM:BA provides various measures for the protection of biodiversity, including the control of activities affecting threatened or protected species and ecosystems and activities involving alien and invasive species. Various planning

tools are provided for, including bioregional plans and biodiversity management plans. IDP's must align with national biodiversity framework and bioregional plans.

- **National Environmental Management: Protected Areas Act (No. 57 of 2003) (NEM:PAA)** - The purpose is to effect a national system of representative protected areas to preserve the country's biodiversity, natural landscapes and seascapes, including freshwater ecosystems and aquatic / wetland dependent species, and manage such areas in a sustainable manner.
- **National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA)** - Through the regulation of waste management, including disposal of waste, water resources are protected. Dumping of waste and various other activities which may affect rivers and wetlands are prohibited.
- **National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (NEM:ICMA) -** NEM:ICMA provides for various mechanisms to regulate activities in the coastal zone, including coastal rivers and wetlands situated within the zone. Where a river / wetland falls within the coastal protection zone, additional considerations are relevant in making a decision whether to grant an environmental authorisation.
- **Environmental Conservation Act (No. 73 of 1989) -** This Act has been superseded by NEMA. However, a Section 31A directive can still be used by the competent authority, local authority or government institution to legally instruct a person that is causing / has caused damage to the environment (including wetlands) to:
    - to cease such activity; or
    - to take such steps as the Minister, competent authority, local authority or government institution, as the case may be, may deem fit,

  within a period specified in the direction, with a view to eliminating, reducing or preventing the damage, danger or detrimental effect.
- **Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) -** The Act provides for the regulation of the prospecting for and extraction of mineral and petroleum resources. In particular the Act provides regulations for environmental management, and pollution control and waste management for all phases of mining activities. In this regard, impacts to rivers and wetlands are required to be identified, assessed and adequately mitigated prior to issuing mining permits and rights.
- **National Forests Act (No. 84 of 1998)** - This Act is underpinned by sustainable forest use and management and provides for the protection of certain forests and trees. The conservation of biological diversity, ecosystems and habitats, and natural resources, especially soil and water, are key components of sustainable forest management in terms of the Act. The Act prohibits the destruction of natural forests (including riparian and swamp forests) without a formal license and regulates use of forests (including riparian and swamp forests). In particular, the cutting, disturbance, damage or destruction of any indigenous tree occurring in a natural forest (including riparian and swamp forests) cannot commence without acquiring a license.
- **Water Services Act (No. 108 of 1997)** - The Act is underscored by the following principles:
    - Recognizing the rights of access to basic water supply and basic sanitation necessary to ensure sufficient water and an environment not harmful to health or well-being.
    - Acknowledging that there is a duty on all spheres of Government to ensure that water supply services and sanitation services are provided in a manner which is efficient, equitable and sustainable.

- Recognizing that the provision of water supply services and sanitation services, although an activity distinct from the overall management of water resources, must be undertaken in a manner consistent with the broader goals of water resource management.

Thus, all water service authorities (WSAs), which are often municipalities, are required to ensure the sustainable provision of basic water supply and sanitation services with the aim of safeguarding resources for future generations. This includes ensuring that impacts to rivers and wetlands are minimized to acceptable levels.

- **National Veld and Forest Fires Act, 101 of 1998** - Where the burning of fire breaks includes burning reeds in wetlands, the requirements of this Act must be also complied with.
- **World Heritage Convention Act, 49 of 1999 (WHCA)** - The WHCA provides for the declaration of world heritage sites, which may include rivers and wetlands. The development implication will be the restrictions on development imposed in the management plans and Regulations for each site.

Annexure B: Description of Assessment Methods

B1 Desktop assessment

Desktop review and consolidation of available information

Available data was used to contextualise the study area including an assessment of soils, geology, hydrology, geomorphology, climate and vegetation types. The conservation context and associated conservation significance of the project area was described using available spatial datasets including Freshwater Ecosystem Priority Areas or NFEPA Project (CSIR,2011) and the Aquatic Systematic Conservation Plan for the Province (EKZNW, 2007). DWA have also recently completed an exercise to consolidate available information and to assess the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of rivers nationwide. While this dataset requires verification, it provides a very useful dataset to inform an assessment of this nature. In addition, a number of specialist reports were reviewed, including the Aquatic Specialist Reports (EP389-01, 2018; EP350-01, 2019).

Desktop mapping and classification of water resources

Given the extent of the development, desktop mapping is regarded as critical to inform planning of onsite field assessments. This mapping was informed by the preliminary mapping done for the Errol Sprigg Road expansion (2018) and the N2 Section 18 re-alignment and borrow pits (2019) prepared by Eco-Pulse Consulting and refined and updated for the study area using recent aerial photography of the route and any available contour information. This mapping focused on areas within 500m of the route alignment as required for water use licensing. Preliminary desktop classification of water resources was be based onthe National Wetland Classification System for South Africa (SANBI, 2009). See ***Annexure A3 and A4*** below for detailed classification guidelines.

Flagging water resources to inform field assessments

The focus of field visits was to delineate water resources along the road alignment and to gather relevant supporting information necessary to inform water use licensing. Whilst it would be ideal to visit each and every stream/river and wetland that will be impacted, this was impractical for an assessment of this nature, based on scale and accessibility constraints.

Water resources were therefore flagged and prioritized for field verification based on available desktop information. Two key criteria were used for this flagging process (see Table 3-5, below for details):

- **Impact potential:** Informed at a desktop level based on the following classes:
    - **Low:** Water resources located within 500m of the proposed development but that are unlikely to be impacted to any meaningful extent by the proposed development (e.g. river well outside development footprint / wetland well above the planned road)
    - **Moderate:** Water resources which will not be directly impacted by the proposed development but are at risk as a result of potential indirect impacts (e.g. wetlands within 50m of road servitude)
    - **High:** Water resources that will be directly impacted by the proposed development or water resources that are at a high risk of being impacted due to their location in relation to the

proposed development (e.g. large rivers running alongside the servitude / sensitive wetlands located close to the servitude.

- **Sensitivity of the receiving environment**. At a desktop level, this was informed by:
  - The current state (PES) of the receiving environment (e.g. degraded vs largely intact ecosystems);
  - Size or type of system (small systems are often less sensitive due to limited habitat diversity and seasonality)
  - The FEPA catchment status & other available information (e.g. EIS of large Rivers).
  - River FEPA status (River FEPA or Non-River FEPA)

This was used to assign a flag status to water resources along the route alignment to inform field work (Table 1).

Table 3. Criteria and scores used to flag wetlands.

	Scoring range (0 – 1) →		
Field	**Low sensitivity**	**Moderate sensitivity**	**High sensitivity**
Size	0 - Small (>2ha)	0.5 - Medium (2-10ha)	1 - Large (<10ha)
Desktop PES	0 - E/F	0.5 - C D	1 - A/B
Potential Impact	0 - Low (>50m)	0.5 - Medium (within 50m)	1 - High (Crossing)

Table 4. Criteria and scores used to flag rivers.

	Scoring range (0 - 1) →			
Field	**Low sensitivity**	**Moderate sensitivity**		**High sensitivity**
Channel Type	0 - Ephemeral/Seasonal	0.5 - Small		1 - Large Perennial
FEPA Catchment	0.25 - Upstream Management Catchment	0.5 - Phase 2 FEPA/Fish Rehab	0.75 - Fish Support Area	1 - FEPA
River FEPA	0 - Non-River FEPA		1 - River FEPA	
Desktop PES	0 - E/F	0.5 – C/D		1 - A/B
Potential Impact	0 - Low (>50m)	0.5 - Medium (within 50m)		1 - High (Crossing)

Table 5. Description and level of field assessment required for respective flag status.

FLAG STATUS SYMBOL IN GIS		FLAG STATUS DESCRIPTION	LEVEL OF FIELD ASSESSMENT
	"Green" Flag	Given the status of the receiving environment and the nature or proximity of the proposed activity, the potential impacts on the receiving system are negligible. Collection of basic site-level information should be collected where feasible to improve desktop information.	Largely desktop with very limited field verification
	"Orange" Flag	Given the status of the receiving environment and/or the nature or proximity of the proposed activity, the potential impacts on the receiving system are likely to be limited. Impacts within these areas are likely to be successfully mitigated through the application of generic mitigation measures. **Limited field verification should be undertaken to verify desktop information (including delineation) and to**	Largely desktop with some filed verification where accessibility allows

		collect site-specific information to inform the PES & EIS assessments where possible.	
	"Red" Flag	Given the status of the receiving environment and/or the nature or proximity of the proposed activity, the potential impacts are likely to be significant and generic mitigation measures may not be sufficient. Such areas **require further specialist investigation to determine the extent of features that will be impacted, to collect more detailed information on PES/EIS and to identify potential site-specific options for mitigation**.	Desktop assessment and mapping refined through onsite delineation and assessment where assess ability allows.

Approach to and intensity of field sampling

Water resources along the proposed road alignment were assessed by a team of aquatic ecologists including Ryan Kok and Juliette Lagesse. Prior to commencing with field work, a formal and streamline approach was discussed by all team members (Including Douglas Macfarlane and Adam Teixeira-Leite). This assisted in calibrating different approaches that could possibly be taken and consistency of assessments between users.

Field work was then undertaken. In total, field work was undertaken over a period of 3 days. This allowed the project team to obtain a sound overview of water resources likely to be impacted by the proposed road development and was regarded as adequate to inform future planning.

B2 Wetland/Riparian delineation

A GPS (Global Positioning System) was used to capture the location of sampling points used to inform the delineation while additional information on plant and soil indicators were also captured.

Wetland delineation

Onsite delineation efforts were informed by the flagging process as a first step but were limited in some instances on the ground based on accessibility. The following principles were applied based on-site accessibility with the proposed road alignment:

- **Within easily accessible areas**, most wetlands within the road reserve were delineated in the field, with limited extrapolation using aerial photography.
- **In moderately accessible areas**, field work will be limited to a selection of wetlands along the route that can be accessed within the time-frames allocated for field work. Where sites cannot be accessed, delineation will be based on desktop information, informed by an understanding of wetland indicators for that area or region.
- **In highly inaccessible areas** that cannot be practically accessed, delineation will be undertaken at a desktop level.

The outer boundary of wetlands was identified and delineated according to the **Department of Water Affairs wetland delineation manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas'*** (DWAF, 2005a). Three specific wetland indicators were used in the detailed field delineation of wetlands, which include:

- **Terrain unit indicator**

A practical index used for identifying those parts of the landscape where wetlands are likely to occur based on the general topography of the area (Figure 1).

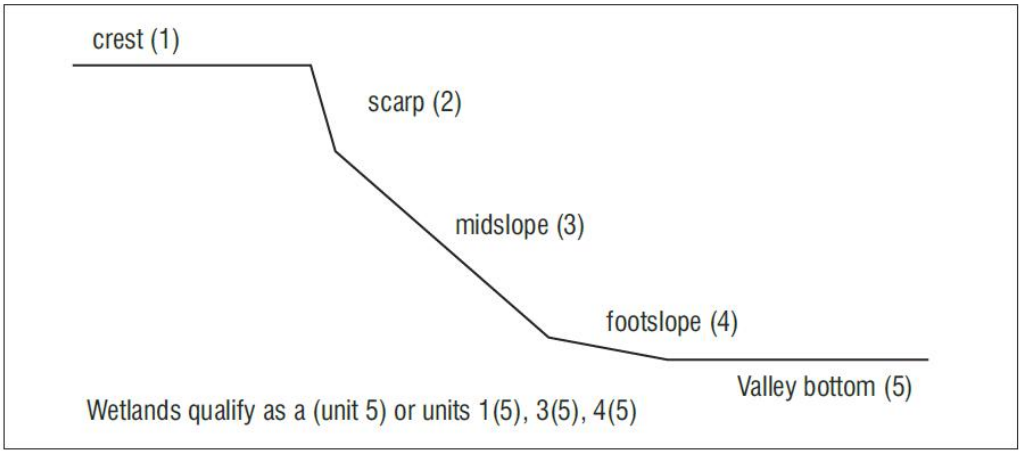


Figure 2 Diagram representing the different terrain units (DWAF, 2005a).

- **Wetland vegetation indicator**

Vegetation in an untransformed state is a useful guide in finding the boundary of a wetland as plant communities generally undergo distinct changes in species composition as one proceeds along the wetness gradient from the centre of a wetland towards adjacent terrestrial areas. An example of criteria used to classify wetland vegetation and inform the delineation of wetland zones is provided in Table 6.

Table 6. Criteria used to inform the delineation of wetland habitat based on wetland vegetation (adapted from Macfarlane *et al., 2007* and DWAF, 2005a).

Vegetation	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
Herbaceous	Mixture of non-wetland species and hydrophilic plant species restricted to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Emergent plants including reeds and bulrushes; floating or submerged aquatic plants

Vegetation	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
Woody	Mixture of non-wetland and hydrophilic species restricted to wetland areas	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species restricted to wetland areas with morphological adaptations to prolonged wetness (e.g.: prop roots)
SYMBOL	**HYDRIC STATUS**	**DESCRIPTION/OCCURRENCE**	
ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)	
fw	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas	
f	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas	
fd	Facultative dry-land species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)	
d	Dryland species	Almost always grow in drylands	

- **Soil wetness indicator**

According to the wetland definition used in the National Water Act (NWA, 1998), vegetation is the primary indicator which must be present under normal circumstances. However, in practice the soil wetness indicator (informed by investigating the top 50cm of wetland topsoil) tends to be the most important, and the other three indicators are used to refine the assessment. The reason for this is that vegetation responds relatively quickly to changes in soil moisture and may be transformed by local impacts; whereas the soil morphological indicators are far more permanent and will retain the signs of frequent saturation (wetland conditions) long after a wetland has been transformed/drained (DWAF, 2005a). Thus, the on-site assessment of wetland indicators focused largely on using soil wetness indicators, determined through soil sampling with a soil auger, with vegetation and topography being a secondary indicator. A Munsell Soil Colour Chart was used to ascertain soil colour values including hue, colour value and matrix chroma as well as degree of mottling in order to inform the identification of wetland (hydric) soils. Soil sampling points were recorded using a GPS (Global Positioning System) and captured using Geographical Information Systems (GIS) for further processing. An example of soil criteria used to assess the presence of wetland soils is provided below in Table 5 while Figure 2 provides a conceptual overview of soil and vegetation characteristics across the different wetness zones.

Table 7. Soil criteria used to inform wetland delineation using soil wetness as an indicator (after DWAF, 2005a).

Soil depth	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
0 – 10cm	**Matrix chroma**: 1- 3 (Grey matrix <10%) **Mottles**: Few/None high chroma mottles **Organic Matter**: Low **Sulphidic**: No	**Matrix chroma**: 0- 2 (Grey matrix >10%) **Mottles**: Many low chroma mottles **Organic Matter**: Medium **Sulphidic**: Seldom	**Matrix chroma**: 0- 1 (Prominent grey matrix) **Mottles**: Few/None high chroma mottles **Organic Matter**: High **Sulphidic**: Often
30 – 50cm	**Matrix chroma**: 0 – 2 **Mottles**: Few/Many	As Above	As Above

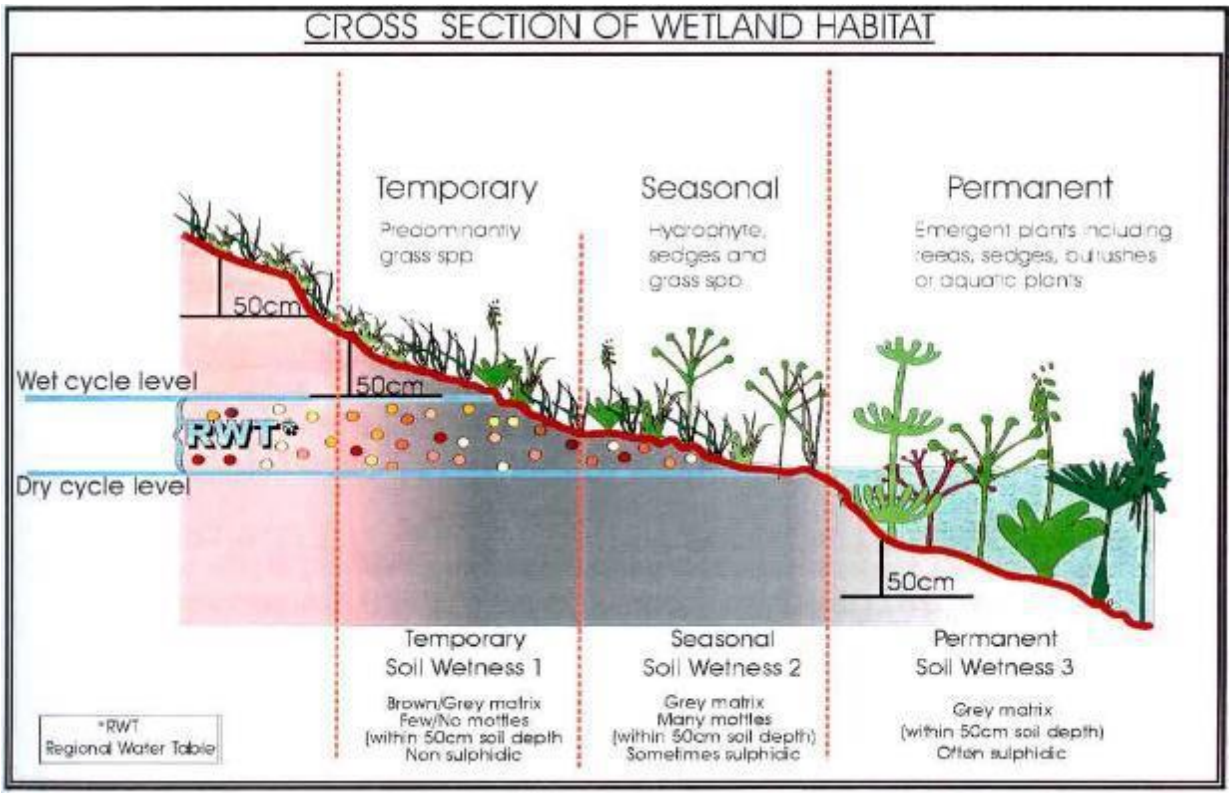


Figure 3 Diagram representing the different zones of wetness found within a wetland (DWAF, 2005a).

Delineation of riparian areas

The identification and location of drainage features and associated riparian areas (also known as the riparian zone) was identified according to the methods in the Department of Water Affairs wetland delineation manual *'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (*DWAF, 2005a*)*. According to the manual, this involves marking the outer edge of the macro-channel bank and associated vegetation. Like wetlands, riparian areas have their own unique set of indicators required in order to delineate these features. Delineation of riparian areas generally requires that the following be considered:

- **Topography associated with the watercourse**: the outer edge of the macro-channel bank associated with a river/stream provides a rough indication of the outer edge of a riparian area.
- **Vegetation**: this is the primary indicator of a riparian area, whereby the edge of the riparian zone is defined as the zone where a distinctive change in species composition and physical structure occurs between those of surrounding/adjacent terrestrial areas. In this case a combination of aerial photography analysis and on-site field information (pertaining to the vegetation health, compactness, crowding, size, structure and numbers of individual plants) was used to differentiate between riparian and terrestrial vegetation.
- **Alluvial soils and deposited material**: this includes relatively recently deposited sand, mud, etc. deposited by flowing water that can be used to confirm the topographical and vegetation indicators.

While this methodology was applied to identify the extent of in stream and riparian habitat within the landscape, riparian boundaries were not mapped as part of this assessment for smaller rivers and streams, instead these systems were mapped as line features.

B3 Classification of wetlands

For the purposes of this study, wetlands were classified according to HGM (hydro geomorphic) type (Level 4A classification level) using the National Wetland Classification System which was developed for the South African National Biodiversity Institute (SANBI, 2009) as outlined in Table 8, below.

Table 8. Wetland classification (after SANBI, 2009).

LEVEL 3	LEVEL 4A	
Landscape Setting	**HGM Type**	**Description**
SLOPE	Channel (river)	*Areas of channelled flow including rivers and streams where water is largely confined to a main channel during low flows. Flood waters may over top the banks of the channel and spread onto an adjacent floodplain*
	Hillslope seep	*Wetlands on slopes formed mainly by the discharge of sub-surface water.*
VALLEY FLOOR	Channel (river)	*River channels in a valley floor setting.*
	Channelled valley-bottom wetland	*Valley floors with one or more well-defined stream channels, but lacking characteristic floodplain features.*
	Unchanneled valley-bottom wetland	*Valley floors with no clearly defined stream channel.*
	Floodplain wetland	*Valley floors with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbows and natural levees.*
	Depression	*Basin-shaped areas that allow for the accumulation of surface water, an outlet may be absent (e.g. pans).*
	Valleyhead seep	*Seeps located at the head of a valley, often the source of streams.*
PLAIN	Channel (river)	*River channels in a plain landscape setting.*
	Floodplain wetland	*Floodplain wetlands as above but in a plain landscape setting.*
	Unchanneled valley-bottom wetland	*Unchanneled valley bottom type wetlands as above but in a plain landscape setting.*
	Depression	*Depression type wetlands as above but in a plain landscape setting.*
	Flat	*Extensive areas characterised by level, gently undulating or uniformly sloping land with a very gentle gradient.*
BENCH (HILLTOP / SADDLE / SHELF)	Depression	*Depression wetlands located on a bench.*
	Flat	*Flat wetlands located on a bench.*

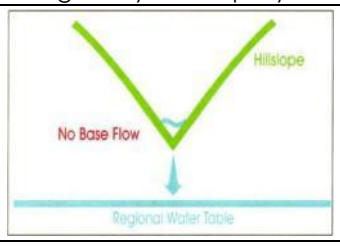
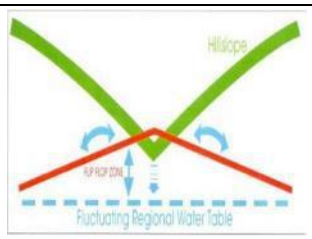
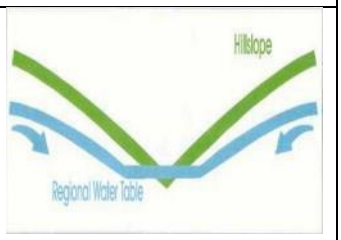
B4 Classification of riparian areas

Channels within the project areas were mapped in GIS using a combination of digital satellite imagery in conjunction with GPS points and data captured in the field. The classification of channels was based on the size of channels (Table 9) and the nature of flows through the channel (Table 10).

Table 9. Classification of channels according to channel size.

CHANNEL WIDTH	RESOURCE DESCRIPTION
>10 m	**Major Rivers**
2 – 10 m	**Rivers**
<2 m	**Streams**

Table 10. Classification of channels according to nature of flows.

	CHANNEL SECTION (CLASS)		
	"A" type	**"B" type**	**"C" type**
	Ephemeral systems	**Weakly ephemeral to seasonal systems**	**Perennial systems**
DESCRIPTION	*A water-course that has no riparian habitat and no soil hydromorphy (i.e. strongly ephemeral systems). Signs of wetness rarely persist in the soil profile*	*A water-course with riparian vegetation/habitat and intermittent base flow (i.e. weakly ephemeral to non-perennial/seasonal systems). These channels show signs of wetness indicating the presence of water for significant periods of time.*	*A water-course with permanent-type riparian vegetation/habitat, permanent base flow and permanent inundation (i.e. perennial systems).*
HYDROLOGY	A-section channels are situated well above the zone of saturation (no direct contact between surface water system and ground water system) and hence do not carry base-flows They do however carry storm water runoff following intense rainfall events (ephemeral), but this is generally short-lived.	Channel bed situated within the zone of the seasonally fluctuating regional water table (i.e. intermittent base flow depending on water table). Periods of no flow may be experienced during dry periods, with residual pools often remaining within the channel.	Water course is situated within the zone of the permanent saturation, meaning flow is all year round except in the case of extreme drought.
TOPOGRAPHICAL POSITION	Valley head (upper reaches of catchments). Channel type also linked to steep slopes which are responsible for water leaving the system rapidly.	Mid-section of valley (middle reaches of catchments).	Valley bottom areas (middle to lower reaches of catchments).
DIAGRAM			

B5 Wetland integrity and functional assessment

Whilst a detailed assessment of wetland condition and EIS using tools such as WET-Health (Macfarlane *et al.*, 2008) and WET-Ecoservices (Kotze *et.al.*, 2007) would be ideal, these tools are too cumbersome for an assessment of

this nature where numerous small wetlands, with typically small catchments and similar characteristics need to be assessed. The following streamlined approach will therefore be applied to assess wetlands along the route:

WET-Health Assessment (Wetland Integrity/Present Ecological State)

This was based on the principles contained in the WET-Health (Macfarlane *et al*, 2008) but informed by expert judgment rather than the collection of detailed quantitative data. This involved:

- Investigating broad land-use in the wetlands catchment and assigning a "catchment alteration score" reflecting anticipated changes to water and sediment inputs to the system;
- Identifying and subjectively rating within-wetland impacts such as those associated with dams, erosion, agriculture and infrastructure on wetland **vegetation, hydrology** and **geomorphology**;
- Assigning a PES score based on joint consideration of catchment and within-wetland impacts for each component of wetland health.
- Calculating an overall combined PES score (as per WET-Health calculation below) and assigning an overall PES category for each wetland system (Table 11).

Table 11. Guideline for interpreting the magnitude of impacts on wetland integrity (after Macfarlane et al., 2008).

IMPACT CATEGORY	DESCRIPTION	Score
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 – 10

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 12, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

Table 12. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane et al., 2008)

PES CATEGORY	DESCRIPTION	RANGE
A	Unmodified, natural.	0 – 0.9
B	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
C	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
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

It should be noted that while WET-Health is the most appropriate technique currently available to undertake assessments of this nature, it is nonetheless a rapid assessment tool that relies on qualitative information and expert judgment. While the tool has been subjected to an initial peer review process, the methodology is still being tested and will be refined in subsequent versions. *WET-Health datasheets will be made available to the client on request.*

B6 Wetland ecological importance and sensitivity

This was based on the principles of WET-Ecoservices (Kotze *et.al.*, 2007) and the EIS (Ecological Importance and Sensitivity) assessment tools (Rountree, *in prep*). The EIS assessment of wetland resources will involve subjectively assessing ecological importance and hydrological / functional importance and importance (Table 13) using available desktop information and field data through a simplified process as detailed below:

- The **Ecological importance (EI)** of each wetland was assessed by considering (i) the threat status of the wetland based on the wetland vegetation group in which the wetland is located and (ii) the present ecological state of the wetland.
- **Hydrological / Functional importance (HI)** was based on (i) typical levels of services provided by different wetland types (Kotze *et al.*, 2007), (ii) the anticipated demand for hydrological services (e.g. flood attenuation & water quality enhancement) based on the location of the wetlands relative to upstream impacts and downstream beneficiaries and (iii) the size of the wetland (larger wetlands are likely to be more important than small wetlands at providing these services.

Table 13. Descriptions of common wetland ecosystem goods and services (after Kotze et al., 2009).

	ECOSYSTEM SERVICE	Description
Hydrological/functional importance	Flood Attenuation	*Refers to the effectiveness of wetlands at spreading out and slowing down storm flows and thereby reducing the severity of floods and associated impacts.*
	Stream Flow Regulation	*Refers to the effectiveness of wetlands in sustaining flows in downstream areas during low-flow periods.*
	Sediment Trapping	*Refers to the effectiveness of wetlands in trapping and retaining sediments from sources in the catchment.*
	Nutrient & Toxicant Retention and Removal	*Refers to the effectiveness of wetlands in retaining, removing or destroying nutrients and toxicants such as nitrates, phosphates, salts, biocides and bacteria from inflowing sources, essentially providing a water purification benefit.*
	Erosion Control	*Refers to the effectiveness of wetlands in controlling the loss of soil through erosion.*
	Carbon Storage	*Refers to the ability of wetlands to act as carbon sinks by actively trapping and retaining carbon as soil organic matter.*
Ecological importance	Biodiversity Maintenance	*Refers to the contribution of wetlands to maintaining biodiversity through providing natural habitat and maintaining natural ecological processes.*

The level of predicted importance of ecosystem services provided by wetlands was rated according to the rating table found in Table 14, below. This was informed by wetland characteristics that affect the ability of wetlands to supply benefits and local and catchment context that affects the demand placed on wetlands to provide goods and services.

Table 14. Rating table used to rate importance of different ecosystem services.

Score	Rating	Importance or level of supply of ecosystem services
<1	**Low**	The wetland is not considered to be important for providing this service/benefit.
1-1.8	**Moderately-Low**	The importance of the wetland in providing ecosystem goods and services is regarded as moderately low.
1.8 – 2.8	**Moderate**	The wetland is considered important for providing this particular ecosystem service to a moderate degree.
2.8 – 3.4	**Moderate-High**	The wetland is considered important for providing this particular ecosystem service to a high degree.
>3.4	**High**	The wetland is considered very important for providing this particular ecosystem service to a high degree.

The final EIS was then determined based on the maximum score obtained for each of the different values assessed.

B7 Setting of management objectives

Management and mitigation measures need to be employed to ensure that water resources attain the desired future class, in the face of potential development impacts. This should be informed by the management objective for the water resource which, in the absence of classification, is typically based on the Present Ecological State (PES) and the Ecological Importance and Sensitivity (EIS) of the water resource (DWAF, 2007).

Based on this approach, management objectives for water resources will thus be either to improve the ecological class or to maintain the ecological class as indicated in Table 17, below.

Table 15. Management measures for water resources in the short-term.

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good - Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Maintain	E/F Maintain

B8 Assessment of ecological impacts

For the purposes of this assessment, the assessment of potential impacts was undertaken using the "Impact Assessment Methodology for EIAs" designed by Eco-Pulse Consulting (2018). This assessment was informed by baseline ecological information contained in this report relating to the importance and sensitivity of habitats, information on the proposed development activity provided by the client and experience with impacts resulting from similar development projects.

Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). Importance and acceptability can only be assessed if one understands the importance or value of the water resource affected to society. This of course varies, depending on what aspect of water resource management is being considered. In order to better frame this assessment, we therefore differentiate between four key elements or ultimate consequences when assessing impacts to freshwater ecosystems. These include:

- ***Water Resource Management***: The inter-connected nature of water resources is emphasised here by recognising that an impact at a particular site will ultimately affect downstream users and the ability to meet user requirements. An understanding of the catchment context, with particular emphasis on the existing use of and reliance on water resources by downstream communities is therefore required. Key concerns therefore relate to any direct impacts on water quantity and quality together with habitat-related impacts that could exacerbate downstream impacts by undermining the ability of wetlands and riparian areas to attenuate floods, trap sediments and assimilate pollutants (regulating & supporting services).
- ***Ecosystem Conservation***: The focus here is specifically on understanding the significance of impacts in relation to the ability to meet habitat conservation targets. This is informed by an understanding of conservation significance that is influenced by factors such as the ecosystem threat status, regional conservation context, condition of habitat, and connectivity to other intact habitats.
- ***Species Conservation:*** The focus here is specifically on species of special concern include Red Data Book or Red List taxa in threatened or conservation concern categories, Threatened or Protected Species

listed under the National Environmental Management: Biodiversity Act, endemic taxa, locally threatened taxa and/ or any particular taxa of special management concern.

- ***Direct Use Values:*** The emphasis here is specifically on understanding and assessing the social impacts of the development based on an understanding of the impacts on provisioning (water supply, harvestable natural resources, cultivated foods or food for livestock) and cultural services available to local communities. This assessment is therefore based on an understanding of the current importance of water resources for religious ceremonies, tourism & recreation or educational activities.

The approach adopted is to identify and describe all key potential primary and secondary (indirect) impacts resulting from the proposed construction and operational activities. The significance of these impacts is then assessed in relation to the consequence that such impacts will have on each of the four ultimate consequences listed above. This allows the assessor to assess each impact within a very clear frame of reference and to them consider these holistically in terms of the projects cumulative impacts.

In terms of practically undertaking the assessment, the extent of the impact is rated first. Thereafter, remaining impact rating criteria are scored based on the predefined extent of impacts. Intensity is rated as the realistic consequence (end-point) of an activity under the various mitigation scenarios. Probability rates the likelihood of the impact(s) being assessed occurring across the predefined extent and has been specifically linked to expected probabilities of occurrence. Finally, impact duration rates the time period or lifecycle of a specific impact should it occur.

The assessment of impact significance is based on the basic risk formula: **Risk = consequence x probability**. However, the calculation of consequence has been modified to assess significance rather than risk. The basic significance formula utilised is:

Impact significance = impact consequence x impact probability, where Impact consequence = (impact intensity + impact extent) x impact duration.

In order to improve the repeatability of the system, concise descriptions have been developed to assist the user in rating extent and intensity criteria (Table 18). These have been specifically tailored for each of the four ultimate consequences considered as part of the significance assessment. An overall statement of impact significance is then obtained by qualitatively assessing the cumulative effect of all impacts on each aspect of the water resource being assessed.

Table 16. Criteria and numerical values for rating environmental impacts to water resources.

Score	Rating	Description
Extent (E) – relates to the expected extent of the impact in spatial and population terms		
10	**National**	***The effects of an impact are experienced over a very large geographic area. Given the extent of impacts, they are likely to be relevant at a national scale.*** ***Water resource management:*** • Water resources are affected across a very extensive geographic area (e.g. spanning a number of water management areas / crossing international boundaries); and / or • Indirect impacts continue to affect water resources far from the development site (e.g. impacts continue to be experienced > 100km downstream). ***Ecosystem conservation:*** • The extent of direct impacts results in extensive impacts to water resources relative to the remaining extent (e.g. affecting >100ha wetlands / >10km watercourses); and / or • The extent of direct impacts is high relative to the extent of affected habitat types (e.g. affecting >10% of a remaining ecosystem type); and / or • The proposed development affects large areas (e.g. > 1000 ha) across a broad geographic area and affecting a range of terrestrial habitat types. ***Species conservation:*** • Impacts affect a large proportion of the population of an important species at a national level (e.g. >10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a very large geographic area. ***Direct use values***: • Impacts will affect a society at a national scale (e.g. large number of stakeholders across multiple district municipalities / provinces).
8	**Regional**	***The effects of an impact are experienced over a large geographic area. Given the extent of impacts, they are likely to be relevant at a regional scale.*** ***Water resource management:*** • Water resources are affected across a broad geographic area (e.g. extending across a large number of quaternary catchments); and / or • Indirect impacts continue to affect water resources a considerable distance from the development site (e.g. 10 - 100km downstream). ***Ecosystem conservation:*** • The extent of direct impacts results in large-scale impacts to water resources relative to the remaining extent, (10-100ha wetlands / 2-10km watercourses); and / or • The extent of direct impacts is notable relative to the extent of affected habitat types (e.g. affecting 1 - 10% of a remaining ecosystem type); and / or • The proposed development affects *a large area (100 – 1000ha) and typically extends across a range of terrestrial habitat types.* ***Species conservation:*** • Impacts affect a large proportion of the population of an important species at a regional level (e.g. 1 - 10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a large geographic area. ***Direct use values:*** • Impacts will affect a society at a regional scale (e.g. large number of communities and stakeholders across a number of local municipalities).
5	**Local**	***The effects of an impact are experienced over a limited geographic area. Given the extent of impacts, they are likely to be relevant at a local scale.*** ***Water resource management:*** • Water resources are affected within a localised geographic area (e.g. single quaternary catchment); and / or • Indirect impacts continue to affect water resources some distance from the development site (e.g. 1 - 10km downstream). ***Ecosystem conservation:*** • The extent of direct impacts results in localised impacts to water resources relative to the remaining extent, (1 - <10ha wetlands / 200m - <2km watercourses); and / or

Score	Rating	Description
		• The extent of direct impacts is limited relative to the extent of affected habitat types (e.g. affecting <1% of a remaining ecosystem type); and / or • The proposed development affects *a moderately large area (10 – 100ha) but may extend across a wide range of terrestrial habitat types.* ***Species conservation:*** • Impacts affect species populations that are important at a local scale (e.g. < 1% of population affected); and / or • The proposed development will affect a number of important species across a local geographic area. ***Societal impacts***: • Impacts will affect society at a local scale (e.g. a number of communities across a single local municipality).
2	**Surrounding Area**	***The effects of an impact are experienced over a very small area. Given the extent of impacts, they are likely to be relevant at a very localised scale.*** ***Water resource management:*** • Water resources are affected within a small geographic area (e.g. single quinery catchment); and / or • Indirect impacts affect water resources a limited distance downstream of the development site (e.g. <1km downstream). ***Ecosystem conservation:*** • Direct impacts affects a small area proportion of water resources (e.g. 0.1-1ha wetlands / 20 – <200m watercourses); and / or • The proposed development affects a small localised area (1 – 10ha) and is often confined to a very few terrestrial habitat types. ***Species conservation:*** • Impacts affect populations of important species beyond the site level; ***Direct use values:*** • Impacts will affect society at a very local scale (e.g. a number of households within a single community).
0.5	**Site**	***The effects of an impact are confined to a very small footprint. Given the extent of impacts, they are likely to be relevant at a site scale.*** ***Water resource management:*** • Impacts are largely confined to the development footprint with limited downstream impact (<100m downstream effect). ***Ecosystem conservation:*** • Direct impacts are typically confined to a single water resource or few water resources within a small focal area (typically <0.1ha wetlands / 20m watercourses); and / or • The proposed development affects a small area (<1ha) and is typically confined to very few terrestrial habitat types. ***Species conservation:*** • Impacts are very localised and are unlikely to affect important species beyond the site level; ***Direct use values:*** • Impacts will affect society at a very local scale (single or few households within a single local community)
Intensity (I) – defines the severity and importance of the impact to water resources / habitats / species or human populations within defined impact extent		

Score	Rating	Description
10	**High**	***Water resource management:*** • Loss of regulating and supporting services critical to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss will compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Loss of largely intact critically endangered habitat; and / or • Loss of habitat associated with validated FEPA Rivers & wetlands; and / or • Loss of particularly unique / especially important special habitat features. ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of critically endangered species; and / or • Loss of or seriously compromises viable landscape-level corridors and longitudinal connectivity (e.g. dams on free-flowing rivers) ***Direct use values:*** • Loss of human life; and / or • Marked deterioration in human health; and / or • Loss of ecosystem services that are critical to support / protect livelihoods of dependant vulnerable communities; and / or
7	**Moderately-High**	***Water resource management:*** • Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs) ; and / or • Loss is very likely to compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Serious modification (2 or more classes) of critically endangered habitat; and / or • Loss of largely intact endangered habitat types; and / or • Loss of moderately modified critically endangered habitat types (and with reasonable rehabilitation potential) ; and / or • Loss of habitat that has special habitat attributes (e.g. high habitat diversity / species richness). ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of endangered species; and / or • Loss of regionally important species populations (e.g. at municipal scale). ***Direct use values:*** • Loss of human livelihoods; and / or • Some deterioration in human health; and / or • Loss of ecosystem services that are important (highly valued but not critical to) supporting / protecting vulnerable communities. Alternative options / resources are not available to meet community needs without incurring significant costs.
4	**Moderate**	***Water resource management:*** • Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss could compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Moderate modification (1 classes) of critically endangered habitat / serious modification (2 classes) of endangered habitat; and / or • Loss of largely intact vulnerable habitat types; and / or • Loss of moderately modified endangered habitat types (and with reasonable rehabilitation potential). ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of vulnerable / endemic / specially protected species; and / or • Loss of or seriously compromises viable corridors that are locally important for species movement. ***Direct use values:*** • Notable impact on human livelihoods; and / or

Score	Rating	Description
		• Moderate reduction in the availability of ecosystem services that are important for supporting / protecting vulnerable communities; and / or • Loss of ecosystem services that are moderately valued by local communities. Alternative options / resources are available but limited.
2	**Moderately-Low**	***Water resource management:*** • Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss is unlikely to compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Moderate modification (1 classes) of endangered habitat / serious modification (2 classes) of vulnerable habitat; and / or • Loss of largely intact least-threatened habitat types; and / or • Loss of moderately modified vulnerable habitat types (and with reasonable rehabilitation potential). ***Species conservation:*** • Reduction in populations of vulnerable / endemic / specially protected species (without compromising viability of locally occurring populations); and / or • Loss of populations of locally important species. ***Direct use values:*** • Limited but identifiable impact on human livelihoods; and / or • Moderate reduction in the availability of ecosystem services with a noticeable but limited impact to livelihoods.
0	**Low**	***Water resource management:*** • Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss will not compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Loss of highly degraded threatened vegetation types (and with low rehabilitation potential) ; and / or • Moderate modification (1 classes) of vulnerable habitat; and / or • Loss of moderately modified least threatened habitat types. ***Species conservation:*** • Limited impact to any locally important species populations. ***Direct use values:*** • None / very limited impact on human livelihoods; and / or • None / limited reduction in the availability of ecosystem services with very limited impact to livelihoods.
Duration (D) – relates to the duration of the impact in time (consideration should be given to reversibility which may reduce the duration of impact)		
1	**Permanent**	The impact will continue indefinitely (>30 years) and is essentially regarded as irreversible.
0.95	**Long-term**	The impact and its effects will continue over the long-term (10 - 30 years).
0.85	**Medium-term**	The impact and its effects will persist for a number of years (1 – 10).
0.75	**Short-term**	The impact and its effects will persist for a number of months after the impact has occurred (2 -12 months) but is unlikely to persist for more than a year.
0.5	**Immediate**	The impact and its effects will cease within days or weeks after the impact has occurred (0 – 2 months).
Probability (P) – relates to the expected likelihood and frequency of the impact causing event occurring		
1	**Definite**	More than 80% likelihood of occurrence. The impact is typically recorded under similar conditions and settings.
0.95	**Highly Probable**	The impact has a 50-80% chance of occurring and thus expected to occur. The impact is known to occur regularly in similar conditions and settings.
0.8	**Probable**	The impact has a 20-50% chance of occurring and thus is quite likely to occur. The impact is known to occur quite frequently in similar conditions and settings (less than once in 10 years).

Score	Rating	Description
0.6	**Possible**	The impact has a 5-20% chance of occurring. This impact could occur and is known to occur irregularly under the similar conditions and settings (less than once in 20 years).
0.4	**Unlikely**	The possibility of the impact occurring is low with less than 5% chance of occurring. The impact has little chance of materialising (less than once in 50 years).

Table 17. Impact significance categories and definitions.

Impact Significance	Impact Significance Score Range	Definition
High	**14.5 - 20**	**Totally unacceptable** and fatally flawed from an environmental perspective. The proposed activity should only be approved under very special circumstances (i.e. national priorities with large societal benefit). If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderately High	**12 – 14.4**	**Generally unacceptable** and should ideally be avoided. The potential impact will affect a decision regarding the proposed activity and require that the need and desirability for the project be clearly substantiated to justify the associated ecological risks. If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms
Moderate	**8.5 – 11.9**	**Potentially unacceptable** and should ideally be reduced to lower significance levels. The potential impact should influence the decision regarding the proposed activity and requires a clear and substantiated need and desirability for the project to justify the risks. If authorised, offsets should be considered to compensate for residual impacts.
Moderately Low	**4.5 - 8.4**	**Acceptable** with low to moderate risks. The potential impact may not have any meaningful influence on the decision regarding the proposed activity.
Low	**0 – 4.4**	**Acceptable**. The potential impact is very small or insignificant and should not have any meaningful influence on the decision regarding the proposed activity.

A confidence rating was also given to the impacts rated in accordance with Table 14, below:

Table 18. Confidence ratings used when assigning impact significance ratings.

Level of confidence	Contributing factors affecting confidence
Low	A low confidence level is attributed to a low-moderate level of available project information and somewhat limited data and/or understanding of the receiving environment.
Medium	The confidence level is medium, being based on specialist understanding and previous experience of the likelihood of impacts in the context of the development project with a relatively large amount of available project information and data related to the receiving environment.
High	The confidence level is high, being based on a sound understanding of the state, functioning and sensitivity of the receiving environment, high availability of project-related data and good understanding of similar impact scenarios.

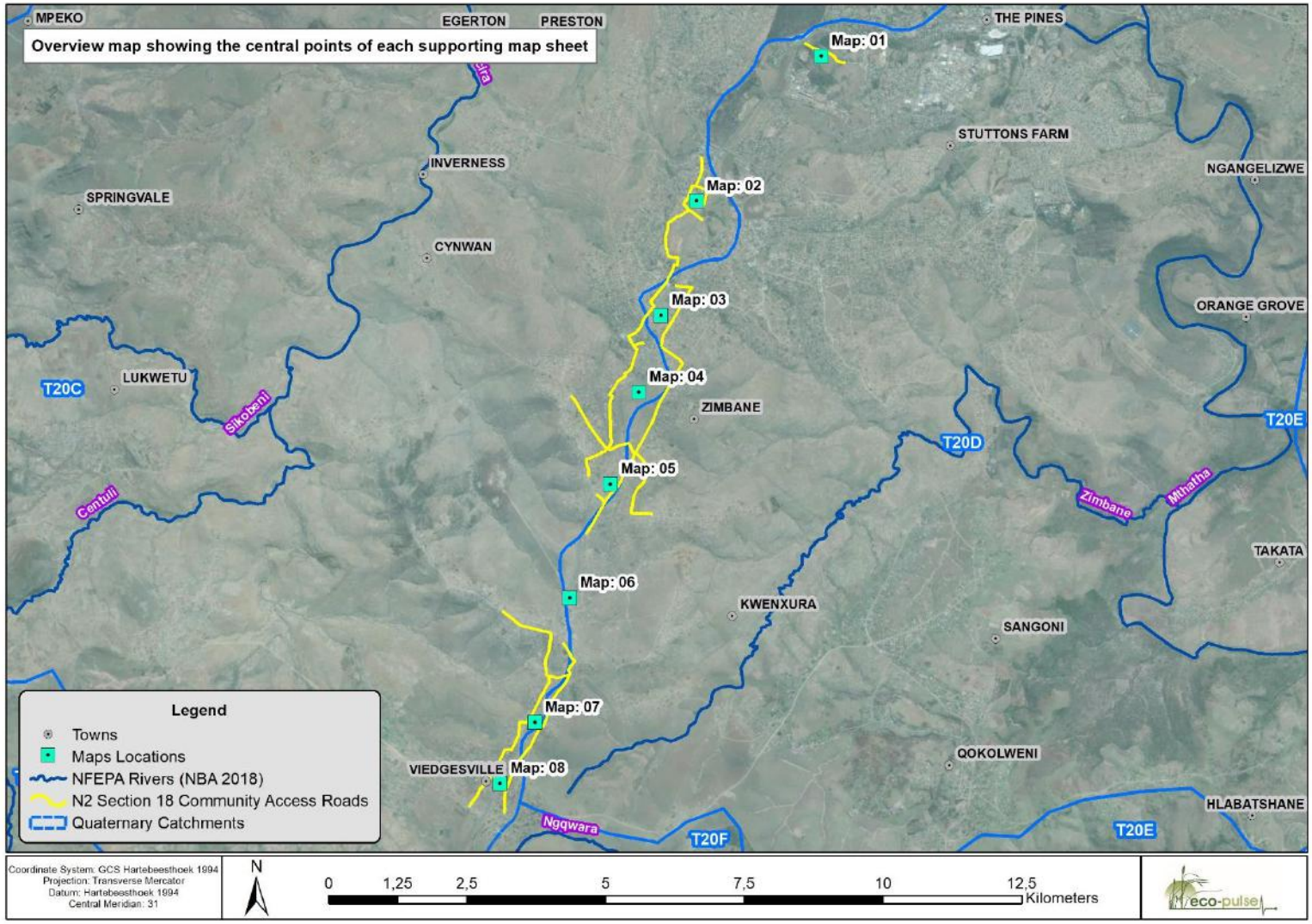
B9 Identification of mitigation measures

'Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve/protect the environment and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on aquatic ecosystems, including rivers and wetlands, is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. Examples of mitigation can include changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites.

Specialist working knowledge, available literature, consulting engineers and experience with other similar projects was used in compiling the recommended mitigation measures for this project, as well as by consulting following key documents:

- Best practice construction and mitigation procedures in wetlands and water-bodies (US Federal Energy Regulatory Commission, 2002);
- Guidelines and specifications for developments affecting wetlands and general construction activities [DWAF (2005b), DWAF (2005c);
- Generic construction EMP guidelines (eThekwini Municipality, 2009); and
- South African National Roads Agency (SANRAL) drainage manual (SANRAL, 2007; 2013).

Given that the proposed road upgrade has yet to be finalised, options for avoiding sensitive ecosystems can still be considered when identifying mitigation measures for this development. As such, the mitigation measures are evaluating and identifying design elements and practical on-site mitigation measures that could be used to minimise potential impacts.


Overview map showing the central points of each supporting map sheet
MPEKO
EGERTON
PRESTON
THE PINES
Map: 01
STUTTONS FARM
NGANGELIZWE
INVERNESS
Map: 02
SPRINGVALE
CYNWAN
Map: 03
ORANGE GROVE
LUKWETU
T20C
Map: 04
ZIMBANE
Sikobeni
T20E
T20D
Map: 05
Centuli
Zimbane
Mthatha
TAKATA
Map: 06
KWENXURA
SANGONI
Map: 07
QOKOLWENI
VIEDGESVILLE
Map: 08
HLABATSHANE
Ngqwara
T20F
T20E
Legend
Towns
Maps Locations
NFEPA Rivers (NBA 2018)
N2 Section 18 Community Access Roads
Quaternary Catchments
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 31
N
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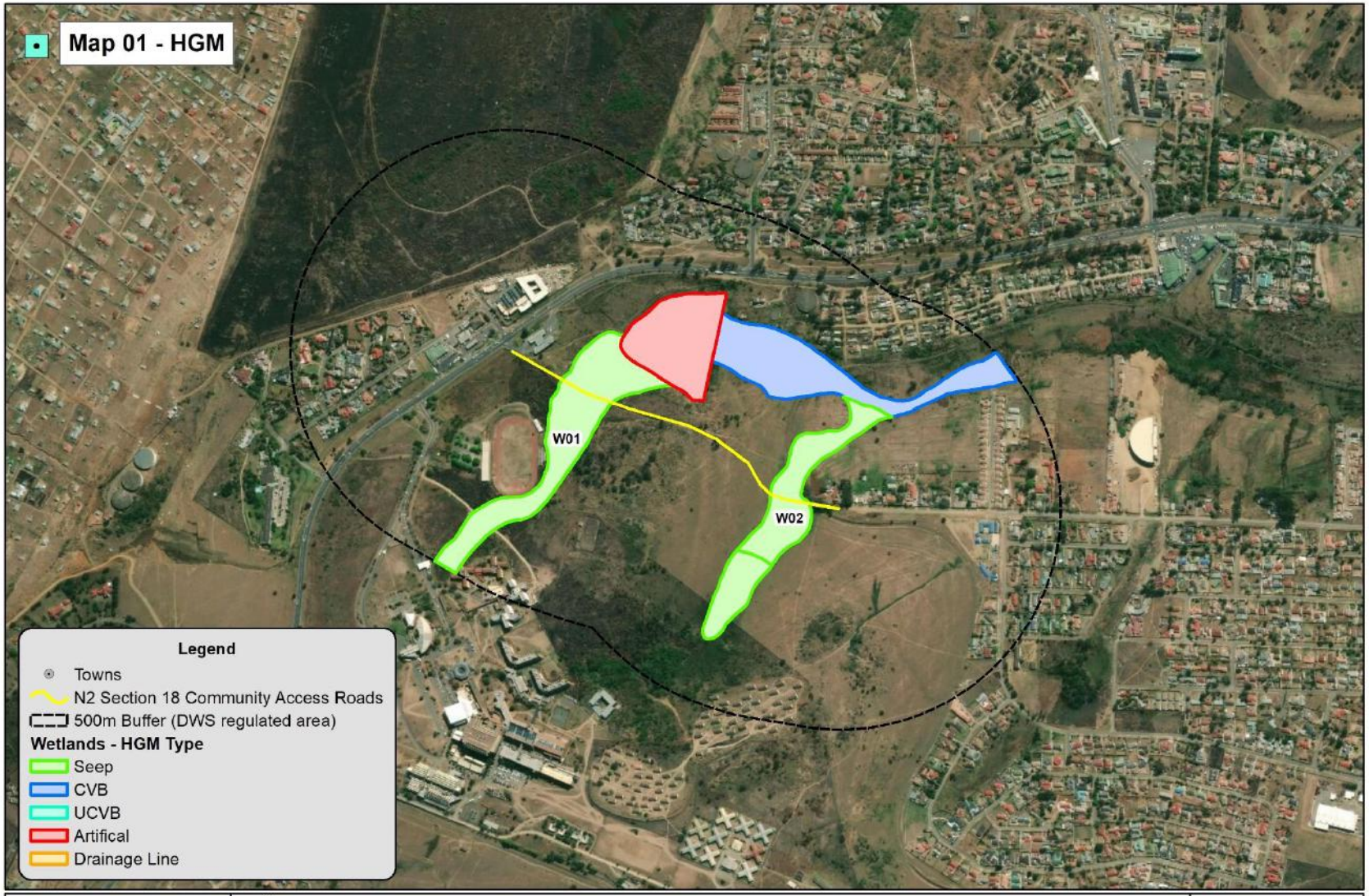
1,25
2,5
5
7,5
10
12,5
Kilometers
eco-pulse



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Datum: Hartebeesthoek 1994
Central Meridian: 31

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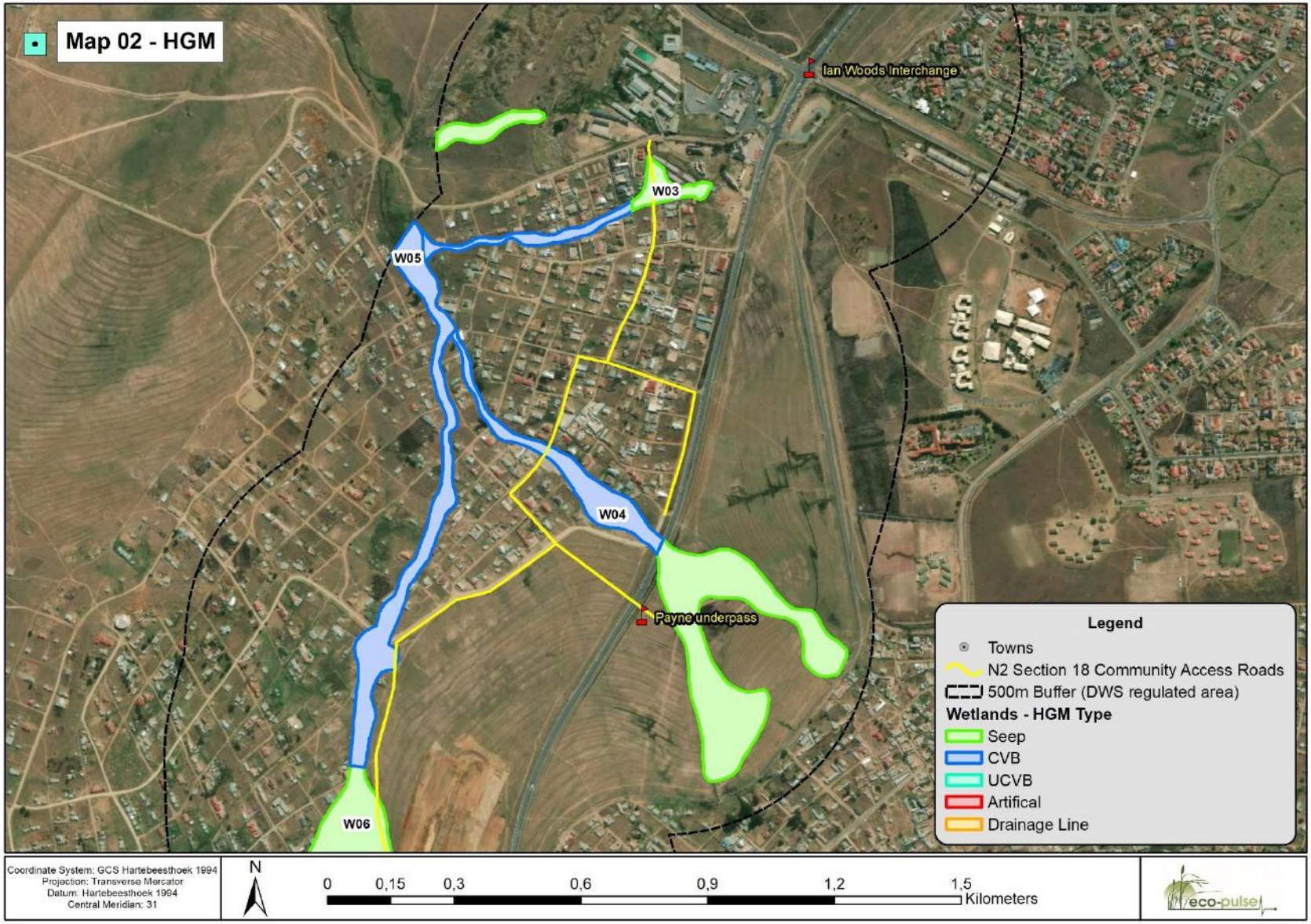
eco-pulse


Map 02 - HGM
Ian Woods Interchange
W03
W05
W04
Payne underpass
W06
Legend
Towns
N2 Section 18 Community Access Roads
500m Buffer (DWS regulated area)
Wetlands - HGM Type
Seep
CVB
UCVB
Artifical
Drainage Line
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 31
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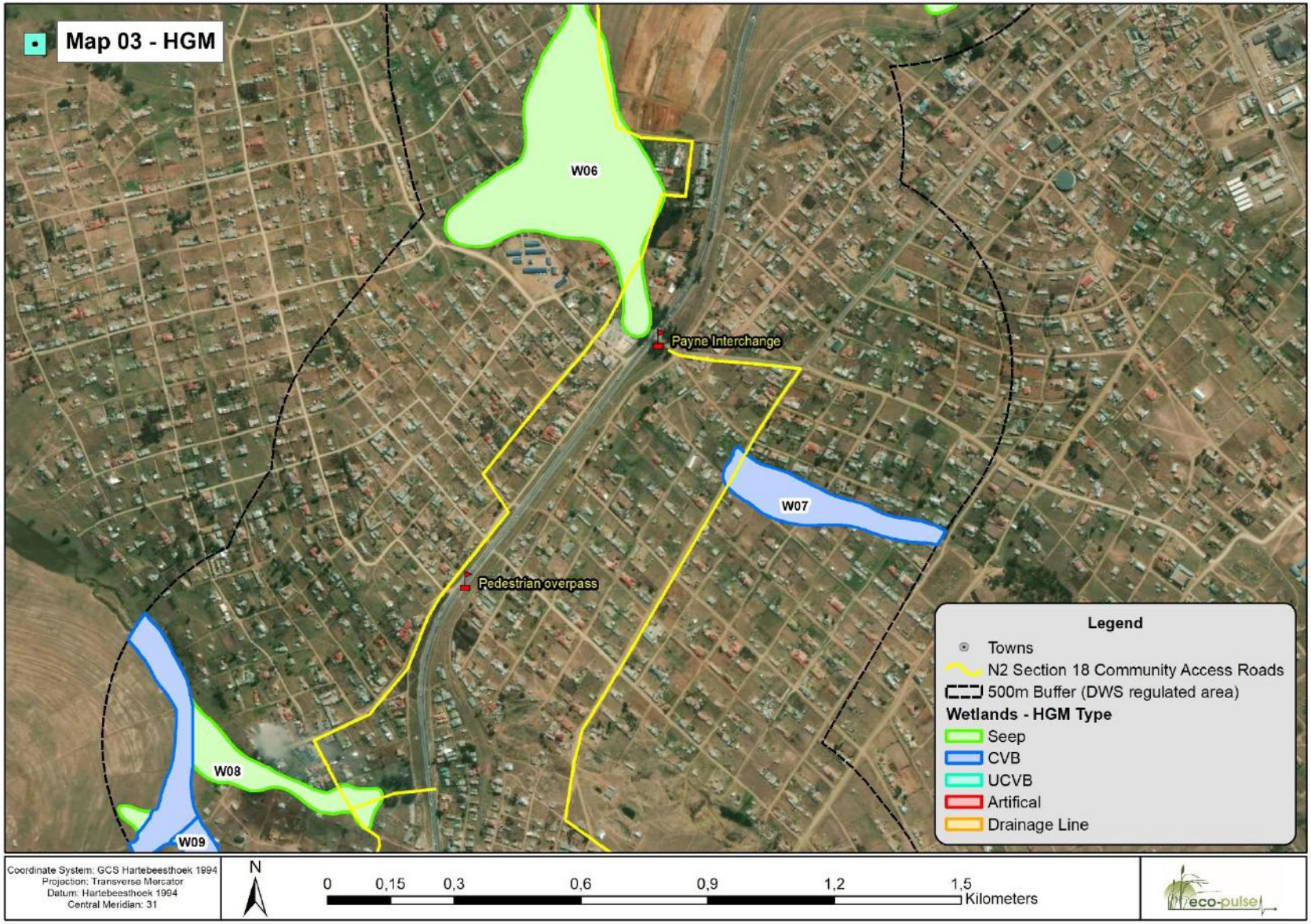
Kilometers
eco-pulse


Map 03 - HGM
W06
Payne Interchange
W07
Pedestrian overpass
W08
W09
Legend
Towns
N2 Section 18 Community Access Roads
500m Buffer (DWS regulated area)
Wetlands - HGM Type
Seep
CVB
UCVB
Artifical
Drainage Line
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 31
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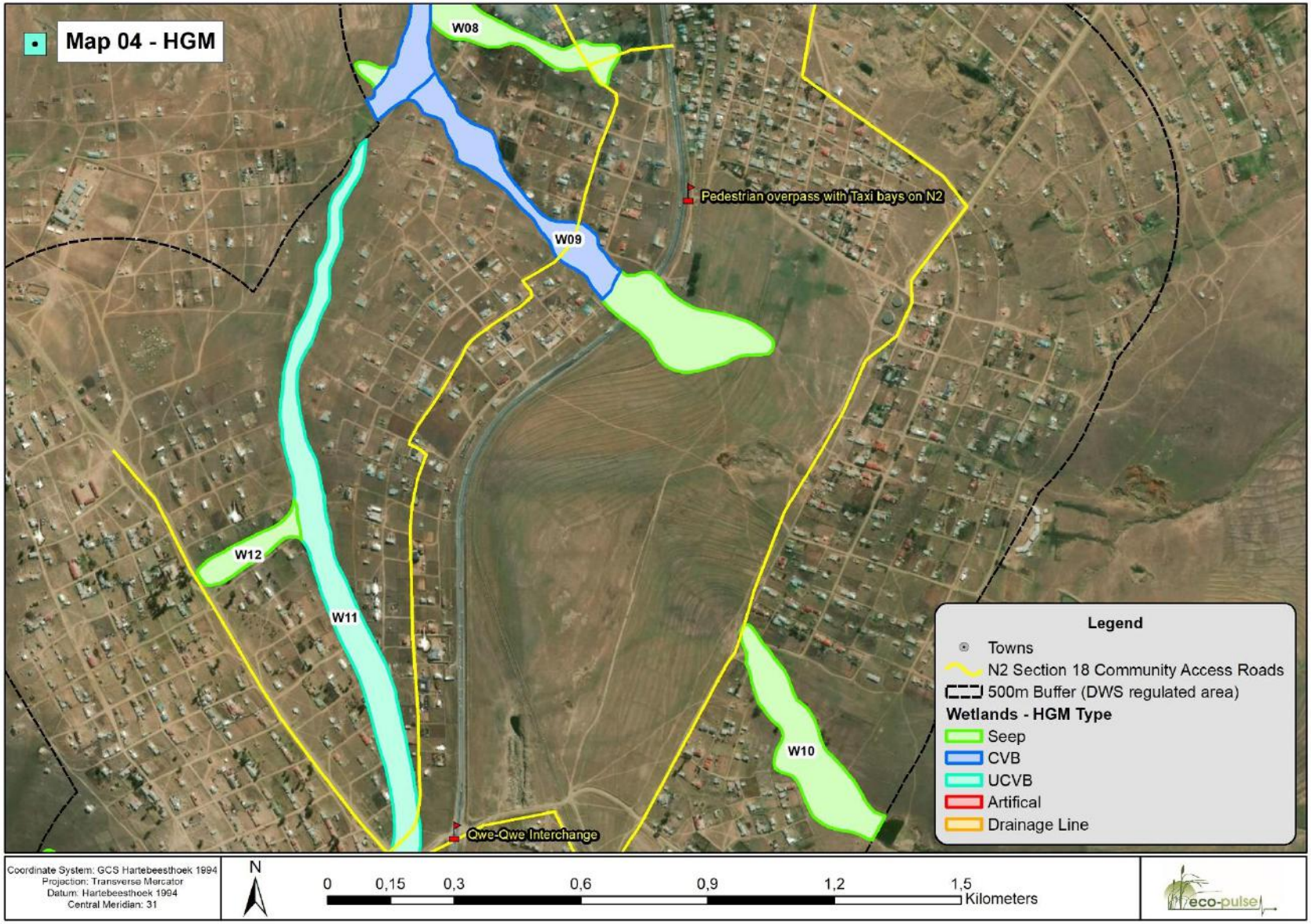
Map 04 - HGM
W08
W09
W10
W11
W12
Pedestrian overpass with Taxi bays on N2
Qwe-Qwe Interchange
Legend
Towns
N2 Section 18 Community Access Roads
500m Buffer (DWS regulated area)
Wetlands - HGM Type
Seep
CVB
UCVB
Artifical
Drainage Line
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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Kilometers
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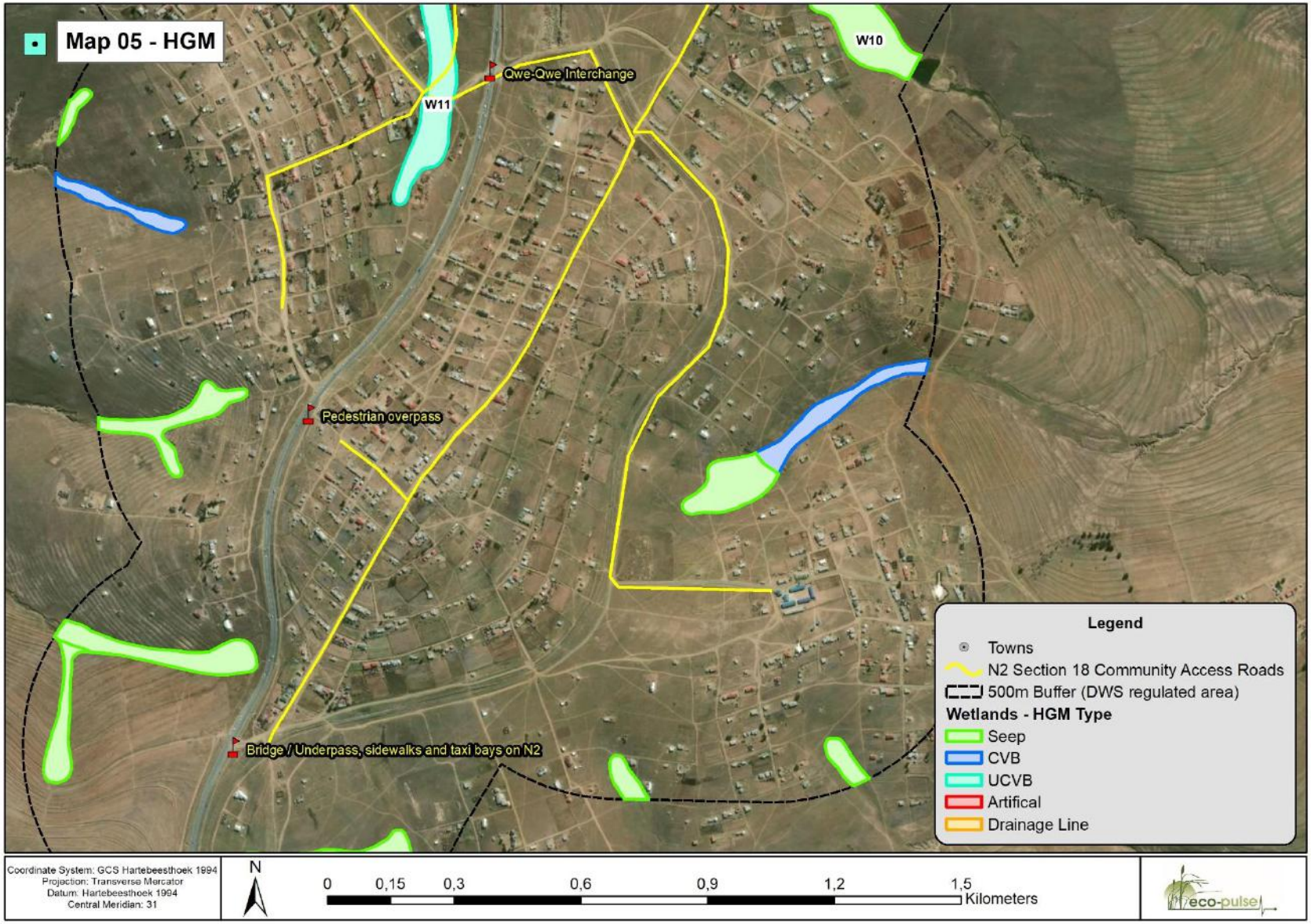
Map 05 - HGM
W11
W10
Qwe-Qwe Interchange
Pedestrian overpass
Bridge / Underpass, sidewalks and taxi bays on N2
Legend
Towns
N2 Section 18 Community Access Roads
500m Buffer (DWS regulated area)
Wetlands - HGM Type
Seep
CVB
UCVB
Artifical
Drainage Line
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 31
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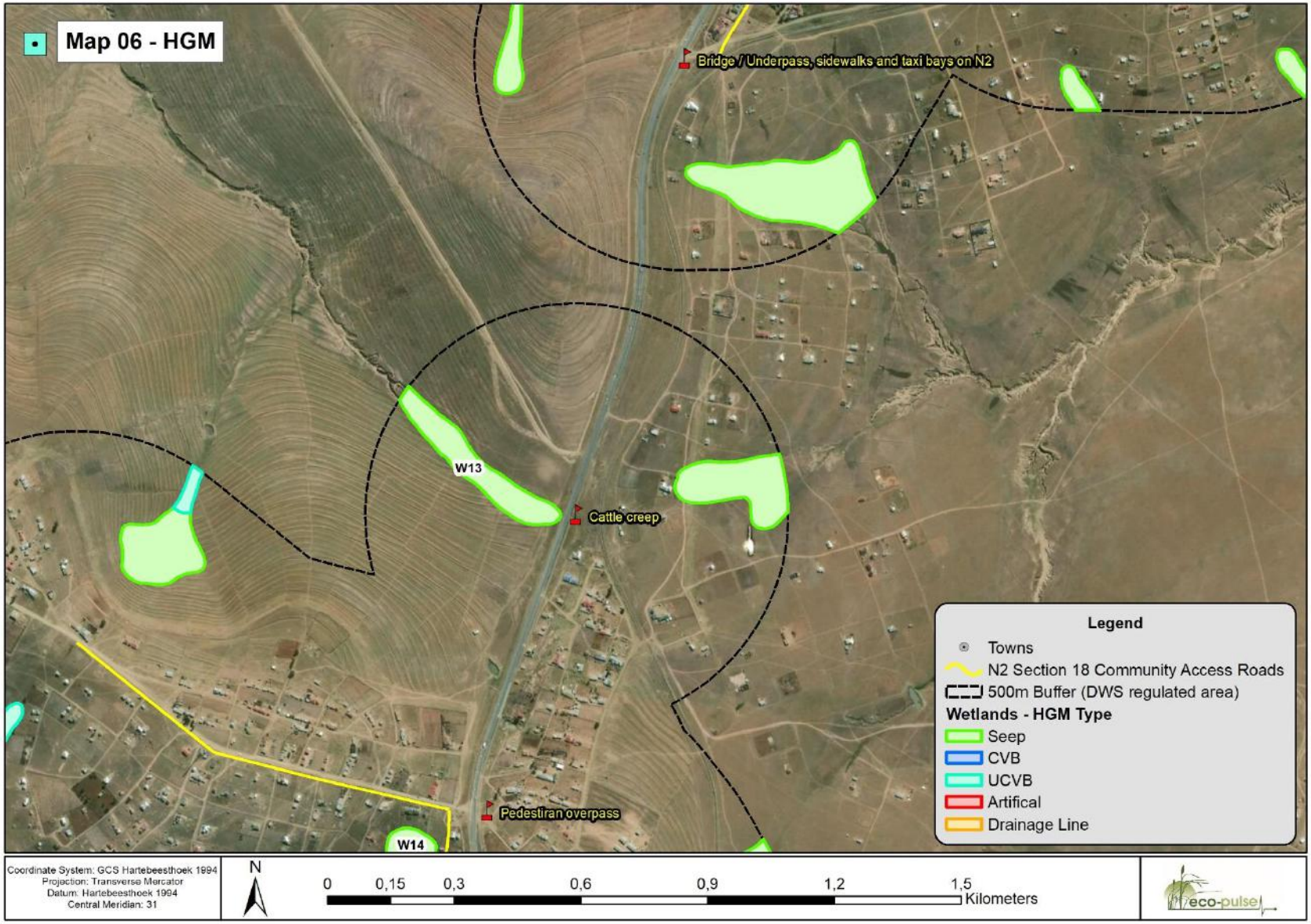
Kilometers
eco-pulse


Map 06 - HGM
Bridge / Underpass, sidewalks and taxi bays on N2
W13
Cattle creep
Pedestiran overpass
W14
Legend
Towns
N2 Section 18 Community Access Roads
500m Buffer (DWS regulated area)
Wetlands - HGM Type
Seep
CVB
UCVB
Artifical
Drainage Line
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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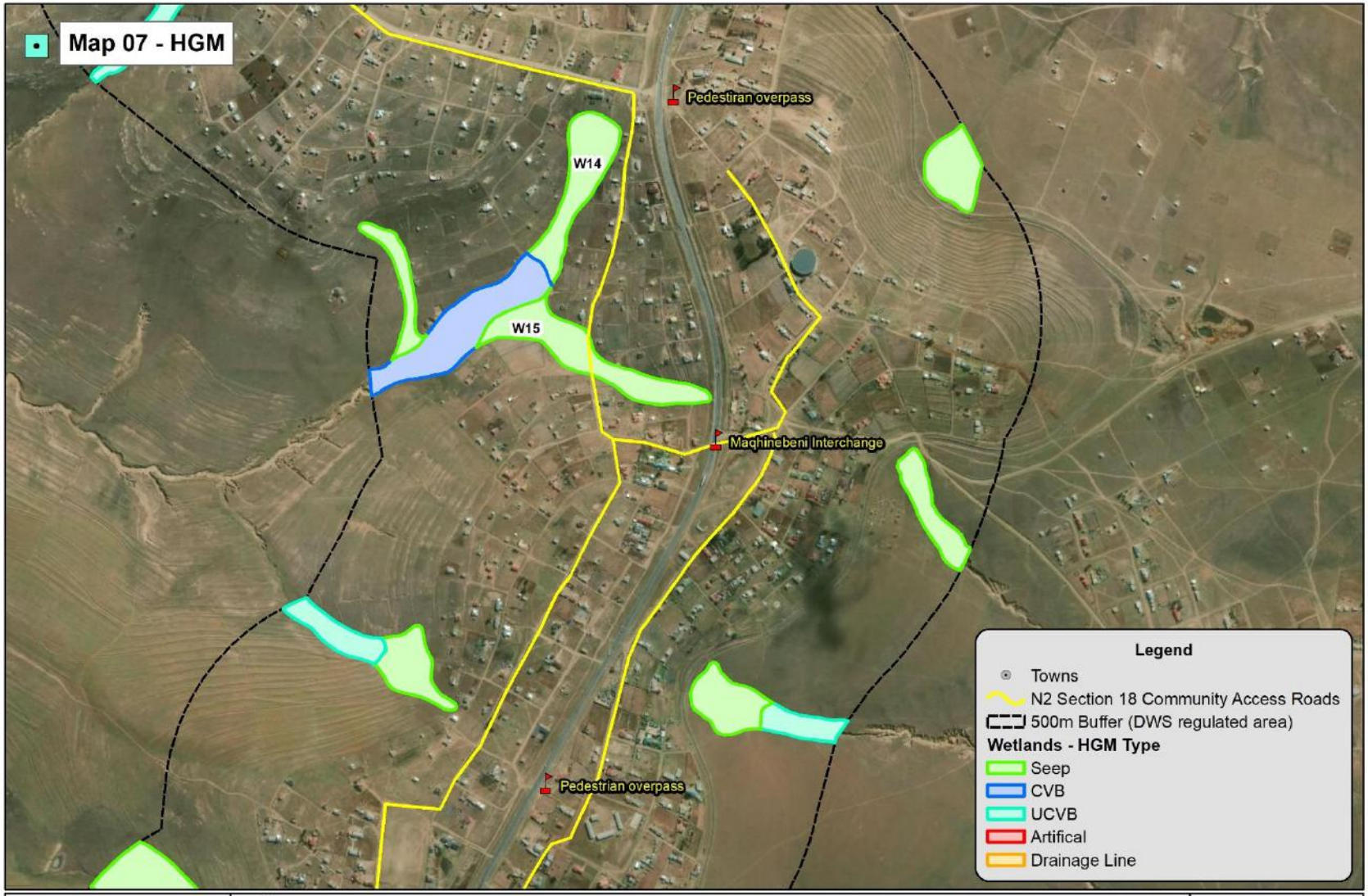
Kilometers
eco-pulse



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Central Meridian: 31

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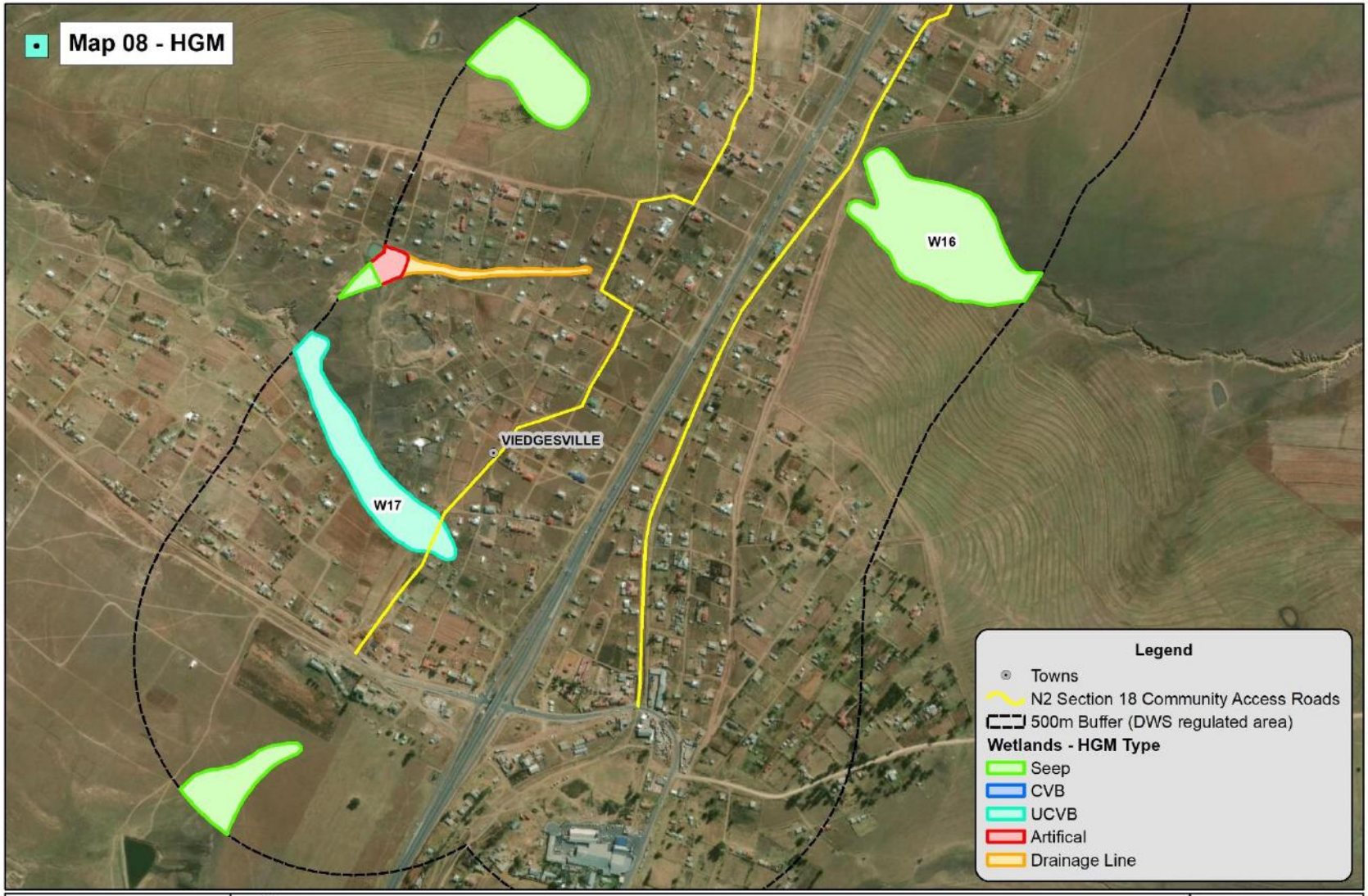
eco-pulse



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Central Meridian: 31

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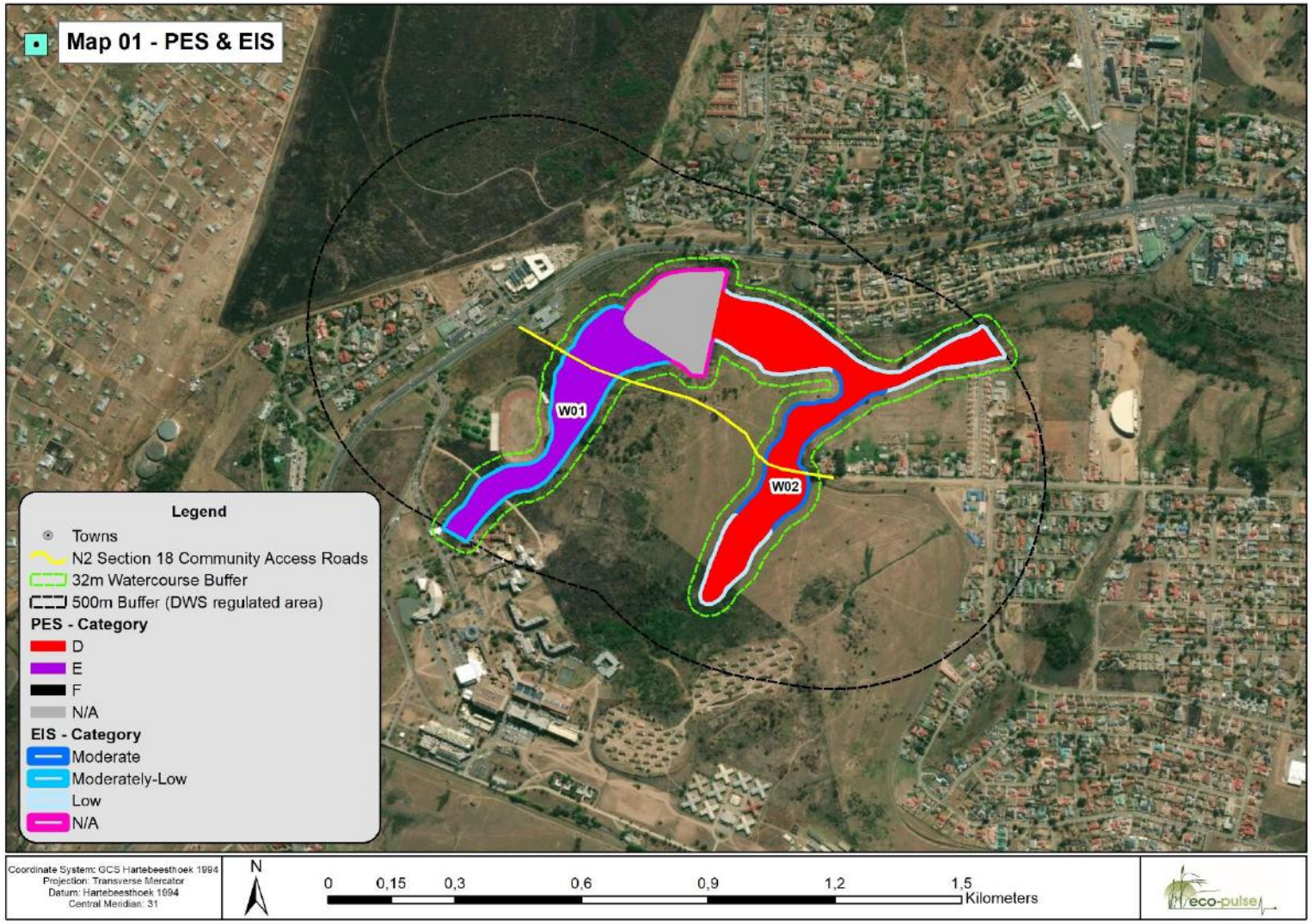
eco-pulse


Map 01 - PES & EIS
W01
W02
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
D
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EIS - Category
Moderate
Moderately-Low
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Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
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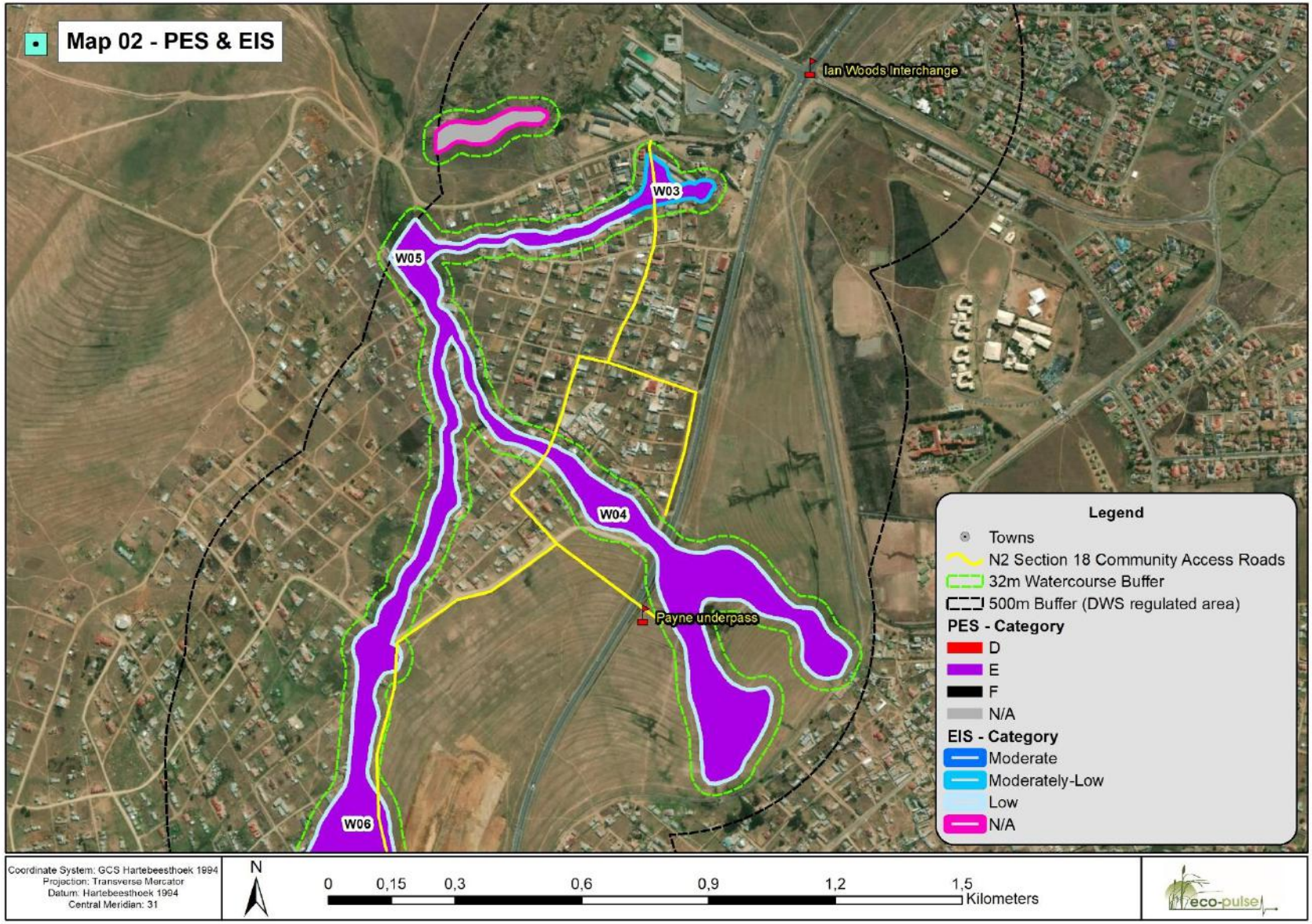
Map 02 - PES & EIS
Ian Woods Interchange
W03
W05
W04
Payne underpass
W06
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
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EIS - Category
Moderate
Moderately-Low
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Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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Kilometers
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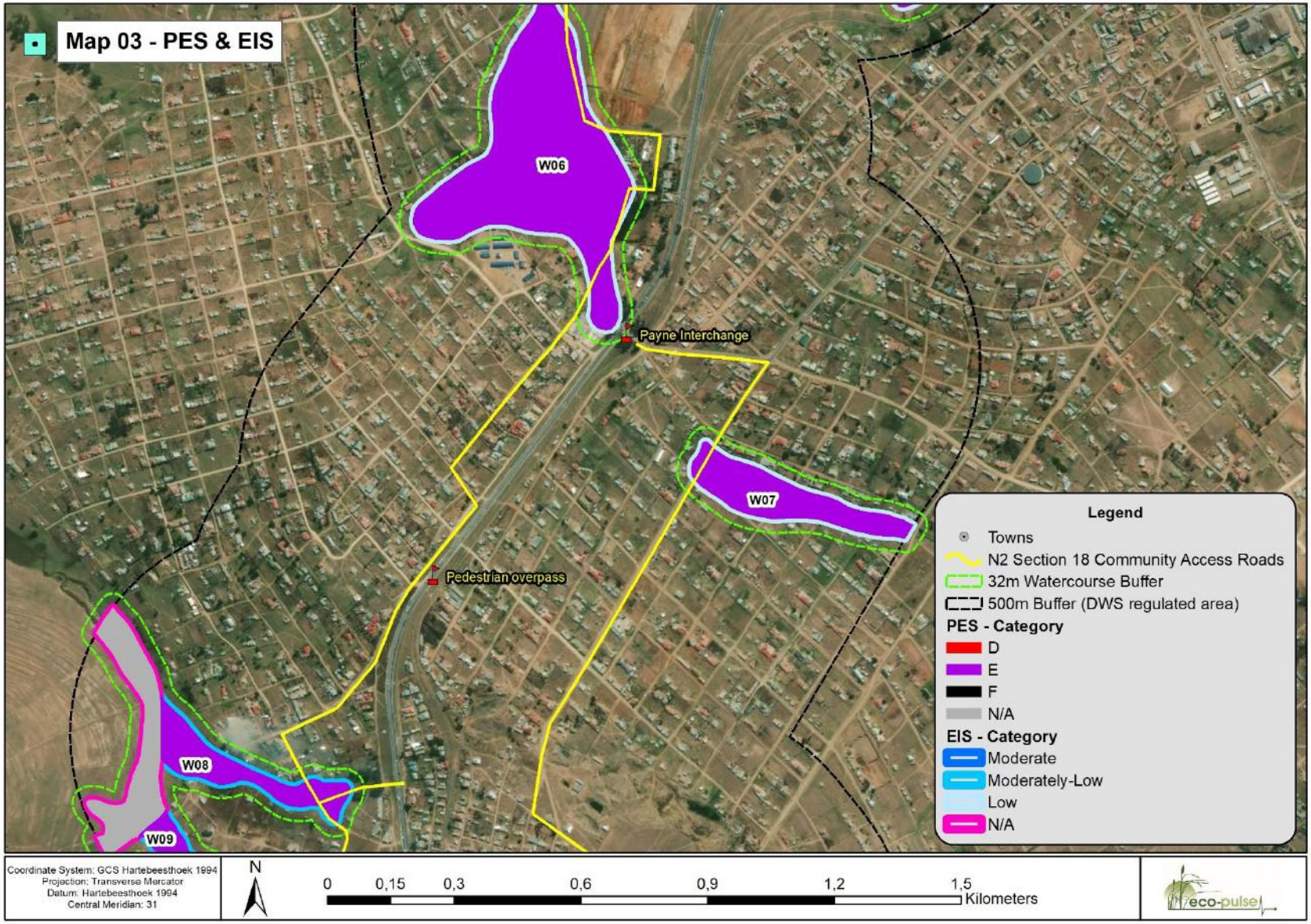
Map 03 - PES & EIS
W06
W07
W08
W09
Payne Interchange
Pedestrian overpass
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
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EIS - Category
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Moderately-Low
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Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
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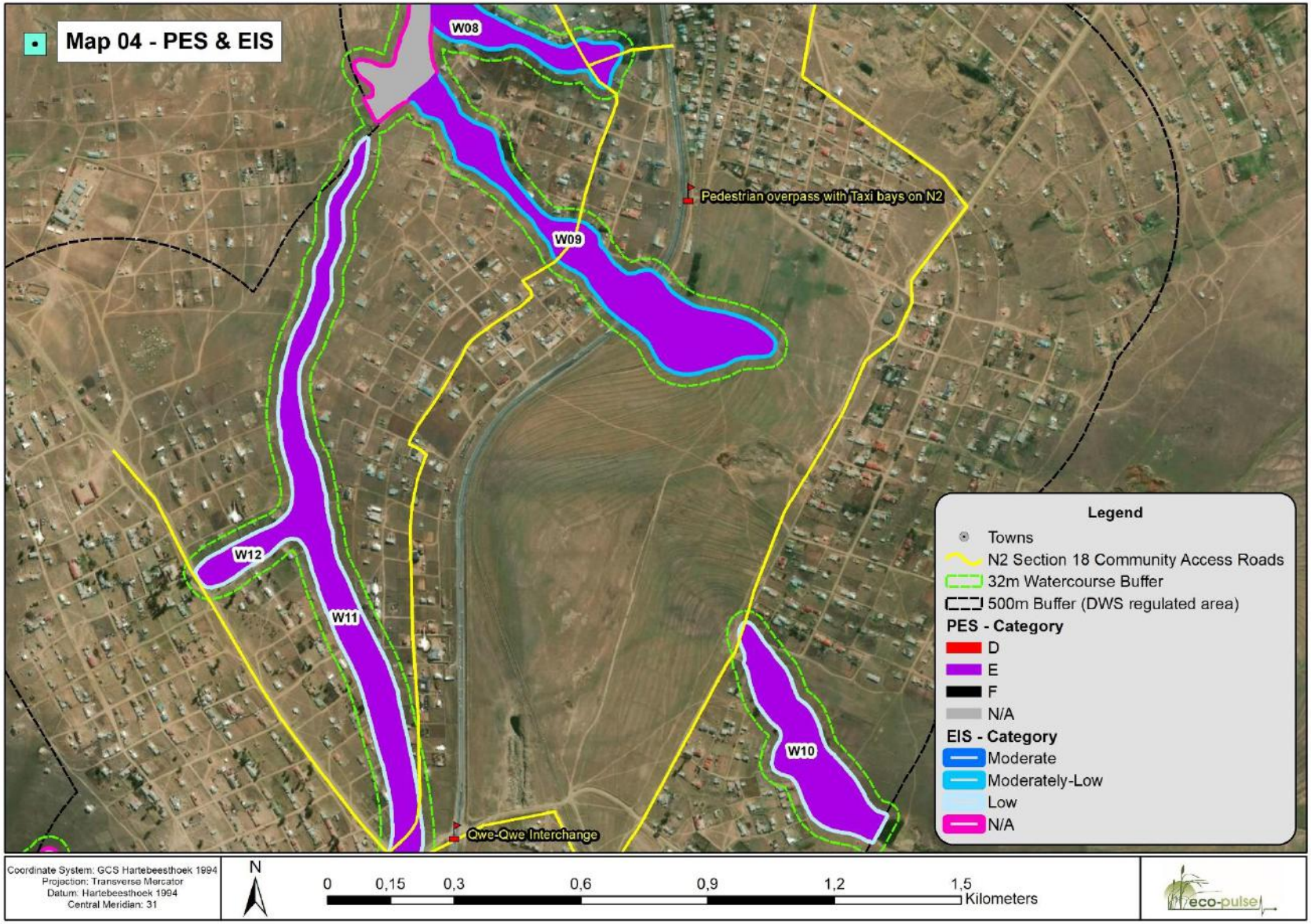
Map 04 - PES & EIS
W08
W09
W10
W11
W12
Pedestrian overpass with Taxi bays on N2
Qwe-Qwe Interchange
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
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EIS - Category
Moderate
Moderately-Low
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Coordinate System: GCS Hartebeesthoek 1994
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Kilometers
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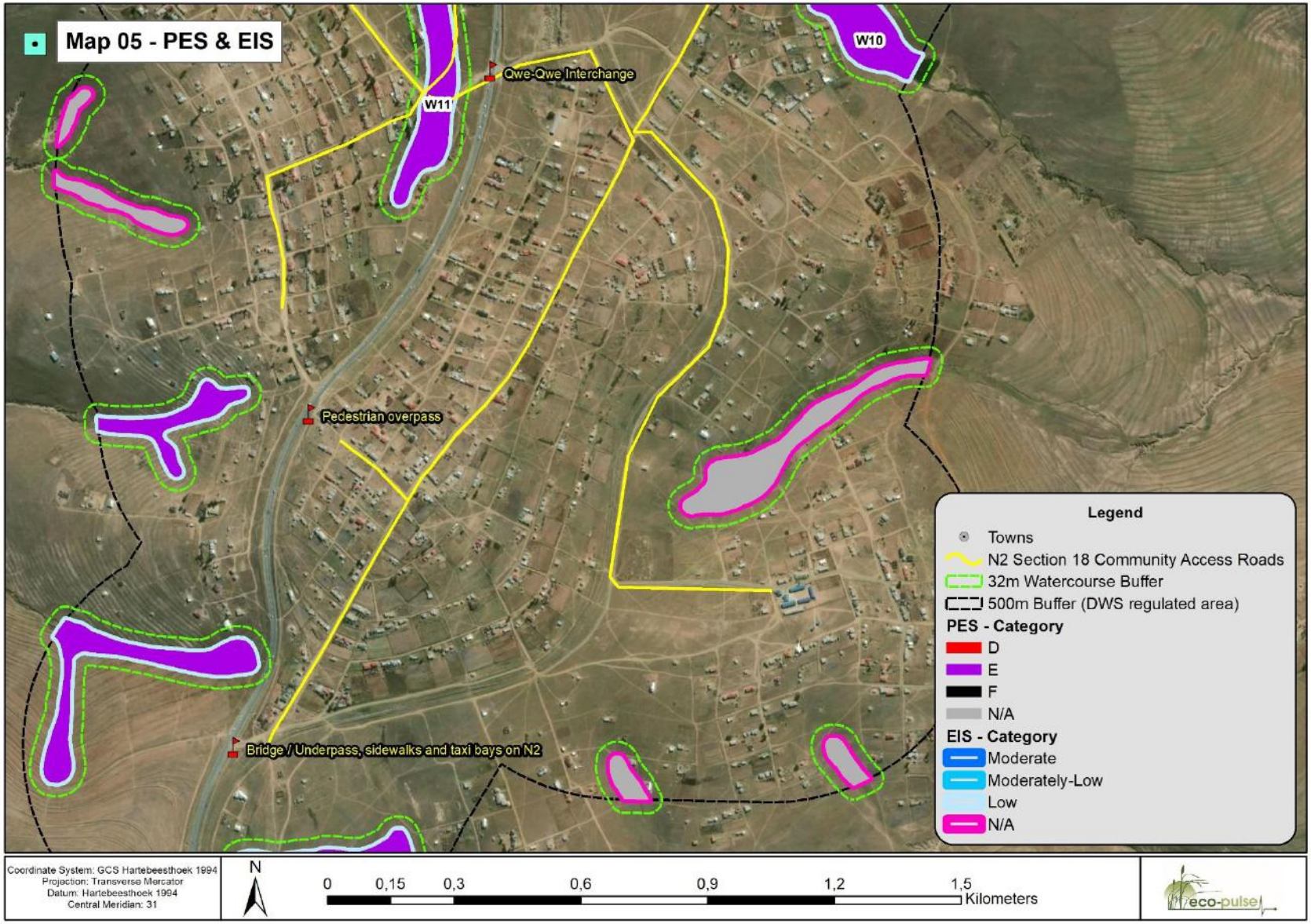
Map 05 - PES & EIS
W11
W10
Qwe-Qwe Interchange
Pedestrian overpass
Bridge / Underpass, sidewalks and taxi bays on N2
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
D
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EIS - Category
Moderate
Moderately-Low
Low
N/A
Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 31
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Kilometers
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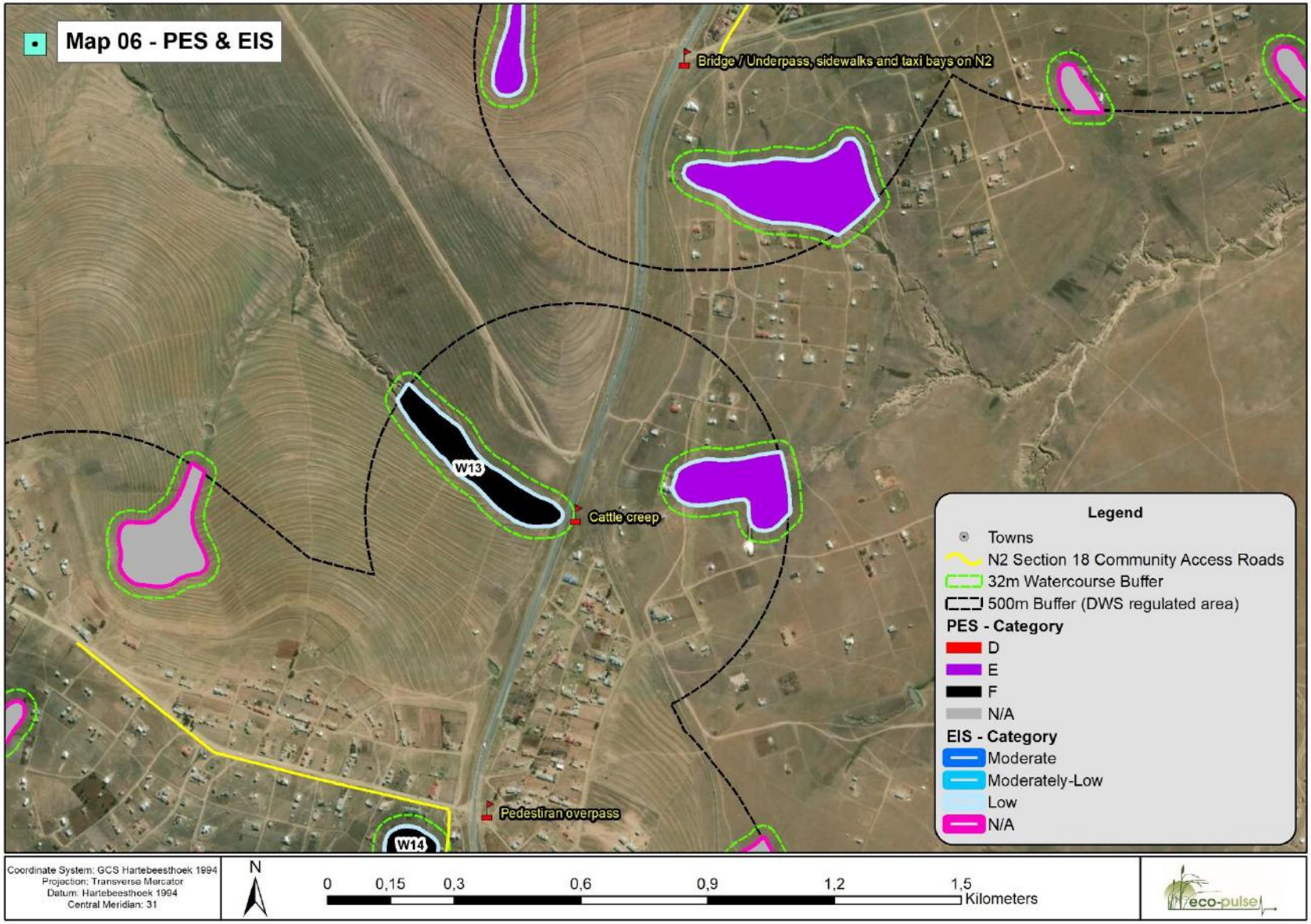
Map 06 - PES & EIS
Bridge / Underpass, sidewalks and taxi bays on N2
W13
Cattle creep
Pedestiran overpass
W14
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
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EIS - Category
Moderate
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Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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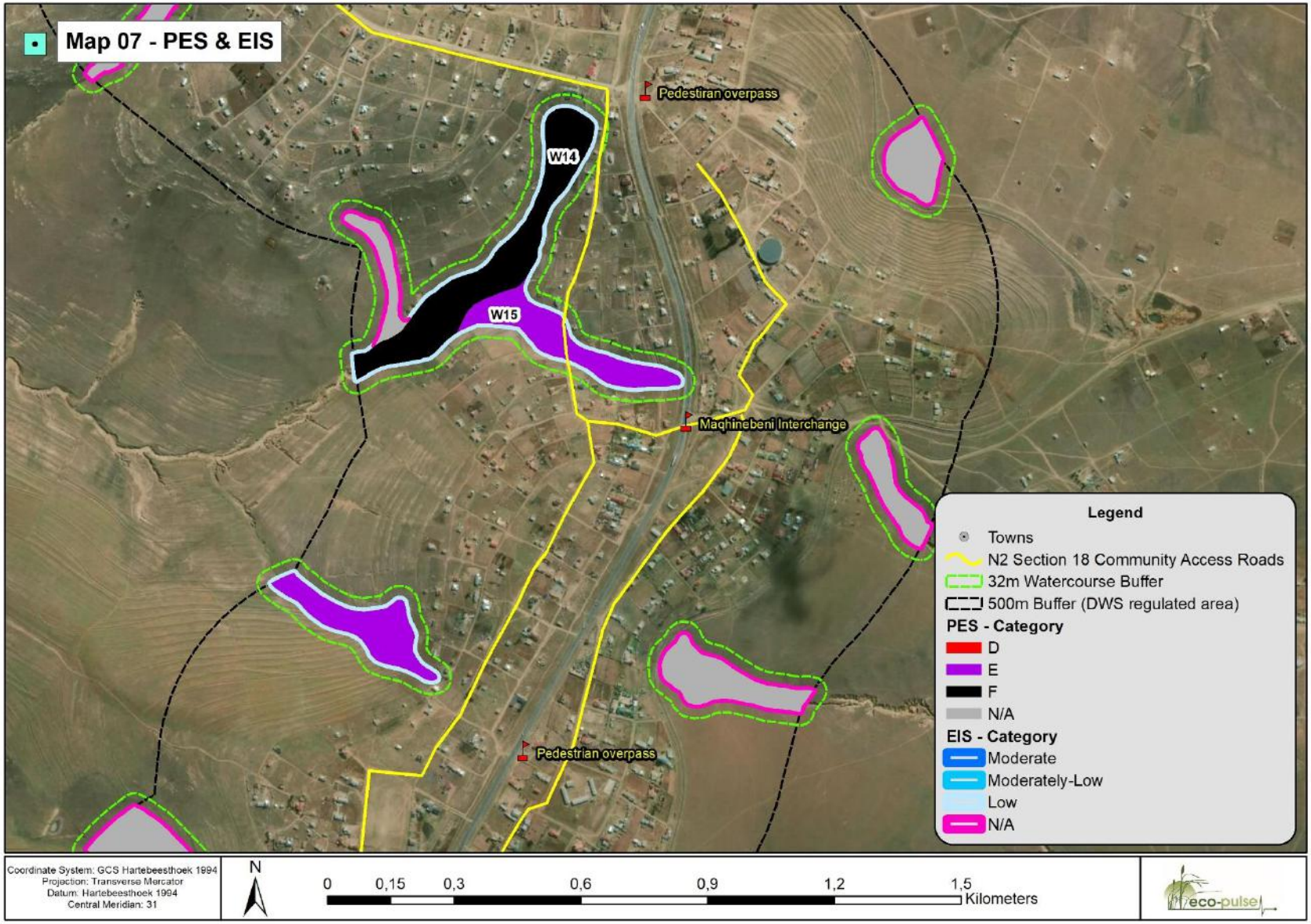
Map 07 - PES & EIS
Pedestrian overpass
W14
W15
Maqhinebeni Interchange
Pedestrian overpass
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
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EIS - Category
Moderate
Moderately-Low
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Coordinate System: GCS Hartebeesthoek 1994
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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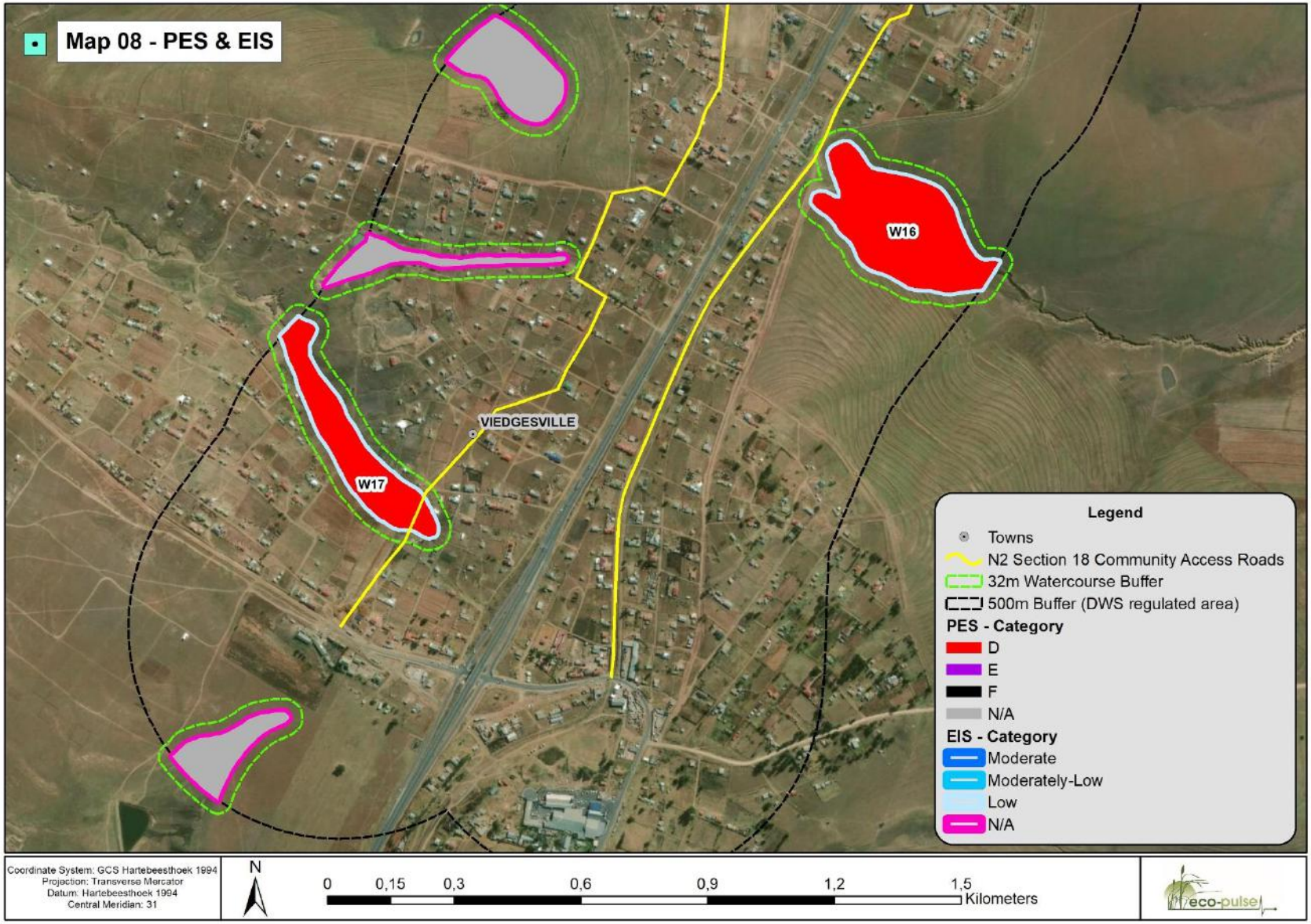
Map 08 - PES & EIS
W16
W17
VIEDGESVILLE
Legend
Towns
N2 Section 18 Community Access Roads
32m Watercourse Buffer
500m Buffer (DWS regulated area)
PES - Category
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Annexure D: Impact Significance Tables

Construction Phase Impact Significance Assessment												
Realistic 'Poor' (standard) Mitigation Scenario												
No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
C1	Direct physical loss or modification of freshwater habitat	Negative	Direct impact	Direct impact	Irrelevant	Irrelevant	Moderate	Surrounding Area	Permanent	Definite	Moderately-Low	Medium
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderate	Surrounding Area	Long-term	Highly Probable	Moderately-Low	Medium
C3	Impacts to water quality	Negative	Indirect Impact	Direct impact	Irrelevant	Direct impact	Moderately-Low	Local	Medium-term	Probable	Moderately-Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderately-Low	Surrounding Area	Medium-term	Definite	Low	Medium
Realistic 'Good' (best-practical) Mitigation Scenario												
No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
C1	Direct physical loss or modification of freshwater habitat	Negative	Direct impact	Direct impact	Irrelevant	Irrelevant	Moderate	Site	Permanent	Definite	Moderately-Low	Medium
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderate	Surrounding Area	Long-term	Probable	Moderately-Low	Medium
C3	Impacts to water quality	Negative	Indirect Impact	Direct impact	Irrelevant	Direct impact	Moderately-Low	Surrounding Area	Medium-term	Possible	Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderately-Low	Site	Medium-term	Highly Probable	Low	Medium

Operational Phase Impact Significance Assessment

Realistic 'Poor' (standard) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
O1	Direct physical loss or modification of freshwater habitat	Negative	Irrelevant	Irrelevant	Irrelevant	Irrelevant	N/A				Low	Medium
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderate	Surrounding Area	Long-term	Definite	Moderately-Low	Medium
O3	Impacts to water quality	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderate	Local	Long-term	Probable	Moderately-Low	Medium
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderately-Low	Site	Long-term	Probable	Low	Medium

Realistic 'Good' (best-practical) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
O1	Direct physical loss or modification of freshwater habitat	Negative	Irrelevant	Irrelevant	Irrelevant	Irrelevant	N/A				Low	Medium
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderate	Surrounding Area	Long-term	Highly Probable	Moderately-Low	Medium
O3	Impacts to water quality	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderate	Surrounding Area	Long-term	Possible	Low	Medium
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct impact	Direct impact	Irrelevant	Direct impact	Moderately-Low	Site	Long-term	Possible	Low	Medium

Annexure E: DWS Risk Matrix Tables

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I Water Use Risk Assessment Protocol)

Project Name: N2 Mthatha Community Access Roads

Date: 13/07/2020

Name of Assessor(s): Mr. Ryan Kok *(Pr.Sci.Nat.)* — **SACNASP Registration No.** 122290

Name of Reviewer: Mr. Ryan Kok *(Pr.Sci.Nat.)* — **SACNASP Registration No.** 122290

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

No.	Phase(s)	Activity	Aspect (Stressor)	Impact	Severity: Flow Regime	Severity: Physico & chemical (water Quality)	Severity: Habitat (Geomogh & Vegetation)	Severity: Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level	Control measures	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes	PES & EIS of Affected Watercourse
1	Construction	Clearing, earthworks, infilling etc	C1 - Physical disturbance	Impact C1	1	1	2	2	1,5	1	3	5,5	3	4	5	2	14	77	Moderate	M	Refer to Mitigation & Management Plan in Section 6 in the Report	52	Low	Refer to Report, 17 watercourses assessed
			C2 - Runoff and sediment	Impact C2	2	1	1	2	1,5	2	3	6,5	2	3	5	1	11	71,5	Moderate	M	Refer to Mitigation & Management Plan in Section 6 in the Report	46,5	Low	Refer to Report, 17 watercourses assessed
			C4 - Noise, dust, light, alien plants	Impact C4	1	1	1	1	1	1	1	3	2	2	5	2	11	33	Low	M	Refer to Mitigation & Management Plan in Section 6 in the Report	33	Low	Refer to Report, 17 watercourses assessed
2	Construction	Hazardous materials handling etc	C3 - Pollutants	Impact C3	1	1	1	1	1	2	1	4	3	3	5	2	13	52	Low	M	Refer to Mitigation & Management Plan in Section 6 in the Report	52	Low	Refer to Report, 17 watercourses assessed
3	Operation	Mainetance and repair	O1 - Physical disturbance	Impact O1	1	1	2	2	1,5	1	4	6,5	1	1	5	1	8	52	Low	M	Refer to Mitigation & Management Plan in Section 6 in the Report	52	Low	Refer to Report, 17 watercourses assessed
4	Operation	Road use	O2 - Runoff and sediment	Impact O2	1	1	2	2	1,5	2	3	6,5	2	3	5	2	12	78	Moderate	M	Refer to Mitigation & Management Plan in Section 6 in the Report	53	Low	Refer to Report, 17 watercourses assessed
			O3 - Pollutants	Impact O3	1	1	1	1	1	2	2	5	2	2	5	2	11	55	Low	M	Refer to Mitigation & Management Plan in Section 6 in the Report	55	Low	Refer to Report, 17 watercourses assessed
			O4 - Nois, light, car strikes, alien plants etc	Impact O4	1	1	1	1	1	1	2	4	3	3	5	2	13	52	Low	M	Refer to Mitigation & Management Plan in Section 6 in the Report	52	Low	Refer to Report, 17 watercourses assessed