DRAFT AQUATIC AND WETLAND DELINEATION REPORT: FOR THE PROPOSED UPGRADE OF THE NATIONAL ROUTE 1 SECTION 4 BETWEEN DOORNFONTEIN (KM 63.0) AND LAINGSBURG (KM 81.7), TWO BRIDGES AND EIGHTY-SIX MINOR CULVERTS, EIGHT MAJOR CULVERTS IN THE WESTERN CAPE PROVINCE, CENTRAL KAROO DISTRICT MUNICIPALITY AT LAINGSBURG LOCAL MUNICIPALITY.

PRODUCED BY:	PRODUCED FOR:
 Physical Address: **5 13th Avenue, Fairlands, Randburg 2170** Mobile Number: **071 2082 364** Email: **info@ntumbulukoconsulting.co.za**	**South African National Roads Agency SOC Limited** SANRAL SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD Reg.No.1998/009584/30

July 2024

CONDITIONS RELATING TO THIS REPORT

DECLARATION OF INTEREST

Ntumbuluko Consulting Pty (Ltd) has no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development. Ntumbuluko Consulting Pty (Ltd) is not a subsidiary, legally or financially of the proponent. The study was undertaken by Mr Tshuxekani Maluleke, he is a registered Natural Scientists with the following details:

Specialist Name	Tshuxekani Maluleke (Wetland and Aquatic Specialist)
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2017 Environmental Impact Assessment (EIA) Regulations, that: • I act as the independent specialist in this application; • I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant; • I declare that there are no circumstances that may compromise my objectivity in performing such work; • I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity; • I will comply with the Act, regulations and all other applicable legislation; • I have no, and will not engage in, conflicting interests in the undertaking of the activity;

	• I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; • All the particulars furnished by me in this form are true and correct; and • I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.
Signature	
Date	2024/08/14

QUALIFICATIONS

SPECIALIST	QUALIFICATION
Mr Tshuxekani Maluleke (SACNASP Reg. No. 120501)	MSc Environmental Sciences (Wits University) BSc Hons Zoology (University of Limpopo) BSc Hons Animal, Plant and Environmental Sciences (Wits University)

INDEMNITY

Although Ntumbuluko Consulting Pty (Ltd) exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this report and its implementation in terms of the National Environmental Management Act of 1998, and exempt Ntumbuluko Consulting Pty (Ltd) and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of this report. Ntumbuluko Consulting Pty (Ltd) accepts no liability, and the client indemnifies Ntumbuluko Consulting Pty (Ltd) and its directors, managers, agents, and employees against all actions, claims, demands, losses, liabilities, costs, damages, and expenses arising from or in connection with services rendered, directly or indirectly, by Ntumbuluko Consulting Pty (Ltd) and by the use of this document.

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LIST OF ABBREVIATIONS AND ACCRONYMS

BGIS: Biodiversity Geographic Information System

DEM: Digital Elevation Model

DWAF: Department of Water Affairs and Forestry

DWS: Department of Water Affairs and Sanitation

EA: Environmental Auhorisation

EIS: Ecological Importance and Sensitivity

EMPr: Environmental Management Program

GIS: Geographic Information System

HGM: Hydrogeomorphic

NFEPA: National Freshwater Priority Area

NWA: National Water Act (Act no 36 of 1998)

PES: Present Ecological Status

QDS: Quarter Degree Square

SANBI: South African National Biodiversity Institute

TWQRs: Target Water Quality Ranges

WMA: Water Management Areas

WUL: Water Use Licence

TERMS OF REFERENCE

Ntumbuluko Consulting Pty (Ltd) was requested to conduct a wetland delineation of the wetland/s present on the study sites. This report includes the delineation and provides an assessment on the ecological state of these areas.

1. INTRODUCTION

Ntumbuluko Consulting (Pty) Ltd has been appointed by Earthlink Environmental Services (Pty) Ltd on behalf of the South African National Roads Agency SOC Ltd or SANRAL to conduct an aquatic and wetland study for the Proposed upgrade of National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7), within the Laingsburg Local Municipality, in the Central Karoo District Municipality, Western Cape Province, The investigation has been undertaken to form part of the Water Use Licence Application (WULA), and associated management plan (EMP). This report presents the findings of the wetland assessment and delineation of which the fieldwork was conducted on the **06 July 2024** (**Figures 1-1**).

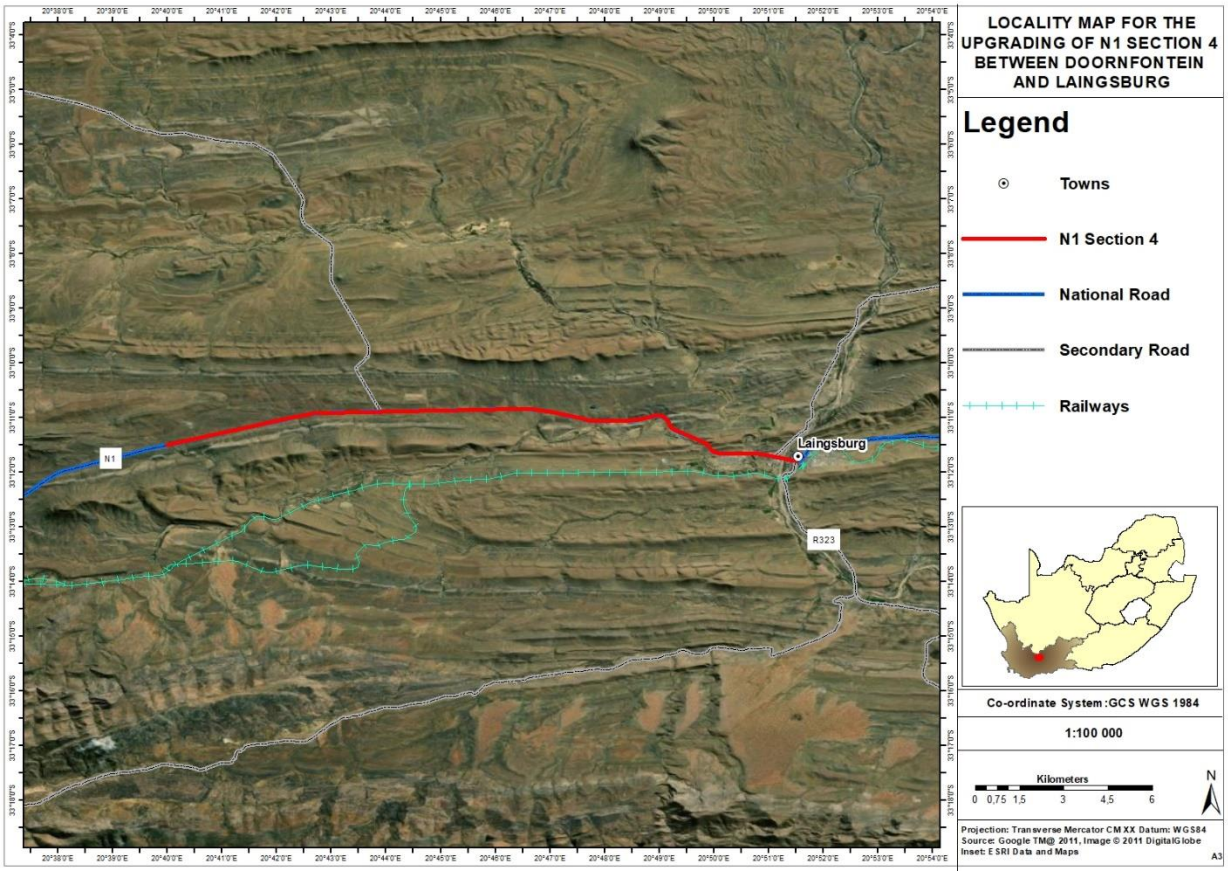

Figure 1-1: Locality Map (Study Site).

2. BACKGROUND

The South African National Roads Agency Soc Ltd (SANRAL) proposes to upgrade the National Road (N1) Section 4 between Doornfontein (Km 63.0) And Laingsburg (Km 81.7). The project commences at Doornfontein stream at km 63.0 and ends at km 76.7, the road traverses an easy rolling to flat terrain. From km 76.7 to km 79.6 the speed is reduced due to the very sharp horizontal curves. This section is hilly (commonly referred to as the "pass" section). From km 79.6 the road enters the town of Laingsburg and ends at km 81.7.

The following bridge will be upgraded in the proposed road upgrade project:

- ✓ Buffels River Bridge;
- ✓ Wilgerhout River Bridge; and
- ✓ Doornfontein River Bridge.

Bridge drainage report and Major Culvert drainage report was submitted and approved by SANRAL.

Proposed upgrades:

- ✓ Doornfontein River bridge: New bridge for the new left carriageway;
- ✓ Wilgerhout River bridge: Raise the deck and widening; and
- ✓ Buffels River bridge: New bridge for the right carriageway, new raised deck on existing carriageway.

3. LEGAL FRAMEWORK

3.1 National Environmental Management Act (Act No. 107 of 1998)

The EIA Regulations, promulgated under NEMA, focus primarily on creating a framework for co-operative environmental governance. NEMA provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by State Departments and to provide for matters connected therewith.

3.2 National Waste Act, 2008 (Act No. 59 of 2008)

The NEMWA aims at promoting sustainable waste management practices through the implementation of "Integrated Waste Management Planning", where "Integrated Waste Management Planning is viewed as a holistic approach of managing waste, aimed at optimising waste management practises to ensure that the implementation thereof yields practical solutions that are environmentally, economically and socially sustainable and acceptable to the public and all relevant spheres of government".

3.3 National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) aims to provide management of the national water resources to achieve sustainable use of water for the benefit of all water users. This requires that the quality of water resources is protected as well as integrated management of water resources with the delegation of powers to institutions at the regional or catchment level. The purpose of the Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in responsible ways. Of specific importance to this application is Section 19 of the NWA, which states that an owner of land, a person in control of land or a person who occupies or uses the land which thereby causes, has caused or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring and must therefore comply with any prescribed waste standard or management practices.

Regulations GN 704 dated June 1999 under the NWA, 1998 (Act 36 of 1998) stipulates that no development activities may take place within the 1:100 year floodline of a watercourse, or within 100 m of the watercourse, whichever is the furthest.

Regulations GN 509 dated August 2016 under the Section 21 c and i water uses of the NWA, 1998 (Act No 36 of 1998) stipulates the:

"Extent of a watercourse" as:

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

"Regulated area of a watercourse" for section 21(c) or (i) of the Act water uses in terms of this Notice means:

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

(b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

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

3.4 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)

The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA and the protection of species and ecosystems that warrant national protection. As part of its implementation strategy, the National Spatial Biodiversity Assessment was developed.

4. SCOPE OF WORK

The scope of work entailed the following:

- Field visit to delineate the outer boundary of wetland/riparian habitats within a 500 m buffer from the existing National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7) according to the methods contained in the manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005);
- Assess and describe the health of any wetland units identified, through evaluation of indicators based on geomorphology, hydrology and vegetation as per the WET-Health methods;
- Assess and describe the Ecological Services, Importance and Sensitivity (EIS) of any wetlands identified on site;
- Identify potential negative impacts on the wetland(s) or watercourses along the National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7) and assess the significance of these impacts;
- Provide recommended mitigation measures for the identified impacts in order to avert or lower the significance of the negative impacts.

5. ASSUMPTIONS AND LIMITATIONS

- It is assumed that wetland plant species flowering only during specific times of the year could be confused with a very similar species of the same genus.
- Some wetland plant species that emerge and bloom during another time of the year or under very specific circumstances may have been missed entirely.
- In order to obtain a comprehensive understanding of the dynamics of the wetland habitats of the study area, surveys should ideally have been replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this survey was conducted in one season during a once-off site visit of five days.
- Data collection in this study relied heavily on data from representative, homogenous wetland sections, as well as general observations, analysis of satellite imagery from the past until the present, generic data and a desktop analysis.
- No formal water quality or aquatic faunal assessments (e.g., SASS 5) were conducted as part of this study. All comments on these subjects were made from estimations of the current, visible situation in the field.
- The specialist responsible for this study reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.

6. SITE LOCATION

The proposed development will take place along the National Road (N1) Section 4 between Doornfontein (Km 63.0) And Laingsburg (Km 81.7), in the Western Cape. The upgrade will start at Doornfontein stream at km 63.0, and end at km 76.7. The upgrade will traverse an easy rolling to flat terrain, from km 76.7 to km 79.6. This section is hilly (commonly referred to as the "pass" section) from km 79.6 the road enters the town of Laingsburg and ends at km 81.7 (**Figure 6-1**).

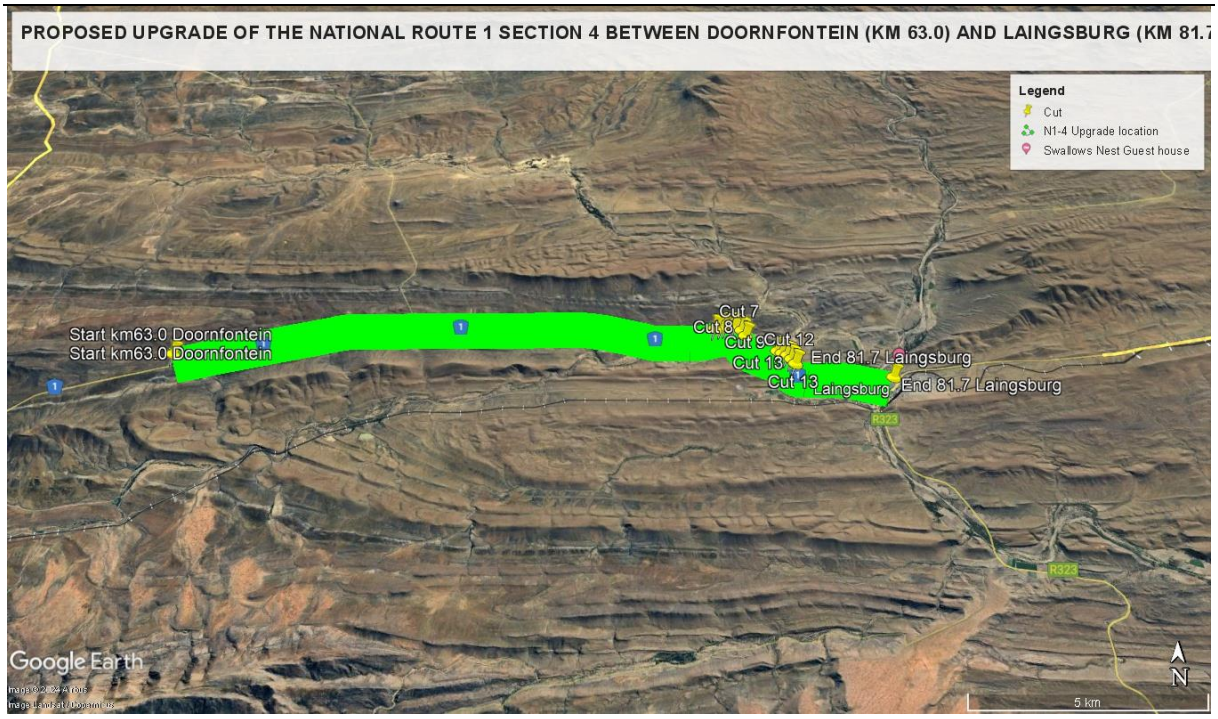

Figure 6-1: Locality Map

7. METHODOLOGY

7.1 Wetland Assessment

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act No. 36 of 1998 as:

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

7.1.1 Desktop Assessment

Examination of the National Freshwater Ecosystem Priority Areas (NFEPA)'s databases were undertaken for the project. The NFEPA project aims to produce maps which provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or FEPAs. FEPAs are determined through a process of systematic biodiversity planning and involved collaboration of over 100 freshwater researchers and practitioners. They are identified based on a range of criteria dealing with the maintenance of key ecological processes and the

conservation of ecosystem types and species associated with rivers, wetlands and estuaries (MacFarlane et al., 2009).

The assessment of the study site involved the investigation of aerial photography, GIS databases including the NFEPA and South African National Wetland maps as well as literature reviews of the study site in order to determine the likelihood of wetland areas within this site.

7.1.2 Field Assessment

The wetland delineation was conducted as per the procedures described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1' (Department of Water Affairs, 2005) (**Figure 7-1**). This document requires the delineator to give consideration to four indicators in order to find the outer edge of the wetland zone:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation. Signs of wetness are characterised by a variety of aspects. These include marked variations in the colours of various soil components, known as mottling; a gleyed soil matrix or the presence of Mn/Fe concretions. It should be noted that the presence of signs of wetness within a soil profile is sufficient to classify an area as a wetland area despite the lack of other indicators.

In assessing whether an area is a wetland, the boundary of a wetland or a non-wetland area should be considered to be the point where the above indicators are no longer present. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland, to delineate the boundary of that wetland and to assess its level of functionality and health.

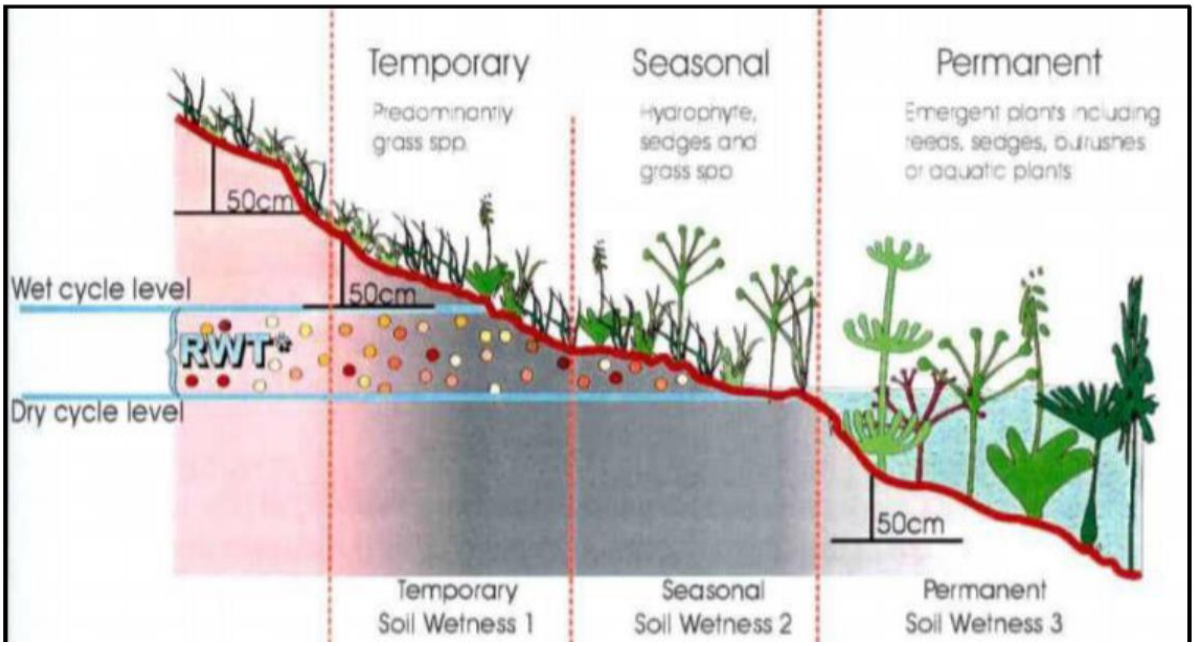

Figure 7-1: Different zones of wetness found in wetlands, indicating how the soil wetness and vegetation indicators change (DWAF, 2005).

7.1.3 Wetland Functionality and Health

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. Many of these functional benefits contribute directly or indirectly to increased biodiversity within the transformed study area as well as downstream of the study area through provision and maintenance of appropriate habitat and associated ecological processes (**Table 7-1**).

Table 7-1: Ecosystem services provided by wetlands (Kotze et al, 2008).

Ecosystem services supplied by wetlands	Indirect benefits	Regulating and supporting benefits	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream.
			Streamflow regulation		Sustaining streamflow during low flow periods.
			Water quality enhanced benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters.
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters.
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters.
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter.
	Biodiversity Maintenance				Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity of the surrounding area.
	Direct benefits	Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes.
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods.
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g., for baptisms or harvesting of culturally significant plants.
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife.
	Education and research				Sites of value in the wetland for education or research.

An indication of the functions and ecosystem services provided by wetlands can be assessed through the WET- Ecoservices manual (Kotze et al., 2008) and are based on a number of characteristics that are relevant to the particular benefit provided by the wetland. A Level 2 WET-Ecoservices assessment was undertaken for the wetlands occurring on site. A Level 2 assessment is the highest form of WET-Ecoservices assessment that can be undertaken and involves an on-site and desktop assessment.

Each wetland's ability to contribute to ecosystem services within the study area is further dependant on the particular wetland's Present Ecological State (PES) in relation to a benchmark or reference condition. A Level 2 Wetland Health assessment

was conducted on the wetlands delineated as per the procedures described in 'Wet-Health: A technique for rapidly assessing wetland health' (MacFarlane et al., 2009). This document assesses the health status of a wetland through evaluation of three main factors –

Hydrology: defined as the distribution and movement of water through a wetland and its soils.

Geomorphology: defined as the distribution and retention patterns of sediment within the wetland.

Vegetation: defined as the vegetation structural and compositional state.

The WET-Health tool evaluates the extent to which anthropogenic changes have impacted upon wetland functioning or condition through assessment of the above-mentioned three factors. Scores range from 0 indicating no impact to a maximum of 10 which would imply that impacts had completely destroyed the functioning of a particular component of the wetland. Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions (**Table 7-2**).

Table 7-2: Guideline for interpreting the magnitude of impacts on wetland integrity.

IMPACT CATEGORY	DESCRIPTION	RANGE
None	No discernible modification or the modification is such that it has no impact on wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a clearly adverse effect on this component of habitat integrity. Well in excess of 50% of the wetland integrity has been lost.	6 – 7.9
Critical	The modification is present in such a way that the ecosystem processes of this component of wetland health are totally / almost totally destroyed.	8– 10

The tool evaluates the health of the wetland and is determined by a score known as the Present Ecological Score. The health assessments for the hydrology,

geomorphology and vegetation components were then represented by the Present Ecological State (PES) categories. The PES categories are divided into six units (A-F) based on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in **Table 7-3**.

Table 7-3: Health categories used by WET-Health for describing the integrity of wetlands.

DESCRIPTION	IMPACT SCORE	HEALTH CATEGORY
Unmodified, natural.	0 – 1.0	A
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 - 2.0	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2.1 - 4.0	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4.1 - 6.0	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6.1 - 8.0	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.1 - 10.0	F

Since hydrology, geomorphology and vegetation are interlinked their scores have been aggregated to obtain an overall PES health score using the following formula (MacFarlane et al., 2009):

Health = ((Hydrology score) x3 + (Geomorphology score) x2 + (Vegetation score) x2)) ÷ 7

This gives a score ranging from 0 (pristine) to 10 (critically impacted in all respects). Hydrology is weighted by a factor of 3 since it is considered to have the greatest contribution to wetland health. Due to differences in the pattern of water flow through various hydro-geomorphic (HGM) types (**Figure 7-2**), the tool requires that the wetland is divided into distinct HGM units at the outset. Ecosystem services for each HGM unit are then assessed separately.

Each HGM unit is discussed on the following pages in more detail in terms of the functional integrity, Present Ecological Score and the impacts which affect these.

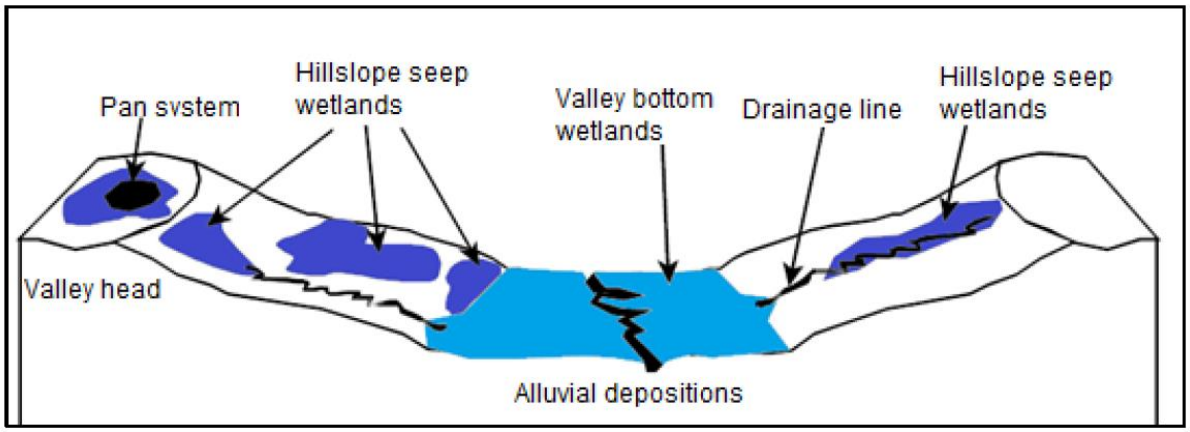

Figure 7-2: Diagrammatic representation of common wetland systems identified in Southern Africa (based on Kotze et al., 2008).

7.2 Risk Assessment to Watercourses

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines.

The matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

Consequence = Severity + Spatial Scale + Duration

Whereas likelihood is calculated as:

Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection.

Significance is calculated as:

Significance \Risk= Consequence x Likelihood.

Each metric of the severity (flow regime, water quality, geomorphology, biota and habitat) and spatial scale, duration, frequency of the activity, frequency of the incident/impact and detection are rated to a 1 to 5 scale (GNR 509, of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as Defined in Section 21(C) or Section 21(I), 2016). The score is then placed into one of the three classes, with low risks to the watercourse will qualify for a General Authorisation (GA). Medium and high-risk activities will require a Section 21(C) and (I) water use licence as per the National Water Act of 1998 (**Table 7-4**).

Table 7-4: Significance of the Section 21 C and I ratings matrix as prescribed by the National Water Act 1998 (Act No. 36).

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

8. BACKGROUND INFORMATION

8.1 GEOLOGY & SOILS

The area consists of mainly mudstone, shale and sandstone of the Adelaide Subgroup (Beaufort Group), accompanied by sandstone, shale and mudstone of the Permian Waterford Formation (Ecca Group) and sandstone and shale of other Ecca Group Formations as well as Dwyka Group diamictites (all of the Karoo Supergroup). This geology gives rise to shallow, skeletal soils. The region is classified as Fc land type (to a large extent), with Ib land type playing a subordinate role.

8.2 CLIMATE

The probability of rain is given for the entire year, but it is higher in winter. The Mean Annual Precipitation (MAP) is slightly above 200 mm. There are two slight rainfall optima: one in March and another spread from May to August. The mean annual temperature is close to 16°C, and the incidence of frost relatively high (30 days). See also climate diagram for SKv 6 Koedoesberge-Moordenaars Karoo (**Figure 8-1**).

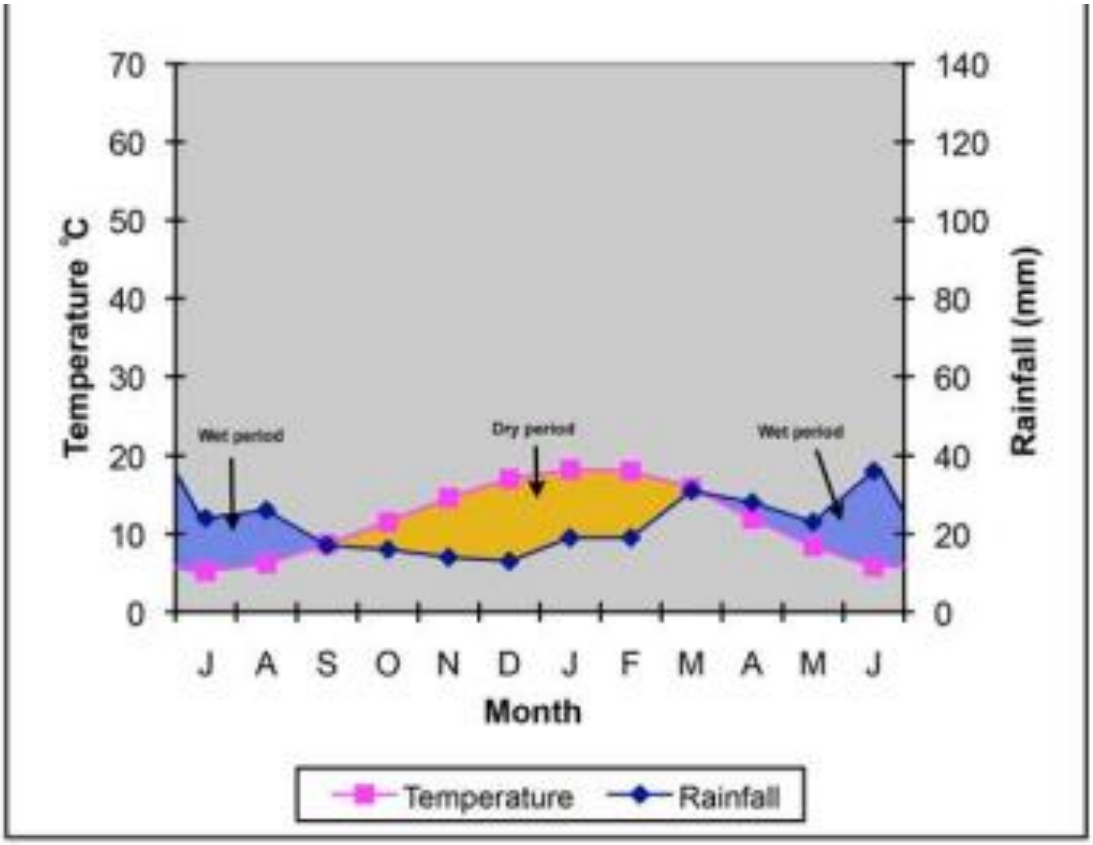

Figure 8-1: Climate diagram for SKv 6 Koedoesberge-Moordenaars Karoo

8.3 VEGETATION & LANDSCAPE ALONG THE NATIONAL ROUTE 1 SECTION 4 BETWEEN DOORNFONTEIN (KM 63.0) AND LAINGSBURG (KM 81.7)

8.3.1 Koedoesberge-Moordenaars Karoo (SKv 6)

The bulk (~98%) of the National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7) traverses through the Koedoesberge-Moordenaars Karoo (SKv6) vegetation unit (**Figure 8-2**). This vegetation unit is typically found in slightly undulating to hilly landscape which is dominated by low succulent scrub and dotted by scattered tall shrubs, patches of 'white' grass visible on plains, the most conspicuous dominants being dwarf shrubs of *Pteronia*, *Drosanthemum* and *Galenia*.

8.3.2 Southern Karoo Riviere (AZi 6)

A small section (<2%) of the road is found within the Southern Karoo Riviere (AZi 6) (**Figure 8-2**). This vegetation unit is found in narrow riverine flats supporting a complex of *Acacia karroo* or *Tamarix usneoides* thickets (up to 5 m tall) and fringed by tall *Salsola*-dominated shrubland (up to 1.5 m high), especially on heavier (and salt-laden) soils on very broad alluvia. In sandy drainage lines *Stipagrostis namaquensis* may occasionally also dominate. Mesic thicket forms in the far eastern part of this region may also contain *Leucosidea sericea*, *Rhamnus prinoides* and *Ehrharta erecta*.

8.4 DISTRIBUTION OF THE VEGETATION UNITS FOUND ONSITE

8.4.1 Distribution of the Koedoesberge-Moordenaars Karoo (SKv 6)

The Koedoesberge-Moordenaars Karoo vegetation unit is distributed in the Western Cape and Northern Cape (smaller portion) Provinces, Koedoesberge and Pienaarse Berg low mountain ranges bordering on southern Tanqua Karoo and separated by the Klein Roggeveld Mountains from the Moordenaars Karoo in the broad area of Laingsburg and Merweville. The unit also includes the Doesberg region east of Laingsburg and piedmonts of the Elandsberg as far as beyond the Gamkapoort Dam at Excelsior (west of Prince Albert). This vegetation unit thrives in altitudes ranging between 500–1 250 m (most of the area at 680–1 120 m).

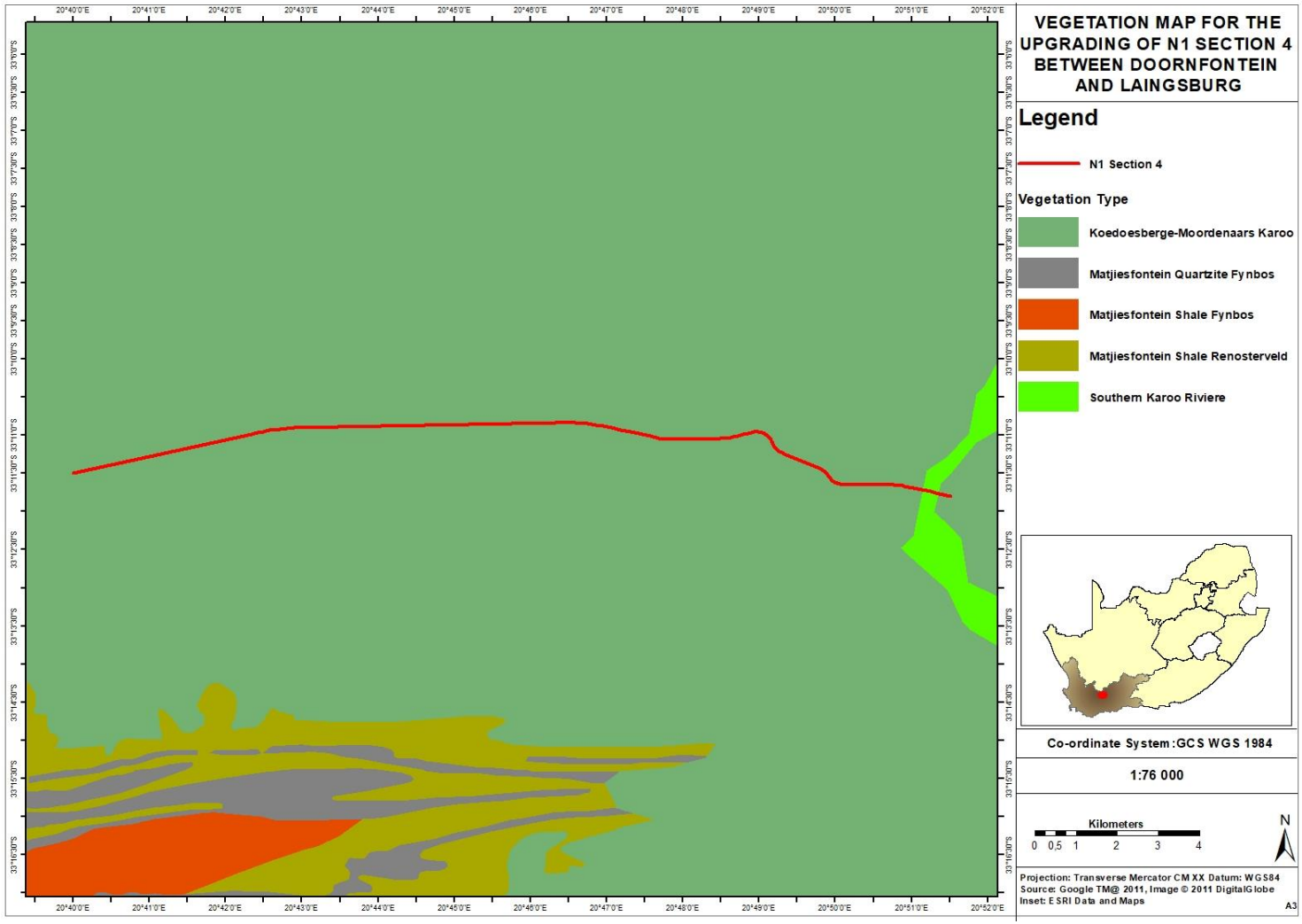

Figure 8-2: The vegetation type associated with the National Route 1 Section 4 Between Doornfontein (Km 63.0) And Laingsburg (Km 81.7), (2012 Vegetation Map

8.4.2 Distribution of the Southern Karoo Riviere (AZi 6)

The Southern Karoo Riviere (AZi 6) is distributed in the Western and Eastern Cape Provinces, Alluvia of the Buffels, Bloed, Dwyka, Gamka, Sout, Kariega, and Sundays Rivers and their tributaries), east of Laingsburg as far west as Graaff-Reinet and Jansenville. This vegetation unit is embedded within the Koedoesberge-Moordenaars Karoo, Prince Albert Succulent Karoo, Gamka Karoo, Eastern Lower Karoo, and southern parts of the Eastern Upper Karoo as well as some parts of the Albany Thicket Biome south of Cradock. This vegetation unit thrives in altitudes ranging between Altitude ranging from 250–1 550 m.

8.5 CONSERVATION STATUS OF THE VEGETATION UNITS ONSITE

8.5.1 Conservation status of the Koedoesberge-Moordenaars Karoo (SKv 6)

The Koedoesberge-Moordenaars Karoo vegetation unit is classified as **Least threatened**. A conservation target 19% has been set, with a very small portion enjoying statutory conservation in the Gamkapoort Nature Reserve. The vegetation unit is transformed only to a very small extent. There are no serious alien plant invasions recorded. Erosion is moderate (88%) and only to lesser extent high or very low.

8.5.2 Conservation status of the Southern Karoo Riviere (AZi 6)

The Southern Karoo Riviere (AZi 6) is classified as **Least threatened**. A conservation target 24%, with only an estimated 1.5% statutorily conserved in the Karoo National Park as well as in the Aberdeen, Bosberg, Commando Drift, Gamkapoort and Karoo Nature Reserves and in about 10 private reserves, mainly set up for game farming. Some 12% transformed for cultivation and building of dams, including Beaufort West, Beervlei, De Hoop, Floriskraal, Kommandodrift, Lake Arthur, Leeu-Gamka, Mentz and Vanryneveldspas Dams. The frequent disturbance include floods, concentrated grazing pressure, and associated input of nutrients, increase vulnerability of these habitats to invasion of alien woody species such as *Agave americana*, *Opuntia species*, *Prosopis species*, *Salix babylonica* and *Schinus molle*, and forbs including *Atriplex eardleyae*, *A. lindleyi* subsp. inflata, *Cirsium vulgare*, *Salsola kali and Schkuhria pinnata*.

The important taxa that is found onsite is summarised in Table 8-1.

Table 8-1: Important Taxa within the National Route 1 Section 4 Between Doornfontein (Km 63.0) And Laingsburg (Km 81.7), (Mucina and Rutherford 2006).

PLANT FORM	SPECIES
KOEDOESBERGE-MOORDENAARS KAROO (SKV 6)	
SUCCULENT SHRUBS	*Hereroa odorata (d), Antimima fergusoniae, A. maxwellii, A. wittebergensis, Aridaria noctiflora subsp. straminea, Crassula nudicaulis, C. rupestris subsp. commutata, Cylindrophyllum comptonii, Drosanthemum framesii, D. karrooense, D. lique, Euphorbia decussata, E. eustacei, E. mauritanica, Hoodia gordonii, H. grandis, Lycium oxycarpum, Manochlamys albicans, Peersia macradenia, Pelargonium crithmifolium, Ruschia grisea, R. intricata, Salsola aphylla, Sarcocaulon crassicaule, Sceletium rigidum, Tetragonia robusta var. psiloptera, Trichodiadema barbatum, Tylecodon reticulatus, T. wallichii subsp. wallichii, Zygophyllum flexuosum.*
TALL SHRUB	*Diospyros pallens.*
LOW SHRUBS	*Pteronia incana (d), Amphiglossa tomentosa, Aptosimum indivisum, A. spinescens, Asparagus burchellii, A. capensis var. capensis, Athanasia minuta subsp. inermis, Barleria stimulans, Berkheya spinosa, Chrysocoma ciliata, Eriocephalus africanus, E. ericoides, E. pauperrimus, E. spinescens, Euryops lateriflorus, Felicia filifolia, F. macrorrhiza, F. muricata, F. scabrida, Galenia africana, G. fruticosa, Garuleum bipinnatum, Helichrysum lucilioides, Hermannia grandiflora, H. multiflora, Lessertia fruticosa, Limeum aethiopicum, Melolobium candicans, Menodora juncea, Microloma armatum, Monechma spartioides, Muraltia scoparia, Pelargonium hirtum, Pentzia incana, Polygala seminuda, Pteronia adenocarpa, P. ambrariifolia, P. empetrifolia, P. glauca, P. glomerata, P. pallens, P. scariosa, P. sordida, Rhigozum obovatum, Senecio haworthii, Tripteris sinuata, Zygophyllum microphyllum, Z. retrofractum, Z. spinosum. Semiparasitic Shrub: Thesium lineatum.*
WOODY CLIMBERS	*Asparagus fasciculatus, A. racemosus, A. retrofractus, Microloma sagittatum.*
HERBACEOUS CLIMBER	*Fockea sinuata*
SEMIPARASITIC EPIPHYTIC SHRUB	*Viscum capense*

HERBS	*Atriplex suberecta, Felicia bergeriana, Gazania jurineifolia subsp. scabra, Hermannia althaeifolia, H. pulverata, Lepidium africanum, L. desertorum, Leysera tenella, Pelargonium minimum, P. nervifolium, Syncarpha dregeana, Ursinia nana, Zaluzianskya inflata, Z. peduncularis. Geophytic Herbs: Drimia intricata, Geissorhiza karooica, Ixia marginifolia, I. rapunculoides, Ornithogalum adseptentrionesvergentulum, Oxalis obtusa, Romulea austinii, R. tortuosa subsp. tortuosa, Strumaria karooica, S. pubescens, Trachyandra thyrsoidea.*
SUCCULENT HERBS	*Astroloba foliolosa, A. spiralis, Brownanthus vaginatus, Crassula deceptor, C. muscosa, C. tomentosa, Deilanthe thudichumii, Haworthia marumiana var. archeri, Mesembryanthemum stenandrum, Pectinaria articulata, Piaranthus parvulus, Psilocaulon coriarium, P. junceum, Quaqua arenicola subsp. arenicola, Q. arida, Q. ramosa, Stapelia pillansii, S. rufa, Stapeliopsis exasperata, Tetragonia microptera, Tripteris aghillana var. integrifolia.*
PARASITIC HERB	*Hyobanche glabrata*
GRAMINOIDS	*Aristida adscensionis, A. diffusa, Ehrharta calycina, E. delicatula, Enneapogon scaber, Fingerhuthia africana, Karroochloa tenella, Pentaschistis airoides, Stipagrostis ciliata, S. obtusa.*
SOUTHERN KAROO RIVIERE (AZI 6)	
SMALL TREES	*Acacia karroo (d), Rhus lancea (d).*
TALL SHRUBS	*Diospyros lycioides (d), Tamarix usneoides (d), Cadaba aphylla, Euclea undulata, Grewia robusta, Gymnosporia buxifolia, Melianthus comosus.*
LOW SHRUB	*Asparagus striatus.*
SUCCULENT SHRUBS	*Lycium cinereum (d), Amphiglossa callunoides, Lycium hirsutum, L. oxycarpum.*
ROCKY SLOPES OF RIVER CANALS GRAMINOID	*Stipagrostis namaquensis (d)*
ALLUVIAL SHRUBLANDS & HERBLANDS LOW SHRUBS	*Ballota africana, Bassia salsoloides, Carissa haematocarpa, Pentzia incana.*
SUCCULENT SHRUBS	*Malephora uitenhagensis (d), Salsola aphylla (d), S. arborea (d), Drosanthemum lique, Salsola geminiflora, S. gemmifera.*
GRAMINOIDS	*Cynodon incompletus (d), Cenchrus ciliaris, Cyperus marginatus.*

REED BEDS	*Megagraminoid: Phragmites australis (d).*

8.6 ENVIRONMENTAL SCREENING TOOL

The proposed infrastructure footprint was assessed at desktop level using the National Web-based Environmental Screening Tool. According to the Tool, the Aquatic Biodiversity Theme for the study area is rated 'Very High Sensitivity' due to the presence of wetland features in and around the study area (**Figure 8-3**).

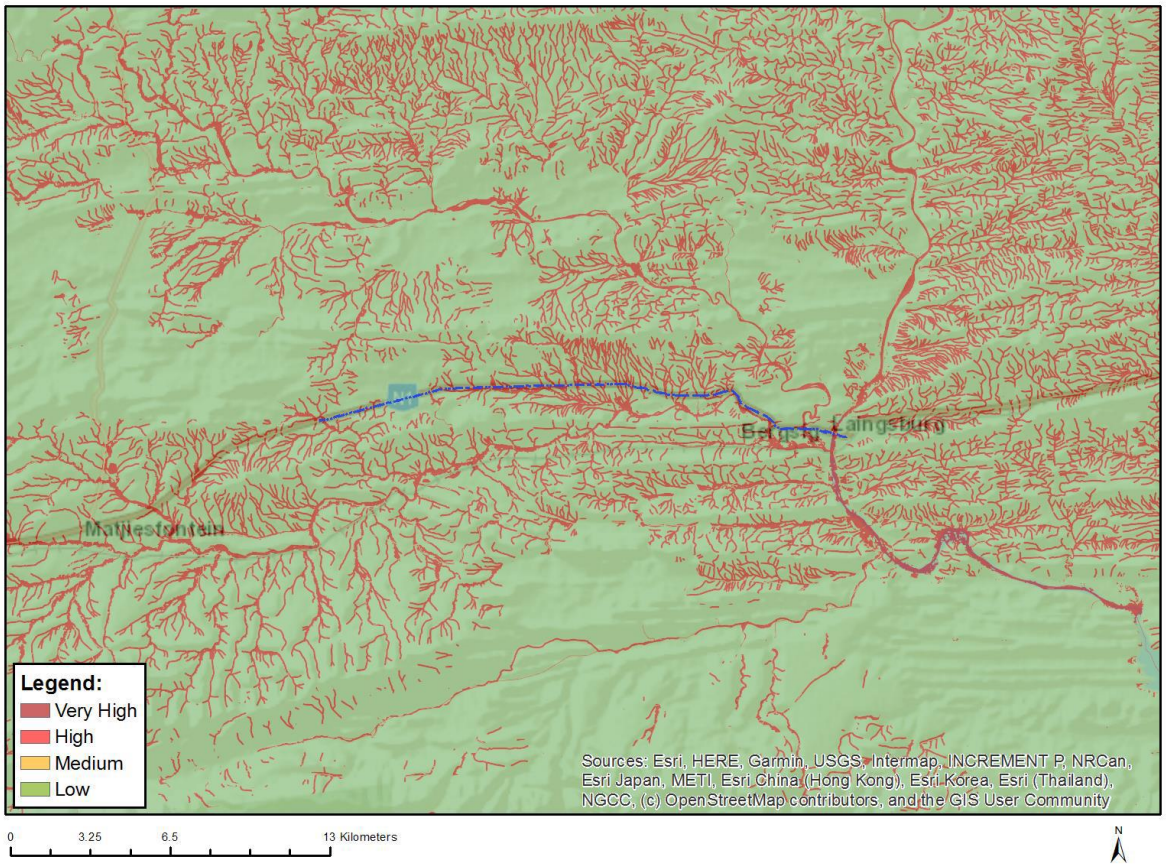

Figure 8-3: MAP Of Relative Aquatic Biodiversity Theme Sensitivity.

8.7 SURFACE HYDROLOGY

The aquatic sensitivity of the proposed site is classified as **VERY HIGH** in the Screening Report. The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important wetlands in South Africa (**Figure 8-4**). The study site is located within the Gouritz Water Management Area (WMA=27), Groot Subwater Management Area (WMA=17). The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important wetlands in South Africa. The

proposed development is located within a number of watercourses which include the Buffels rivers.

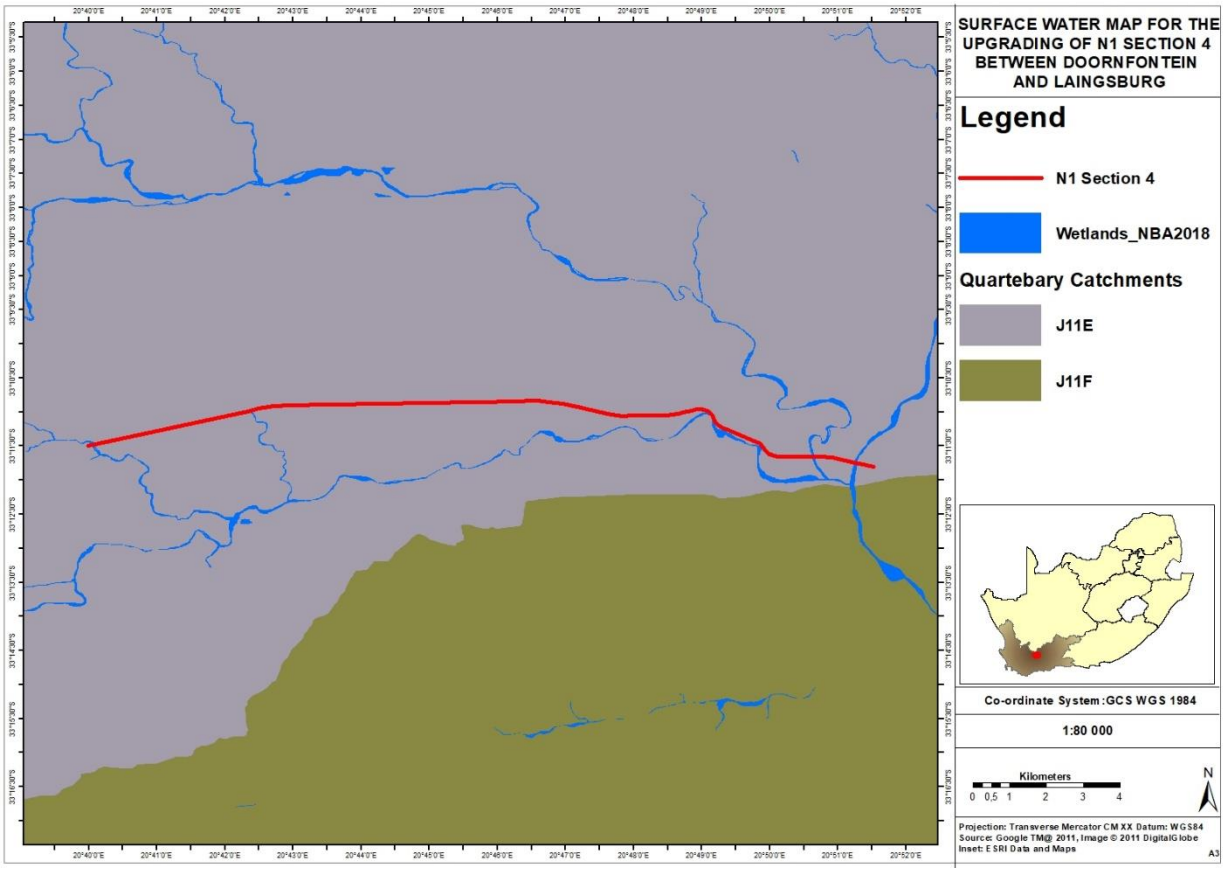

Figure 8-4: Surface Water Management.

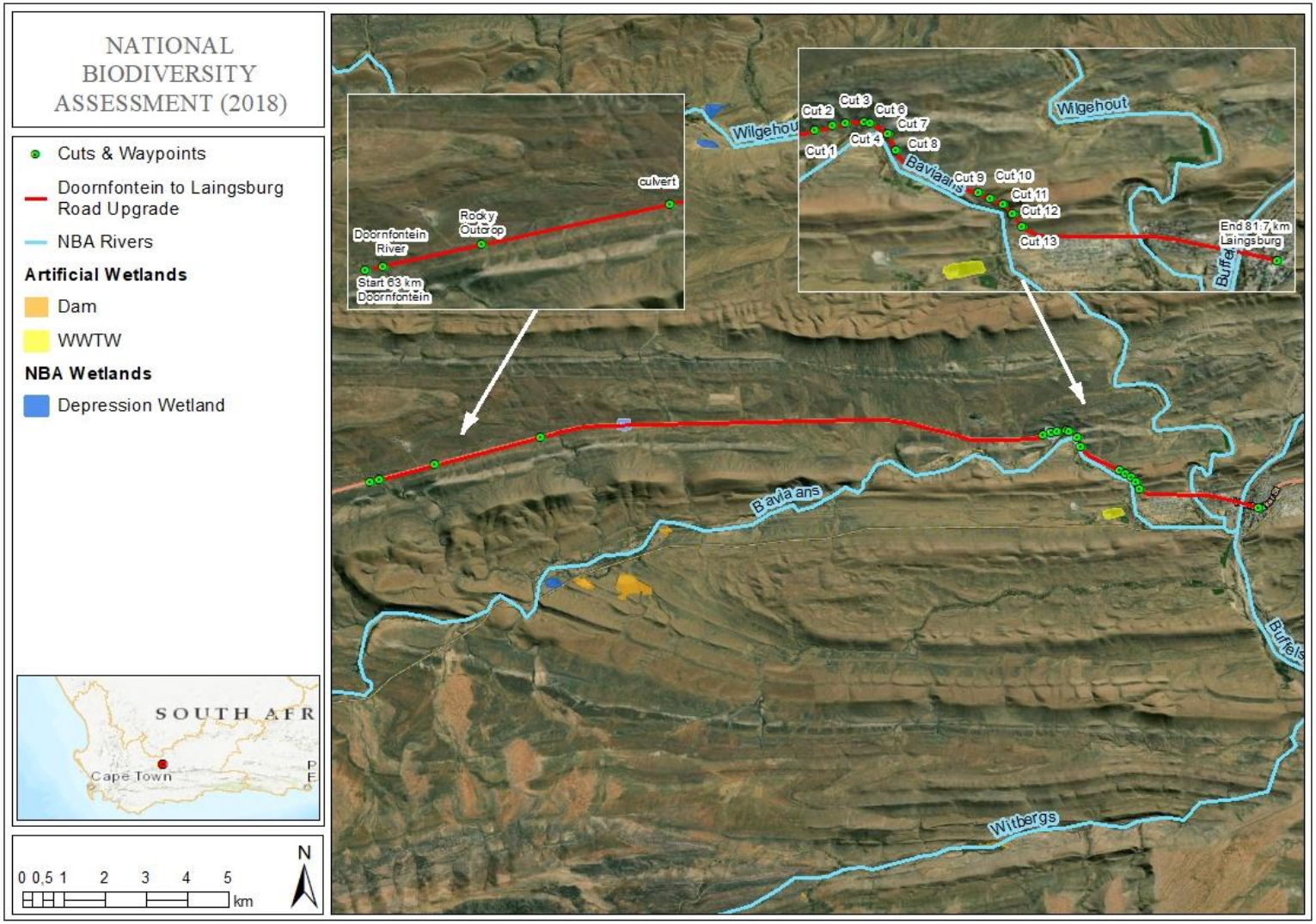

Figure 8-5: NBA Wetland Map.

9. RESULTS

9.1 Wetland Delineation and Assessment

This section provides the findings of the various methodologies utilised during the wetland assessment.

9.1.1 Desktop Assessment

Examination of the National Freshwater Ecosystem Priority Areas (NFEPA) database were undertaken for the study site. The NFEPA project aims to produce maps which provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. They were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (MacFarlane et al., 2009). Identification of FEPA Wetlands are based on a combination of special features and modelled wetland conditions that include expert knowledge on features of conservation importance as well as available spatial data on the occurrence of threatened frogs and wetland-dependent birds, the proposed development traverses a number of watercourses along the national route 1 section 4 between Doornfontein (km 63.0) and Laingsburg (km 81.7) (**Figure 9-1**).

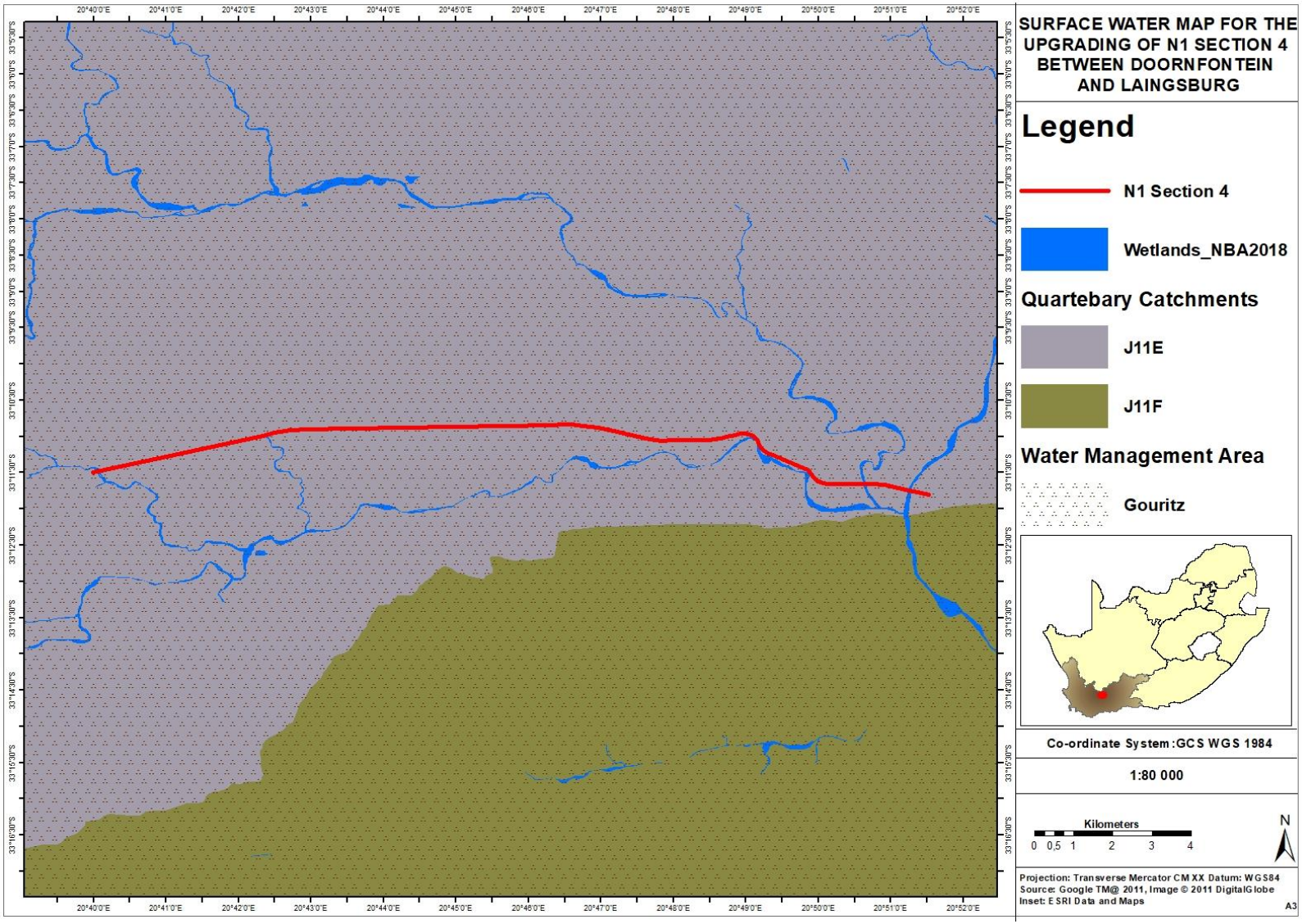

Figure 9-1:Surface Water Map.

9.1.2 FIELD SURVEY

The entire length of the national route 1 section 4 between Doornfontein (km 63.0) and Laingsburg (km 81.7), was surveyed, the areas that are earmarked for the development of two bridges, minor culverts, and major culverts were surveyed and assessed for any signs of aquatic life (**Figure 9-2**).

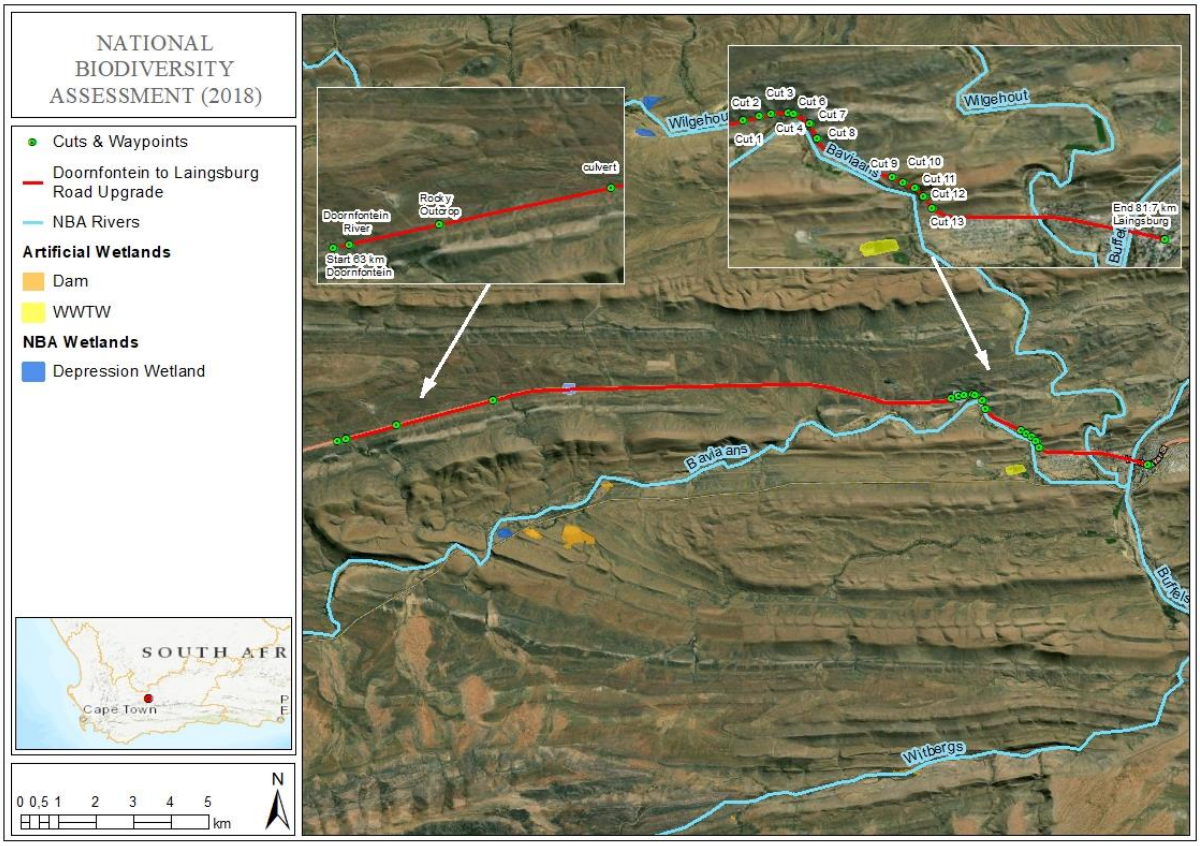

Figure 9-2: Sampling Points (Nb! Marked as way points in the map.)

9.1.2.1 WETLAND FEATURES

The proposed upgrade of the National route 1 section 4 between Doornfontein (km 63.0) and Laingsburg (km 81.7), traverses a number of watercourses which drainage lines, non-perennial rivers and a single perennial river. The watercourses near Doorfontein (KM63) were dry with evidence with minor evidence of the most recent rains (**Figure 9-3**). The rains were not sufficient to cause the water to flow, they moistened the soil. The watercourse does not have any hydrophytes or an aquatic species, it is a terrestrial environment (**Figure 9-3**).

Figure 9-3: Culvert 1 observed onsite with evidence of moisture emanating from the most recent rains. The first culvert is placed on unnamed tributary.

The proposed development will the expansion of the bridge that crosses the Doornfontein River (

Figure 9-4). The river was observed to be dry and dominated by terrestrial plant species, and none of the expected aquatic species.

Figure 9-4: Doornfontein River with the associated existing bridge.

The development will include eight major culverts (**Figure 9-5**) in the western cape province, central karoo district municipality at Laingsburg local municipality. The watercourse was observed to be dry.

Figure 9-5:one of the major culvert observed.

The proposed upgrade will traverse the buffels river near Laingsburg which was the river that had an active flow. The watercourse had a number of aquatic species including phragmites species. The surrounding area is dominated by the Southern Karoo Riviere veldtype which supporting a complex of *Acacia karroo* or *Tamarix usneoides* thickets (**Figure 9-6**).

Figure 9-6: Buffels river observed onsite.

9.1.3 Terrain indicator

The topography of an area is generally a good practical indicator for identifying those parts in the landscape where wetlands are likely to occur. Generally, wetlands occur as a valley bottom unit however wetlands can also occur on steep to mid slopes where groundwater discharge is taking place through seeps (DWAF, 2005). In order to classify a wetland system, the localised landscape setting must be taken into consideration through ground-truthing of the study site after initial desktop investigations (Ollis et al., 2014).

The study site can be characterized as Gently to moderately sloping upper pediment slopes (**Figure 9-6**).

Figure 9-7: Slope of the National route 1 section 4 between Doornfontein (km 63.0) and Laingsburg (km 81.7

The section of the very sharp horizontal curves with steep slopes (Figure 9-8).

Figure 9-8:Step slope.

9.1.4 Soil wetness and soil form indicator

The watercourses onsite have water and support a host of hydrophytes and alien invasive plant species. Wetland areas were identified and mainly delineated according to the presence of hydric (wetland) soil types. Hydric soils are defined as those which show characteristics (redoximorphic features) resulting from prolonged and repeated saturation. Characteristics include the presence of mottling (i.e., bright insoluble manganese and iron compounds) a gleyed matrix and/or Mn/Fe concretions. The watercourses consist mainly of sandy soils (**Figure 9-9**).

Figure 9-9:Soils observed within the watercourses.

9.1.5 Wetland Delineation

Any wetlands identified on the site were categorised according to the National Wetland Classification System for South Africa (Ollis et al., 2013). The wetland area was classified as a hydrogeomorphic (HGM) unit. An HGM unit is a recognisable physiographic wetland-unit based on the geomorphic setting, water source of the wetland and the water flow patterns (MacFarlane et al., 2009). The proposed project is located within 500m of a number of watercourses (perennial and non-perennial) (**Figure 9-*10***).

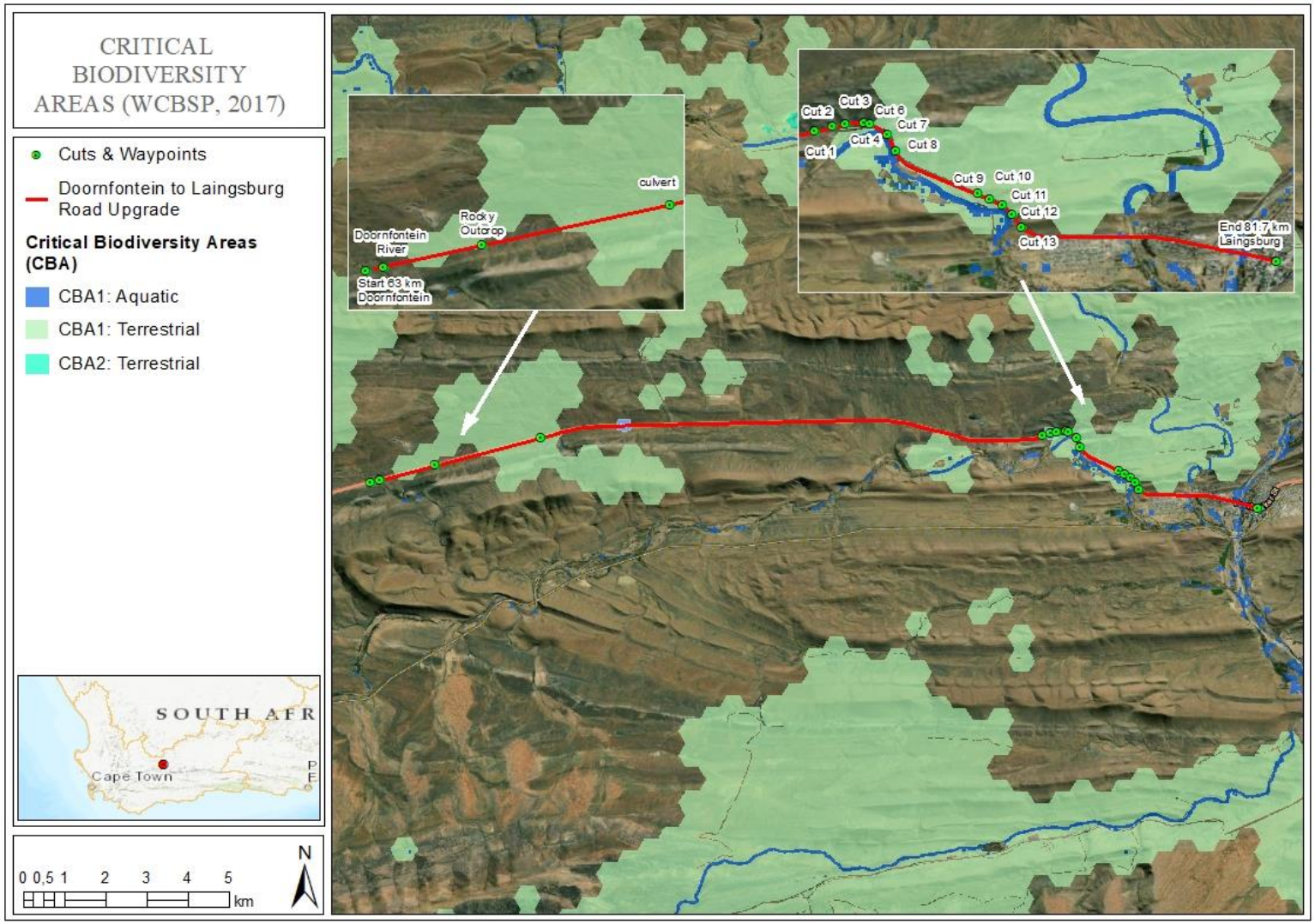

Figure 9-10:Wetland delineation Map/Aquatic CBA1.

9.2 Wetland Functional and Health Assessment

9.2.1 Wetland Ecological Importance and Sensitivity

The EIS and functions were calculated using the new draft DWA guidelines and model, as developed by M. Rountree, but not yet published. Information used form the SIBIS and VEGMAP products. A mean score between 0 and 4 is obtained, with 0 as the lowest and 4 as the highest score. No classification of the scores is given.

The watercourses onsite have an Ecological Importance and Sensitivity (EIS) score of 1 (**Table 9-1**). This is a value between 0 and 4, with 0 being very low and 4 very high. The rivers, therefore, have a Medium EIS score. It is regarded as being modified.

Table 9-1: EIS calculation of the Buffels River and assocoiated watercourses

ECOLOGICAL IMPORTANCE AND SENSITIVITY	SCORE (0-4)	CONFIDENCE (1-5)	MOTIVATION
Biodiversity Support	3.0	4	
Presence of Red Data species	4	4	No known red data or protected species observed on site.
Populations of unique species	0	4	No unique plant or animal populations were observed.
Migration/breeding/feeding sites	2	4	Though a few bird species were observed, few nests were present.
Landscape scale			
Protection status of the wetland	4	5	The river and surrounding area are surrounded by mountains and open shrubs.
Protection status of the vegetation type	4	4	The watercourse is not located in an Endangered and Vulnerable vegetation types. Although dominated by Phragmites it is very homogeneous as a result of the polluted state of the water. The vegetation surrounding the watercourse has pioneer and alien invasive species with indigenous species present.

ECOLOGICAL IMPORTANCE AND SENSITIVITY	SCORE (0-4)	CONFIDENCE (1-5)	MOTIVATION
Regional context of the ecological integrity	4	5	The watercourse is in PES class C due to the disturbance.
Size and rarity of the wetland type/s present	4	5	The watercourse is particularly rare and has a vulnerable ecosystem present.
Diversity of habitat types	1	5	The watercourse has a medium species diversity as well as habitat diversity. The wetland is dominated by a homogeneous stand of Phragmites australis along the river banks,

9.2.2 Wetland Health and PES

It should be noted in **Table 9-2** by Kleynhans (1999) that if a score of less than 2 is attributed to any impact, the lowest rating, rather than the mean, is used to attribute PES class.

Table 9-2:PES classes (from Kleynhans 1999) indicating the interpretation of the mean scores to rate the PES category.

WITHIN GENERALLY ACCEPTABLE RANGE		
Category	**Score**	**Description**
A	>4	Unmodified, or approximates natural condition and/or represents a natural condition due to successful rehabilitation process/program(s) which has occurred and/or are in the process of occurring.
B	>3 and 4	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged Moderately modified.
C	>2 and 3	Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

D	2	Largely modified. A large loss of natural habitats and basic Ecosystem functions has occurred.
OUTSIDE GENERAL ACCEPTABLE RANGE		
E	>0 and 2	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive Critically modified.
F	0	Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat

The wetland perennial rivers in the study area have EIS categories and EMC values as indicated in **Table 9-3**.

Table 9-3: Summary of EIS onsite.

Wetland	EIS category	EMC
Buffels River	C	C
Doornfontein Stream	-	-
Baviaans Stream	C	C
Unnamed tributariesies	C	C

9.2.3 Wetland ecoservices

WET-EcoServices (Kotze et al. 2004) is a tool for evaluating the services provided by the watercourses (Rivers, allowing for more informed planning and decision-making. In general, the riverine wetland provides low-moderate ecosystem services (spider diagram right). Because of the destruction of natural vegetation and the resulting loss of habitat for insects and amphibians, it has a low species richness and biodiversity. (See **Figure 9-11**).

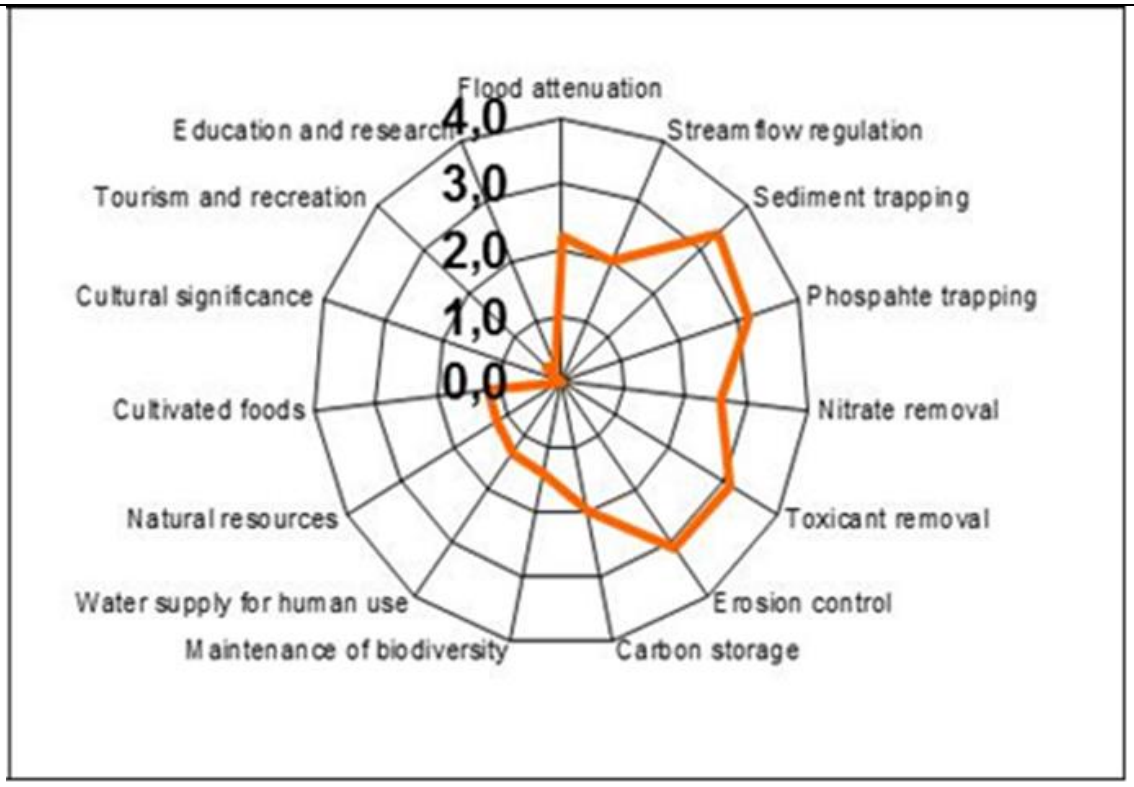

Figure 9-11: Eco services

9.3 Western Cape Protected Area Expansion Strategy (WCPAES)

According to the Conservation Plan[1], National route 1 section 4 between Doornfontein (km 63.0) and Laingsburg (km 81.7 traverses a number of Critical Biodiversity Areas (CBA), and an Ecological Support Area (ESA) (**Figure 9-12 and Figure 9-13)**, Sensitivity map). Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan, while Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. **NB! The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. It should inform land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity**[2].

[1] Biodiversity Sector Plan Handbook. Compiled by Lötter M.C., Cadman, M.J. and Lechmere-Oertel R.G.
[2] Chapter 12 of the National Biodiversity Assessment (Driver et al. 2012)

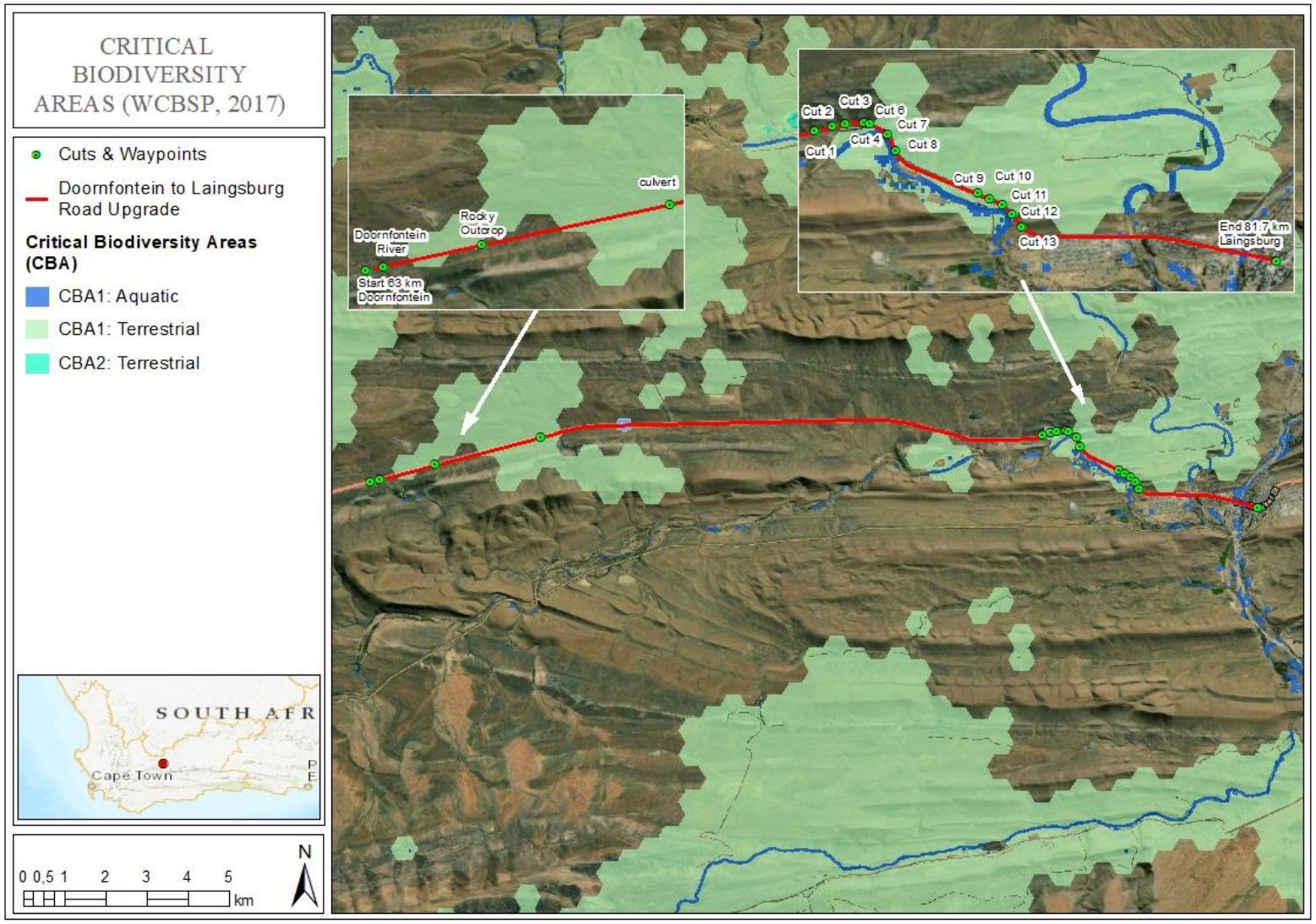

Figure 9-12: Critical Biodiversity Areas (WSBSP, 2017).

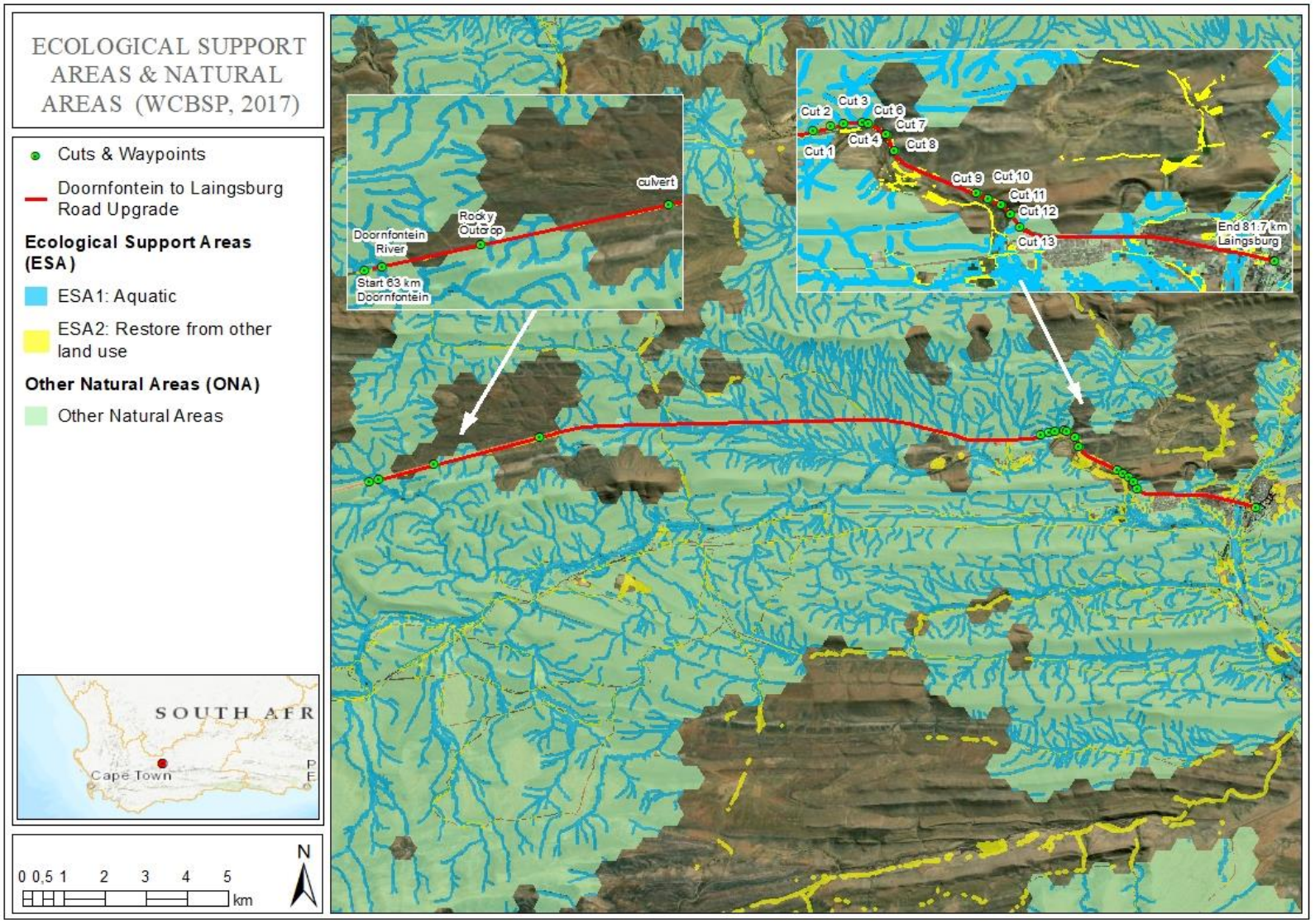

Figure 9-13: Ecological Support Area (WCBSP, 2017).

9.3.1 Freshwater Aquatic Species

The freshwater habitats (watercourses) onsite consist mainly of terrestrial plant species (**Figure 9-*14***). The Buffel river had an abundance of phragmite species along the banks of the Buffels rver. The other watercourses are dry, and thus unable to accommodate fish. During the site inspection there was evidence of avifaunal species within the watercourses (**Figure 18**).

Figure 9-14:Typical Freshwater Habitat onsite.

9.3.2 INVERTEBRATES

No invertebrates were observed onsite, the freshwater ecosystems onsite. In order to get accurate results, invertebrate traps should be placed along the watercourses for a number of days.

10. RISK ASSESSMENT OF DELINEATED WETLAND

The following impact assessment is supplied, the assessment was conducted only for existing degradation of the study site by the existing Road site with the focus on wetland habitats. From the assessments it is clear that impacts can be expected from the proposed activities (**Table 10-1**).

Table 10-1: Impact 1: Degradation and / or destruction of Freshwater habitats (Watercourses and the wetland).

Impact Name	**1. Degradation and/or destruction of watercourse habitats.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	1	1
Extent of Impact	1	1	Reversibility ofImpact	2	1
Duration ofImpact	2	1	Probability	3	2
Environmental Risk (Pre-mitigation)					-4.50

Mitigation Measures

In terms of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity orprocess undertaken which causes or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (inter alia):

- Cease, modify, or control any act or process causing the pollution/degradation.
- Comply with any prescribed waste standard or management practice.
- Contain or prevent the movement of pollutants or the source of degradation.
- Remedy the effects of the pollution/degradation.
- Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.

According to the NWA (1998) part of the definition of pollution of water resources states that any physical alterations to a water resource, for example the excavation of a wetland / stream or changes to the morphology of such a water resource may be considered to be pollution. Activities which cause an alteration to the biological properties of a wetland i.e. the fauna and flora contained within and supported by that water resource are therefore also considered to be a form of pollution.

Any construction activities in or within a delineated buffer zone of a water resource may only take place afterthe necessary water use license has been obtained.

Where wetlands may be encroached upon by proposed activities, the edge of the wetland must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase, color-codedas follows:

- RED – Indicating the edge of the wetland (Note: This includes the permanent, seasonal and temporal zonesof wetlands, or parts thereof; and no vehicles or building materials are allowed in this zone). These should beput along the entire length of the site.
- ORANGE – Indicating the edge of the buffer zone

Construction machinery and associated vehicles may not be allowed to enter wetlands. Strictly no re-fueling ofvehicles or machinery should be allowed to take place in any area close to a wetland. During and after construction areas of exposed soil can easily erode and subsequently end up in the wetlands. A well-designed storm water system must be put in place to avoid erosion into wetlands. Naturalrunoff from the natural terrestrial habitat surrounding the wetlands should however not be restricted unnecessarily.	
The use of potential pollutants (paint, chemicals, etc.) during construction and operational phases must bestrictly controlled and a high quality of management and supervision concerning such materials must be enforced, especially close to wetland buffer zone areas. Sanitary facilities must be made available to construction workers to prevent urine and human waste enteringthe wetlands. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquaticspecialist is appointed during all phases to monitor impacts and related mitigation measures regardingwetland habitats.	
Environmental Risk (Post-mitigation)	-2.00
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it isprobable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	1
The impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.17
Final Significance	-2.33

Table 10-2: Impact 2: Loss of indigenous fauna and flora diversity associated with watercourses.

Impact Name	**2. Loss of indigenous fauna and flora diversity associated with wetlands.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**

Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	1	Reversibility ofImpact	4	2
Duration ofImpact	2	2	Probability	2	1
Environmental Risk (Pre-mitigation)					-5.00
Mitigation Measures					
Destruction of natural wetland vegetation must be avoided at all costs. Special attention should be paid to alien and invasive control within the whole study area. Alien and invasivevegetation control should take place throughout all development phases to prevent loss of habitat of indigenous fauna and flora. Movement of vehicles and construction workers in wetlands and buffer zones should be strictly prohibited. Noharvesting of plants or animals should be allowed. Any specimens of protected plant species known to occur in the wetlands and the delineated buffer zone and may potentially be impacted by the construction activities, are to be fenced off for the duration of the activity. Conservation of these specie and their natural habitat must be a high priority. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats. Red Data listed and protected species as well as sensitive habitats related to wetlands should be strictly monitored. Any conservation recommendations and measures that aim to mitigate the impacts of this development must also be monitored by such a specialist during the construction, operational and decommissioning phases.					
Environmental Risk (Post-mitigation)					-1.50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but					

the value(services and/or functions) of these resources is limited.	
Prioritisation Factor	1.33
Final Significance	-2.00

Vegetation clearing has occurred and resulted increased turbidity and sedimentation in the watercourse as well as altered flow patterns. The machinery used has a risk of hydrocarbon spills into the watercourse. There are impacts on the flow patterns to the watercourse.

This report highlights the findings for a one site survey, limiting the confidence for the risk assessment in **Table 10 and 11 above**.

Construction Phase

Increased sedimentation may occur as a result from the runoff from the tar road. This has the potential to change habitat structure within the receiving environment and this will in turn result in changes in ecosystem function. Changes in habitat structure due to sedimentation would result in changes in the species composition.

Water quality impairment has the potential to change ecosystem function, change community structure as species sensitive to water quality impairment are eliminated and tolerant species increase in number, this results in a loss of biodiversity of sensitive species.

Invasive alien plants have far-reaching detrimental effects on native biota and has been widely accepted as being a leading cause of biodiversity loss. They typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, and promote erosion, change litter accumulation and soil properties. In addition, certain alien plants exacerbate soil erosion whilst others contribute to a reduction in stream flow thereby potentially increasing sediment inputs and altering natural hydrology of receiving watercourses. These impacts negatively affect areas that are largely natural (with low existing weed levels) greater than for areas already characterised by dense infestations of alien plants with low indigenous plant diversity (Macfarlane *et al*., 2014).

10.1.1 Sedimentation and soil erosion

Soil erosion will result in the deposition of sediment into the freshwater system; posing a risk to the downstream catchment geomorphological/functional integrity. Subsequent impacts that are likely to result are:

- sedimentation of the watercourse that will be destructive to many faunal species affecting their habitat; breeding and feeding cycles.

Local site factors such as soil erodibility, vegetation cover, gradient of local slopes and regional rainfall/runoff intensity will affect the probability and intensity of erosion impacts (Macfarlane *et al*., 2014). Typical results of erosion & sedimentation on water resources may include:

- Localised scouring at stormwater discharge points into watercourses
- Deposition of large masses of sediment downstream causing localised channel braiding, instability of the riverbanks and alterations in water distribution.

10.1.2 Pollution of water resources and soil

Changes to the water quality will result in changes to the ecosystem structure and function as well as a potential loss of biodiversity. Water quality pollution leads to modification of the species composition where sensitive species are lost and organisms tolerant to environmental changes dominate the community structure. Any substances entering and polluting watercourses will directly impact downstream ecology through surface runoff during rainfall events, or subsurface water movement, particularly during the wetter summer months.

Contaminants such as hydrocarbons, solids, pathogens and hazardous materials may enter watercourses (examples include petrol/diesel, oil/grease, paint, cement/concrete and other hazardous substances). These contaminants negatively affect aquatic ecosystems including sensitive or intolerant species of flora and fauna. Where significant changes in water quality occur, this will ultimately result in a shift in aquatic species composition, favouring more tolerant species, and potentially resulting in the localised exclusion of sensitive species. Water quality monitoring must be implemented to ensure sustainable management of water sources within that area. Sudden drastic changes in water quality can also have chronic effects on aquatic biota leading to localised extinctions. Deterioration in water quality will also

affect its suitability for human domestic/agricultural use and have far reaching impacts for local communities who may rely on rivers as water supply (Macfarlane et al., 2014).

10.1.3 Alien Invasive Species

There are alien invasive plant species currently present along the Road. Any ground disturbance provides an opportunity for alien invasive plant species to spread and for new species to establish themselves in the areas. Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler & Kercher, 2004). Such changes on the ecology of the riparian habitat have/will have a detrimental impact on its ability to maintain both floral and faunal biodiversity. Invasive alien plant species, particularly woody species, have much increased water usage compared with indigenous vegetation. Many alien invasive plant species are particularly found in riparian ecosystems and their invasion results in the destruction of indigenous species; increased inflammable biomass (high fire intensity); erosion; clogging of waterways such as small streams and drainage channels causing decreased river flows and incision of river beds and banks. This results in an overall impact on the hydrological functioning of the system.

10.1.4 Mitigation

The proposed upgrading of the road will have negative effects on the environment. The following mitigation measures may reduce the severity of impacts:

- Rehabilitation of the disturbed areas;
- Minimising pollutants entering the watercourse;
- Implement a programme for the clearing/eradication of alien species including long term control of such species;
- Wetland monitoring and biomonitoring must take place bi-annually.

Sedimentation and soil erosion

Mitigation options

- Do not allow surface water or stormwater to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place.

- Exposed soils must be rehabilitated as soon as practically possible to limit the risk of erosion. Erosion control measures must be employed where required.
- Riparian vegetation bordering on drainage lines, wetlands and rivers will be considered environmentally sensitive and impacts on these habitats should be avoided.
- If erosion has taken place, rehabilitation will commence as soon as possible.

Pollution of water resources and soil

Mitigation options

- Demarcate wetland areas to avoid unauthorised access.
- No washing of any equipment in close proximity to a watercourse is permitted.
- No releases of any substances that could be toxic to fauna or faunal habitats within the channels or any watercourses is permitted.
- Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately.
- Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency.
- Signs should also be placed at appropriate locations to remind workers of good housekeeping practices including litter and pollution control.
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected so as to prevent leaks.
- All contractors and employees should undergo induction which is to include a component of environmental awareness.

Alien Invasive Species

Mitigation Options

- An alien invasive management programme must be incorporated into an Environmental Management Programme.
- Ongoing alien plant control must be undertaken, particularly in the disturbed areas as these areas will quickly be colonised by invasive alien species, especially in the riparian zone, which is particularly sensitive to AIP infestation.
- Herbicides must be carefully applied, in order to prevent any chemicals from entering the river. Spraying of herbicides within or near to the wetland areas is strictly forbidden.
- Re-instate indigenous vegetation (grasses and indigenous trees) in disturbed areas.
- After rehabilitation, re-vegetate any exposed surfaces and mulch re-vegetated areas.
- Select appropriate species for wetland and terrestrial areas and ensure species diversity is enhanced, with species commonly found in the natural wetland area.

10.2 ASSESSMENT OF THE NO-GO ALTERNATIVE

Currently there is no proposal from a wetland point of view of a no-go alternative, Since the road is already in existence. In addition, the necessary culverts and crossing structures have been constructed.

10.3 MONITORING REQUIREMENTS

In the event that the proposed road upgrade activities will encroach on the watercourses/wetland, the following is strongly advised from a wetland point of view:

- It is strongly advised that a wetland/aquatic specialist is appointed during the construction, operational and decommissioning phases to monitor impacts and related mitigation measures regarding wetlands and the faunal and floral assemblages occurring in this habitat.
- If the no-go alternative is enforced no monitoring is advised at this stage.

11. FINAL COMMENTS

The aquatic sensitivity of the proposed site is classified as VERY HIGH in the Screening Report. The study site is located within the Gouritz Water Management Area (WMA=27), Groot Subwater Management Area (WMA=17), and the existing

National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7), is located within 500m of two of watercourses (Perennial and non-perennial Rivers).

The watercourses are non perennial with the exception of the Buffels river which plays an it plays a major role in the water management area. The contractor should ensure that the construction process does not negatively impact the watercourse, and lead to the deterioration of the quality of the water onsite.

Since the applicant is proposing the expansion of two bridges, it is important to take note of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity or process undertaken which causes or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution/degradation.
- Comply with any prescribed waste standard or management practice.
- Contain or prevent the movement of pollutants or the source of degradation.
- Remedy the effects of the pollution/degradation.

Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.

12. RECOMMENDATIONS

- Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats.
- Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
- No stockpiling of material may take place within the wetland/watercourse areas and temporary construction camps and infrastructure should also be located outside the wetland footprint.

- Regular cleaning up of the wetland areas should be undertaken to remove litter.
- Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.
- Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.
- Store and handle potentially polluting substances and waste in designated, bunded facilities.
- Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
- Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
- Keep sufficient quantities of spill clean-up materials on site.

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