FEN CONSULTING

FRESHWATER ASSESSMENT

FOR THE PROPOSED WILDEBOSCH ROAD EXTENSION TO TRUMALI ROAD, PARADYSKLOOF, STELLENBOSCH MUNICIPALITY, WESTERN CAPE

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EXECUTIVE SUMMARY

Freshwater Ecological Network (FEN) Consulting (Pty) Ltd was appointed by Zutari (Pty) Ltd to conduct a specialist freshwater assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Wildebosch Road extension to Trumali Road (hereafter, the 'proposed road extension') through erven RE/16527 and RE/369 in the Paradyskloof suburbs of Stellenbosch within the Stellenbosch Municipal area.

An unchannelled valley bottom wetland (UCVBW) was identified during the field visit in October 2023 that would be traversed by the proposed road extension. The UCVBW was determined to be in a Moderately Modified Present Ecological State (PES Class C), with a moderate Ecological Importance and Sensitivity (EIS) and ecoservice provisioning importance in terms of sediment trapping, nutrient assimilation of runoff from adjacent vineyards, erosion prevention of incoming freshwater from the upgradient catchment and resources which can be harvested.

The Department of Forestry, Fisheries and the Environment (DFFE) Environmental Screening tool designates the investigation area as having a very high aquatic biodiversity sensitivity, due to falling within the Boland surface water Strategic Water Source Area (SWSA).

The DWS Risk Assessment Matrix determined several moderate risks that are associated with the proposed road extension, most of which were assigned to activities during the construction phase. The moderate risks stem from direct impacts within the wetland for which the maximum severity score (5) must be assigned, as per GN509. These activities include dewatering of a portion of the wetland in the vicinity of the proposed road extension area, the construction of the foundation of the road and installation of the pipe culverts. The determined moderate risk scores are above the threshold value, and therefore could not be manually down adjusted to realise a low risk significance score. Therefore, as per GN509, the proponent must follow the WUA protocol in terms of a Water Use License Application (WULA), which is at the sole discretion of the Department of Water and Sanitation, the freshwater custodians of South Africa.

Irrespective of the final moderate risk significance determination for the proposed road extension, the proponent must make provision for the suggested mitigation measures, of which construction during the summer dry season, preserving the flow between the upstream and downstream areas during construction, and designing the road culverts in such a manner that the hydrology of this wetland is not altered during the operational phase are most pertinent.

In terms of EA, the development within the NEMA 32 m ZOR of the UCVBW may trigger Activity 12 and 19 of GN983 – Listing Notice 1 of the 2014 Environmental Impact Assessment (EIA) regulations (GN 982 of 04 December 2014 - as amended) and Activity 14 of GN985 – Listing Notice 3 (GN 985 of 04 December 2014 - as amended), to be determined by the Environmental Assessment Practitioner (EAP).

Based on the findings of the freshwater ecosystem assessments and the results of the risk assessment, it is the opinion of the specialist that the activities associated with the proposed road extension will not further degrade this wetland system. This is on condition that adherence to cogent, well-conceived and ecologically sensitive construction plans are implemented, where applicable and the mitigation measures provided in this report as well as general good construction practice are adhered to. Therefore, the proposed road extension is considered acceptable from a freshwater ecological and resources management perspective.

MANAGEMENT SUMMARY

Freshwater Ecological Network (FEN) Consulting (Pty) Ltd was appointed by Zutari (Pty) Ltd to conduct a specialist freshwater assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Wildebosch Road extension to Trumali Road (hereafter, the 'proposed road extension') through erven RE/16527 and RE/369 in the Paradyskloof suburbs of Stellenbosch within the Stellenbosch Municipal area.

The unchannelled valley bottom wetland (UCVBW) that was identified to be traversed by the proposed road extension has been impacted by off channel impoundment and afforestation that have decreased the upstream catchment yield, thereby impinging on the hydrological budget of this wetland. The remaining surface flows after catchment offtake move longitudinally through the wetland within a channel, which has presumably carved its course in this wetland over time through increased stormwater input, thereby decreasing ecoservice provision through decreased hydrological spread of diffuse flows. Runoff from the agriculturally-transformed catchment to the west and stormwater generated from the residentially-transformed catchment to the east, together with several road crossings in the upstream catchment are envisaged to negatively impact the water quality of this wetland, particularly through elevated sediment, total suspended solids, nutrient and toxicant inputs, albeit not severely. Disturbance to the catchment of this wetland has caused the encroachment of alien or otherwise problematic vegetation which have dominated this wetland.

These impacts were considered in the ecological assessments that were conducted for this wetland, which are tabulated below in Table A.

Table A: Summary of results of the field assessment of the UCVB wetland.

Present Ecological State (PES)	Primary Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Category C (Moderately Modified)	• Erosion control • Sediment trapping • Nutrient assimilation • Harvestable resources	Moderate	REC Category: C (Moderately modified) BAS: Category: C/B (Moderately modified to largely natural) RMO Category: C (Maintain)
Extent of modification anticipated	**Low** The extent of modification to this wetland is envisaged to be low on condition that the diffuse hydrology is preserved and the road reserve area, including the wetland section it crosses is rehabilitated post construction.		
Impact Significance and Business Case	**Low** The impact significance of the proposed road extension is considered low in light of the existing impacts that are already acting on this wetland, but no cumulative impacts are envisaged on condition that the mitigation measures as listed in this report are followed. The proposed road extension offers a solution to alleviate traffic on the regional R44 road and creates future development opportunities in the area due to providing new access road options.		

Following the ecological assessments of this wetland, the DWS Risk Assessment Matrix was applied to ascertain the significance of possible impacts which may occur as a result of the proposed road extension. The results of this assessment are presented in Section 7, Appendix F and Table B (below) of this report.

The DWS Risk Assessment Matrix determined several moderate risks that are associated with the proposed road extension, most of which were assigned to activities during the construction phase. The moderate risks stem from direct impacts within the wetland for which the maximum severity score (5) must be assigned, as per GN509. These activities include dewatering of a portion of the wetland in the vicinity of the proposed road extension area, the construction of the foundation of the road and installation of the pipe culverts. The determined moderate risk scores are above the

threshold value (80), and therefore could not be manually down adjusted to realise a low risk significance score (55), considering that GN509 allows for a maximum down adjustment of 25 points. Therefore, as per GN509, the proponent must follow the WUA protocol in terms of a Water Use License Application (WULA), which is at the sole discretion of the Department of Water and Sanitation, the freshwater custodians of South Africa.

Table B: Summary of the results of the DWS Risk Assessment applied to the wetland.

No.	Activity and Aspect	Risk Rating
	CONSTRUCTION PHASE	
1	**SITE PREPARATION FOR CIVIL WORKS** ➢ Stockpiling of construction equipment, materials, vehicles and machinery; ➢ Removal of vegetation and associated disturbances to soil; ➢ Possible indiscriminate vehicle movement; and ➢ Diversion of water away from the construction area	**M**
2	**CONSTRUCTION OF THE WILDEBOSCH ROAD THROUGH THE WETLAND** ➢ Undercutting roadbed prism and placement of pioneering layer consisting of rock and/or sand fill; ➢ Construction of road fill; ➢ Trenching for the installation of pipe culverts; ➢ Creation of soil stockpiles ➢ Backfilling to the level of the pipe culverts; ➢ Construction of road pavement layers; ➢ Construction of the culvert headwalls using concrete, ➢ Installation of the inlet and outlet erosion protection structures; ➢ Application of asphalt, paint and sealants; and ➢ Operation of machinery.	**M**
3	**REHABILITATION OF THE UCVBW** ➢ Resloping, reprofiling and revegetation of the wetland banks to prevent future erosion; and ➢ Alien and invasive plant removal and revegetation using indigenous wetland plant species	**M**
	OPERATION PHASE	
4	**OPERATION OF THE CULVERT CROSSING** ➢ Inadequate flow and loss of freshwater connectivity to the downstream areas; and ➢ Erosion around the culvert crossing and sedimentation of the downstream reach	**L**
5	**OPERATION OF THE ROAD SIDE DRAINS** ➢ Additional stormwater input into the wetland	**L**
6	**MONITORING OF STRUCTURAL INTEGRITY OF THE ROAD CULVERT CROSSINGS** ➢ Proactive monitoring to ensure structural integrity is maintained and to identify early signs of erosion around the culverts and ensure that any litter or debris which may accumulate on and around the culverts is cleared to maintain the flow of water.	**L**
7	**FUTURE MAINTENANCE OF THE ROAD CULVERT CROSSINGS** ➢ Disturbances to or removal of vegetation while accessing culverts to carry out maintenance activities and ➢ Disturbances to wetland soil.	**M**
8	**ONGOING ALIEN AND INVASIVE VEGETATION REMOVAL (IF REQUIRED).** ➢ Proactive monitoring to ensure structural integrity is maintained and to identify early signs of erosion, incision and alien vegetation encroachment.	**M**

Irrespective of the final moderate risk significance determination for the proposed road extension, the proponent must make provision for the suggested mitigation measures, of which construction during the summer dry season, preserving the flow between the upstream and downstream areas during construction, and designing the road culverts in such a manner that the hydrology of this wetland is not altered during the operation phase are most pertinent.

In terms of EA, the development within the NEMA 32 m ZOR of the UCVBW may trigger Activity 12 and 19 of GN983 – Listing Notice 1 of the 2014 Environmental Impact Assessment (EIA) regulations (**GN 983 of 04 December 2014 - as amended**) and Activity 14 of GN324 – Listing Notice 3 (**GN 985**

of 04 December 2014 - as amended) of the 2014 EIA regulations **GN 982 of 04 December 2014 (as amended)**, to be determined by the Environmental Assessment Practitioner (EAP).

Good practice measures that are particularly important for the construction of the proposed road extension includes, but is not limited to the following:

- It is imperative that construction occurs during the drier summer months (January -April) using as much manual labour (not machinery) as possible to minimise the wetland disturbance footprint in terms of soil disturbance and vegetation trampling, and further to minimise hydrocarbon and oil spillages;
- Alien vegetation must be managed throughout the construction and operation phases and removed vegetation may not be stockpiled on site, but must be disposed of at an appropriate landfill facility;
- Water must be allowed to flow to the downstream reach at all times and rip-rap or a similar erosion protection structure must be placed at the outlet to the diversion pipe to prevent erosion of the wetland floor;
- Suitable sediment traps such as geotextile wrapped hay bales or geotextile nets must be installed downstream of the proposed road extension to prevent potential sedimentation of the downstream reach of this wetland during unforeseen rainfall events due to bare ground;
- Soil surrounding the repair works must be suitably loosened on completion of construction activities and revegetated to prevent erosion;
- The duration of impacts within the wetland must be minimised as far as possible by ensuring that the duration of time in which flow alteration will take place is minimised. The construction period must be kept as short as possible;
- Rehabilitation works of the proposed road extension area (including the wetland that is traversed) must be undertaken just before the wet season (preferably within April/May) to ensure survival of new vegetation species and prevent proliferation of alien and invasive plants;
- The pipe culverts must be designed in a manner to preserve the natural hydrology of this UCVBW, flows must not be concentrated downstream of the pipe culvert;
- The stormwater channel that runs along the southern boundary of the UCVBW must be infilled upstream to promote the diffuse spread of water (albeit interflow) through the wetland;
- Any loss in wetland longitudinal connectivity due to a failed culvert design must be remedied as soon as possible to reduce the duration of impact;
- An erosion protection structure must be installed at the discharge point of the side drains into the wetland and all stormwater must collect into an attenuation facility that is operated according to Sustainable Urban Drainage System principles in terms of the quantity and quality of stormwater discharging into the wetland; and
- The erosion protection structures must be monitored bi-annually to ensure that these structures are still intact and can continue to safeguard the wetland against erosion.

Based on the findings of the freshwater ecosystem assessments and the results of the risk assessment, it is the opinion of the specialist that the activities associated with the proposed road extension will not further degrade this wetland system. This is on condition that adherence to cogent, well-conceived and ecologically sensitive construction plans are implemented, where applicable and the mitigation measures provided in this report as well as general good construction practice are adhered to. Therefore, the proposed road extension is considered acceptable from a freshwater ecological and resources management perspective.

DOCUMENT GUIDE

The table below lists the aquatic biodiversity specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity ***with very high sensitivity*** in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist.	Appendix G
2.2	Description of the preferred development site, including the following aspects-	Executive and management summaries
2.2.1	a. Aquatic ecosystem type; b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns.	Section 4: Table 1 Section 5: Table 4 and Table 7
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified.	Section 4: Table 1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status.	Section 4: Table 1 Section 5: Table 7
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater).	Section 5
2.3	Identify any alternative development footprints within the preferred development site which would be of a "low" sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification.	Section 6
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 7: Table 9
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Yes, with implementation of the mitigation measures proposed in Section 7: Table 9
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a surface water feature, etc.). d. Assessment of the risks associated with water use/s and related activities.	Section 5: Table 7
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system);	Section 5: Table 7

	b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over abstraction or instream or off-stream impoundment of a wetland or river); c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. Loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc).	
2.4.5	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 5: Table 7
2.4.6	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 5: Table 7
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	NA
3.	**The report must contain as a minimum the following information:**	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Appendix G
3.2	A signed statement of independence by the specialist;	Appendix G
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 3.1 and 5.2
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Section 3, Appendix C and Appendix D
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 7: Table 9
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 7: Table 9
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 6: Figure 14
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 7: Table 9
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Section 7: Table 9
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 7.1
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 7.1
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 7: Table 9
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate.	Section 8
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 8
3.16	Any conditions to which this statement is subjected.	Section 8

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of facultative vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks **Note: the term 'surface water feature' is used in this report and is deemed to encompass the National Water Act definition of a watercourse'**
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CoCT	City of Cape Town
DFFE	Department of Forestry, Fisheries and the Environment
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
m	Meter
MAP	Mean Annual Precipitation
MC	Management Class
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
RMO	Recommended Management Objective
RQIS	Research Quality Information Services
RQS	Resource Quality Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SA RHP	South Africa River Health Programme
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Freshwater Ecological Network (FEN) Consulting (Pty) Ltd was appointed by Zutari (Pty) Ltd to conduct a specialist freshwater assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Wildebosch Road extension to Trumali Road (hereafter, the 'proposed road extension') through erven RE/16527 and RE/369 in the Paradyskloof suburbs of Stellenbosch within the Stellenbosch Municipal area.

In order to identify all freshwater ecosystems that may potentially be impacted by the proposed road extension a 500 m "zone of investigation" was implemented around the study area in accordance with Government Notice (GN) 509 of 2016 as published in the Government Gazette 40229 of 2016 as it relates to the NWA to assess possible sensitivities of the receiving freshwater environment. This area – i.e., the 500 m zone of investigation around the study area will henceforth be referred to as the "investigation area".

The purpose of this report is to define the ecology of the study area by mapping freshwater ecosystems and describing their characteristics in terms of their Present Ecological State (PES), Ecological Importance and Sensitivity (EIS). This report aims to provide detailed information to guide the management of the proposed road extension activities, specifically those which have a bearing on the receiving freshwater environment. This is to ensure ongoing functioning of the ecosystem in support of local and regional conservation requirements and the provision of ecological services in the local area, while considering the need for sustainable economic development. This report, after consideration of the above, must guide the Environmental Assessment Practitioner (EAP), by means of a reasoned opinion and recommendations, as to the viability of the proposed development from a freshwater management perspective.

1.2 Structure of this report

This report investigates the impact significance of the proposed road extension as explained in Section 2 below, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA) as well as the NWA by means of the Risk Assessment Matrix, as promulgated in GN 509 of 2016 as it relates to the NWA. The following structure is applicable to this report:

Section 1: Introduction
Provides an Introduction, the structure of this report and the assumptions and limitations.

Section 2: Project Description
Provides the location of the proposed development as well as a summary of the related activities.

Section 3: Assessment Approach
Provides the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the risk assessment approach.

Section 4: Desktop Assessment Results
Reports on the findings from the relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2011 database; the Western Cape Biodiversity Spatial Plan database (2017) and the National Biodiversity Assessment (2018)), were undertaken to aid in defining the PES and EIS of freshwater ecosystems.

Section 5: Site Based Freshwater Assessment Results
This section reports the following:

- A description and delineation of the freshwater ecosystems in the vicinity of the proposed development according to "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2] : A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones";
- Delineation of all freshwater ecosystems (using desktop methods) within 500 m of the study area in accordance with GN 509 of 2016 as it relates to the NWA;
- The classification of freshwater hydrogeomorhic (HGM) types according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The PES of the freshwater ecosystems according to the resource directed measures guideline as advocated by MacFarlane *et al.* (2020);
- The EIS of the freshwater ecosystems according to the method described by Rountree and Kotze (2013);
- The services provided by the freshwater ecosystems according to the method of Kotze *et al.* (2020) in which services to the ecology and to the people are assessed; and
- The allocation of a suitable Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) of the freshwater ecosystems based on the results obtained from the PES, Ecoservices and EIS assessments.

Section 6: Legislative Requirements
Provides the applicable legislative requirements based on the findings from Section 5 and indicates any applicable zones of regulation that may trigger various authorisation requirements.

Section 7: Risk Assessment
Provides the outcomes of the DWS Risk Assessment Matrix which highlight all potential impacts that may affect the freshwater ecosystems. Management and mitigation measures are provided and an assessment on the reversibility of the impact which should be implemented during the construction and operational phases of the proposed road extension in order to assist in minimising the impact on the receiving environment.

Section 8: Conclusion
Summarises the key findings and recommendations based on the risk assessment outcomes.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The determination of any freshwater ecosystems is confined to physical delineation within the study area, and desktop delineation (using aerial photography and digital satellite imagery) in the broader investigation area, and is based on a single site visit undertaken on the 24th of October 2023. The broader extent of freshwater ecosystems will be considered when describing the impact of the catchment on the freshwater ecosystem that was identified in the study area (where and if applicable);
- Global Positioning System (GPS) technology is inherently somewhat inaccurate, and some inaccuracies due to the use of handheld GPS instrumentation may occur; however, the delineations as provided in this report are deemed appropriately accurate to fulfil the authorisation requirements;

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

[2] Although an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas). This is still considered a draft document currently under review.

- Wetlands and/or riparian watercourses and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative wetland or riparian species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundaries may occur. However, if the Department of Water Affairs and Forestry (DWAF) (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. The freshwater ecosystem delineation as presented in this report is, however, regarded as the best estimate of the boundaries based on the site conditions present at the time of the site visit and are deemed appropriately accurate to guide any future development plans.

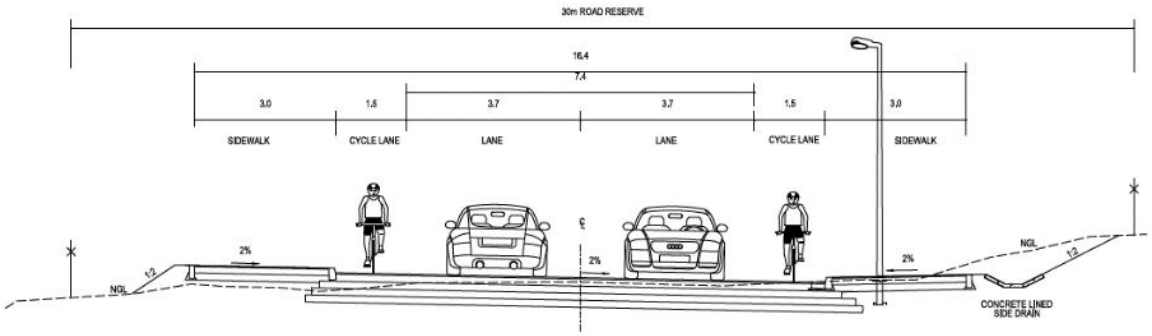
2 PROJECT DESCRIPTION

Stellenbosch Municipality Department of Roads and Stormwater intend to facilitate the proposed road extension of Wildebosch Road, which commences at Paradyskloof Road where a small portion of road reserve exists (Erf RE/16527) and traverses the farmland (Erf RE/369) in a northerly direction to meet the existing Trumali Road, which is currently a surfaced narrow three meter wide access road for the Paradyskloof Water Treatment Works. Trumali Road is proposed for widening as part of the proposed road extension works.

It is understood that the primary reason for the project is to provide an alternative road alignment to the recently constructed Skilplaats Road which would also have immediate benefits, due to access restrictions on the R44, and the proposed road extension further creates development opportunities to neighbouring land parcels.

It is envisaged that a drainage box culvert will be required for the Wildebosch extension over the UCVBW. According to the Roads Master Plan, the proposed Wildebosch extension should contain a surfaced four meter wide road in each direction between kerbs with a separated three meter wide non-motorised transport facility. Side slopes and drainage elements should be implemented as best suited for the terrain. Figure 1 illustrates the typical cross section of the Wildebosch extension.

Figure 1: Typical cross section of a road with a 30 m wide road reserve.



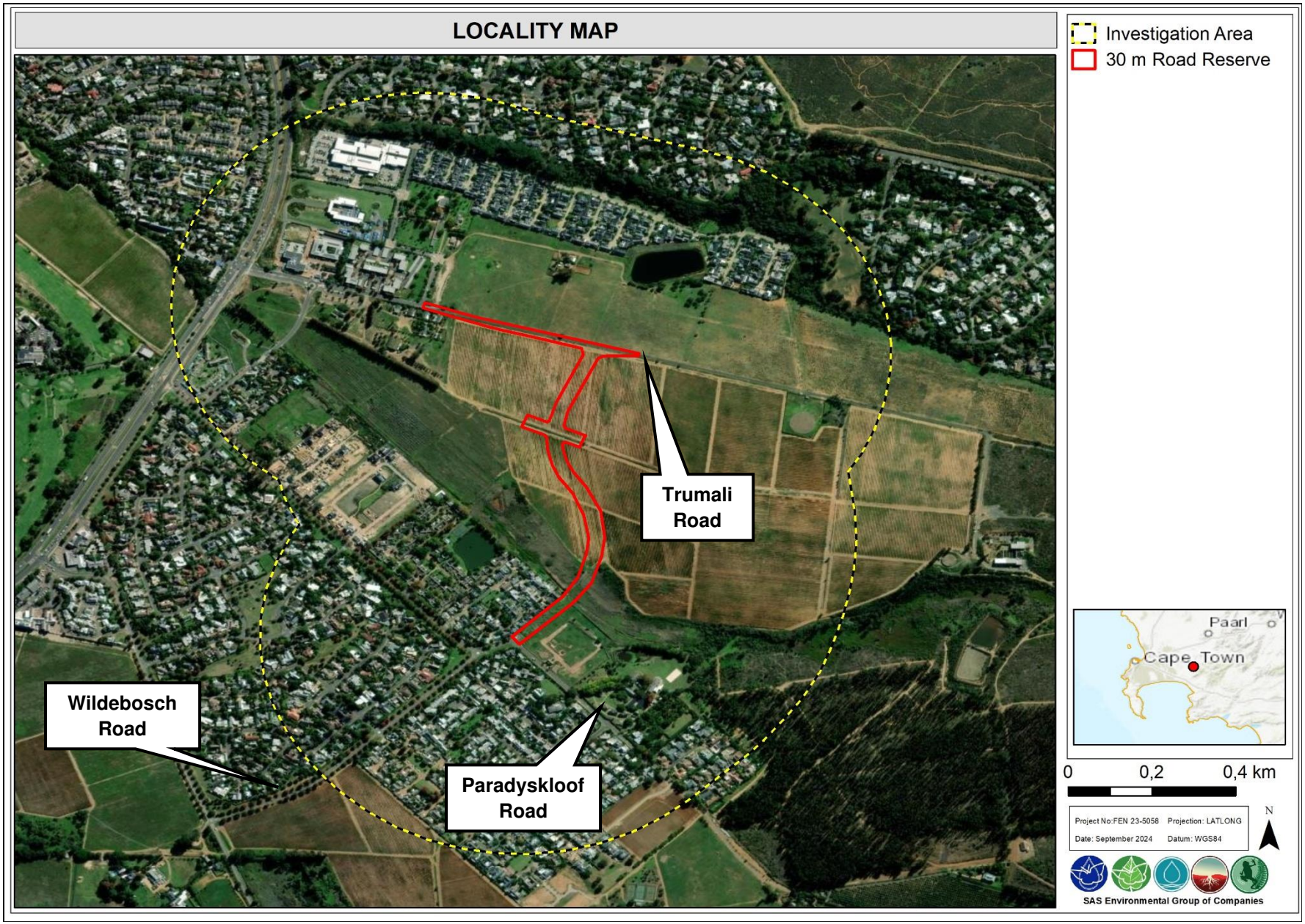


Figure 2: Digital satellite image depicting the study area (30 m road reserve) and investigation areas in relation to the surrounding area.

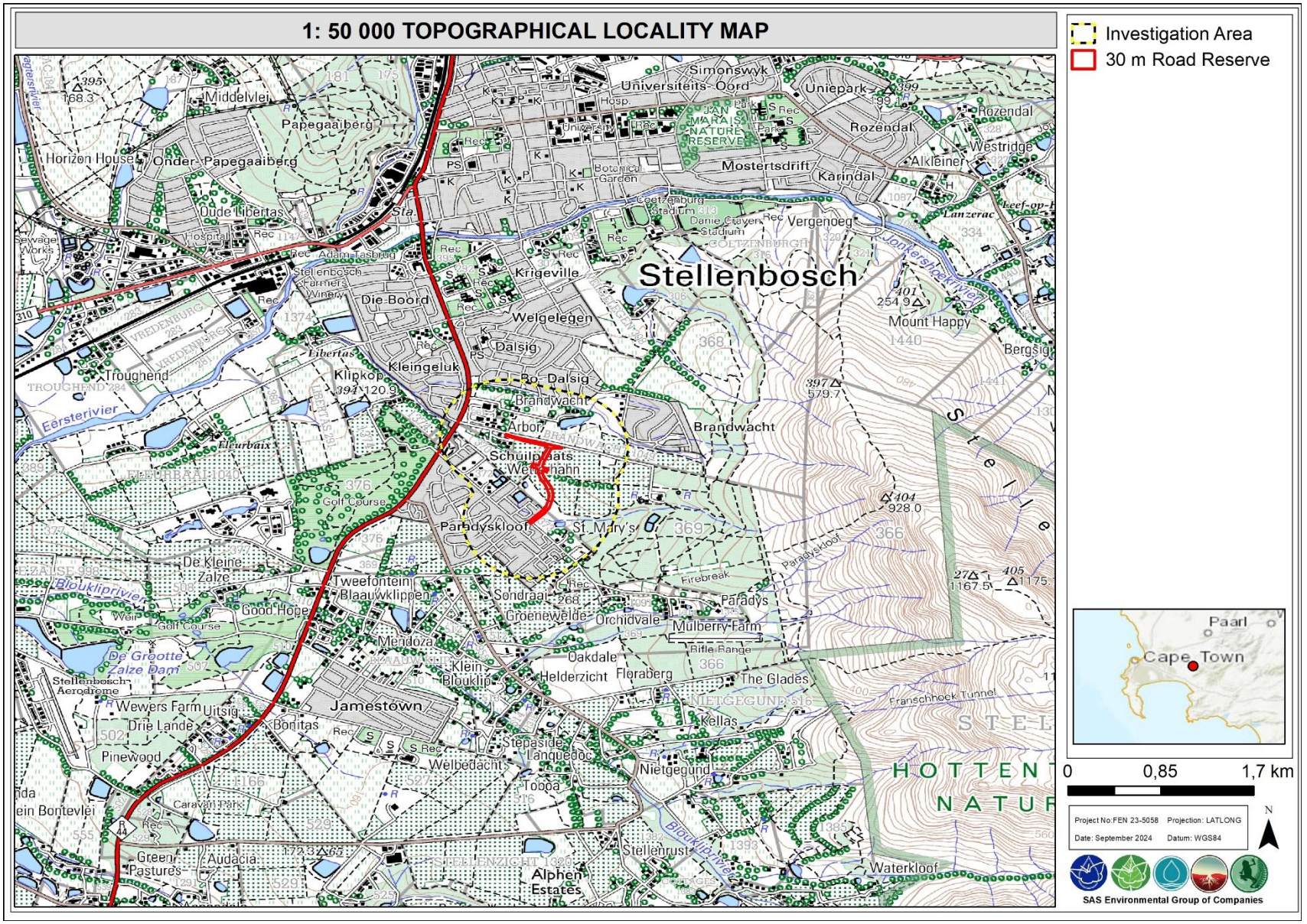


Figure 3: Location of the study area (30 m road reserve) and investigation areas depicted on a 1:50 000 topographical map, in relation to surrounding area.

3 ASSESSMENT APPROACH

3.1 Field Verification

For the purposes of this investigation, the definitions of a watercourse and wetland and riparian habitat as per that in the NWA were considered. The definitions are as follows:

A watercourse means:

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

It should be noted that in this report "freshwater ecosystem" is used and carries the same meaning as "watercourse" as defined by the NWA.

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

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

A field verification was undertaken in October 2023 (Western Cape spring period), during which the presence of any watercourse characteristics as defined by DWAF (2008) or wetland and riparian habitats as defined by the NWA were noted (please refer to Section 4 and 5 of this report). The delineations took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). This method is underpinned by several freshwater ecosystem distinguishing factors, including the following:

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

In addition to the delineation process, detailed assessment of the delineated freshwater ecosystems was undertaken, at which time factors affecting the integrity of the freshwater ecosystem were taken into consideration which aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater ecosystem. A detailed explanation of the methods of assessment undertaken is provided in **Appendix C** of this report.

3.2 Sensitivity Mapping

The freshwater ecosystems associated with the study and investigation areas were delineated on a desktop basis using digital satellite imagery. Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map is presented in Section 6 of this report and should guide the final layout for the proposed development.

3.3 Risk Assessment and Recommendations

Following the completion of the ecological assessments, a risk assessment was conducted (please refer to the method of approach and definitions in **Appendix D and F**). Mitigation recommendations associated with the proposed road extension together with general management measures applicable to the construction and operational activities are discussed in Section 7 and 8 of this report, while the general management measures which are considered to be best practice mitigation applicable to this project, are outlined in **Appendix F**.

4 RESULTS OF THE DESKTOP ANALYSIS

4.1 Analyses of Relevant Databases

The following section contains data accessed as part of the desktop assessment and presented as a "dashboard-style" report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. Where required, further discussion and interpretation are provided.

It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics associated with the proposed road extension at the scale required to inform the EA and/or WUA processes. Given these limitations, this information is considered useful as background information to the study, is important in legislative contextualisation of the risks and impacts and was thus used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance during the field survey. It must, however, be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process.

Table 1: Desktop data relating to the characteristics of the study area and surroundings.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	South Western Coastal Belt
Catchment	Berg/Bot/Potberg
Quaternary Catchment	G22H
WMA	Berg
subWMA	Greater Cape Town
Dominant characteristics of the Southern Coastal Belt Ecoregion Level II (24.06) (Kleynhans *et al.*, 2007)	
Level II Code	24.06
Dominant primary terrain morphology	Hills, Plains.
Dominant primary vegetation types	Mountain Fynbos, Sand Plain Fynbos 100 - 1100
Altitude (m a.m.s.l)	500 - 800
MAP (mm)	<20 - 30
The coefficient of Variation (% of MAP)	30 - 55
Rainfall concentration index	Winter
Rainfall seasonality	14 - 18
Mean annual temp. (°C)	6 - 18
Winter temperature (July)	14 - 28
Summer temperature (Feb)	100 - >250
Median annual simulated runoff (mm)	24.06
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 10)	
Sub-quaternary reach	G22H-09237 (Blouklip River)
Reach Distance from the study area	±1.6 km south
Assessed by an expert?	Yes
PES Category Median	Largely Modified (Class D)
Mean EI Class	Moderate
Mean ES Class	High
Stream Order	1
Default Ecological Class (based on median PES and highest EI or ES mean)	High (B)

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The proposed road extension area and associated investigation area is not located in a sub-quaternary catchment considered of importance as freshwater ecological priority areas.
NFEPA Wetlands (Figure 7)	According to the NFEPA database (2011), no natural wetlands are indicated to be within the proposed road extension area or associated investigation area. Six artificial wetlands are indicated to be within the investigation area, outside of the proposed road extension area. All artificial wetlands are indicated as channelled and unchannelled valley bottom wetlands and are considered to be in a Heavily to Critically Modified ecological condition (WETCON = Z).
Wetland Vegetation Type (Figure 6)	The proposed road extension area and associated investigation area are located in the Southwest Sand Fynbos, West Coast Shale Renosterveld, and West Coast Granite Renosterveld Wetland Vegetation types which are all indicated as Critically Endangered as per Mbona et al. (2015).
NFEPA Rivers	As per the NFEPA database (2011), no rivers are indicated within the proposed road extension area or associated investigation area. The Blouklip River is indicated south of the investigation area and this river is considered to be in a Heavily to Critically Modified ecological condition (RIVCON = Z).

Importance of the study area according to the Western Cape Biodiversity Spatial Plan (WCBSP) (2017) (Figure 8)
The WCBSP: Stellenbosch (2017) indicates small sections of Terrestrial CBA1 and ESA2: (Restore from other land use) traversing the proposed road extension area. CBA 2: Terrestrial, and ESA 2: (Restore from plantation or high-density IAP areas) are also indicated in the investigation area. CBA Areas are areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and study area where the objective is to maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate. ESA2 areas are areas that are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of PAs or CBAs and are often vital for delivering ecosystem services.
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 9)
According to the NBA 2018: SAIIAE, no natural wetlands and no rivers are indicated within the investigation area or to traverse the proposed road extension area. The Blouklip River is indicated south of the investigation area and this river is considered to be in a Largely Modified (PES2018: Class D) ecological condition. The river is Critically Endangered (ETS2018) and Not Protected (EPL2018). The Artificial Wetlands Database indicates four dams and two open reservoirs within the investigation area.
Strategic Water Source Areas (SWSA) (2017)

Surface water SWSAs are defined as areas of land that supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The sub-national Water Source Areas (WSAs) are not nationally strategic as defined in the report but were included to provide a complete coverage.	The proposed road extension area is indicated as of **very high aquatic sensitivity** for being within the Boland surface water SWSA

Land type Data (Figure 5)
The proposed road extension area and associated investigation area are indicated to be within the Ac17 and Ca28 Land Type groupings. Ac Land types Red and yellow, freely-drained apedal soils with Hutton, Griffin and Clovelly soils occupying more than 40% of the landscape. Ac Land Types are dominated by yellow soils (red soils < 10%).Ca Land Types indicate land that qualifies for the plinthic catena (Avalon, Bainsvlei, Longlands, Glencoe, Wasbank, and Westleigh and occupy more than 10% of the land surface), but which has, in upland positions, margalitic soils (Estcourt, Sterkspruit, Swartland, Valsrivier and Kroonstad) and occupy more than 10% of the land surface).
National web-based Environmental Screening Tool (Accessed November 2023) (Figure 4)

The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the migration hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	The southern half and tiny portions of the northern half of the study area are located in an area considered of **very high** aquatic biodiversity sensitivity, due to the study area being located within **Aquatic CBAs and within a Strategic Water Source Area.**

CBA = Critical Biodiversity Areas; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Meters Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; UCVB; unchanneled valley bottom wetland; and WMA = Water Management Area

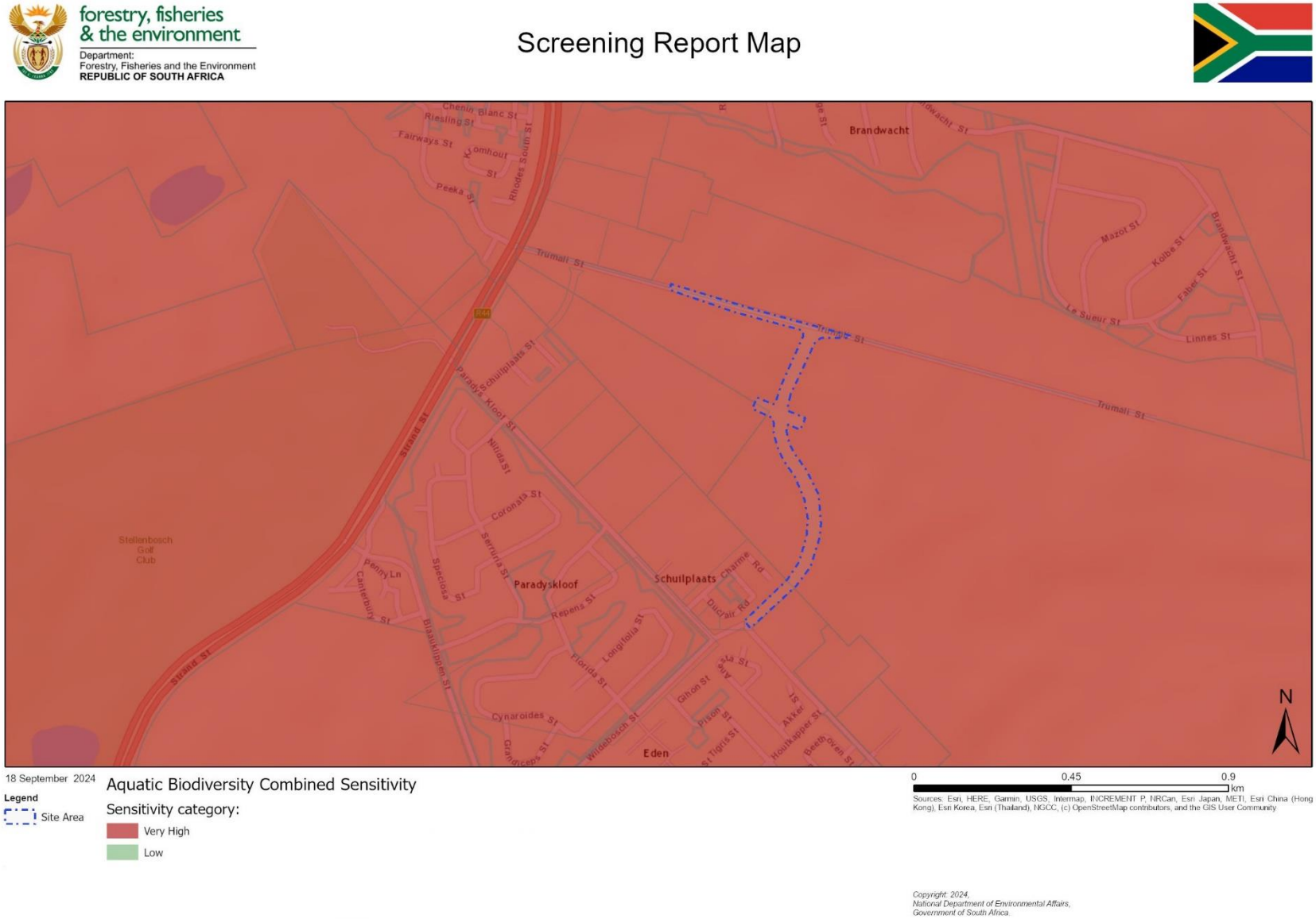


Figure 4: Aquatic Biodiversity Sensitivity as per the DFFE Environmental Screening Tool for the proposed road extension area – 30 m road reserve (blue outline).

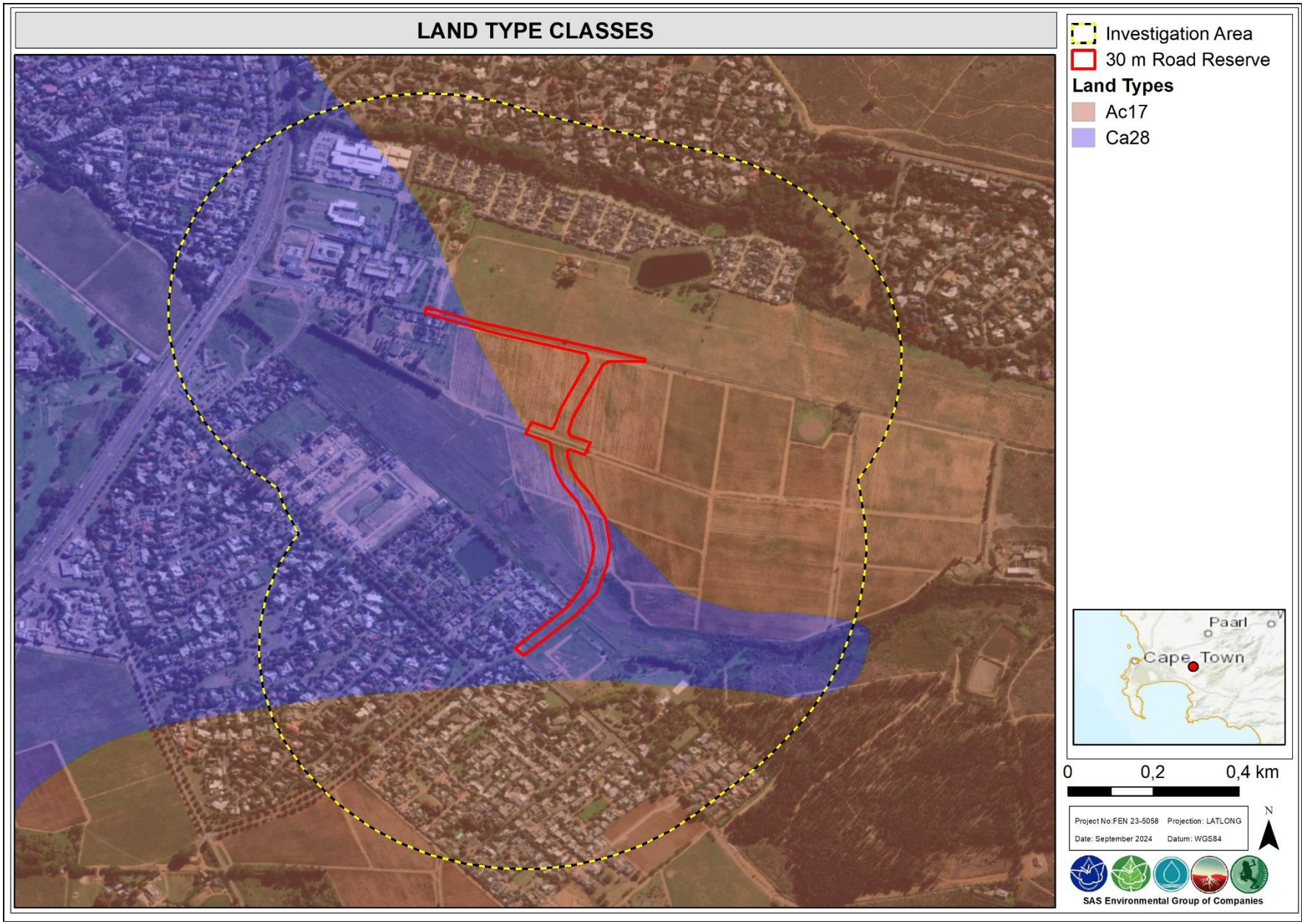


Figure 5: Land types associated with the proposed road extension area (30 m road reserve) and investigation area, according to Job et al. (2019).

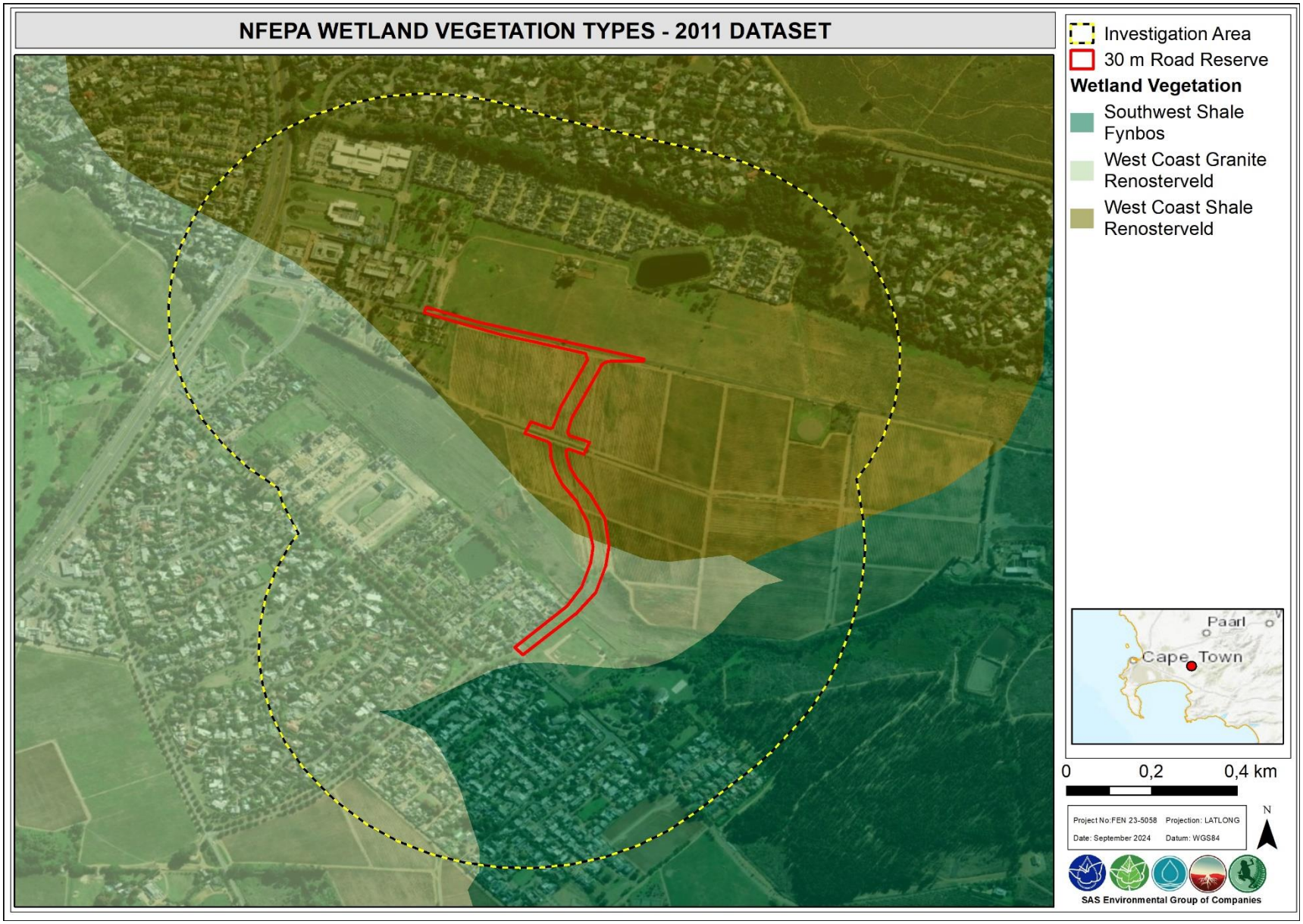


Figure 6: Wetland vegetation types associated with the proposed road extension area (30 m road reserve) and investigation areas as indicated by the NFEPA database (NFEPA, 2011).

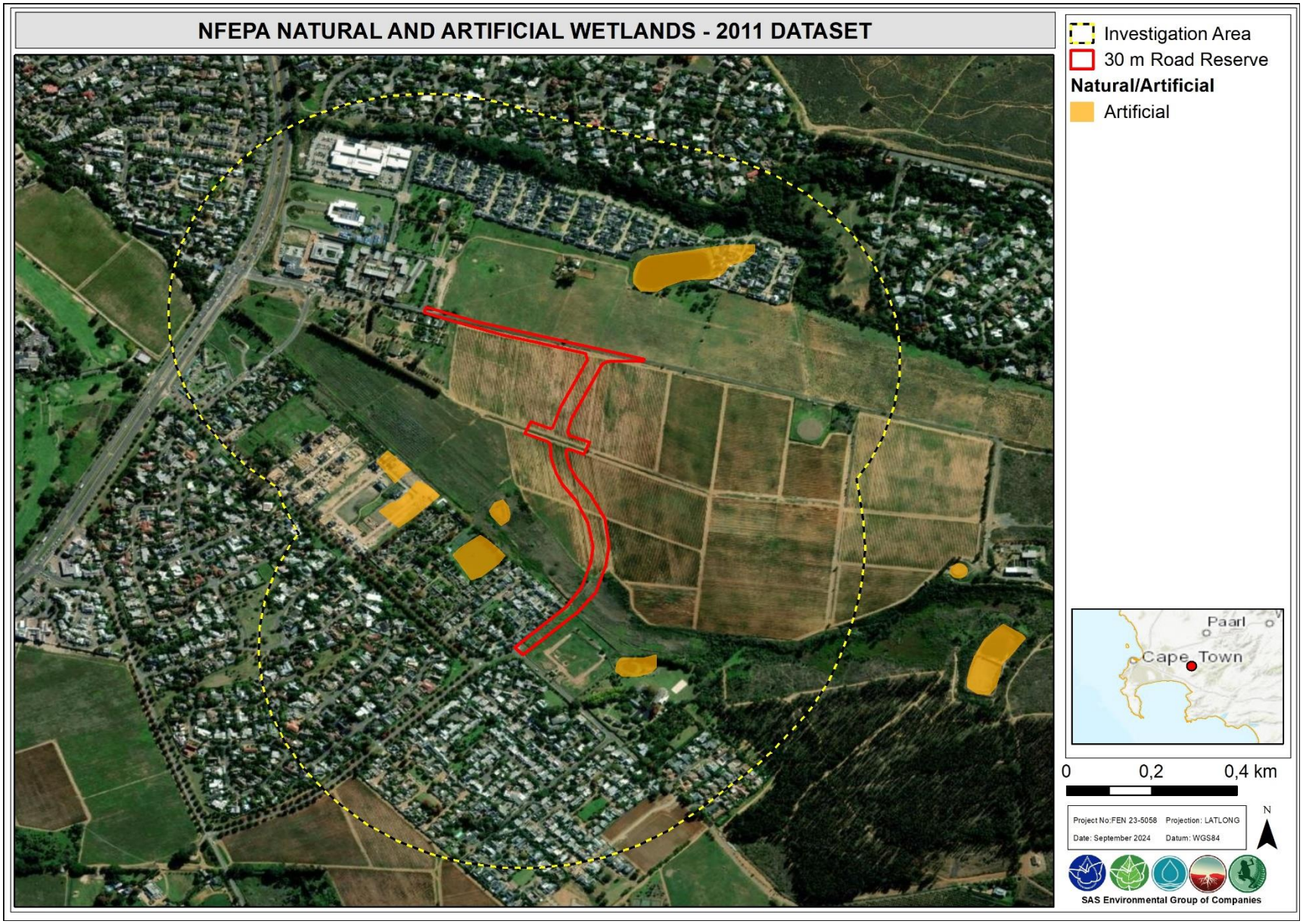


Figure 7: Natural and artificial wetlands associated with the proposed road extension area (30 m road reserve) and investigation areas as indicated by the NFEPA database (NFEPA, 2011).

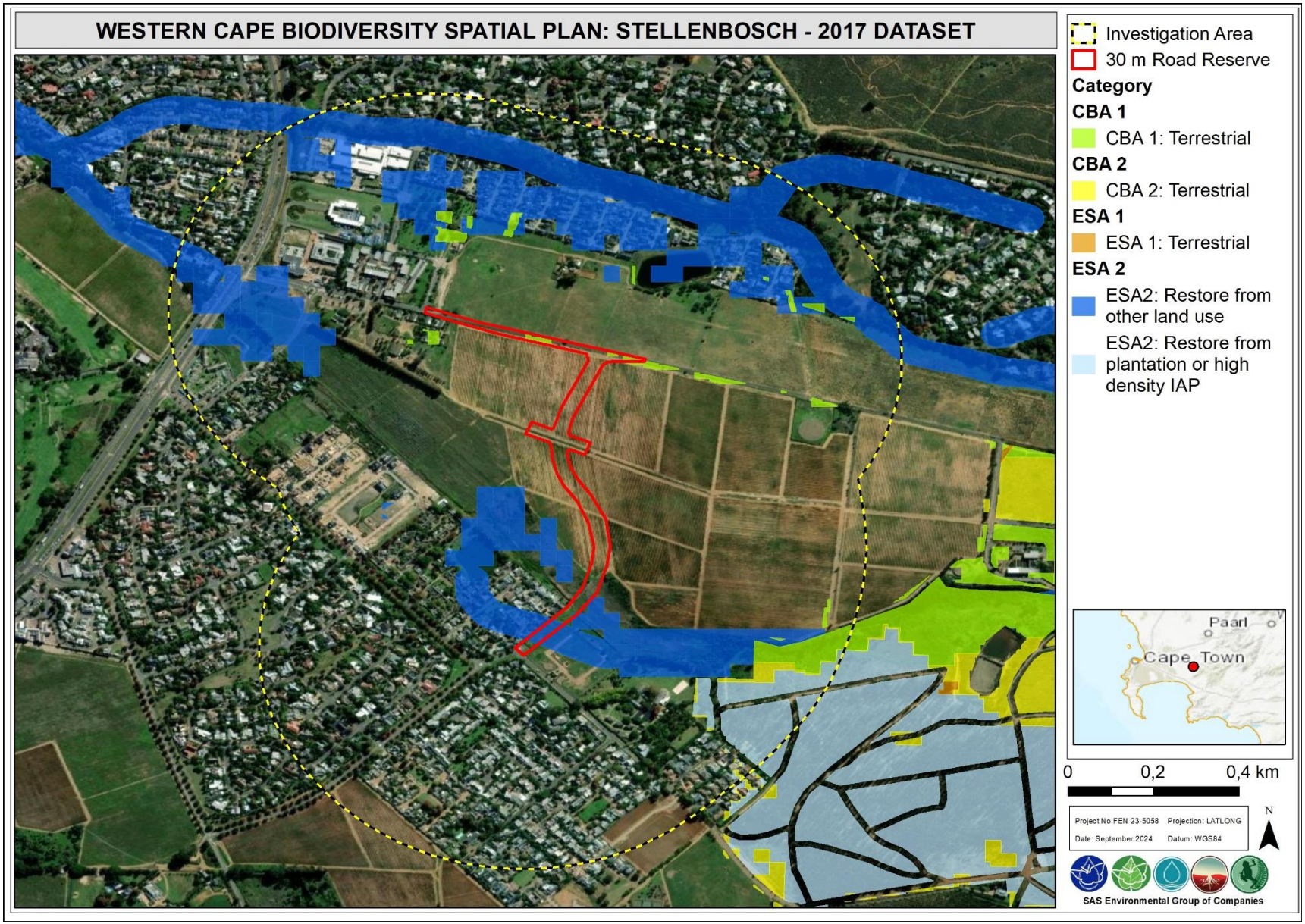


Figure 8: Conservation areas associated with the proposed road extension area (30 m road reserve) and investigation areas, as identified by the Western Cape Biodiversity Spatial Plan (2017).

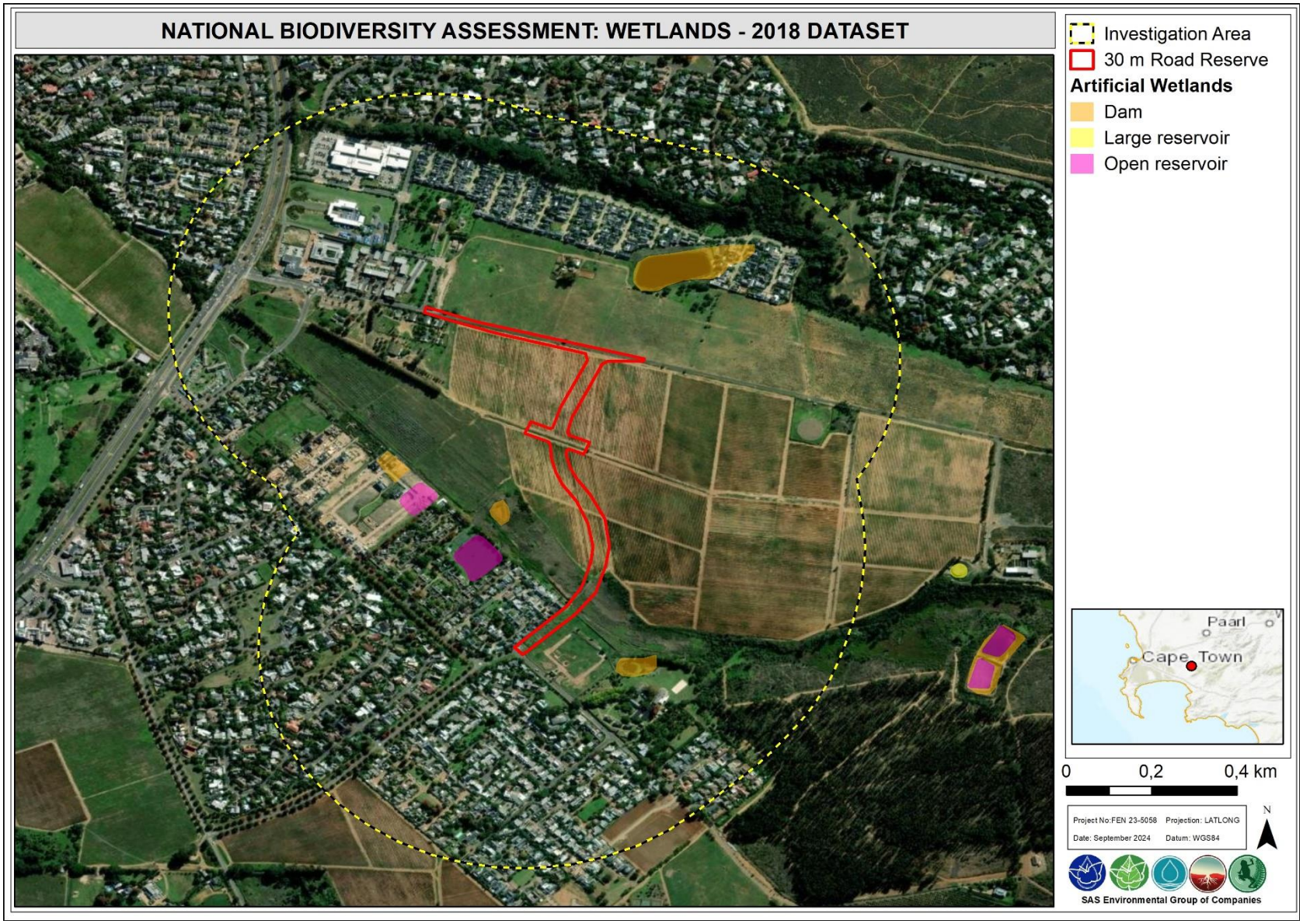


Figure 9: Freshwater ecosystem HGM types within the proposed road extension area and investigation areas, as identified by the National Biodiversity Assessment (2018)

4.2 Analyses of Relevant Databases

4.2.1 Ecological Status of Sub-quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS Database]

The PES/EIS database, as developed by the DWS RQIS department, was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology are based on information collated by the DWS RQIS department from available sources of reliable information, such as South African River Health Program (SA RHP) sites, Ecological Water Requirements (EWR) sites and Hydro Water Management system (WMS) sites. The G22H-09237 (Blouklip River) sub-quaternary catchment reach (SQR) within the South Western Coastal Belt Ecoregion is applicable below.

Key information on fish species, invertebrates and background conditions associated with the SQR G22H-09237 (Blouklip River) as contained in these databases and pertaining to the Present Ecological State (PES), ecological importance (EI) and ecological sensitivity (ES) are described below.

The Ecological Importance (EI) data for SQR G22H-09237 (Blouklip River) indicates that the *Galaxias zebratus* and the Sandelia capensis fish species occur at this site.

Table 2: Invertebrates previously collected from or expected at the SQR G22H-09237 (Blouklip River) monitoring point.

Aeshnidae	Hydropsychidae 1 Sp
Ancylidae	Hydropsychidae 2 Sp
Athericidae	Hydroptilidae
Baetidae > 2 Sp	Leptoceridae
Baetidae 2 Sp	Leptophlebiidae
Caenidae	Libellulidae
Ceratopogonidae	Muscidae
Chironomidae	Oligochaeta
Coenagrionidae	Physidae
Corixidae	Potamonautidae
Culicidae	Simuliidae
Dytiscidae	Tabanidae
Elmidae/Dryopidae	Teloganodidae
Gerridae	Thiaridae
Gomphidae	Tipulidae
Gyrinidae	Turbellaria
Hirudinea	Veliidae/Mesoveliidae
Hydracarina	

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reach SQR G22H-09237 (Blouklip River) on the DWS RQS PES/EIS database.

	G22H-09237 (Blouklip River)
Synopsis	
PES Category Median	Largely Modified (D)
Mean EI class	Moderate
Mean ES class	High
Length	13.66
Stream order	1
Default EC[4]	B (High)

PES Details	
Instream habitat continuity MOD	Large
RIP/wetland zone continuity MOD	Serious
Potential instream habitat MOD activities	Moderate
Riparian/wetland zone MOD	Large
Potential flow MOD activities	Large
Potential physico-chemical MOD activities	Moderate
EI Details	
Fish spp/SQ	2
Fish average confidence	1.00
Fish representivity per secondary class	Low
Fish rarity per secondary class	Moderate
Invertebrate taxa/SQ	35
Invertebrate average confidence	4.37
Invertebrate representivity per secondary class	High
Invertebrate rarity per secondary class	Very High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	High
Habitat diversity class	Very High
Habitat size (length) class	Moderate
Instream migration link class	Moderate
Riparian-wetland zone migration link	Low
Riparian-wetland zone habitat integrity class	Moderate
Instream habitat integrity class	High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very Low
Riparian-wetland natural vegetation rating based on expert rating	High
ES Details	
Fish physical-chemical sensitivity description	Moderate
Fish no-flow sensitivity	Moderate
Invertebrates physical-chemical sensitivity description	Very High
Invertebrates velocity sensitivity	Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very High
Stream size sensitivity to modified flow/water level changes description	High
Riparian-wetland vegetation intolerance to water level changes description	High

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

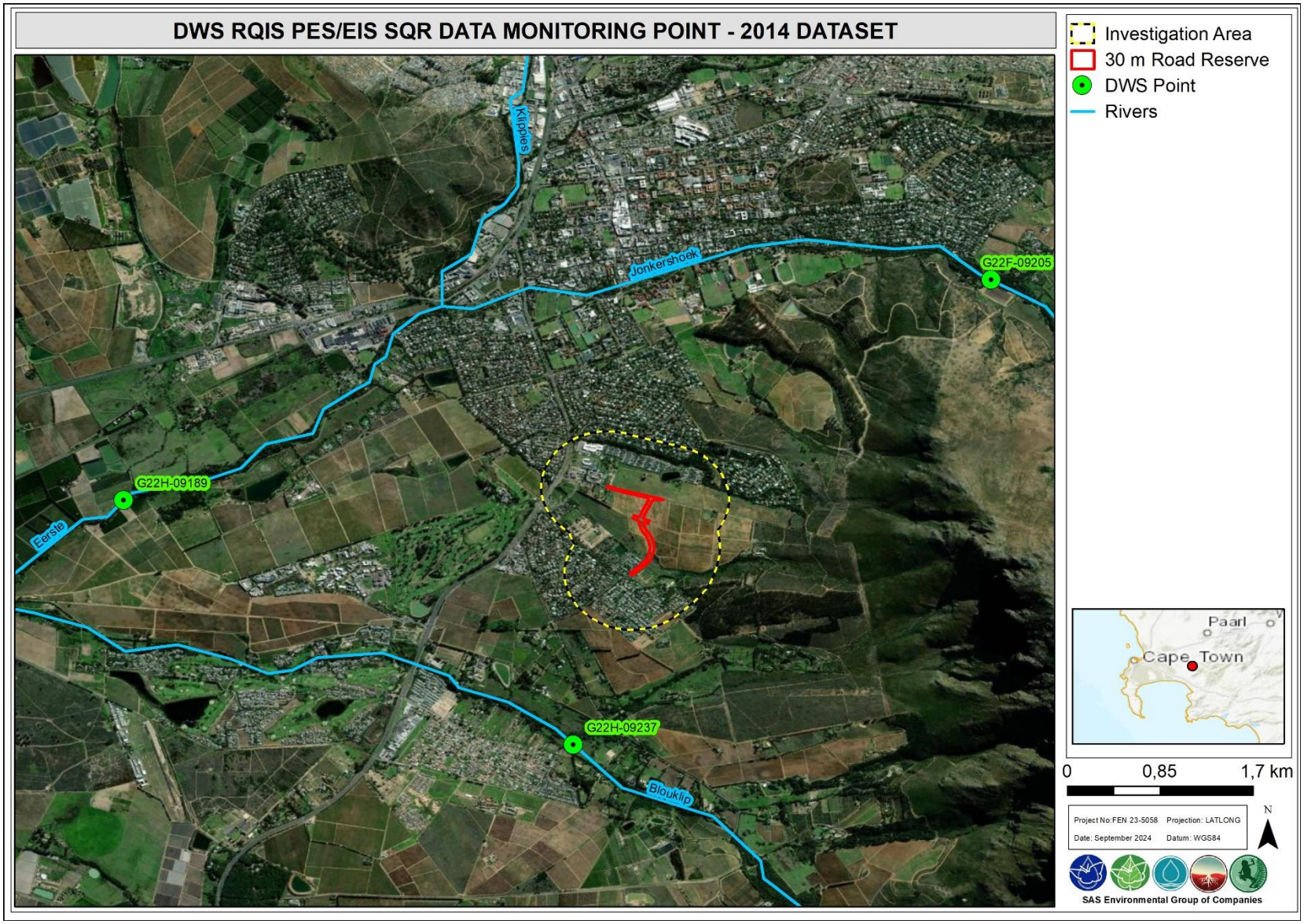


Figure 10: DWS RQIS PES EIS data monitoring point in the vicinity of the proposed road extension area and investigation area.

5 RESULTS: FRESHWATER ECOLOGICAL ASSESSMENT

5.1 Analysis of available historical and recent aerial and digital satellite imagery

In preparation for the field assessment, aerial photographs, digital satellite imagery and provincial and national wetland databases (as outlined in Section 4 of this report) were used to identify points of interest in the surrounding area at a desktop level. Based on the historical aerial photographs, a diversity of digital signatures is identifiable that correspond with those displayed by freshwater ecosystems. In this regard, specific mention is made to the following:

- **Linear features**: Since water flows/moves through the landscape, surface water features often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- **Vegetation associated with surface water features**: a distinct increase in density as well as shrub size near flow paths and areas of increasing wetness;
- **Hue**: water flow paths often show as white/grey or black and outcrops or bare soil displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with surface water feature vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas where there is less soil moisture or surface water present; and
- **Texture:** with areas displaying various textures, created by varying vegetation cover and soil conditions.

5.2 Freshwater Ecosystem Delineation

Points of interest were verified on the 24th of October 2023 and delineated using a mixture of physical (DWAF (2008) and Job (2009) soil characteristic guidelines) and desktop (digital satellite imagery) delineation indicators - the latter where mobility became challenged. The DWAF (2008) delineation guidelines require the following freshwater features to be considered:

Riparian and non-riparian areas

- Terrain units in terms of topography and elevation are used to determine in which parts of the landscape a freshwater ecosystem is most likely to occur;
- Flowing surface water can be used to determine the active zone; and
- The presence of alluvial soil or a distinct change in topography is used to define the channel edge of riverine systems without riparian vegetation, this vegetation which defines the outer boundary of riparian areas.

Wetlands

- Terrain units in terms of topography and elevation are used to determine in which parts of the landscape a freshwater ecosystem is most likely to occur;
- Obligate and facultative vegetation species could be used in conjunction with terrain units as well as the point where a distinct change in the vegetation composition is observed, to determine the boundary of a wetland;
- Soil form indicators are used to determine the presence of soil that is associated with prolonged and frequent saturation and a fluctuating water table within 50 cm of the land surface; and

- Soil hydrogeomorphic features such as mottling, gleying and streaking can be used to identify soil which regularly experience fluctuations in the water table, are well drained or remain waterlogged for extended periods of time.

It should be noted that for an area to be identified as a freshwater ecosystem, at least two of the above indicators per riparian/non riparian area or wetland should be present (*Pers Comm* Prof. F. Ellery).

The following freshwater ecosystems were identified, as depicted on the freshwater ecosystem delineation map that follows (Figures 11). Refer to the relevant photos as indicated below.

- Traversed by the proposed road extension:
  - An UCVBW
- Within the investigation area:
  - An UCVBW, along the northern portion of the investigation area

Evidence of the delineation indicators for the UCVBW according to the above delineation guidelines is provided below.

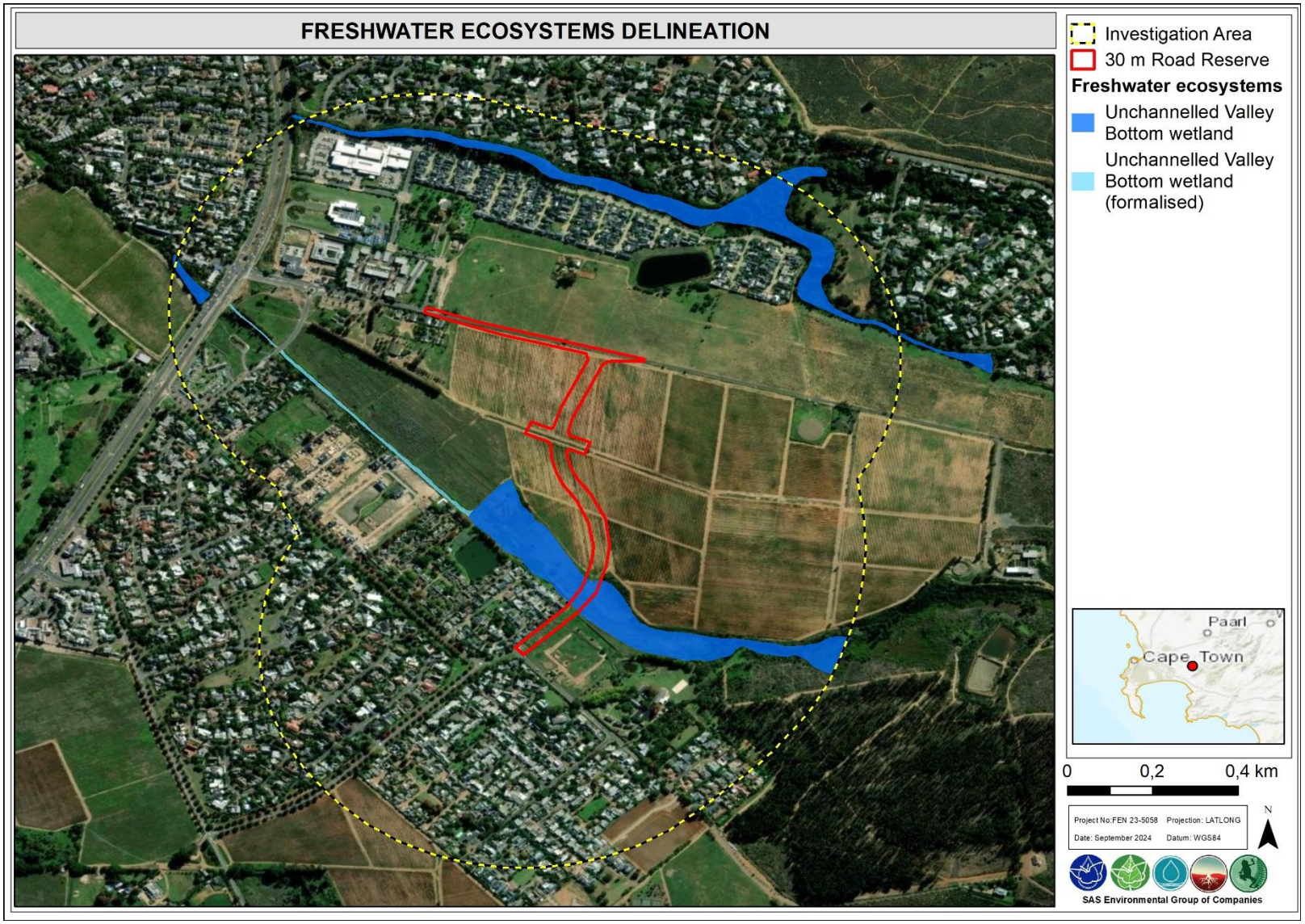


Figure 11: Freshwater ecosystem delineation in relation to the proposed road extension area, investigation area and surrounds.

- **Terrain units** were used to determine in which part of the landscape freshwater ecosystems would most likely occur. The identified UCVB wetland occurs at the valley base and flows in a north westerly direction, collected upgradient catchment water and lateral freshwater inputs along its course;
- **Obligate and facultative vegetation species** associated with areas where a distinct change between terrestrial and wetland vegetation occurs were used to determine the wetland boundary. Please refer to Table 4 for the list of plant species identified and Figures 12 and 13 for the photographs.

Table 4: Obligate and facultative wetland species within the UCVBW that will be traversed by the proposed road extension.

Scientific Name	Common Name	Wetland Plant Type	Red Data Status/Alien status
Zantedeschia aethiopica	Arum lily	Obligate	Indigenous - Least Concern
Pennisetum macrourum	Riverbed grass	Obligate	Indigenous - Least Concern
Plecostachys serpyllifolia	Cob Web Bush	Facultative	Indigenous – Least Concern
Senecio pterophorus	Perdegifbos	Opportunistic	Indigenous - Least Concern
Juncus effusus	Soft Rush	Obligate	Alien
Lantana camara	Tickberry	Obligate	Alien – NEMBA Level 1b[3]
Cyperaceae sp.	Uncertain	Obligate	Uncertain
Lolium perene	Perennial Rye Grass	Facultative	Alien
Holcus lanatus	Common Velvet Grass	Facultative	Alien - naturalised
Echium plantagineum	Patterson's Curse	Opportunistic	Alien – NEMBA Level 1b
Vicia villosa	Hairy Vetch	Opportunistic	Alien
Plantago lanceolata	Ribwort plantain	Opportunistic	Alien
Briza maxima	Big Quaking Grass	Opportunistic	Of Mediterranean origin
Populus alba	White Poplar Tree	Opportunistic	Alien – NEMBA Level 2
Cirsium vulgare	Spear Thistle	Opportunistic	Alien – NEMBA Level 1b

- **Soil hydrogeomorphic features** indicative of wetlands such as mottling and streaking are telling of seasonal saturation, and therefore, alternating periods of reduction and oxidation which causes minerals to precipitate out of solution (mottle), or organic matter to be leached out of infiltration routes (streaking). Gleying indicates waterlogged soil for prolonged periods, causing a sufficient state of reduction which creates their characteristic blue or green tint.

Figure 12: Mottling present in the soil underlying the UCVBW.

[3] Category 1b are invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued. Category 2 species are deemed to be potentially invasive, in which a permit is required to carry out a restricted activity.

- **Soil forms** that give rise to the formation of wetlands according to DWAF (1995) are listed in Table 5 below.

Table 5: Soil forms as an indicator of wetland presence (DWAF 2005).

Always indicative of wetlands	Potentially indicative of wetlands
Champagne, Katspruit, Willowbrook and Rensburg	**Signs of wetness are incorporated at the form level** **Avalon, Bainsvlei,** Bloemdal, Cartref, Dresden, Estcourt, Fernwood, **Glencoe**, Kinkelbos, Klapmuts, Kroonstad, **Longlands**, Lamotte, Montagu, Pinedene, Sepane, Tukulu, Vilafontes, **Wasbank, Westleigh**, Witfontien **Signs of wetness are incorporated at the family level** Addo, Brandvlei, Dundee, Etosha, Glenrosa, Groenkop, Houwhoek, Inhoek, Jonkersberg, Kimberley, Molopo and Tsitsikamma

The investigation area falls within the Ac17 and Ca28 land types. Ac Land types comprise Red and yellow, freely-drained apedal soils with Hutton, Griffin and Clovelly soils occupying more than 40% of the landscape. Ac Land Types are dominated by yellow soils (red soils < 10%).Ca Land Types indicate land that qualifies for the plinthic catena (Avalon, Bainsvlei, Longlands, Glencoe, Wasbank, and Westleigh and occupy more than 10% of the land surface), but which has, in upland positions, margalitic soils (Estcourt, Sterkspruit, Swartland, Valsrivier and Kroonstad) and occupy more than 10% of the land surface). The soil forms within the Ca land type, that underly the UCVBW are potentially indicative of wetlands.

The above soil forms have been mapped and provided in land type specification sheets which is used in conjunction with the Soil Classification Working Group (2018) which states that wetland soil in the study area and wider area occupied by the land type typically occurs where an orthic (A horizon) overlays a yellow-brown apedal B horizon, E horizon or soft plinthic B horizon. This is particularly true of the Longlands, Avalon, Swartland, Westleigh, Oakleaf and Pinedene soil series that are listed within this landtype.

According to the Soil Classification System (SCS) spatial layer for hydrological soil groups, the investigation area is underlain by a Class A/B soil which represents a range from sand, loamy sand, sandy loam and loam textures (Figure 12) (Abraham *et al.,* 2019). Class A/B soils have high infiltration rates and rapid permeabilities and thereby low inherent runoff potential (Schulze *et al.,* 1992). The hydrology of these soil is therefore best described as shallow interflow where the textural discontinuity between the A and B/E horizons facilitates the build-up of water in the top soil.

5.3 Freshwater Ecosystem Classification

The UCVB wetland associated with the proposed development was classified according to the Classification System outlined in **Appendix C** of this report as an Inland System falling within the Southern Coastal Belt Ecoregion and the West Coast Granite Renosterveld WetVeg group. Table 6 below presents the classification from level 3 to 4 of the Wetland Classification System.

Table 6: Wetland classification within the study area according to Ollis *et al.* (2013)

Freshwater Ecosystem	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Unchanneled Valley Bottom Wetland	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	A valley-bottom wetland located on the valley floor without a river channel running through it. Water inputs are dominated by diffuse flows which are formed when a river channel loses confinement and spreads out over a wider area, causing the concentrated flow associated with the river channel to change to diffuse flow (i.e., the river becomes an unchannelled valley-bottom wetland). This is typically due to a change in gradient brought about by a change in base level at the downstream edge of the wetland and the resulting accumulation of sediment or an unchannelled valley-bottom wetland could occur at the downstream end of a seep, where a slope grades into a valley near the head of a drainage line. There may also be groundwater input into the wetland.

5.4 Freshwater Ecosystem Assessment

The freshwater ecosystem assessment is provided below in Table 7, which provides a summary of the field verification findings in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the UCVB wetland. The details pertaining to the methodology used to assess the UCVBW is contained in Appendix C and the assessment results are provided in Appendix E.

Table 7: Summary of the assessment of the UCVBW.

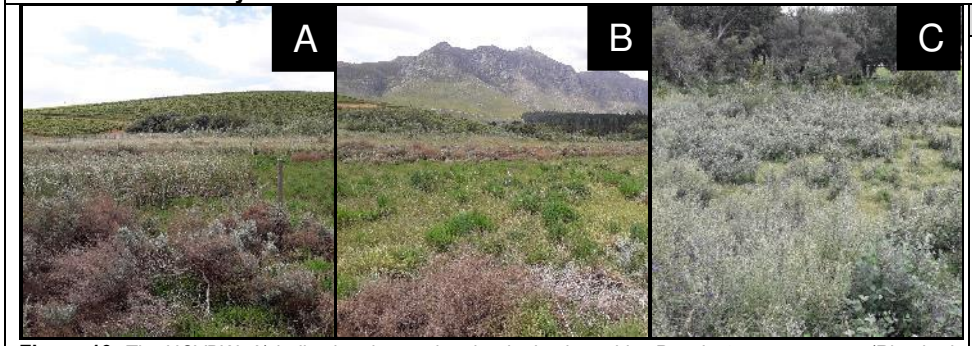
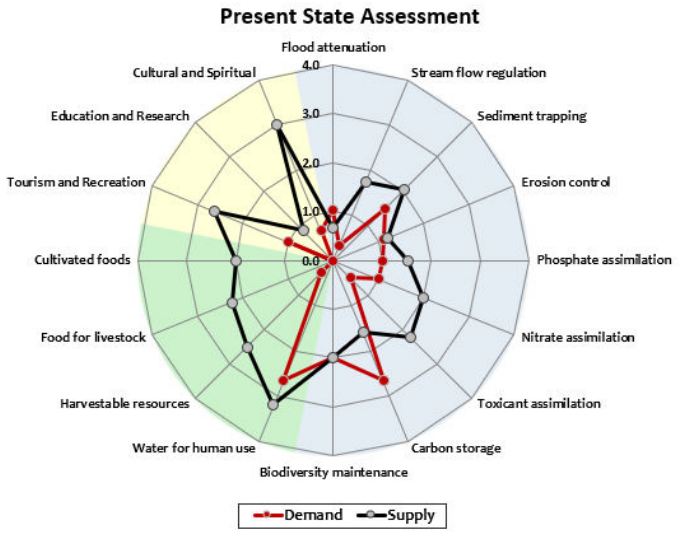


Figure 13: The UCVBW, A) indicating the section that is dominated by *Pennisetum macrourum* (Riverbed grass) that will be traversed by the proposed road extension, B) looking north at pasture-like habitat dominated by *Holcus lanatus* (Velvet grass), and C) serious encroachment by *Populus alba* (Silver poplar) elsewhere.



WET-Ecoservices

The WET-Ecoservices model determined a high to very high ecosystem supply for sediment trapping, water for human use, harvestable resources, livestock grazing, tourism and recreation and cultural and spiritual practices. Carbon storage and water for human use are ecoservices in the greatest demand. Integration of the supply and demand scores determined that water for human use is a highly important ecoservice of this UCVBW. The remainder of the ecoservices were deemed of very low to moderate ecoservice importance due either to a high supply in a catchment of low demand (e.g. nutrient assimilation and livestock grazing) , or conversely, due to a low supply in a catchment of a high demand (e.g. carbon storage).

Present Ecological Status Discussion

PES Class: Moderately Modified (Class C)

Hydrological regime

The hydrological regime is considered **largely modified** due to impoundment of a portion of the upgradient catchment yield. The naturally diffuse spread of flows within the wetland have been altered by the development of a channel that concentrates water, that has formed presumably as a result of stormwater input. The dense infestation of poplar trees within the study area, but presumably also higher up in the catchment will desiccate the wetland soil, by decreasing shallow interflow due to elevated levels of sub surface water consumption.

Geomorphology and sediment balance

Sediment distribution and retention is considered **moderately modified** due to decreased diffuse spread of sediment across the wetland floor due to decreased flows as a result of impoundment, and concentration of flows in the stormwater channel. Entrapped sediments in the impoundments are offset by an increase in sediment supply from adjacent agricultural practices and stormwater input. These impacts have largely altered sediment distribution and retention patterns in the wetland.

Habitat and biota

The wetland is densely vegetated with a high basal cover of alien and invasive species, some of which have become naturalised. The vegetation community is considered to be **seriously modified**. Refer to the species list in Table 2 above.

Water Quality

Water quality is considered **largely natural** considering that the pH and Electrical Conductivity (EC) fell with the range (pH – 6.5-8) and (EC ≤ 30 mS/m) as stipulated by the resource water quality objectives of South Africa (DWA 2011). Dissolved oxygen was very low, but is acceptable given the slow, percolation hydrology of this wetland. pH = 6.72, EC = 25 mS/m, Total Dissolved Solids (TDS) = 175 mg/l, Salinity = 115 ppm, Dissolved Oxygen (DO) = 1.30 mg/l and DO (%) = 2.67%.

EIS Discussion

EIS Category: Moderate

The moderate EIS of this wetland is derived primarily from its functional importance as the high basal vegetation cover provides a high degree of sediment trapping, erosion protection and nutrient assimilation, which are all relevant considering agricultural and stormwater input from the adjacent catchment. Stream flow regulation of the receiving Eerste River is also important. This wetland is not recognised provincially nor nationally and due to the dense infestation of alien vegetation is not marked for ecological importance. Direct human benefits are also considered of low importance.

REC, BAS and RMO Categories

REC: Category C/B **BAS: Category: C/B (Moderately Modified to largely natural)** **RMO: Maintain**

The RMO for a Class C PES and moderate EIS is to maintain the ecological condition of this wetland as a PES Class C. The BAS is realised at a PES Class C/B, which would require catchment clearing of alien vegetation and the removal of all preferential flows draining the wetland floor, thereby reinstating diffuse flow. This however falls outside the scope of this project. The REC is realised at a C (moderately modified) which is achievable in the short term through alien vegetation clearing, followed by revegetation with indigenous species within the vicinity of the proposed road extension area.

Extent of Modification

Low - The extent of modification to this wetland is envisaged to be low on condition that the diffuse hydrology is preserved and the road reserve area, including the wetland section it crosses is rehabilitated post construction.

Impact Significance and Business Case

Low - The impact significance of the proposed road extension is considered low in light of the existing impacts that are already acting on this wetland, but no cumulative impacts are envisaged on condition that the mitigation measures as listed in this report are followed. The proposed road extension offers a solution to alleviate traffic on the regional R44 road and creates future development opportunities in the area due to providing new access road options.

6 LEGISLATIVE REQUIREMENTS

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

- The Constitution of the Republic of South Africa, 1996[4];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA);
- The EIA Regulations (GN 982) of 04 December 2014 as amended;
- The National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA); and
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

Certain articles of legislation related to the above Acts and legislation impose potential zones of regulation on freshwater ecosystems in both a national and provincial context. The Zones of Regulation (ZoR) are not necessarily development exclusion zones, rather areas in which EIA and Water Use Authorisation legislative tools have been introduced for the protection and sustainable use of freshwater resources by requiring that certain types of activities within a freshwater ecosystem, or within a certain distance of a freshwater ecosystem require authorisation. The definition and motivation for a regulated zone of activity for the protection of freshwater ecosystems can be summarised as follows:

Table 8: Articles of legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation	Zone of applicability
Water Use Authorisation Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). **Department of Water and Sanitation**	In accordance with General Notice 509 of 2016, a regulated area of a watercourse for section 21 (c) and 21 (i) of the National Water Act, 1998 (Act 36 of 1998) is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • **a 500m radius from the delineated boundary (extent) of any wetland or pan**.

[4] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

Regulatory authorisation	Zone of applicability
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended in 2017. **Department of Environmental Affairs and Development Planning (DEADP)**	Activities of Listing Notice 1 (GN 983) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) **Activity 12**: *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres;or* *(ii) 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.* **Activity 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 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;* *(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* *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.* Activities of Listing Notice 3 (GN 985) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) **Activity 14** *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—* *(a) **within a watercourse**;* *(b) in front of a development setback; or* *(c) if no development setback has been adopted, within **32 metres of a watercourse**,* *Western Cape:* *i) Outside urban areas:* *(bb) National Protected Area Expansion Strategy Focus areas;* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.*

As per Table 8 above, the following zones of regulation (ZoR) apply to the identified freshwater ecosystems that are associated with the proposed development within the investigation area:

- A 32 m ZoR in accordance with NEMA was applied all UCVBWs falling within the investigation areas; and
- A 500 m ZoR in accordance with the NWA in terms of GN 509 was applied to these UCVBWs

The above ZoR are illustrated below in Figure 14 below.

Development within the NWA and NEMA ZOR will require that the WUA and EA processes be followed. See Section 7 for more details.

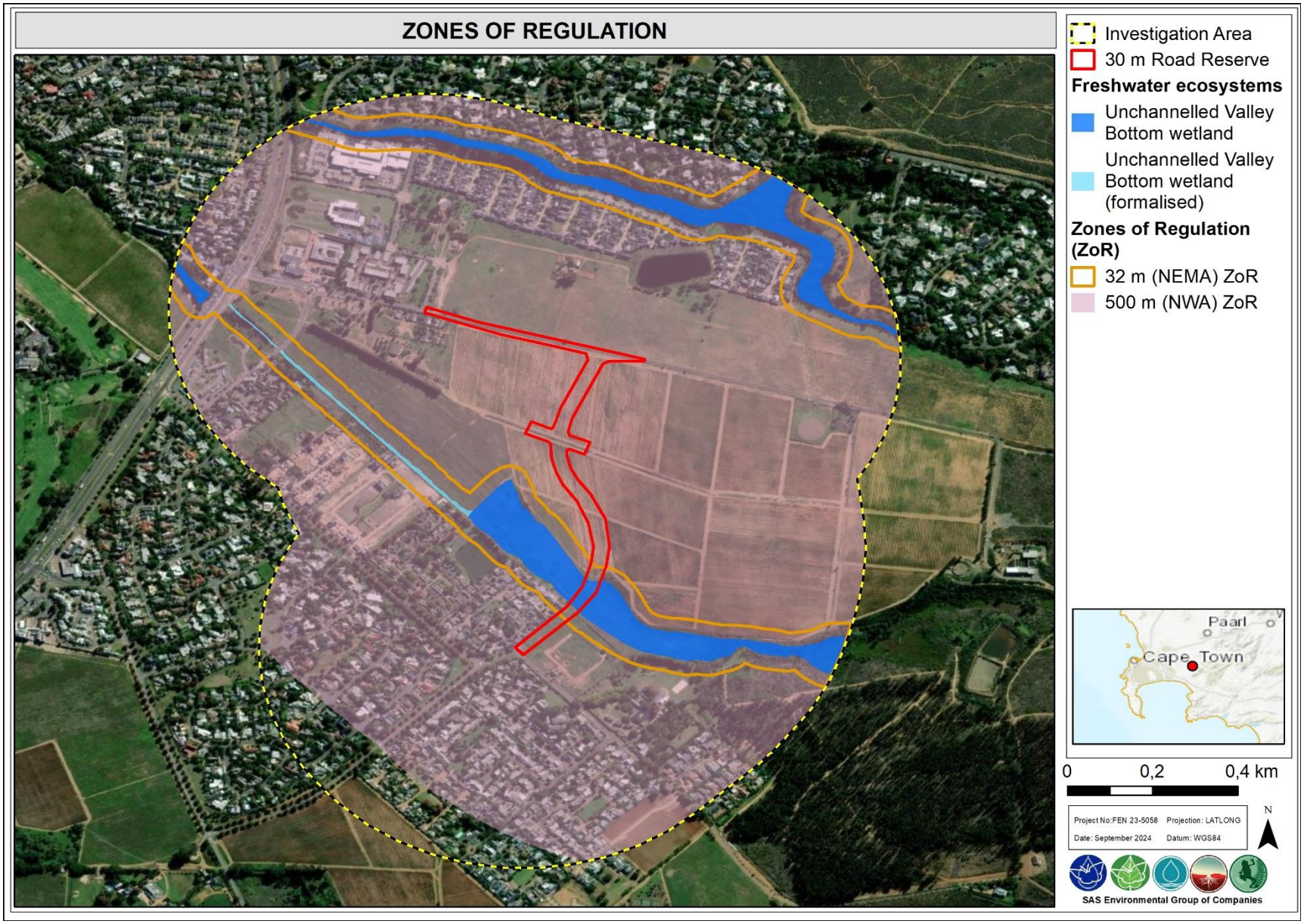


Figure 14: Freshwater ecosystem delineation associated with the proposed road extension and investigation area and applicable zones of regulation in terms of NEMA and GN509 as it relates to the NWA.

7 RISK ASSESSMENT

Following the assessment of the UCVB wetland, the DWS specified Risk Assessment Matrix (as promulgated in GN509 of 2016) was applied to ascertain the significance of risk associated with the proposed development on the key drivers and receptors of the wetland.

7.1 Risk Assessment considerations and outcome

- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DFFE *et al.* (2013) would be followed, i.e., the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- Thus, the DWS risk assessment was applied assuming that all listed mitigation measures are implemented and therefore the results of the DWS risk assessment provided in this report presents the perceived impact significance ***post-mitigation***;
- There are four key ecological risks on the assessed freshwater ecosystem that were assessed, namely:
  - Loss of surface water feature habitat and ecological structure resulting in impacts to biota;
  - Changes to the socio-cultural and service provision;
  - Impacts on the hydrology and sediment balance of the wetland; and
  - Impacts on water quality;
- Each of the above ecological risks is rated according to the perceived impact, with the average impact across these ecological risks representing the ***severity score***. A maximum severity score of 5 is mandatory for direct impacts within wetlands; which is applicable to the proposed road extension;
- The proposed development activities and the associated risks they pose are largely site specific and not of a significant extent relative to the area of the freshwater ecosystems assessed, and therefore have a limited ***spatial scale*** (i.e., within the respective Erf boundaries);
- The ***duration*** scores were based on the degree of impact to the PESEIS of a freshwater ecosystem, with the maximum duration (score = 3) perceived;
- While the operation of the proposed development will be a permanent activity, the construction of the proposed development is envisioned to take no more than a few months, however, the ***frequency of the activity*** during construction may be daily during this time;
- Although the frequency of the activity may be daily, the nature and proximity of the activity to the freshwater ecosystem and its PESEIS will determine the ***frequency of impact***. A high frequency of impact is envisaged due to direct impacts within the subject wetland;
- The default score for ***legal issues*** for the majority of the proposed development activities is '5', due to activities taking place within the 500 m ZoR of the wetland;
- Most impacts are considered easily ***detectable*** and mitigation measures thereof are considered to be easily practicable; and
- It is recommended that the wetland must be rehabilitated and revegetated with suitable indigenous vegetation species.

The results of the risk assessment are summarised in Table 7 that follows, including key mitigation measures for each activity that must be implemented to reduce the impacts of the proposed development activities.

Table 9: Summary of the results of the DWS Risk Assessment applied to the UCVB wetland considering the significance of the proposed development

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
CONSTRUCTION PHASE									
1	**SITE PREPARATION FOR CIVIL WORKS**	• Stockpiling of construction equipment, materials, vehicles and machinery; • Removal of vegetation and associated disturbances to soil; • Possible indiscriminate vehicle movement; and • Diversion of water away from the construction area.	• Desiccation of wetland soil as a result of vegetation cover loss; • Potential proliferation of alien and invasive vegetation species due to disturbance • Soil contamination from oils and hydrocarbons; • Temporary disruption of the hydrology of the wetland and desiccation of portions of the downstream areas by diverting flows away from the road construction area; • Loss of freshwater habitat and ecological structure resulting in impacts on biota; and • Temporary diminishing of ecoservice provision of the freshwater ecosystems as a result of habitat and biota loss.	5	8	15	120	M	• It is imperative that construction occurs during the drier summer months (January -April) using as much manual labour (not machinery) as possible to minimise the wetland disturbance footprint in terms of soil disturbance and vegetation trampling, and further to minimise hydrocarbon and oil spillages; • Only authorised maintenance personnel may be permitted to enter the wetland as part of the clearing activities to prevent unnecessary disturbance to this wetland; • Contractor laydown areas (if applicable) are to be established at least 32m outside of the delineated extent of this wetland; • The outer boundary of the wetland must be demarcated using a weather resistant material by an ECO and marked as a 'no-go' area where no construction activities are planned and all construction footprint areas must remain as small as possible; • Vegetation clearing must be limited to what is essential within the proposed road extension area; • Indigenous vegetation must be retained as far as possible and used during the rehabilitation phase of this wetland; • Alien vegetation must be managed throughout the construction phase; • All alien and invasive vegetation species, debris and litter removed from the crossing must be removed from site (no stockpiling allowed); and • Vehicle servicing and re-fuelling must occur off-site.

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
CONSTRUCTION PHASE									
2	**CONSTRUCTION OF THE WILDEBOSCH ROAD THROUGH THE WETLAND**	• Undercutting roadbed prism and placement of pioneering layer consisting of rock and/or sand fill; • Construction of road fill; • Trenching for the installation of pipe culverts; • Creation of soil stockpiles • Backfilling to the level of the pipe culverts; • Construction of road pavement layers; • Construction of the culvert headwalls using concrete, • Installation of the inlet and outlet erosion protection structures; • Application of asphalt, paint and sealants; and; • Operation of machinery.	• Altered runoff patterns, leading to preferential flow paths and increased erosion and sedimentation of the downstream reach of the wetland, and associated decreases in the ecosystem provisioning of this freshwater ecosystem; • Potential disturbance of the wetland slopes, further leading to sedimentation of this system; • Temporary disruption of the hydrology of the wetland and desiccation of portions of the downstream areas by diverting flows away from the road construction area; • Possible spills / leaks from construction vehicles and machinery and from paints and sealants during pavement construction; • Alien invasive plant encroachment on stockpiles, creating opportunities for the spread of alien vegetation throughout the wetland; • Ground disturbances and dust pollution during construction which may impact on wetland water quality; • Potential pollution of the wetland by spillage of road material in the wetland, thereby polluting the downstream reach and causing hydro-morphological alterations to the wetland; • Potential contamination of soils and surface water as a result of concrete works, leading to further reduced ability to support biodiversity; and • Compaction of soils, disrupting the growth medium of the wetland vegetation	5	9	16	144	M	• Stockpiles as a result of the removal of wetland soil may not exceed 2 m in height and must be placed outside of the delineated extent of the wetland; • Stockpiles must not be contaminated with hydrocarbons and oils; • The top organic layer of the soil stockpile must be separated from the lower layers and protected from moisture loss and alien vegetation encroachment, using a geotextile such as hessian sheeting, for use during the rehabilitation phase of this project; • Similarly, the imported road construction material must also be protected from alien vegetation encroachment using hessian sheeting, thereby also preventing deposition into the wetland by wind action; • Water must be allowed to flow to the downstream reach at all times and rip-rap or a similar erosion protection structure must be placed at the outlet to the diversion pipe to prevent erosion of the wetland floor; • Suitable sediment traps such as geotextile wrapped hay bales or geotextile nets must be installed downstream of the proposed road extension to prevent potential sedimentation of the downstream reach of this wetland during unforeseen rainfall events due to bare ground; • Soil surrounding the repair works must be suitably loosened on completion of construction activities and revegetated to prevent erosion; • Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with the wetland or the surrounding terrestrial area; and • The duration of impacts within the wetland must be minimised as far as possible by ensuring that the duration of time in which flow alteration will take place is minimised. The construction period must be kept as short as possible. • **Control measures specific to concrete and asphalt works:** Asphalt, concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal must minimise or eliminate discharges into the freshwater ecosystems. High alkalinity associated with cement can dramatically affect and contaminate both soil and ground water. The following measures must be adhered to: • Fresh asphalt, concrete and cement mortar must not be mixed near the freshwater ecosystems. Mixing of cement may be done within the construction camp, however it may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete; • No mixed concrete or asphalt shall be deposited directly onto the ground or within the freshwater features. All concrete and/or asphalt must be brought in via a cement mixing truck which must remain within the road reserve, and cement/asphalt must be piped down to the proposed bridge footprint. Any areas that require manual application of cement/asphalt require that the mixed road surfacing materials be placed on a batter board or other suitable platform/mixing tray until it is deposited;

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									• A washout area must be designated outside of the freshwater features, and wash water must be treated on-site or discharged to a suitable sanitation system; • At no point may batter boards/mixing trays or cement trucks be rinsed off on site and run-off water be allowed into the freshwater features; • Cement bags (if any) must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream; and • Spilled or excess concrete/asphalt must be disposed of at a suitable landfill site. Chain of custody documentation must be provided.
3	**REHABILITATION OF THE UCVBW**	• Resloping, reprofiling and revegetation of the wetland banks to prevent future erosion; and • Alien and invasive plant removal and revegetation using indigenous wetland plant species	• Exposure of soil, leading to increased runoff and erosion which can lead to increased sedimentation of the wetland; • Exposed soils can be subjected to moisture loss as a result of increased soil temperatures; and • Soil compaction as a result of trampling by staff.	5	7	12	84	M	• Rehabilitation works must be undertaken just before the wet season (preferably within April/May) to ensure survival of new vegetation species and prevent proliferation of alien and invasive plants; • The stormwater channel that runs along the southern boundary of the UCVBW must be infilled upstream to promote the diffuse spread of water (albeit interflow) through the wetland; • All areas to be cleared of vegetation must be done so in a phased approach, to reduce the risk of proliferation of alien vegetation to retain a level of protection to the freshwater ecosystem during construction; • All cleared vegetation must be disposed of at a licensed refuse facility and may not be mulched or burned on site; • Bare soil must ideally be restocked with indigenous vegetation immediately after the removal of alien invasive vegetation, and in cases where the soil will remain unplanted for a few days it must be covered with a hessian net to retain moisture and prevent soil desiccation.
OPERATION PHASE									
4	**OPERATION OF THE CULVERT CROSSING**	• Inadequate flow and loss of freshwater connectivity to the downstream areas; and • Erosion around the culvert crossing and sedimentation of the downstream reach.	• Concentrated flow path creation downstream of the pipe culverts and loss of diffuse flows, leading to erosion, and desiccation and subsequent loss of wetland habitat, and ultimately decreases in ecoservice provision.	1.5	3.5	15	52.5	L	• The pipe culverts must be designed in a manner to preserve the natural hydrology of this UCVBW, flows must not be concentrated downstream of the pipe culvert; • Any loss in wetland longitudinal connectivity due to a failed culvert design must be remedied as soon as possible to reduce the duration of impact.
5	**OPERATION OF THE ROAD SIDE DRAINS**	• Additional stormwater input into the wetland	• Increased litter, sediment and toxicant input into the wetland; and • Potential erosion at the discharge point into the wetland	1.5	3.5	14	49	L	• An erosion protection structure must be installed at the discharge point of the side drains into the wetland and all stormwater must collect into an attenuation facility that is operated according to Sustainable Urban Drainage System principles in terms of the quantity and quality of stormwater discharging into the wetland.; and • The erosion protection structures must be monitored bi-annually to ensure that these structures are still intact and can continue to safeguard the wetland against erosion.

No.	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
OPERATION PHASE									
6	**MONITORING OF STRUCTURAL INTEGRITY OF THE ROAD CULVERT CROSSINGS IN THE KOMPANJIES RIVER.**	• Proactive monitoring to ensure structural integrity is maintained and to identify early signs of erosion around the culverts and ensure that any litter or debris which may accumulate on and around the culverts is cleared to maintain the flow of water.	• No direct impacts perceived.	1	3	4	12	L	• Hot spots for the build-up of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure. In this regard, special mention is made of periods following high rainfall and subsequent high instream water volumes. Removal of debris must be undertaken in line with the above listed construction mitigation measures; • Any erosion must be identified on an ongoing basis and re-profiled and revegetated accordingly; and • Existing access roads must be used for monitoring purposes to minimise the compaction of soils and loss of riparian and instream habitat.
7	**FUTURE MAINTENANCE OF THE ROAD CULVERT CROSSINGS (INCLUDING THEIR HEADWALLS, WINGWALLS, BALUSTRADES AND EROSION PROTECTION (WHERE APPLICABLE).**	• Disturbances to or removal of vegetation while accessing culverts to carry out maintenance activities and • Disturbances to soils.	• Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances; • Decreases to water quality in terms of turbidity from increased sediment loads during soil disturbance.	5	7	11	77	M	• All mitigatory measures as stipulated in Activity 2 and 3 above must be implemented to ensure no negative impacts to the wetland.
8	**ONGOING ALIEN AND INVASIVE VEGETATION REMOVAL (IF REQUIRED).**	• Proactive monitoring to ensure structural integrity is maintained and to identify early signs of erosion, incision and alien vegetation encroachment.	• Compaction of soil and loss of habitat as a result of ongoing disturbance from vehicles and equipment; • Impacts to water quality as a result of the application of herbicides; and • Disturbance of soil which could lead to erosion.	5	7	11	77	M	• The wetland must be monitored for alien and invasive vegetation encroachment and all alien vegetation/weeds must be removed according to a suitable alien vegetation control plan; and • Where applicable for the eradication of alien and invasive vegetation, care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used and water contamination is avoided.

7.2 Risk Assessment Discussion

The DWS Risk Assessment Matrix determined several moderate risks that are associated with the proposed road extension, most of which were assigned to activities during the construction phase. The moderate risks stem from direct impacts within the wetland for which the maximum severity score (5) must be assigned, as per GN509. These activities include dewatering of a portion of the wetland in the vicinity of the proposed road extension area, the construction of the foundation of the road and installation of the pipe culverts. The determined moderate risk scores are above the threshold value (80), and therefore could not be manually down adjusted to realise a low risk significance score (55), considering that GN509 allows for a maximum down adjustment of 25 points. Therefore, as per GN509, the proponent must follow the WUA protocol in terms of a Water Use License Application (WULA), which is at the sole discretion of the Department of Water and Sanitation, the freshwater custodians of South Africa.

Irrespective of the final moderate risk significance determination for the proposed road extension, the proponent must make provision for the suggested mitigation measures, of which construction during the summer dry season, preserving the flow between the upstream and downstream areas during construction, and designing the road culverts in such a manner that the hydrology of this wetland is not altered during the construction phase are most pertinent.

In terms of EA, the development within the NEMA 32 m ZOR of the UCVBW may trigger Activity 12 and 19 of GN983 – Listing Notice 1 of the 2014 Environmental Impact Assessment (EIA) regulations (**GN 983 of 04 December 2014 - as amended**) and Activity 14 of GN324 – Listing Notice 3 (**GN 985 of 04 December 2014 - as amended)** of the 2014 EIA regulations **GN 982 of 04 December 2014 (as amended)**, to be determined by the Environmental Assessment Practitioner (EAP).

7.3 Cumulative Impacts

Wetlands and riparian areas within the region are under continued threat due to rapid urbanisation in the surrounding areas. Cumulative impacts stem from development activities that exacerbate existing impacts on the past, present and foreseeable future, state of the system.

Typical cumulative impacts pertaining to the proposed development comprise:

- Further disruption of the hydrological connectivity in the landscape;
- Further modification of the hydrological regime in terms of the magnitude, timing, duration and frequency due to catchment hardening and discharge of stormwater into freshwater ecosystems;
- Further erosion and sedimentation and eventual smothering of rivers and wetlands; and
- Further establishment of alien and invasive species.

Although it must be acknowledged that this wetland has already seen hydrological alteration due to impoundment upstream, alien invasive vegetation such as Poplar saplings that have infested the wetland floor, which are known to consume large amounts of water compared to indigenous fynbos species and the cutoff drain ~ 280 m downstream of the proposed road extension, these existing impacts should not justify further degradation of the hydrology of this wetland.

No further modification to the hydrological regime is envisaged on condition that the diffuse spread of water is maintained during the operation phase of the road culvert. The implementation of an alien and invasive vegetation plan during the construction and operation phases of the proposed road extension will further improve the hydrology of the wetland, through removal of water thirsty Poplar trees in particular, which will also decrease the cover of alien and invasive vegetation in the local area.

No further impacts to the water quality of this wetland are envisaged on condition that the proposed road side drains are operated according to SUDs principles, which must treat stormwater quality for

toxins and nutrients before entering into the wetland. Given the mitigation measures listed in this report, no other significant cumulative impacts are envisaged post the short-term construction impacts.

8 CONCLUSION

Freshwater Ecological Network (FEN) Consulting (Pty) Ltd was appointed by Zutari (Pty) Ltd to conduct a specialist freshwater assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Wildebosch Road extension to Trumali Road (hereafter, the 'proposed road extension') through erven RE/16527 and RE/369 in the Paradyskloof suburbs of Stellenbosch within the Stellenbosch Municipal area.

The unchannelled valley bottom wetland (UCVBW) that was identified to be traversed by the proposed road extension suffers to off channel impoundment and afforestation that have decreased the upstream catchment yield, thereby impinging on the hydrological budget of this wetland. The remaining surface flows after catchment offtake collect in a channel, which has presumably carved its course in this wetland over time through increased stormwater input, thereby decreasing ecoservice provision through decreased hydrological spread of diffuse flows. Runoff from the agriculturally-transformed catchment to the west and stormwater generated from the residentially-transformed catchment to the east, together with several road crossings in the upstream catchment are envisaged to negatively impact on the water quality of this wetland, particularly through elevated sediment, total suspended solids, nutrient and toxicant inputs, albeit not severely. Disturbance to the catchment of this wetland has caused the encroachment of alien or otherwise problematic vegetation which have dominated this wetland.

The DWS Risk Assessment Matrix determined several moderate risks that are associated with the proposed road extension, most of which were assigned to activities during the construction phase. The moderate risks stem from direct impacts within the wetland for which the maximum severity score (5) must be assigned, as per GN509. These activities include dewatering of a portion of the wetland in the vicinity of the proposed road extension area, the construction of the foundation of the road and installation of the pipe culverts. The determined moderate risk scores are above the threshold value (80), and therefore could not be manually down adjusted to realise a low risk significance score (55), considering that GN509 allows for a maximum down adjustment of 25 points. Therefore, as per GN509, the proponent must follow the WUA protocol in terms of a Water Use License Application (WULA), which is at the sole discretion of the Department of Water and Sanitation, the freshwater custodians of South Africa.

Irrespective of the final moderate risk significance determination for the proposed road extension, the proponent must make provision for the suggested mitigation measures, of which construction during the summer dry season, preserving the flow between the upstream and downstream areas during construction, and designing the road culverts in such a manner that the hydrology of this wetland is not altered during the operation phase are most pertinent.

In terms of EA, the development within the NEMA 32 m ZOR of the UCVBW may trigger Activity 12 and 19 of GN327 – Listing Notice 1 of the 2014 Environmental Impact Assessment (EIA) regulations (**GN 983 of 04 December 2014 - as amended**) and Activity 14 of GN324 – Listing Notice 3 (**GN 985 of 04 December 2014 - as amended)** of the 2014 EIA regulations **GN 982 of 04 December 2014 (as amended)**, to be determined by the Environmental Assessment Practitioner (EAP).

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place (and the implementation of general construction management and good housekeeping practices, as per **Appendix F**), the significance of impacts arising from the proposed road extension area can be adequately managed. Furthermore, with rehabilitation and long-term management of alien and invasive plant species, the overall PES of the wetland is unlikely to be negatively impacted by the proposed road extension area.

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APPENDIX A – Terms of Use and Indemnity

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

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APPENDIX B – Legislative Requirements

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive normalization of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act, 1998 (Act No. 107 of 1998)	The National Environmental Management Act, 1998 (Act No. 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act , 1998 (Act No. 36 of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i). A watercourse is defined as: a) A river or spring; b) A natural channel in which water flows regularly or intermittently; c) A wetland, lake or dam into which, or from which water flows; and d) Any collection of water which the minister may, by notice in the Gazette, declare a watercourse.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act , 1998 (Act No. 36 of 1998)	In accordance with Government Notice (GN)509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and storm water management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C – Method of Assessment

1. Desktop Study

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

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

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

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

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland feature present in the vicinity of the proposed development.

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

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

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

All wetland or riparian features encountered within the study area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis et. al., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

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

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

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

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

Level 1: Inland systems

From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[5] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or**

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

periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

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

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

Level 3: Landscape Setting

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

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

Level 4: Hydrogeomorphic Units

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

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;

- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al.*, 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et. al.*, 2009).

3. WET-Ecoservices (2020)

The WET-Ecoservices (v2) method by Kotze *et al.* (2020) provides an overall importance score to each of the ecoservices listed below (Table C4). The overall importance score of each ecoservice is calculated by integrating its respective supply and demand scores (Table C3). Each ecoservice supply and demand score in turn is calculated using an algorithm that has been designed to reflect the relative importance and interactions of the attributes represented by indicators that characterise that ecoservice.

The supply of an ecoservice is related to the innate ability of the wetland to provide a particular service, tying to its PES, while the demand on an ecoservice is founded on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency.

The WET-Health (v2) summary thus enables the reader to gauge both the relative importance of the individual ecoservice supply and demand scores and combined (overall) ecoservice importance.

➢ Flood attenuation	➢ Biodiversity maintenance
➢ Stream flow regulation	➢ Provision of water for human use
➢ Sediment trapping	➢ Provision of harvestable resources
➢ Phosphate assimilation	➢ Food for livestock
➢ Nitrate assimilation	➢ Provision of cultivated foods
➢ Toxicant assimilation	➢ Cultural and spiritual experience
➢ Erosion control	➢ Tourism and recreation
➢ Carbon storage	➢ Education and research

Table C3: Integration of ecoservice supply and demand scores to derive overall importance

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0.0	0.0	0.5	1.5	2.5
Low	1	0.0	0.0	1.0	2.0	3.0
Moderate	2	0.0	0.5	1.5	2.5	3.5
High	3	0.0	1.0	2.0	3.0	4.0
Very High	4	0.5	1.5	2.5	3.5	4.0

Table C4: Ecoservice importance categories and descriptions based on integration of supply and demand scores.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

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

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

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

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

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C7) of the wetland system being assessed.

Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

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

5. WET-Health

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

Level of Evaluation

Two levels of assessment are provided by WET-Health:

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

Framework for the Assessment

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

Units of Assessment

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

Quantification of Present State of a wetland

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

an overall magnitude of impact. The impact scores, and Present State categories are provided in the table below.

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

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

Assessing the Anticipated Trajectory of Change

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

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

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

Overall health of the wetland

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

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

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

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

Table C7: Recommended management objectives (RMO) for surface water features based on PES & EIS scores.

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

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

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

Table C8: Description of Recommended Ecological Category (REC) classes.

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

7. Surface water feature Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act, 1998 (Act No. 36 of 1998) as "land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

The wetland zone delineation took place according to the method presented in the DWAF (2005) document "A practical field procedure for identification and delineation of wetlands and riparian areas. An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;

- The presence of wetland vegetation species; and
- The presence of redoximorphic soil feature, which are morphological signatures that appear in soil with prolonged periods of saturation.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008). Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soil and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

APPENDIX D – Risk Assessment Methodology

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

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[6]. The interaction of an aspect with the environment may result in an impact;
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is;
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Frequency of activity** refers to how often the proposed activity will take place;
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor;
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;
- **Spatial extent** refers to the geographical scale of the impact; and
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[7].

[6] The definition has been aligned with that used in the ISO 14001 Standard.

[7] Some risks/impacts that have low significance will however still require mitigation

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat).

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on).

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality).

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity).

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality).

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation).

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource).

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes.

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.
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. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations.

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
- Primary project site and related facilities that the client and its contractors develops or controls;
- Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
- Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts8 are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
- Avoidance or prevention of impact;
- Minimisation of impact;
- Rehabilitation; and
- Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

[8] Mitigation measures should address both positive and negative impacts.

APPENDIX E – Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES)

WET-HEALTH v2 (Macfarlane *et al.* 2020)

Table E1: WET-Health assessment summary of the unchannelled valley bottom wetland.

WET-Health Level 1B assessment: PES Summary

	Wetland PES Summary			
Wetland name	Wildebosch UCVBW			
Assessment Unit	1			
HGM type	Unchannelled VB wetland			
Wetland area (Ha)	3.2 Ha			
Unadjusted (modelled) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.3	2.7	8.5	8.1
PES Score (%)	37%	73%	15%	19%
Ecological Category	E	C	F	F
Combined Impact Score	6.3			
Combined PES Score (%)	37%			
Combined Ecological Category	E			
Hectare Equivalents	1.2 Ha			
Confidence (modelled results)	Low: Relatively low probability of connection to regional aquifer but missing information on the degree of connectivity, the lowering of the water table, and/or groundwater quality			
Final (adjusted) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.2	2.7	1.4	7.0
PES Score (%)	58%	73%	86%	30%
Ecological Category	D	C	B	E
Trajectory of change	↓↓	↓↓	↓↓	↓↓
Confidence (revised results)	Not rated	Not rated	Not rated	Not rated
Combined Impact Score	3.8			
Combined PES Score (%)	62%			
Combined Ecological Category	C			
Hectare Equivalents	2.0 Ha			

ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

(Rountree *et al*. 2013)

Table E2: Ecological Importance and Sensitivity summary for the UCVBW

ECOLOGICAL IMPORTANCE AND SENSITIVITY:		
Ecological Importance	Score (0-4)	*Confidence (1-5)*
Biodiversity support	**0.33**	*5*
Presence of Red Data species	1.00	*5*
Populations of unique species	0.00	*5*
Migration/breeding/feeding sites	0.00	*5*
Landscape scale	**1.00**	*4*
Protection status of the wetland	0.00	*5*
Protection status of the vegetation type	4.00	*5*
Regional context of the ecological integrity	0.00	*4*
Size and rareity of the wetland type/s present	0.00	*4*
Diversity of habitat types	1.00	*4*
Sensitivity of the wetland	**1.33**	*5*
Sensitivity to changes in floods	1.00	*5*
Sensitivity to changes in low flows/dry season	1.00	*5*
Sensitivity to changes in water quality	2.00	*4*
ECOLOGICAL IMPORTANCE & SENSITIVITY	**1.33**	***4.69***

HYDROLOGICAL/FUNCTIONAL IMPORTANCE				Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits		**Flood attenuation**	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream	**1**	*5*
		Streamflow regulation	Sustaining streamflow during low flow periods	**3**	*4*
	Water Quality Enhancement	**Sediment trapping**	The trapping and retention in the wetland of sediment carried by runoff waters	**4**	*5*
		Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality	**3**	*4*
		Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality	**3**	*4*
		Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality	**2**	*4*
		Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.	**4**	*4*
		Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter	**2**	*4*
TOTAL OVERALL SCORE AND CONFIDENCE:				**2.750**	***4***

DIRECT HUMAN BENEFITS			Score (0-4)	*Confidence (1-5)*
Subsistence benefits	***Water for human use***	*The provision of water extracted directly from the wetland for domestic, agriculture or other purposes*	*3*	*5*
	Harvestable resources	*The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.*	*3*	*4*
	Cultivated foods	*Areas in the wetland used for the cultivation of foods*	*0*	*5*
Cultural benefits	***Cultural heritage***	*Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants*	*2*	*5*
	Tourism and recreation	*Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife*	*2*	*5*
	Education and research	*Sites of value in the wetland for education or research*	*0*	*5*
TOTAL OVERALL SCORE AND CONFIDENCE:			**1.67**	**5**

ECOSYSTEM SERVICE PROVISION

WET-ECOSERVICES v2 (Kotze *et al.* 2020)

Table E3: WET-Ecoservices summary for the UCVBW

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.7	1.0	0.0	Very Low
	Stream flow regulation	1.8	0.3	0.4	Very Low
	Sediment trapping	2.1	1.5	1.3	Moderately Low
	Erosion control	1.2	1.1	0.3	Very Low
	Phosphate assimilation	1.5	1.0	0.5	Very Low
	Nitrate assimilation	2.0	1.0	1.0	Low
	Toxicant assimilation	2.2	0.5	1.0	Low
	Carbon storage	1.6	2.7	1.4	Moderately Low
	Biodiversity maintenance	2.0	2.0	1.5	Moderately Low
PROVISIONING SERVICES	Water for human use	3.2	2.7	3.0	High
	Harvestable resources	2.5	0.3	1.2	Low
	Food for livestock	2.3	0.0	0.8	Very Low
	Cultivated foods	2.0	0.0	0.5	Very Low
CULTURAL SERVICES	Tourism and Recreation	2.6	1.0	1.6	Moderately Low
	Education and Research	0.9	0.0	0.0	Very Low
	Cultural and Spiritual	3.0	0.7	1.8	Moderate

APPENDIX F – Risk Assessment and Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the freshwater ecology and biodiversity, will include any activities which take place in close proximity to the proposed development that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the surface water feature identified in this report:

Development footprint

- All development footprint areas should remain as small as possible and should not encroach into the freshwater areas unless absolutely essential and part of the proposed development. It must be ensured that the freshwater habitat is off-limits to construction vehicles and non-essential personnel;
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes should avoid surface water features and be restricted to existing roads where possible;
- Appropriate sanitary facilities must be provided for the life of the construction phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Vegetation

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

Soil

- Sheet runoff from access roads and the walk ways should be slowed down by the strategic placement of berms;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;
- No stockpiling of topsoil is to take place within close proximity to the surface water feature, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the surface water feature;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site;
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed; and
- Side slope and embankment vegetation cover should be monitored to ensure that sufficient vegetation is present to bind these soil and prevent further erosion.

Impact ratings on the surface water feature ecology

The table below serves to summarise the anticipated impacts that might occur during the construction and operational phases as well as the mitigation measures that must be implemented in order to maintain and enhance the ecological integrity of the resource. It is important to note that although all surface water features present within the investigation area were delineated, the risk assessment will focus only on the surface water feature where the proposed development will take place

Table F1: Summary of the results of the DWS Risk Assessment applied to the surface water feature.

No.	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
CONSTRUCTION PHASE																		
1	**SITE PREPARATION FOR CIVIL WORKS**	• Stockpiling of construction equipment, materials, vehicles and machinery; • Removal of vegetation and associated disturbances to soil; • Possible indiscriminate vehicle movement; and • Diversion of water away from the construction area.	• Desiccation of wetland soil as a result of vegetation cover loss; • Potential proliferation of alien and invasive vegetation species due to disturbance • Soil contamination from oils and hydrocarbons; • Temporary disruption of the hydrology of the wetland and desiccation of portions of the downstream areas by diverting flows away from the road construction area; • Loss of freshwater habitat and ecological structure resulting in impacts on biota; and • Temporary diminishing of ecoservice provision of the freshwater ecosystems as a result of habitat and biota loss.	5	5	5	5	5	1	2	8	5	4	5	1	15	**120**	**M**

No.	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
CONSTRUCTION PHASE																		
2	**CONSTRUCTION OF THE WILDEBOSCH ROAD THROUGH THE WETLAND**	• Undercutting roadbed prism and placement of pioneering layer consisting of rock and/or sand fill; • Construction of road fill; • Trenching for the installation of pipe culverts; • Creation of soil stockpiles • Backfilling to the level of the pipe culverts; • Construction of road pavement layers; • Construction of the culvert headwalls using concrete, • Installation of the inlet and outlet erosion protection structures; • Application of asphalt, paint and sealants; and; • Operation of machinery.	• Altered runoff patterns, leading to preferential flow paths and increased erosion and sedimentation of the downstream reach of the wetland, and associated decreases in the ecosystem provisioning of this freshwater ecosystem; • Potential disturbance of the wetland slopes, further leading to sedimentation of this system; • Temporary disruption of the hydrology of the wetland and desiccation of portions of the downstream areas by diverting flows away from the road construction area; • Possible spills / leaks from construction vehicles and machinery and from paints and sealants during pavement construction; • Alien invasive plant encroachment on stockpiles, creating opportunities for the spread of alien vegetation throughout the wetland; • Ground disturbances and dust pollution during construction which may impact on wetland water quality; • Potential pollution of the wetland by spillage of road material in the wetland, thereby polluting the downstream reach and causing hydro-morphological alterations to the wetland; • Potential contamination of soils and surface water as a result of concrete works, leading to further reduced ability to support biodiversity; and • Compaction of soils, disrupting the growth medium of the wetland vegetation	5	5	5	5	5	1	3	9	5	5	5	1	16	**144**	**M**
3	**REHABILITATION OF THE UCVBW**	• Resloping, reprofiling and revegetation of the wetland banks to prevent future erosion; and • Alien and invasive plant removal and revegetation using indigenous wetland plant species	• Exposure of soil, leading to increased runoff and erosion which can lead to increased sedimentation of the wetland; • Exposed soils can be subjected to moisture loss as a result of increased soil temperatures; and • Soil compaction as a result of trampling by staff.	5	5	5	5	5	1	1	7	5	1	5	1	12	**84**	**M**

No.	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
OPERATION PHASE																		
4	**OPERATION OF THE CULVERT CROSSING**	• Inadequate flow and loss of freshwater connectivity to the downstream areas; and • Erosion around the culvert crossing and sedimentation of the downstream reach.	• Concentrated flow path creation downstream of the pipe culverts and loss of diffuse flows, leading to erosion, and desiccation and subsequent loss of wetland habitat, and ultimately decreases in ecoservice provision.	2	1	2	1	1.5	1	1	3.5	5	2	5	3	15	**52.5**	**L**
5	**OPERATION OF THE ROAD SIDE DRAINS**	• Additional stormwater input into the wetland	• Increased litter, sediment and toxicant input into the wetland; and Potential erosion at the discharge point into the wetland	1	2	2	1	1.5	1	1	3.5	4	2	5	3	14	**49**	**L**
6	**MONITORING OF STRUCTURAL INTEGRITY OF THE ROAD CULVERT CROSSINGS IN THE KOMPANJIES RIVER.**	• Proactive monitoring to ensure structural integrity is maintained and to identify early signs of erosion around the culverts and ensure that any litter or debris which may accumulate on and around the culverts is cleared to maintain the flow of water.	• No direct impacts perceived.	1	1	1	1	1	1	1	3	1	1	1	1	4	**12**	**L**
7	**FUTURE MAINTENANCE OF THE ROAD CULVERT CROSSINGS (INCLUDING THEIR HEADWALLS, WINGWALLS, BALUSTRADES AND EROSION PROTECTION**	• Disturbances to or removal of vegetation while accessing culverts to carry out maintenance activities and • Disturbances to soils.	• Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances; Decreases to water quality in terms of turbidity from increased sediment loads during soil disturbance.	5	5	5	5	5	1	1	7	1	4	5	1	11	**77**	**M**

No.	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
8	**ONGOING ALIEN AND INVASIVE VEGETATION REMOVAL (IF REQUIRED).**	• Proactive monitoring to ensure structural integrity is maintained and to identify early signs of erosion, incision and alien vegetation encroachment.	• Compaction of soil and loss of habitat as a result of ongoing disturbance from vehicles and equipment; • Impacts to water quality as a result of the application of herbicides; and • Disturbance of soil which could lead to erosion.	5	5	5	5	5	1	1	7	1	2	5	3	11	**77**	**M**

APPENDIX G – Details, Expertise and Curriculum Vitae of Specialists

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

Cole Grainger	MSc Conservation Ecology (University of Stellenbosch)
Paul Da Cruz	BA (Hons) (Geography and Environmental Studies) (University of the Witwatersrand)

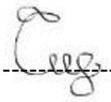
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	FEN Consulting (Pty) Ltd		
Name / Contact person:	Cole Grainger		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	084 397 6753
Telephone:	011 616 7893 (head office)	Fax:	086 724 3132
E-mail:	cole@sasenvgroup.co.za		
Qualifications	MSc Conservation Ecology (University of Stellenbosch)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)		

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

I, Cole Grainger, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

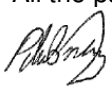


Signature of the Specialist

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

I, Paul Da Cruz, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION CURRICULUM VITAE OF COLE GRAINGER

PERSONAL: DETAILS

Position in Company	Freshwater Specialist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP)

(SACNASP – Reg No. 119870)

EDUCATION

Qualifications

MSc Conservation Ecology (Stellenbosch University)	2017
BSc Conservation Ecology (Stellenbosch University)	2010
BSc Environmental and Biological Sciences (North West University)	2011

Short Courses

Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	2020
SASS5 National Aquatic Ecosystem Health Monitoring Programme	2018

AREAS OF WORK EXPERIENCE

South Africa – Western Cape, Eastern Cape and Northern Cape

KEY SPECIALIST DISCIPLINES

Freshwater Assessment Reporting

- Wetland delineation
- WET-Health, WET-Ecoservices and wetland Ecological Sensitivity and Importance
- Application of NEMA Impact Assessment and GN509 Risk Assessment Matrices

Aquatic Assessments

- Riparian watercourse delineation
- River IHI, VEGRAI and MIRAI Ecological Assessments

Wetland and River Monitoring

- Vegetation structure
- Sedimentation
- Water Quality
- Benthic Algae
- SASS 5
- Waste Classification

Water Use License Applications

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION CURRICULUM VITAE OF PAUL DA CRUZ

PERSONAL DETAILS

Position in Company	Senior Ecologist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Certificated Scientist at South African Council for Natural Scientific Professions (SACNASP)

Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA)

Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

BA (Hons) (Geography and Environmental Studies) (University of the Witwatersrand)	1998
BA (Geography) (University of the Witwatersrand)	1997

Short Courses

Taxonomy of Wetland Plants (Water Research Commission)	2017
Advanced Grass Identification (Frits van Outshoorn)	2010
Grass Identification (Frits van Outshoorn),	2009
Soil Form Classification and Wetland Delineation; (TerraSoil Science)	2008

AREAS OF WORK EXPERIENCE

South Africa – All Provinces

Southern Africa – Lesotho, Botswana

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy (Wind and solar)
2. Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
3. Nature Conservation and Ecotourism Development

4. Commercial development
5. Residential development
6. Environmental and Development Planning and Strategic Assessment
7. Industrial/chemical; Non-renewable power Generation

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- EIA / BA Applications
- Environmental Authorisation Amendments
- EMPr Compilation
- Environmental Compliance Monitoring (Environmental Auditing)
- Environmental Screening Assessments and Listing Notice 3 Trigger Identification / Mapping
- Strategic Environmental Assessments and Environmental Management Frameworks
- EIA / Specialist Study Peer Review

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Assessments in support of Environmental Screening Assessments, Precinct Planning & SEA
- Wetland Construction (Compliance) Monitoring

Biodiversity Assessments

- Avifaunal Assessments
- Strategic Biodiversity Assessment

Visual Impact Assessment

- Visual Impact Assessments

GIS / Spatial Analysis

- GIS Spatial Analysis and Listing Notice 3 mapping