Water Resources Assessment

Freshwater and Estuarine Ecological & Impact Assessment for the Proposed Umdoni South Bulk Water Augmentation

Umdoni Local Municipality, KwaZulu-Natal Province

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Client:

Prepared by:

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Abbreviations

Abbreviation	Definition
ASPT	Average Score Per Recorded Taxon
BESS	Battery Energy Storage System
CBA	Critical Biodiversity Area
DO	Dissolved Oxygen
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ECO	Environmental Control Officer
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EN	Endangered
ESA	Ecological Support Area
ETS	Ecosystem Threat Status
FRAI	Fish Response Assessment Index
IHIA	Intermediate Habitat Integrity Assessment
IUCN	International Union for Conservation of Nature
LC	Least Concerned
MASL	Meters Above Sea Level
MIRAI	Macroinvertebrate Response Assessment Index
NEMA	The National Environmental Management Act
NFEPA (FEPA)	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
NWA	National Water Act
NWBEST	National Web Based Environmental Screening Tool
PAOI	Project Area Of Influence
PES	Present Ecological State
RQO's	Resource Quality Objectives
SAIIAE	South African Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SASS5	South African Scoring System version 5
SCC	Species of Conservation Concern
SQR	Sub Quaternary Reach
TBC	The Biodiversity Company
TWQR	Target Water Quality Range
VU	Vulnerable
WMA	Water Management Area

Document Guide

The table below provides the minimum requirements for aquatic specialist assessments, and the relevant sections in the reports where these requirements are addressed. These are as per the "Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity" gazetted 20 March 2020, published in Government Notice No. 320.

Item	Section	Comment
The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of aquatic sciences.	Section 1.3	
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Section 1.3	CV available on request
A signed statement of independence by the specialist(s).	Appendix A	
The assessment must be undertaken on the preferred site and within the proposed development footprint.	Section 4	
A baseline description of the aquatic biodiversity and ecosystems on the site, including: (a) aquatic ecosystem types; (b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns.	Sections 4	
The threat status of the ecosystem and species as identified by the screening tool;	Section 3.10	
An indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area (NFEPA) or sub catchment, a strategic water source area (SWSA), a priority estuary, whether or not they are free -flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area);	Section 3	
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.); and (b) the historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	Section 3	
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 2	
A description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant.	Section 2	
A description of the assumptions made and any uncertainties or gaps in knowledge or data.	Section 1.6	
The assessment must identify any alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification.	Section 8.2	Recommendation have been included to avoid sensitive areas
Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: (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) will the proposed development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns);	Section 7	

(c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary I seasonal I permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water uses and related activities change.		
How will the proposed development impact on the functioning of the aquatic feature? This must include: (a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system); (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 unchannelled 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) the 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 soils, etc.);	Section 7	
How will the proposed 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 7	
A location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant).	Section 7	
Additional environmental impacts expected from the proposed development.	Section 7	
Any direct, indirect and cumulative impacts of the proposed development.	Section 8.6	
The degree to which impacts and risks can be mitigated.	Section 8.6	
The degree to which the impacts and risks can be reversed.	Section 8.6	
The degree to which the impacts and risks can cause loss of irreplaceable resources.	Section 8.6	
A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 6	
Proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr).	Section 9 & 9.1.8	
A motivation must be provided if there were development footprints identified as per above that were identified as having a “low” aquatic biodiversity sensitivity and that were not considered appropriate.	-	N/A
A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not;	Section	
Any conditions to which this above statement is subjected	Section	

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1. Introduction

1.1 Background

The Biodiversity Company was appointed to undertake a Water Resources Assessment (Freshwater and Estuarine Ecological and Impact Assessment) for the proposed Umdoni South Bulk Water Augmentation Project. The designated project site is situated within the Umdoni Local Municipality, part of the Ugu District Municipality in the KwaZulu-Natal province. Focused on the Umdoni Command Reservoir, which serves the communities along the KZN South Coast, the project aims to enhance the secondary bulk pipeline connecting the Umdoni Command Reservoir to nine communities namely Umdoni, Pennington, Kelso, Malangeni, Sezela, Ifafa, Bazley and Elysium. Additionally, the plan includes increasing the capacity of the reservoirs in these respective areas. In line with the minimum requirements for aquatic biodiversity surveys a single aquatic sampling survey was conducted on the 07th and 08th of September 2023. An additional survey was conducted on the 08th of February 2024 for the updated route and reticulation area.

This assessment was conducted in accordance with the Environmental Impact Assessment Regulations. 2014 (amended by GNR 326, 7 April 2017 and GNR. 517, 11 June 2021) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices 320 (20 March 2020) in terms of NEMA, dated 20 March and 30 October 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation” (Reporting Criteria). The National Web-based Environmental Screening Tool (NWBEST) of the Department of Forestry, Fisheries, and the Environment (DFFE) has identified the aquatic sensitivity in the project area as "Very High," considering the presence of watercourses and estuaries within the project footprint. Consequently, a comprehensive assessment by an aquatic biodiversity specialist was conducted for the proposed project.

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 4167 by the Department of Water and Sanitation (DWS) (previously GN 509 of 2016 and GN 3139 of 2023). The said notice was published in the Government Gazette (no. 49833) under Section 39 of the National Water Act (Act no. 36 of 1998) in December 2023, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 4167 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 4167 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM), provided the identified risks are all considered a low risk and the applicant is listed under Appendix D1 or Appendix D2 of the same notice. This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

The purpose of the specialist study is to provide relevant input into the environmental authorisation process and provide a report for the proposed activities associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision-making, as to the ecological viability of the proposed project.

1.2 Project Description

According to the Preliminary Design Report (ENsync Engineers, 2024), the project covers the refurbishment and replacement of the bulk system in Umdoni. The project area’s water infrastructure is being supplied from two water treatment works and includes bulk pipelines storage reservoirs and a reticulation system. The bulk pipeline will be replaced as part of the project scope as it has shown a

level of deterioration and insufficiency. The reservoirs will be in the same location, except for Malangeni Reservoir D. Malangeni Reservoir D will be relocated to an area with sufficient space for the reservoir capacity increase that will not be accommodated by its current location.

There are a few watercourses which will need to be crossed along the proposed pipeline route. For coastal stream crossings, a railway bridge is available where the existing pipeline is currently strapped. Upon construction, the existing pipe will be replaced with the new pipeline which will be a GMS (galvanised metal steel) pipe instead of the material in use currently. Due to the recent floods the engineers recommend that pipes to be secured on the bridge so that it does not get washed away during heavy rainfall/flood events. Where it is not possible to strap the pipe onto the bridge, pipelines will be buried below the ground to avoid any obstruction of the natural stream flow.

The pipeline route crosses a few surfaced road crossings, one of which is the N2. Surfaced (bitumen) road crossings and gravel road crossings will need to be done. It is the requirement of the Department of Transport (DoT) that all road crossings be carried out by pipe boring whilst it is proposed that gravel road crossings be carried out by open cut trenching with the necessary provision for traffic deviations and control. For the N2 road crossing, a pipe jack used for the South Coast Pipeline Phase 2 will be used for the crossing from Umdoni reservoir to Malangeni Reservoir D. This will be subject to SANRAL's approval and the size of the sleeve that will be used in the pipe jack.

A 500 m area has been demarcated for the project to facilitate the identification of water resources within the regulatory zone, this area is referred to as the project area of influence (PAOI). The PAOI was developed by merging the 500 m regulated associated with the upgrade route. The PAOI for the proposed project area is presented in (Figure 1-1). The proposed project methodology for impact consideration was supplied by ENsync Engineers (2023-2024) (Appendix C).

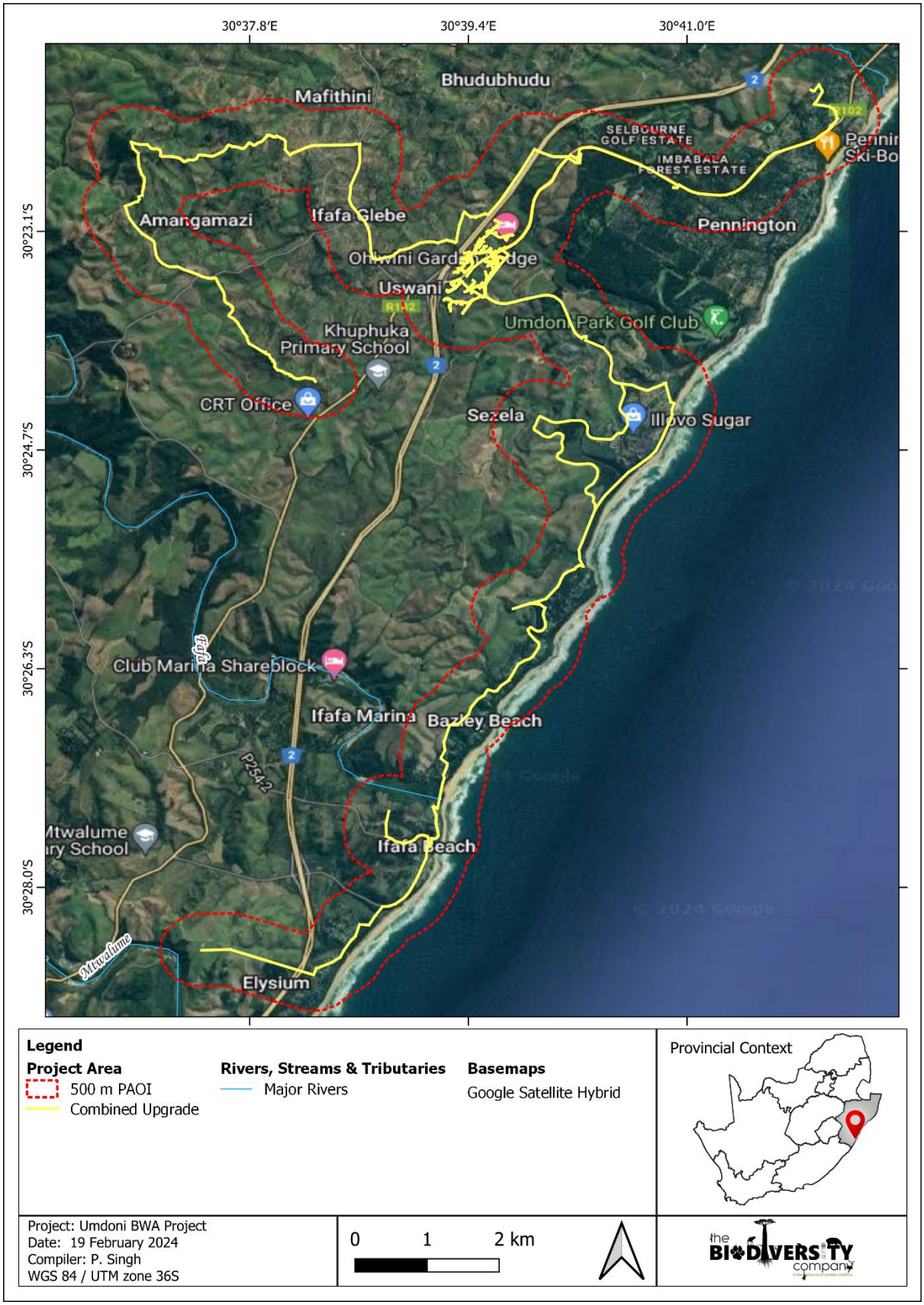


Figure 1-1 Locality of the proposed Umdoni project area and PAOI.

1.3 Specialist Details

Report Name	**Water Resources Assessment – Freshwater and Estuarine Ecological & Impact Assessment for the Proposed Umdoni South Bulk Water Augmentation**
Submitted to	
Fieldwork and Report Writer	**Innocent Makwela (MSc Zoology)** Innocent Makwela is a Junior Aquatic Ecologist for The Biodiversity Company. He attained his MSc in Zoology at the University of Johannesburg, where he focused on the impacts of wetlands on urban streams in Johannesburg. He has been involved in numerous aquatic assessments for Basic Assessments, Environmental Impact Assessments and Biomonitoring projects, assessing anthropogenic impacts through water and sediment quality analysis, fish and macroinvertebrate community composition, environmental sensitivity, as well as habitat assessments. He is an accredited SASS5 Practitioner with the Department of Water and Sanitation.
Report Contributor	**Johannes Jurgens Pearson (Cand. Sci. Nat 156536)** Johannes Jurgens Pearson is a Freshwater Ecologist for The Biodiversity Company. He attained his MSc in Environmental Science at North-West University. He has been involved in numerous aquatic assessments for Basic Assessments, Environmental Impact Assessments and Biomonitoring projects, assessing anthropogenic impacts through water and sediment quality analysis, fish and macroinvertebrate community composition, environmental sensitivity, as well as habitat assessments.
Reviewer	**Prasheen Singh Science (Pr. Sci. Nat. 116822)** Prasheen Singh (MSc in Aquatic Health) is a registered Professional Scientist in the field of Aquatic Science and he is an accredited SASS5 Practitioner. He is an Aquatic Ecologist whose 10 years of experience comprises numerous Aquatic Scientific Studies, Peer Reviews, and Research, and he has served as a SANAS accredited Technical Signatory at an Ecotoxicology Laboratory. Over and above his qualifications he has completed training courses for wetlands, river ecosystem monitoring, hydropedology, and ecosystem restoration.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

1.4 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this project:

- A desktop assessment of all available datasets.
- GIS processing to preliminary identify water accumulation areas.
- The delineation of water resources following the DWAF (2005) guidelines, whereby the outer edges will be identified.
- A functional and integrity assessment of the water resources.
- The risk assessment will be completed following the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 4167 of 2023).

1.5 Key Legislative Requirements

1.5.1 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) and the associated EIA Regulations, as amended in April 2017, state that before certain listed activities take place, an environmental authorisation application (EA) process needs to be followed. This could follow either the Basic Assessment (BA) process or the Scoping and EIA process, depending on the scale of the impact.

GN 350 was gazetted on 20 March 2020, which has replaced the requirements of Appendix 6 of the EIA Regulations in respect of certain specialist reports. These regulations provide the criteria and minimum requirements for specialist assessments, to consider the impacts on soil for activities which require EA.

1.5.2 National Water Act (NWA, 1998)

The Department of Water and Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way.
- The prevention of the degradation of the water resource.
- The rehabilitation of the water resource.

A watercourse is defined in the NWA as:

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake or dam into which, or from which, water flows.
- 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.

The NWA recognises that the entire ecosystem and not just the water in isolation, and 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 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: impeding or diverting the flow of water in a watercourse) and (i: altering the bed, banks, course or characteristics of a watercourse) of the NWA.

1.6 Assumptions and Limitations

The following assumptions and limitations apply to this project:

- It is assumed that all information received from the client is relevant and correct;
- Results for the study are based on a single season site visit (high flow/summer survey) and therefore no ecological trends are included in this report;
- The results of this study are largely based on the outcomes of a standardised rapid assessment and historical information for the catchment;
- 20 m contours were used to assist in the delineation of the watercourse features and may cause some discrepancies in areas between sites;
- Access posed a challenge with sites along the coast being behind private property or on a very steep vegetated ledge;
- Access and safety concerns limited the assessment of many planned survey sites;
- Many sites were estuarine in nature hence the SASS5 and electrofishing methods could not be performed;
- Due to time constraints and the urgency of the project, the wet season survey (February 2024) for the additional areas constituted a visual assessment, with no physico-chemical and biological data to supplement the assessment.

2. Methods

2.1 Approach and Field Assessment

In line with the minimum requirements for aquatic biodiversity surveys a single aquatic sampling survey was conducted on the 07th and 08th of September 2023. The survey constituted a wet season/high flow assessment. Standard methods were implemented to establish the baseline conditions of the considered freshwater reaches. Details pertaining to the specific methodologies applied are provided in the relevant sections below.

2.1.1 Desktop Assessment

The following information sources were considered for the desktop assessment:

- Aerial imagery (Google Earth Pro).
- Vegetation and climate information (Mucina & Rutherford, 2006).
- Land Type Data (Land Type Survey Staff, 1972 - 2006).
- The inland water dataset.
- Topographical river line data.

- Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) per Sub Quaternary Reaches (SQR) for Secondary Catchments in South Africa (DWS, 2014).
- The National Freshwater Ecosystem Priority Areas (NFEPA) (Nel *et al*., 2011).
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al*. 2019).
- National Biodiversity Assessment (NBA) (Van Deventer *et al*. 2019).
- The SANBI National Wetland Map 5 (Van Deventer *et al*. 2019)
- Contour data (5 m).

2.1.2 Water Quality

Water quality was measured *in-situ* using a handheld calibrated multi-parameter water quality meter. The constituents considered that were measured included: pH, electrical conductivity (µS/cm), temperature (°C) and Dissolved Oxygen (DO) in mg/l. Water quality analysis is typically conducted at each sampling site along the watercourses in the project area.

2.1.3 Aquatic Habitat Integrity

The Index of Habitat Integrity (IHI) model was used to assess the integrity of the habitats from a riparian and instream perspective as described in Kleynhans (1996) v2. The habitat integrity of a river refers to the maintenance of a balanced composition of physicochemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact-based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity is obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physicochemical conditions and how these changes would impact the natural riverine habitats.

The criteria and ratings utilised in the assessment of habitat integrity in the current study are presented in Table 2-1 and Table 2-2 respectively. The spatial framework for each IHI was 5 km upstream and downstream of the respective sampling points within the watercourse.

Table 2-1 Criteria used in the assessment of habitat integrity (Kleynhans, 1996).

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in the duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon *et al*., 1993). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993) is also included.
Channel modification	may be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.

Criterion	Relevance
Water quality modification	Originates from point and diffuse point sources. Measured directly or alternatively agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al*., 1992).
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	A decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 2-2 Descriptions used for the Ratings of the Various Habitat Criteria.

Impact Category	Description	Impact Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability is also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is also limited.	6-10
Large	The modification is generally present with a detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

The habitat integrity assessment takes into account the riparian zone and the instream channel of the river. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component (Table 2-3). The relative weighting of criteria remains the same as for the assessment of habitat integrity (DWS, 1999).

Table 2-3 Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996).

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
Total	100	Total	100

The negative weights are added for the instream and riparian facets respectively and the total additional negative weight is subtracted from the provisionally determined integrity to arrive at a final habitat integrity estimate. The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific intermediate habitat integrity category (DWS, 1999). These categories are indicated in Table 2-4.

Table 2-4 Intermediate habitat integrity categories (From Kleynhans, 1996).

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

2.1.4 Integrated Habitat Assessment System

The quality of the instream and riparian habitat influences the structure and function of the aquatic community in a stream; therefore, the assessment of the habitat is critical to any assessment of ecological integrity. The Integrated Habitat Assessment System (IHAS, version 2) was applied at selected sampling sites in order to assess the availability of habitat biotopes for macroinvertebrates. The IHAS was developed specifically for use with the SASS5 index and rapid biological assessment protocols in South Africa (McMillan, 1998). The index considers sampling habitat and stream characteristics. The sampling habitat is broken down into three sub-sections namely Stones-In-Current (SIC), Vegetation (VEG), Gravel Sand & Mud (GSM) and other habitat/ general. It is presently thought that a total IHAS score of over 65% represents good habitat conditions, a score over 55% indicates adequate/fair habitat conditions and a score below 55% indicates poor habitat (McMillan, 1998) (Table 5 3).

Table 2-5 Integrated Habitat Assessment System Scoring Guidelines

IHAS Score	Description
> 65%	Good (Diverse)
55-65%	Adequate (Moderately diverse)

< 55%	Poor (Low diversity)

2.1.5 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of monitoring the health of an aquatic ecosystem.

2.1.6 Macroinvertebrate Habitat

The invertebrate habitat at the site was assessed using the South African Scoring System version 5 (SASS5) biotope rating assessment. A rating system of 0 to 5 was applied, 0 being not available or absent, while 5 was abundant and diverse. The weightings for lower foothill rivers (slope class E) were used to categorize biotope ratings (Rowntree *et al.,* 2000; Rowntree & Ziervogel, 1999).

2.1.7 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g., Chironomidae) to highly sensitive families (e.g., Perlidae). The sensitivity scales were derived from the tolerances to pollution as used in the SASS5 scoring system:

- 1 to 5 - Highly tolerant to pollution (low sensitivity)
- 6 to 10 - Moderately tolerant to pollution (moderate sensitivity)
- 11 to 15 - Very low tolerance to pollution (high sensitivity)

SASS results are expressed both as an index score (SASS score) and the Average Score Per Taxon (ASPT value). Sampled invertebrates are identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Organisms were classified to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002; Fry, 2022). All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the North Eastern Coastal Belt Lower - Ecoregion (Figure 2-1). This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database.

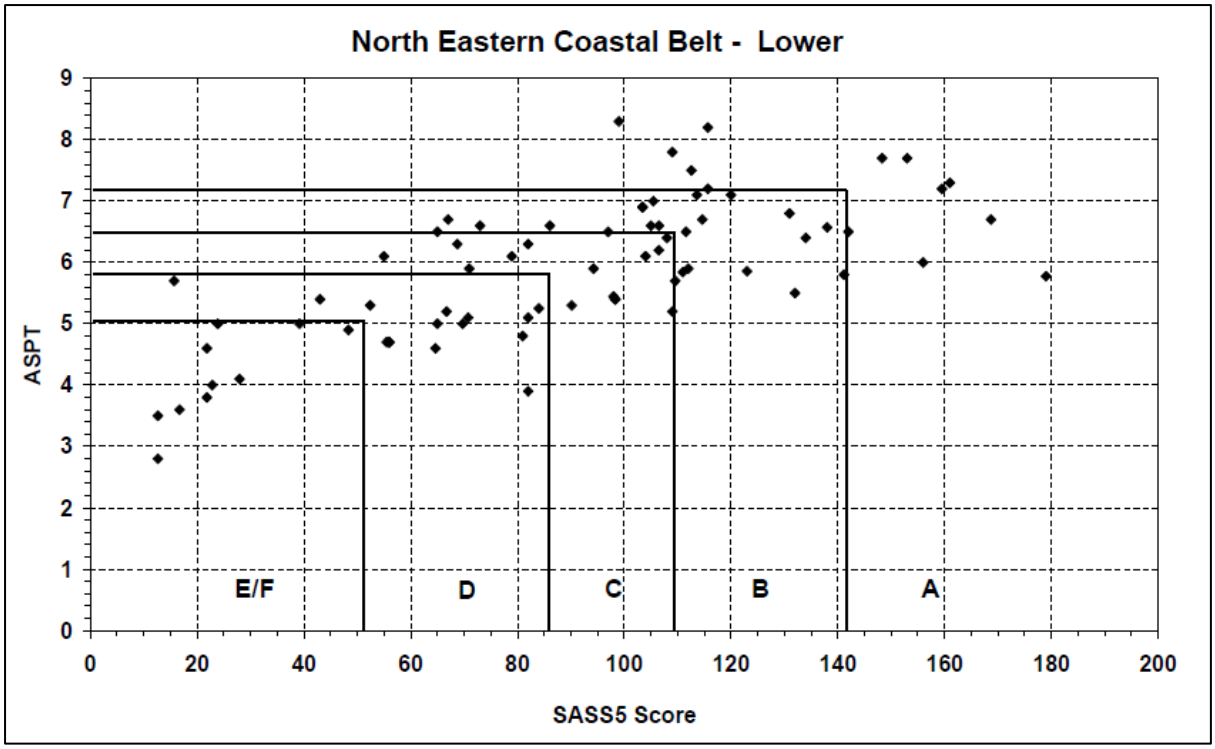


Figure 2-1 Biological Bands for the North Eastern Coastal Belt Lower - Ecoregion, calculated using percentiles.

2.2 Present Ecological State Classification

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007) (Table 2-6). For this study, ecological classifications have been determined for biophysical attributes of the associated watercourses. This was completed using the River Ecoclassification Manual by Kleynhans and Louw (2007). The areas considered in the PES assessment are outlined in the description of the project area section.

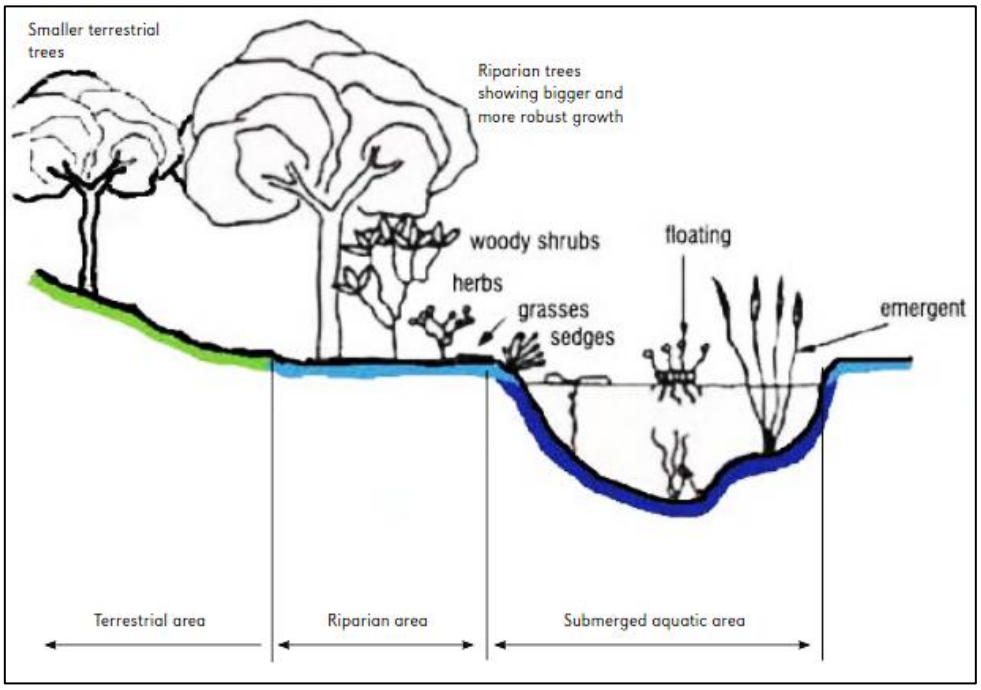
Table 2-6 Present Ecological State (PES) Categories.

Category	Descriptions (Modifications)	Descriptions (Taxa)
A	**Natural**	
	Unmodified, natural.	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	**Largely Natural**	
	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	**Moderately Modified**	
	A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	Moderately impaired. Moderate diversity of taxa.
D	**Largely Modified**	
	A large loss of natural habitat, biota and basic ecosystem functions has occurred.	Considerably impaired. Mostly tolerant taxa present.
E	**Seriously Modified**	

	The loss of natural habitat, biota and basic ecosystem functions is extensive.	Severely impaired. Only tolerant taxa present.
F	**Critically Modified**	
	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	Severely impaired. Only tolerant taxa present.

2.3 Riparian Habitat Delineation

The riparian delineation was completed according to DWAF (2005; Figure 5 4). Typical riparian cross sections and structures are provided in Figure 5 4. Indicators such as topography and vegetation were the primary indicators used to define the riparian zone. Contour data obtained from topography spatial data was also utilised to support the infield assessment and delineation.



2.4 Risk and Impact Assessment

The impact assessment methodology from DWS was used to assess risks and impacts associated with the proposed project. The latter was completed following the requirements of the DWS Risk Assessment Matrix in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 4167 of 2023). The significance of the impact is calculated according to Table 2-7.

Table 2-7 Significance ratings matrix (DWS Risk Assessment Matrix).

Rating	Class	Management Description
1 – 29	Low Risk	Acceptable as is or with proposed mitigation measures. Impact to watercourses and resource quality small and easily mitigated, or positive.
30 – 60	Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. License required.
61 – 100	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. License required.

3. Desktop Baseline Assessment

3.1 Summary of Ecologically Important Landscape Features

The following spatial features describe the general area and associated freshwater resources (ecologically important landscape features). This assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and the South African National Biodiversity Institute (SANBI). The desktop analysis and their relevance to this project are listed in Table 3-1.

Table 3-1 Summary of the ecologically important landscape features for the proposed project.

Desktop Information Considered	Relevant	Features	Section
Sub Quaternary Reach	Yes	The PAOI falls within several desktop SQRs (U80F-05258, U80G-05302, U80G-05097, U80H-05229, U80H-05202, U80H-05186 and U80H-05109). Spanning across three quaternary catchments (U80F, U80G and U80H).	3.2
Resource Quality Objectives (RQOs)	Yes	The PAOI falls within/in proximity of the U8-2 and Southern Cluster 2 resource units	3.2
Estuarine Functional Zones	Yes	The PAOI overlaps with several Estuarine Functional Zones (Mtwalume, iFafa, uMdesingane, iSezela, uMkhumbane and uMuziwezinto).	3.2
Environmental Screening Tool	Yes	PAOI is within a "Very High" Aquatic Biodiversity sensitivity.	3.5
Conservation Plan	Yes	The PAOI overlaps with CBA Irreplaceable, CBA Optimal and ESA areas.	3.7
Strategic Water Source Areas (SWSA)	No	PAOI is not located within an SWSA for surface water and groundwater.	3.8
NFEPA Rivers and Wetlands	Yes	The project area is located within the U80F, U80G and U80H quaternary catchments with no desktop status or NFEPA assigned to the project area. However, the NFEPA data identified several non-priority wetlands and river FEPAs within the PAOI.	3.9
National Wetland Map 5	Yes	This database does recognise the presence of freshwater features within the extent of the PAOI, and includes a river, seep, estuary, and a depression.	3.9
Ecosystem Threat Status	Yes	The PAOI overlaps with Critically Endangered, Endangered and Vulnerable wetlands as well as Endangered rivers.	3.10
Ecosystem Protection Level	Yes	The PAOI varied in protection levels from Not Protected to Poorly Protected, Moderately Protected, and Well Protected wetlands. Meanwhile, all rivers in the PAOI were classified as Poorly Protected	3.11
Protected Areas	Yes	The PAOI is within Priority Focus Areas	3.12

3.2 Hydrological Setting

The project area and PAOI are drained by several perennial and non-perennial rivers and drainage lines, including the Mzinto River, Mkhumbane River, Sezela River, Mdesingane River, Fafa River, Mvuzi River and Mtwalume River systems. The PAOI falls within the U80H, U80G and U80F quaternary catchments (Figure 3-1), within the North Eastern Coastal Belt ecoregion level 1 (Figure 3-2), and the Pongola-Mtamvuna Water Management Area (WMA). Furthermore, the U80F-05258, U80G-05302, U80G-05097, U80H-05229, U80H-05202, U80H-05186 and U80H-05109 Sub-Quaternary Reaches (SQRs) are relevant to the project area and the PAOI overlaps with Estuarine Functional Zones (Figure 3-3). The Resource Quality Objectives (RQOs) for the project area are summarised in Table 3-2. There were no numerical RQOs for the Rivers associated with the project area.

Table 3-2 Summary of resources assigned RQOs for the relevant catchments of the Mvoti to uMzimkhulu (DWS, 2017)

RWQO site code	Resource Name and Class	Quaternary Catchment	Integrated Unit of Analysis (IUA)	Length of SQR	Target Ecological Category (TEC)
U80F-05258	Mtwalume Class II	U80F	U8-2	8.98 km	B

U80G-05097	iFafa Class II	U80G	Southern Cluster 2	63.49 km	B
U80H-05229	uMdesingane Class II	U80H	Southern Cluster 2	4.62 km	C
U80H-05202	iSezela Class II	U80H	Southern Cluster 2	2.94 km	C
U80H-05186	uMkhumbane Class II	U80H	Southern Cluster 2	13.45 km	C
U80H-05109	uMzinto Class II	U80H	Southern Cluster 2	33.14 km	C

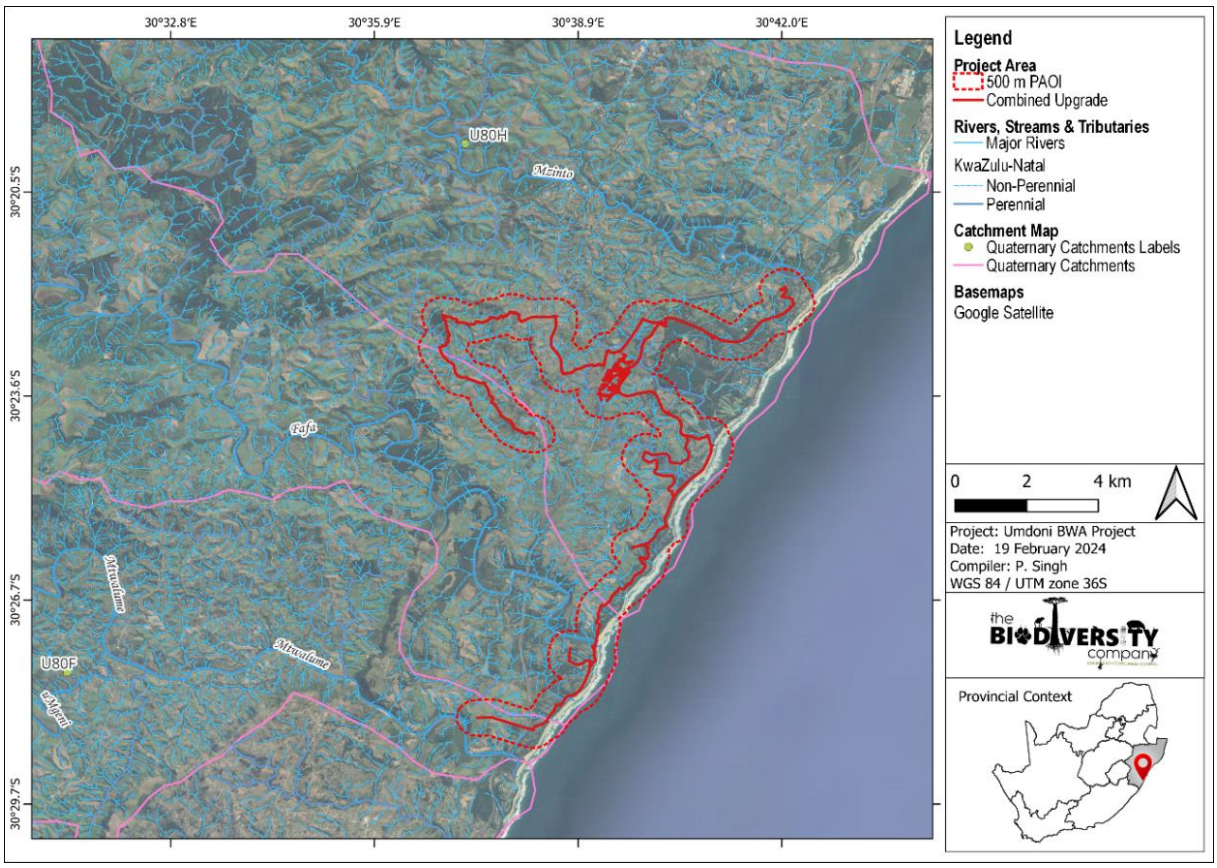


Figure 3-1 Catchment area associated with the project area.

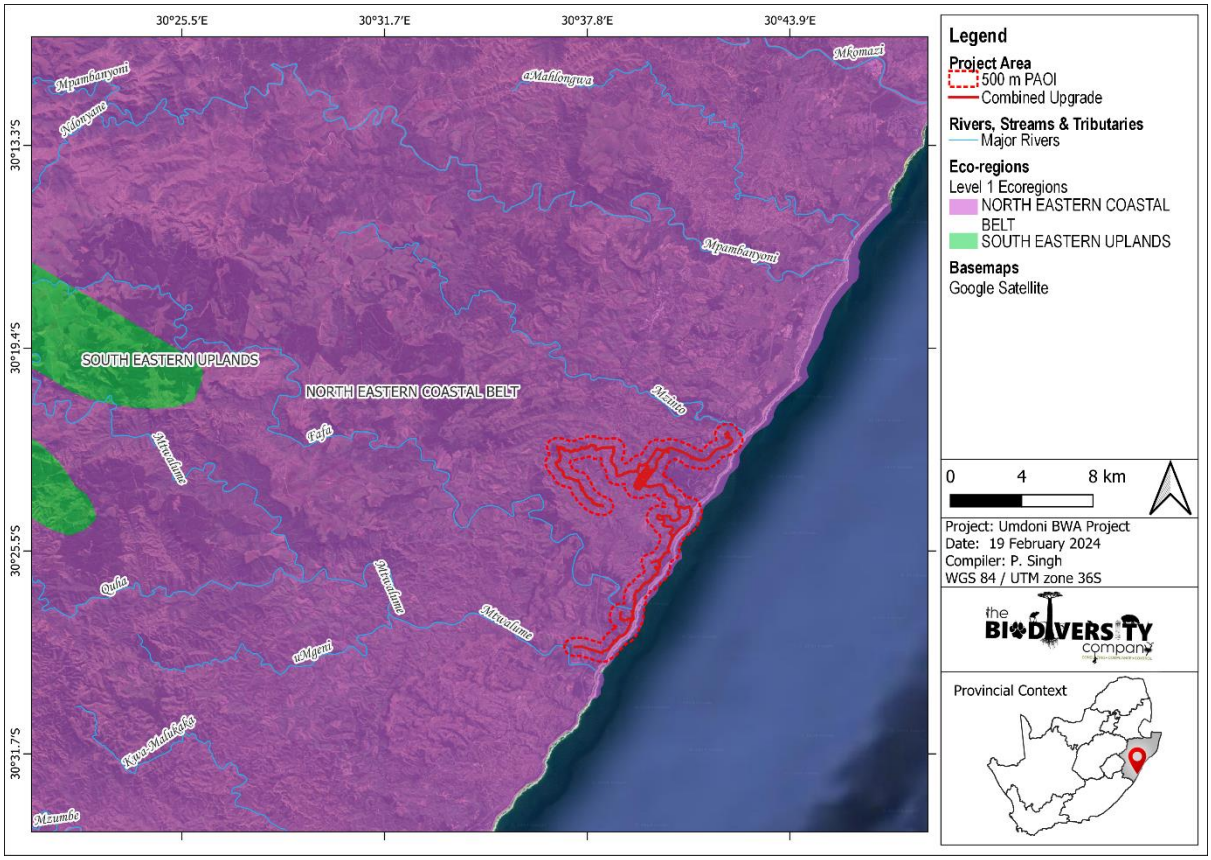


Figure 3-2 Eco-region level 1 associated with the project area.

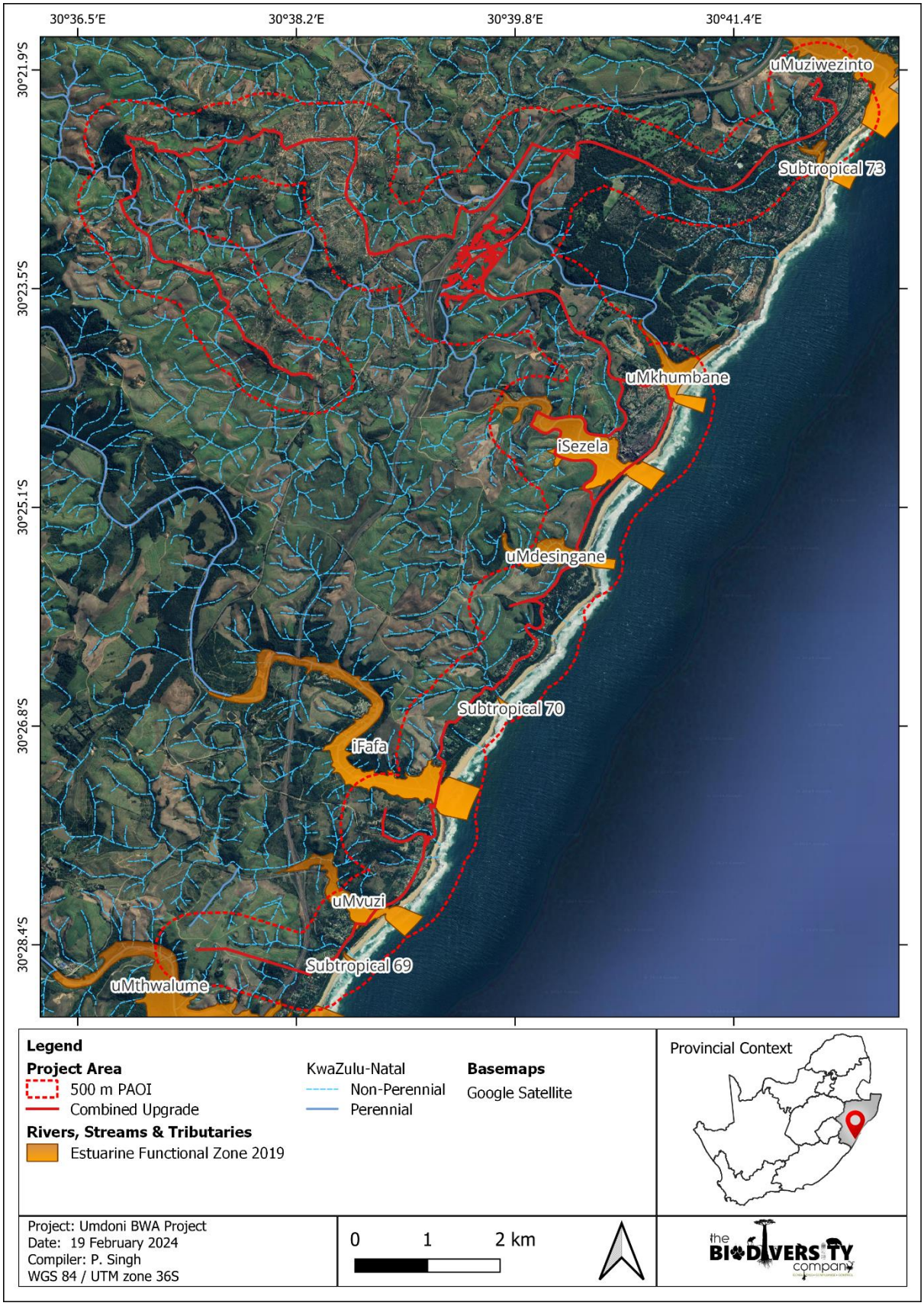


Figure 3-3 Estuarine Functional Zones associated with the project area.

3.3 Fish Presence

Fish sampling is conducted via electroshocking. All fish were identified in the field and released at the point of capture. Fish species are identified using the guides Freshwater Fishes of Southern Africa (Skelton, 2001) and Two Oceans (Branch *et al*., 2007). The identified fish species are compared to those expected to be present for the quaternary catchment, SQR, and/or specific reach (where available). The expected fish species list for the project area was developed from a literature survey to compare to the sampled species at the site. Different fish species represent different sensitivities to water chemistry, habitat and flow which are considered as part of the Fish Response Assessment Index (FRAI) (Kleynhans *et al*., 2007; Skelton 2001).

Table 3-3 Intolerance rating and sensitivity of fish species.

Sensitivity Score	Tolerance/Sensitivity Level
0-1	Highly tolerant = Very low sensitivity
1-2	Tolerant = Low sensitivity
2-3	Moderately tolerant = Moderate sensitivity
3-4	Moderately intolerant = High sensitivity
4-5	Intolerant = Very high sensitivity

Table 3-4 Fish species expected during the 2023 study

Scientific name	Common name	IUCN Status (2024)	Sensitivity	
			Flow	Phys-chem
***Acanthopagrus berda* (E)**	Riverbream	LC	1.10	1.80
Awaous aeneofuscus (Am)	Freshwater Goby	LC	2.00	2.80
Anguilla marmorata (C)	Giant Mottled Eel	LC	2.80	2.50
Anguilla mossambica (C)	Longfin Eel	LC	2.80	2.50
Enteromius viviparus	Bowstripe Barb	LC	2.30	3.00
Clarias gariepinus	Sharptooth Catfish	LC	1.70	1.00
Gilchristella aestuaria	Estuarine Round Herring	LC	1.50	3.00-
Glossogobius callidus	River Goby	LC	1.50	2.30
Glossogobius giuris	Bareye Goby	LC	1.70	2.50
Labeobarbus natalensis	KwaZulu-Natal yellowfish	LC	3.50	3.00
Megalops cyprinoides	Oxeye Tarpon	-	-	-
Mugil cephalus	Flathead Mullet	LC	2.8	2.5
Myxus capensis	Freshwater Mullet	LC	3.50	3.00
Oreochromis mossambicus	Mozambique Tilapia	VU	0.90	1.30
Pseudocrenilabrus philander	Southern Mouth Brooder	LC	1.00	1.40
Tilapia sparrmanii	Banded Tilapia	LC	0.90	1.40

NT: Nearly Threatened; VU: Vulnerable; LC: Least Concern
(C) Catadromous fish are born at sea, spends most of its life in freshwater, then returns to sea to spawn
(An) Anadromous fish are born in freshwater, spends most of its life in seawater, returns to freshwater to spawn
(Am) Amphidromous fish regularly migrate between freshwater and sea (in both directions), but not for the purpose of breeding
(E) Fish restricted to estuaries

3.4 Desktop Present Ecological Status

The PES category of the Mtwalume (U80F-05258), iFafa (U80G-05097), uMdesingane (U80H-05229), iSezela (U80H-05202), uMkhumbane (U80H-05186) and uMzinto (U80H-05109) River reaches and estuaries associated with the project area are classed between Largely Natural (class B) to Largely Modified (class D) (Table 3-5). Mtwalume and iFafa were classed as Largely Natural (class B), uMdesingane, iSezela and uMkhumbane, were classified as Moderately Modified (class C), and uMzinto was classified as Largely Natural (class D). The alteration from natural conditions of these systems is a result of various land uses ranging from cultivation, rural to semi-urban areas, agricultural lands, road crossings, which affect bed modification, water quality, abstraction, exotic vegetation proliferation and lower reaches being estuarine. The lower reaches drain into the Indian Ocean.

Table 3-5 Summary of the Present Ecological State of the Mvoti to uMzimkhulu catchment associated with the proposed project area (DWS, 2014).

Component/Catchment	U80F-05258	U80G-05097	U80H-05229	U80H-05202	U80H-05186	U80H-05109
Main River Name	Mtwalume	iFafa	uMdesingane	iSezela	uMkhumbane	uMzinto
Present Ecological Status (PES)	B – Largely Natural	B – Largely Natural	C – Moderately Modified	C – Moderately Modified	C – Moderately Modified	D – Largely Modified
Ecological Importance Class	High	Very High	High	High	High	High
Ecological Sensitivity	High	Very High	Very High	Very High	Very High	Very High

3.5 Estuarine Desktop Assessment

According to the desktop assessment of the PAOI intersects several estuarine functional zones (EFZ). Namely, iFafa, iSezela, uMdesingane, uMkhumbane, uMthwalume, uMvuzi, Mzinto, subtropical 69 and 70 estuaries.

Estuaries are of great ecological importance due to high productivity and serve as transitional ecosystems between the land and sea (Van Niekerk *et al*., 2015a). Organisms utilize estuaries as important feeding, breeding and nursing homes. Estuaries thus function as critical ecological infrastructure that should be prioritised and protected (Van Niekerk *et al*., 2015a). In addition, estuaries need higher base flows and major flood events to reset and maintain the continuously marine sedimentation process (Van Niekerk *et al*., 2015b). The estuaries in Kwazulu-Natal are exposed to many stressors (e.g., pollution spills, sewage spills, sand mining, habitat destruction) that influence the estuarine condition (CoastKZN, 2024). The Kwazulu-Natal Estuary Observer Programme (EOP) was developed by the Oceanographic Research Institute (ORI) and implemented through the Kwazulu-Natal Department of Economic Development, Tourism and Environmental Affairs (EDTEA) (Coast KZN, 2024). Through the EOP the state of the estuaries in Kwazulu-Natal was evaluated using the Estuarine Health Index (EHI) and classified according to the Present Ecological State (PES) of the specific estuaries, with A being natural and F extremely degraded. Estuaries in the PAOI were included in the EOP which made it possible to extract the relevant information in Table 3-6. There was no relevant information on the subtropical estuaries from the CoastKZN (2024) database.

Table 3-6 Classification of estuaries in the PAOI (Modified from CoastKZN, 2024).

Estuary	Classification (sensu Whitfield 1992)	Present Ecological Status (2018 NBA)	Protected area	Special conservation concern	National conservation priority
iFafa	Temporarily Open/Closed	C/D	None	None	No

iSezela	Temporarily Open/Closed	C	None	None	No
Subtropical 69	-	-	-	-	-
Subtropical 70	-	-	-	-	-
Subtropical 73	-	-	-	-	-
uMdesingane	Temporarily Open/Closed	D	None	None	No
uMkhumbane	Temporarily Open/Closed	C	None	None	No
uMthwalume	Temporarily Open/Closed	C	None	None	No
uMuziwezinto	Temporarily Open/Closed	C/D	None	None	No
uMvuzi	Temporarily Open/Closed	C	None	None	No

3.5.1 uMthwalume

The Mthwalume estuary has high ecological importance due to but not limited to its proximity to important habitats such as the swamp forests with *Barringtonia racemosa* and *Hibiscus tiliaceus*, which are mainly found in coastal swamps and the edges of estuaries. The Mthwalume estuary also facilitates the supratidal saltmarsh, which support unique macrophyte communities (Adams, 2019). The estuary is also expected to have a number of Crustaceans including Penaeidae pawns (*Penaeus monodon* and *P. japonicus*), *Metapenaeus monoceros*, mudprawn (*Upogebia africana*) and the swimming crab (*Scylla serrata*).

The PES of the Mthwalume estuary is moderately modified (class C) and this is largely due to the anthropogenic pressures the system which include commercial agriculture in the form of sugar cane farming. Transport infrastructure such as roads and bridges. Recreational use from line fishing and sites for launching boats, which indirectly leads to littering/solid waste. As well as the extensive extraction of sand (Coast KZN, 2024).

3.5.2 iFafa

The iFafa estuary has very high ecological importance due to the unique habitat from the swamp forests, as well as includes mangroves (*Bruguiera gymnorhiza*), aquatic vegetation (*Stuckenia pectinate* and *Ruppia cirrhosa*). The estuarine fauna expected in iFafa include the swimming crab (*Varuna litterata*). The iFafa estuary also serves as an important nursery for fish that are dependent on estuaries which include the spotted grunter (*Pomadasys commersonnii*) and the vulnerable estuarine bream (*Acanthopagrus vagus*).

The PES of the iFafa estuary is between moderately to largely modified (class C/D) and this is due to anthropogenic impacts from suburban infrastructure, recreation and tourism in the form of line fishing and bait collection. Other pressures include sand mining, fishing, pollution from solid waste and littering, and alien invasive species the snail *Tarebia granifera* (Coast KZN, 2024), which is native to south-east Asia.

3.5.3 Mkhumbane

The Mkhumbane estuary has a high ecological importance, comparable to Mthwalume estuary (3.5.1). With similar important habitat, mainly swamp forests with *Barringtonia racemosa* and *Hibiscus tiliaceus*. The supratidal saltmarsh, which support unique macrophyte communities (Adams, 2019). The estuary is also expected to have swimming crabs (*Scylla serrata* and *Varuna litterata*).

The PES of the Mkhumbane estuary is moderately modified (class C) and this is due to anthropogenic impacts from suburban and transport infrastructure, recreation, and tourism in the form of line fishing, golf course and swimming. Other pressures include pollution from Waste Water Treatment Works (WWTWs), the clearing of habitat and increasing pressures from fishing, and alien invasive species such as the snail *Tarebia granifera*, which is native to south-east Asia (Coast KZN, 2024).

3.5.4 Mvuzi

The Mvuzi estuary has a PES of moderately modified (class C) and high ecological importance, similar to Mthwalume estuary (3.5.1). With similar habitat, mainly swamp forests with *Barringtonia racemosa* and *Hibiscus tiliaceus*. The supratidal saltmarsh, which support unique macrophyte communities (Adams, 2019). The estuary is also expected to have swimming crabs (*Scylla serrata* and *Varuna litterata*) (Coast KZN, 2024).

3.5.5 Sezela

The Sezela estuary has a high ecological importance, with a similar habitat importance with swamp forests. The supratidal saltmarsh, which support unique macrophyte communities (Adams, 2019). The estuary also has extensive *Phragmites australis* redbeeds and the endangered Dusky kob (*Argyrosomus japonicus*), which is a large marine finfish that can grow to lengths of 2 m.

The PES of the Sezela estuary is moderately modified (class C) and this is due to anthropogenic impacts from industrial development and recreation (sports field), commercial sugar cane farming, subsistence fishing and waste disposal. Other pressures include pollution from industrial waste water, and contaminated water impacting aquatic biota. Exacerbated by invasion from water lettuce (*Pistia stratiotes*) and water hyacinth (*Pontederia crassipes*) (Coast KZN, 2024).

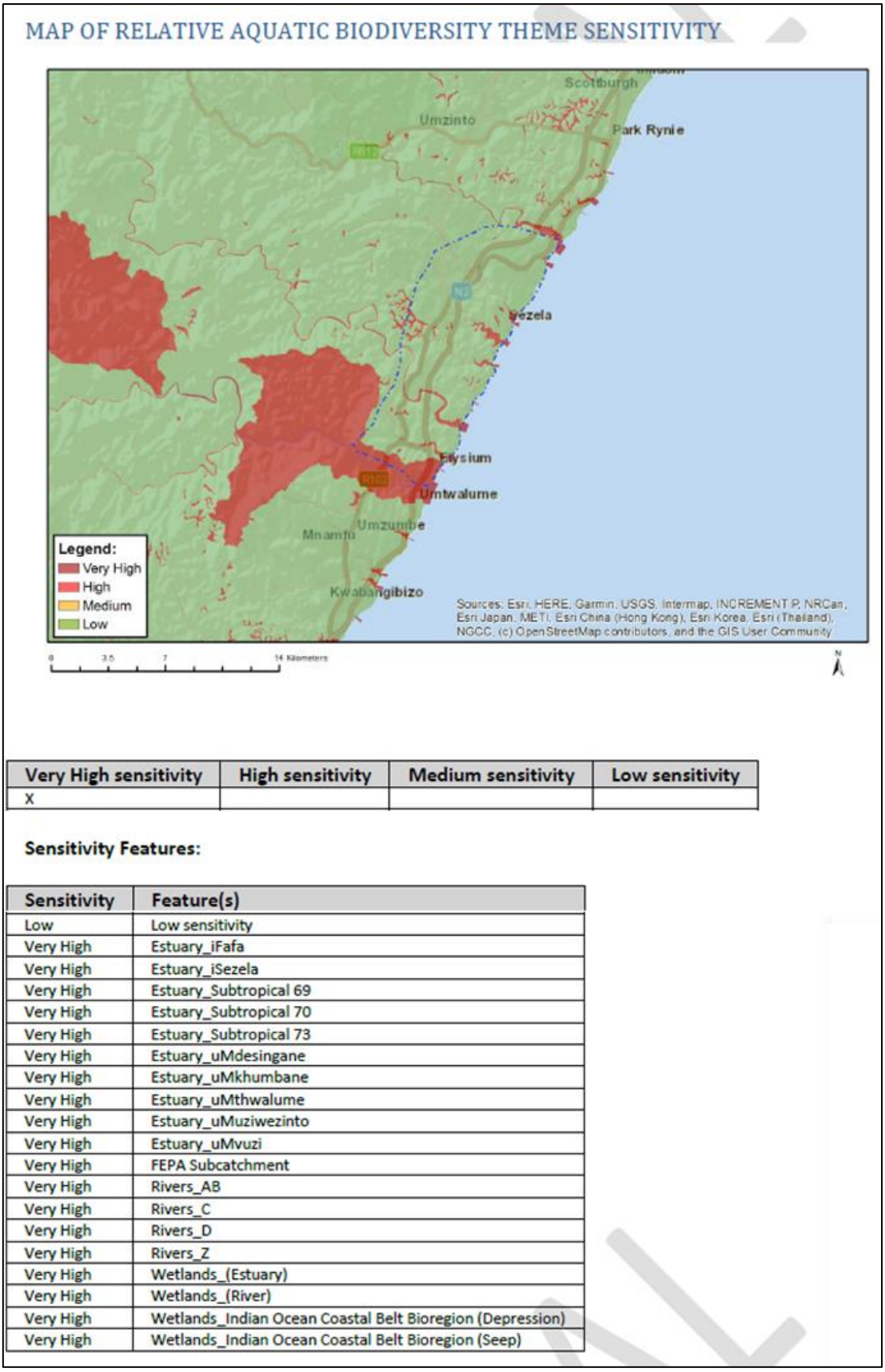
3.5.6 Mdesingane

The Mdesingane estuary has a high ecological importance, with swamp forests as well as aquatic vegetation which include sago pondweed (*Stuckenia pectinata*) and spiral tasselweed (*Ruppia cirrhosa)*. The estuary also has extensive *Phragmites australis* reedbeds and expected to have the endangered Dusky kob (*Argyrosomus japonicus*), which is a large marine finfish that can grow to lengths of 2 m.

The PES of the Sezela estuary is largely modified (class D) and this is due to anthropogenic impacts from commercial farming, subsistence and recreational line fishing. Other pressures include the existence of a weir in the lower reaches, which acts as a sink for poor water quality and may lead to fish kills during periods of high flow. These impacts are exacerbated by invasion from water fern (*Azolla filiculoides*) (Coast KZN, 2024), which is native to the Americas.

3.6 Environmental Screening Tool

This approach has also taken cognisance of the recently published Minimum Criteria for Reporting on Identified Environmental Themes (DWS, 2020). The aquatic biodiversity theme sensitivity as indicated in the screening tool report indicates a "**Very High**" sensitivity for the project area (Figure 3-4).



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Estuary_iFafa
Very High	Estuary_iSezela
Very High	Estuary_Subtropical 69
Very High	Estuary_Subtropical 70
Very High	Estuary_Subtropical 73
Very High	Estuary_uMdesingane
Very High	Estuary_uMkhumbane
Very High	Estuary_uMthwalume
Very High	Estuary_uMuziwezinto
Very High	Estuary_uMvuzi
Very High	FEPA Subcatchment
Very High	Rivers_AB
Very High	Rivers_C
Very High	Rivers_D
Very High	Rivers_Z
Very High	Wetlands_(Estuary)
Very High	Wetlands_(River)
Very High	Wetlands_Indian Ocean Coastal Belt Bioregion (Depression)
Very High	Wetlands_Indian Ocean Coastal Belt Bioregion (Seep)

Figure 3-4 Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool).

3.7 Conservation Plan

The KwaZulu-Natal Biodiversity Spatial Plan classifies areas within the province on the basis of their contribution to reaching the conservation targets within the province.

CBAs are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. CBAs are areas of high biodiversity value and play a role in strategic spatial planning essential in meeting the provincial as well as national biodiversity targets. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses (SANBI, 2017). The two CBA categories within the KZN BSP are the “CBA: Irreplaceable” and “CBA: Optimal” which refer to unique areas of high biodiversity importance and areas of general high biodiversity importance respectively. The conservation of Ecological Support Areas (ESAs), which are also included in the KZN BSP are also imperative units in maintaining the functionality of CBA areas.

The PAOI overlaps with several CBA: Irreplaceable and CBA: Optimal areas (Figure 3-5).

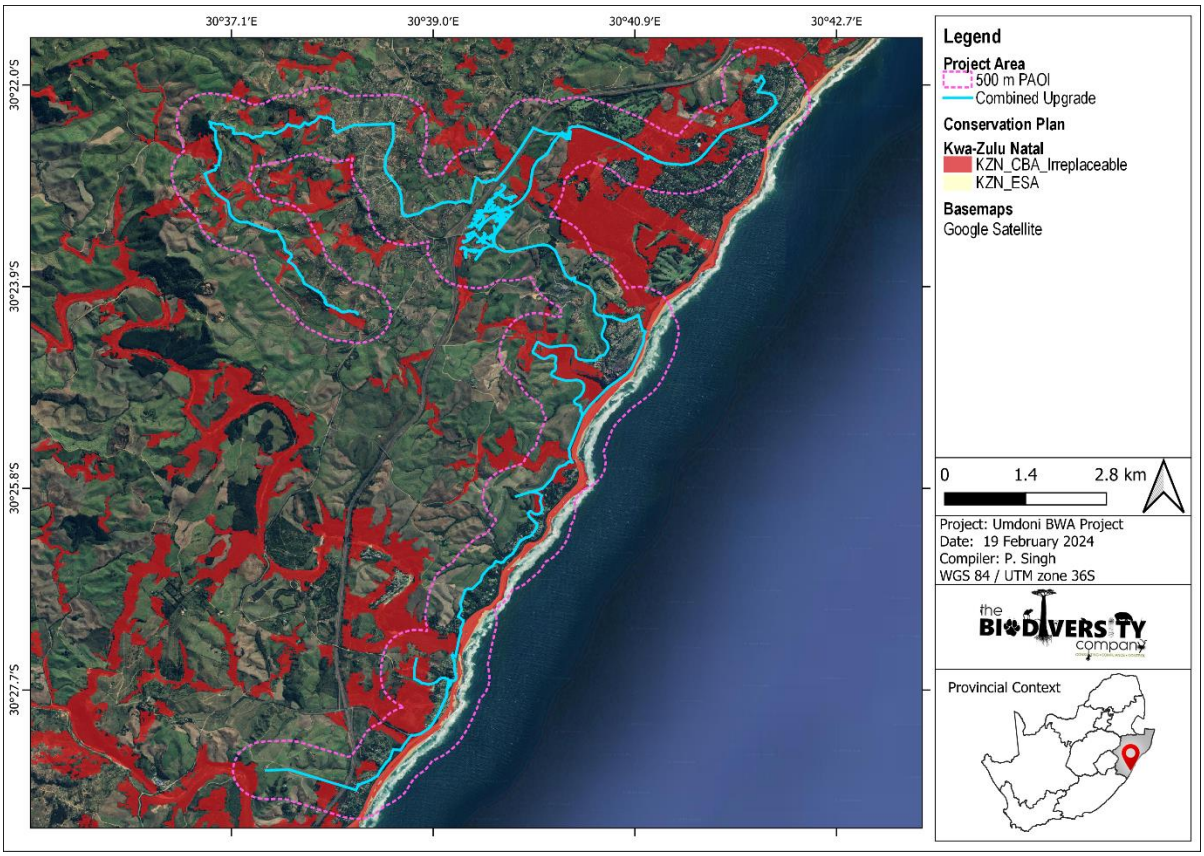


Figure 3-5 Critical Biodiversity Areas (CBA) within the project area.

3.8 Strategic Water Source Areas

Strategic Water Source Areas (SWSAs) are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. The areas supplying ≥ 50% of South Africa’s water supply (which were represented by areas with a mean annual runoff of ≥ 135 mm/year) represent national Strategic Water Source Areas (SANBI, 2013). According to the SWSAs of South Africa, Lesotho and Swaziland, the project area is not located within the SWSAs for surface water (Lotter and Le Maitre, 2021), but does occur within the SWSA for groundwater (West Coast Aquifer) (Le Maitre *et al.*, 2018). Groundwater and interflow play a key role in sustaining surface water flows during the dry

season and account for up to 42% of river baseflow, thereby sustaining aquatic and water-dependent biota. Therefore, the protection and management of these areas are imperative (Le Maitre *et al*., 2018).

The PAOI does not fall within any SWSA (Figure 3-6).

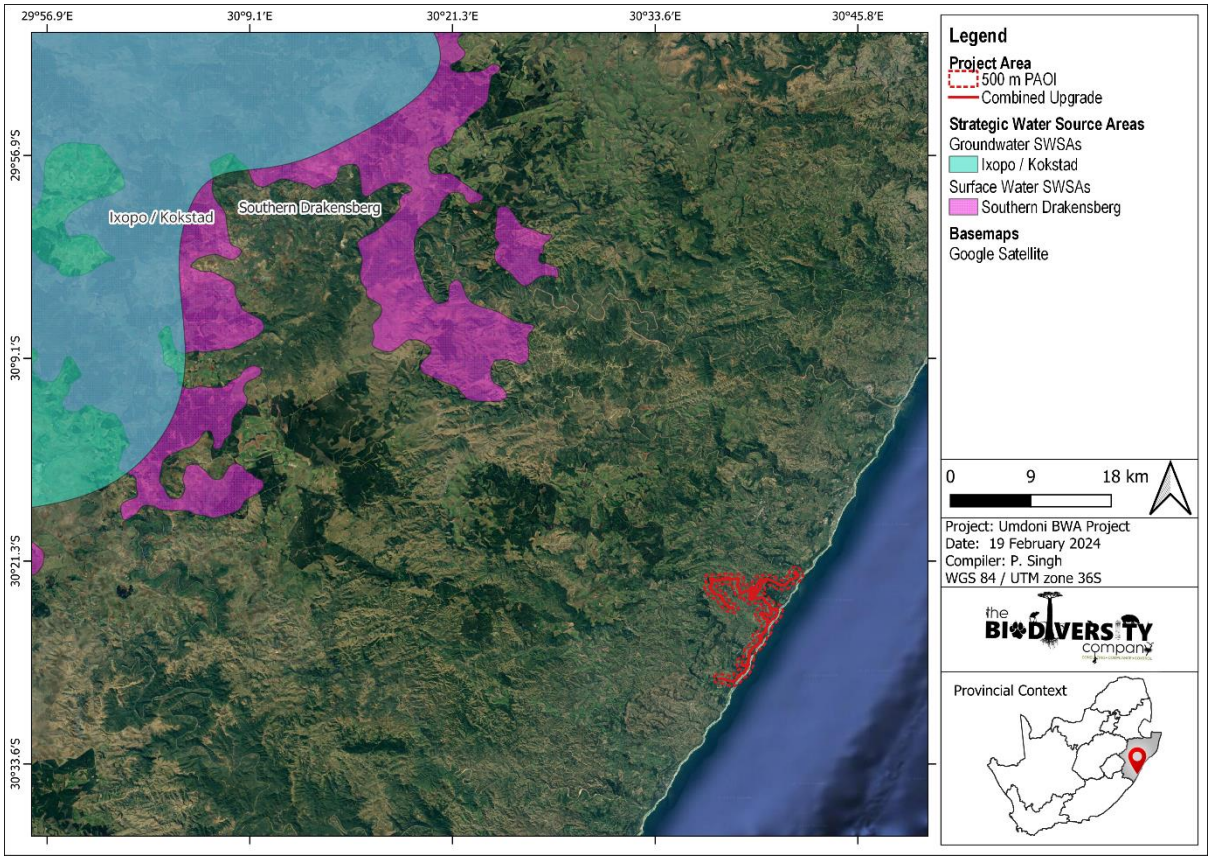


Figure 3-6 The project area in relation to the Strategic Water Source Areas for surface and groundwater.

3.9 National Freshwater Ecosystem Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al.,* 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM: BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011). In an attempt to better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al*., 2011). The FEPAs are intended to be conservation support tools and are envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM: BA) biodiversity goals (Nel *et al.,* 2011).

The NFEPA data identified several non-priority wetlands and one priority wetland within the PAOI (Figure 3-7). Typically, wetlands offer a host of ecosystem services which includes purification of water

quality through phytoremediation by the wetland vegetation. The wetlands are expected to provide attenuation functions as well as cleansing effects from surface runoff associated with catchment activities and must be maintained and protected from degradation notably erosion and sedimentation during the proposed project activities. Furthermore, the project area falls within a FEPA and the Mzinto River, Mkhumbane River, Sezela River, Mdesingane River, Fafa River, Mvuzi River and Mtwalume River within the PAOI are classified as NFEPA rivers.

The National Wetland Map 5 (NWM5) spatial data was published in October 2019 (Van Deventer *et al*. 2019), in collaboration with the South African National Biodiversity Institute (SANBI), with the specific aim of spatially representing the location, type and extent of wetlands in South Africa. The data represents a synthesis of a wide number of official watercourse data, including rivers, inland wetlands and estuaries. This database recognised the presence of freshwater features within the extent of the PAOI, and includes rivers, estuaries, depressions and micro-estuaries (Figure 3-7).

Conserving the water quality, riverine and wetland habitat and associated ecological functioning within the project area and associated catchments will aid in the protection of riverine habitat supporting fish species occurring within the entire catchment and water quality for the aquatic and terrestrial biota within the project. The catchments in which human activities occur need to be managed to maintain water quality and prevent further degradation of local and downstream water resources to contribute to national biodiversity goals and support sustainable use of water resources.

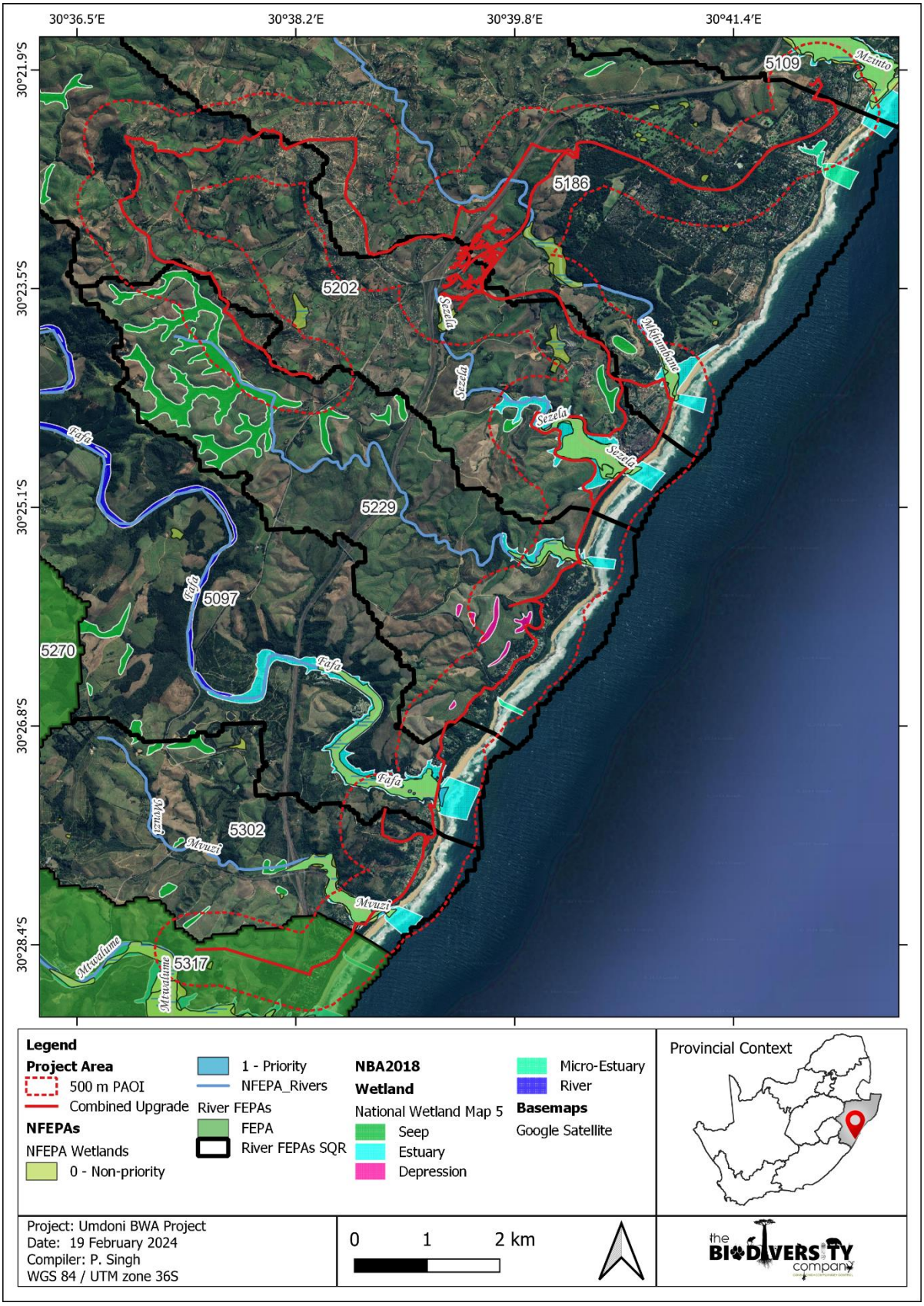


Figure 3-7 NFEPAs and NWM5 associated with the project area (Nel et al., 2011; Van Deventer et al. 2019).

3.10 Aquatic Ecosystem Threat Status

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the National Biodiversity Assessment (NBA) (Van Deventer *et al.,* 2018). The Ecosystem threat status of river and wetland ecosystems outlines the degree to which the ecosystems are still intact or losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Van Deventer *et al*., 2018). Ecosystem types are categorised as Critically Endangered, Endangered, Vulnerable or Least Threatened, based on the proportion of each ecosystem type that remains in good ecological condition (Van Deventer *et al*., 2018). The Ecosystem Threat Status (ETS) of each river assessed was based on the extent to which the system had been modified from its natural condition (SANBI, 2022). According to the SAIIAE dataset, the PAOI overlaps with Critically Endangered, Endangered and Vulnerable wetlands as well as Endangered rivers (Figure 3-8).

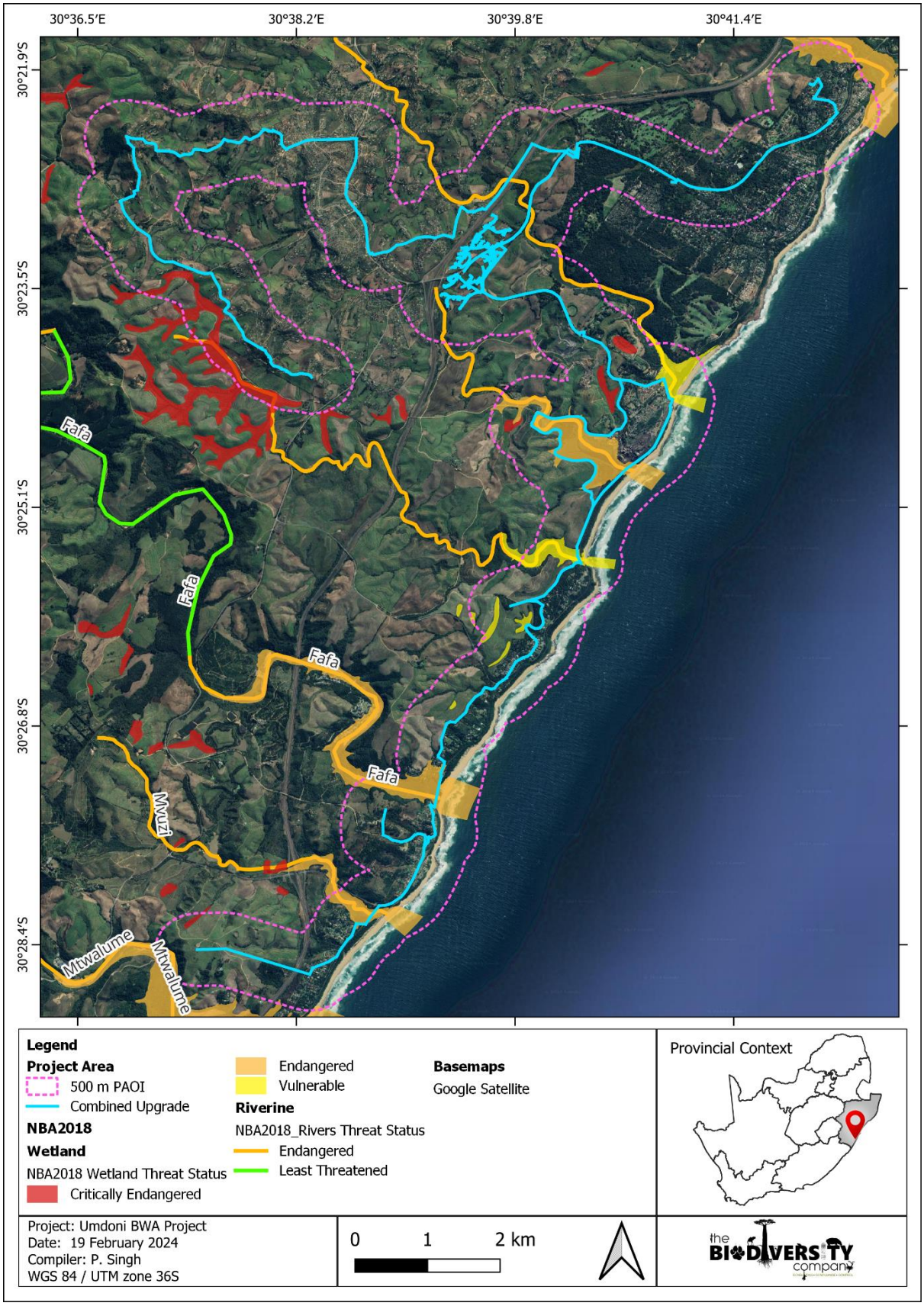


Figure 3-8 Illustration of the Ecosystem Threat Status of the project area (NBA, 2018).

3.11 Aquatic Ecosystem Protection Level

Ecosystem protection level indicates whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Van Deventer *et al*., 2018). The Ecosystem Protection Level (EPL) of each river assessed was based on the extent (expressed as a percentage) to which the system has their biodiversity target located within protected areas and are in a natural or near-natural ecological condition. Rivers in protected areas need to be in good condition (A or B ecological category) to be considered as protected. Well protected rivers have 100% of their biodiversity target located within protected areas, while moderately protected and poorly protected river ecosystem types have at least 50% and 5% of their biodiversity target in protected areas, respectively. Not protected rivers form less than 5% (SANBI, 2022). The PAOI was superimposed on the ecosystem protection level map to assess the protection status of aquatic ecosystems associated with the development (Figure 3-9). As per the SAIIAE dataset, wetlands within the PAOI varied in protection levels from Not Protected to Poorly Protected, Moderately Protected, and Well Protected. Meanwhile, all rivers in the PAOI are classified as Poorly Protected.

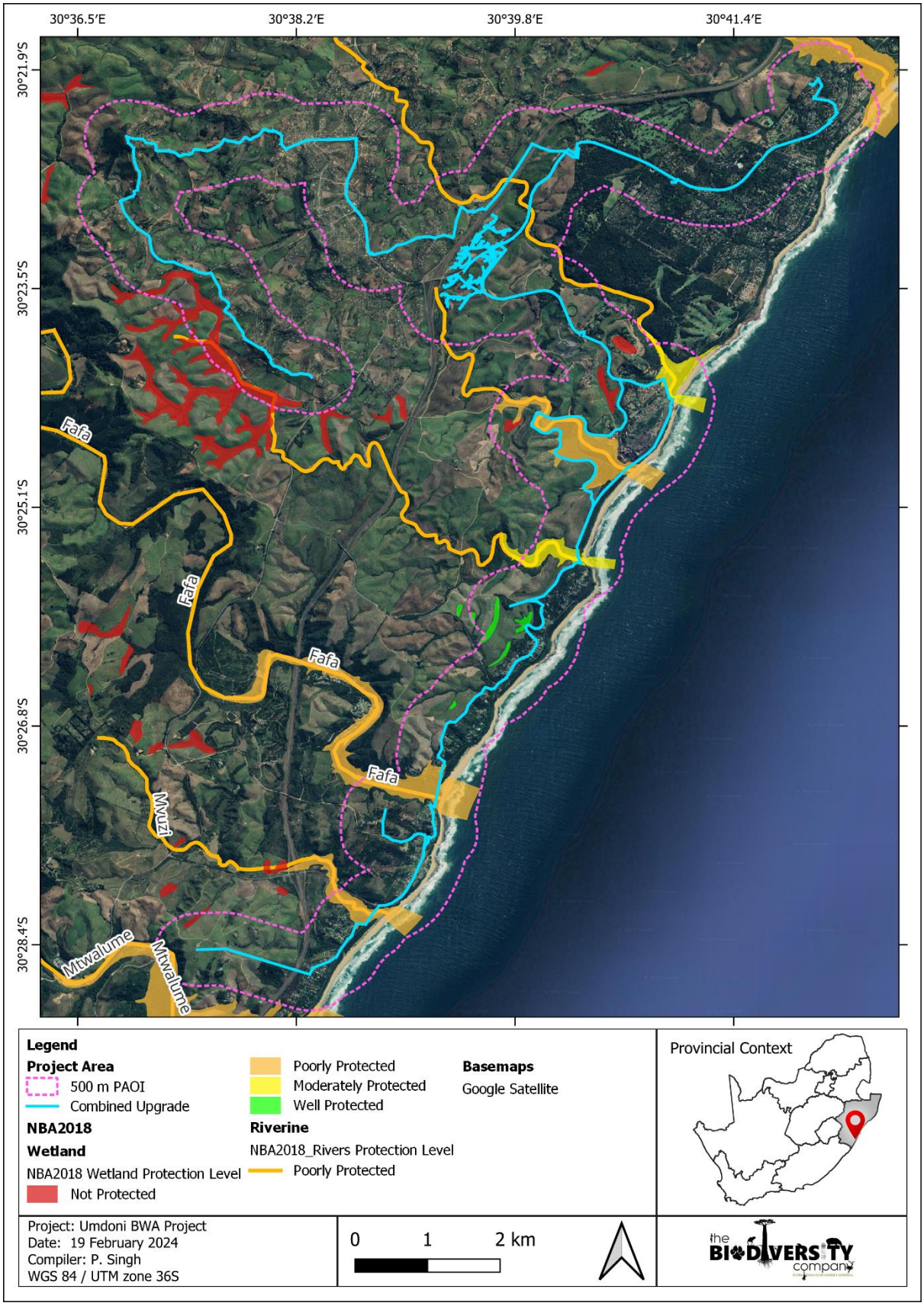


Figure 3-9 Illustration of the Ecosystem Protection Level of the project area (NBA, 2018).

3.12 South African Protected and Conservation Areas

The South African Protected Areas Database (SAPAD) and the South Africa Conservation Areas Database (SACAD) contain spatial data critical for the conservation of South Africa's natural resources (DFFE, 2022). It includes spatial and attribute information for both formally protected areas and areas that have less formal protection, such as conservation areas. These databases are updated regularly and form the basis for the Register of Protected Areas, which is a legislative requirement under the National Environmental Management: Protected Areas Act (Act 57 of 2003). Formally protected areas are categorised according to several different types, and each type is subject to specific legislative restrictions and management guidelines, many of which restrict development to some degree. Generally, these areas are assigned a buffer of influence of between 5 and 10 km (the latter pertaining to National Parks and World Heritage Sites), within which certain laws and management actions may apply. Many of the protected area types are further classified into sub-types as well. Formally protected area types include National Parks, Nature Reserves, Special Nature Reserves, Mountain Catchment Areas, World Heritage Sites, Protected Environments, Forest Nature Reserves and Forest Wilderness Areas, Specially Protected Forest Areas and Marine Protected Areas. The National Biodiversity Assessment of 2011 Protected Areas layer was also consulted. The PAOI is within Priority Focus Areas (Figure 3-10).

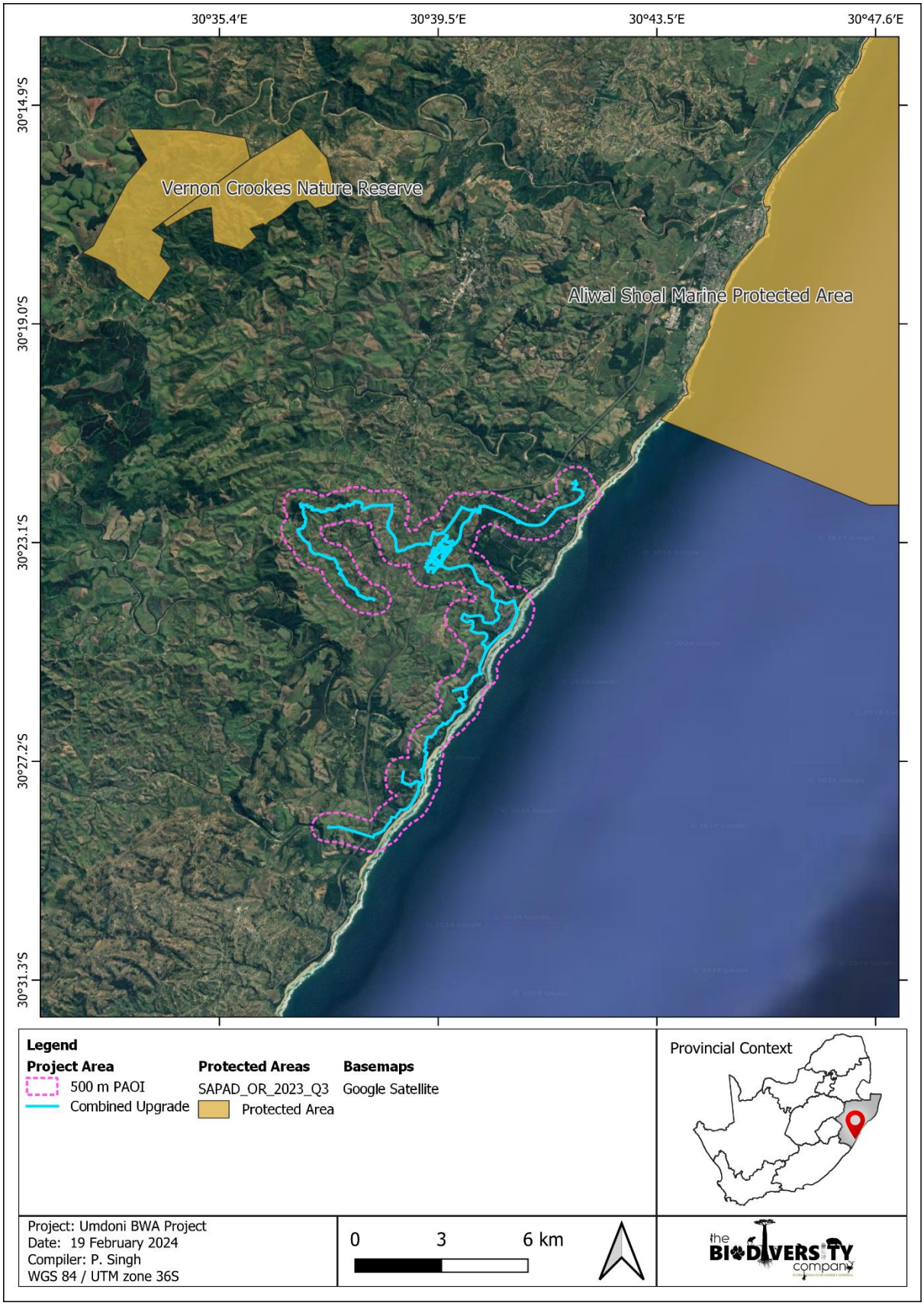


Figure 3-10 The project area in relation to Protected and Conservation Areas in South Africa.

4. Results

After consulting the desktop data and visiting the sites, it was noted that there were no wetlands within the PAOI, only rivers, estuaries and associated tributaries/drainage areas. Therefore, efforts were afforded to an aquatic/riverine assessment rather than a wetland assessment for this study. No wetlands were identified within the PAOI as those areas have been modified with extensive sugarcane farms.

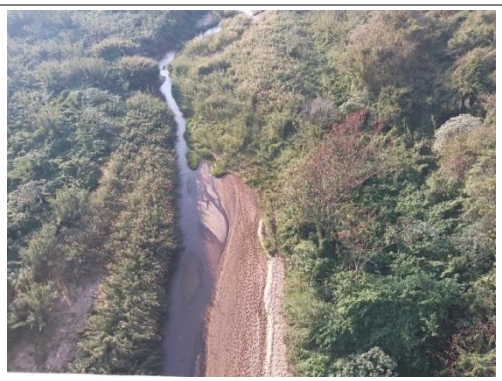
4.1 Field Investigation and Site Condition

Numerous sampling sites were marked for assessment, with emphasis placed on the systems within the PAOI and proximal to the pipeline upgrade. The aquatic sampling points, Global Positioning System (GPS) coordinates, and photographs are provided in Table 4-1 and Figure 4-1 below.

Table 4-1 Investigation site photographs and coordinates (September 2023)

Site	Upstream View	Downstream View
Mtwalume UP		
GPS- coordinates	30°28'38.43"S, 30°36'24.68"E	
Mtwalume MS		
GPS- coordinates	30°28'27.43"S, 30°37'10.61"E	
Mvuzi Trib		
GPS- coordinates	30°28'14.59"S, 30°37'22.49"E	

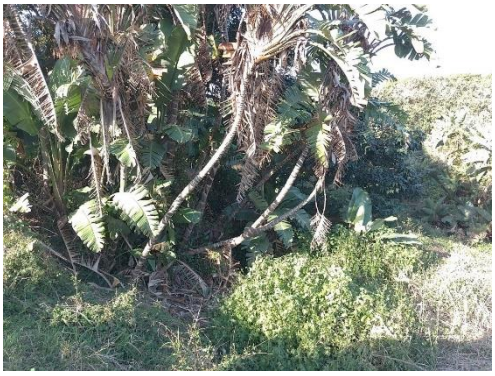
Site	Upstream View	Downstream View
Mvuzi 2		
GPS- coordinates	30°28'4.95"S, 30°38'29.96"E	
Mvuzi 1	No access	
GPS- coordinates	30°28'10.87"S, 30°38'42.50"E	
iFafa Estuary	No access	
GPS- coordinates	30°27'13.52"S, 30°39'12.63"	
Mkhumbane 3		
GPS- coordinates	30°22'43.92"S, 30°39'41.38"E	

Site	Upstream View	Downstream View
Mkhumbane 4		
GPS- coordinates	30°22'52.71"S, 30°39'26.55"E	
Mkhumbane Estuary		
GPS- coordinates	30°24'19.95"S, 30°40'57.16"E	
Mzinto UP		
GPS- coordinates	30°21'38.47"S, 30°41'47.48"E	
D1		
GPS- coordinates	30°28'20.42"S, 30°37'9.95"E	

Site	Upstream View	Downstream View
D2		
GPS- coordinates	30°28'22.76"S, 30°37'16.48"E	
D2.5		
GPS- coordinates	30°28'23.41"S, 30°37'19.14"E	
END2		
GPS- coordinates	30°28'23.73"S, 30°37'25.80"E	
D4		
GPS- coordinates	30°28'15.46"S, 30°37'38.21"E	

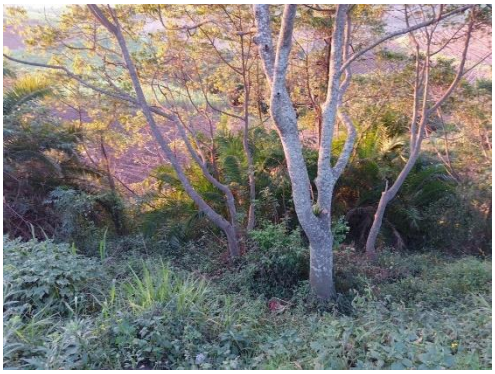
Site	Upstream View	Downstream View
D5		
GPS- coordinates	30°28'23.29"S, 30°37'38.67"E	
D6		
GPS- coordinates	30°28'32.40"S, 30°37'56.02"E	
d6		
GPS- coordinates	30°28'34.80"S, 30°38'7.84"E	
D8		
GPS- coordinates	30°28'23.95"S, 30°37'59.97"E	

Site	Upstream View	Downstream View
D10		
GPS- coordinates	30°28'25.22"S, 30°38'27.92"E	
D12		
GPS- coordinates	30°27'38.70"S, 30°39'7.92"E	
D13		
GPS- coordinates	30°27'36.46"S, 30°38'59.52"E	
D14		
GPS- coordinates	30°27'34.96"S, 30°38'48.21"E	

Site	Upstream View	Downstream View
D15		
GPS- coordinates	30°27'36.42"S, 30°39'8.37"E	
D16		
GPS- coordinates	30°27'35.36"S, 30°39'8.18"E	
D17		
GPS- coordinates	30°26'58.86"S, 30°39'12.02"E	
D18		
GPS- coordinates	30°27'2.49"S, 30°39'15.46"E	

Site	Upstream View	Downstream View
D19		
GPS- coordinates	30°26'44.94"S, 30°39'18.04"E	
D20		
GPS- coordinates	30°26'28.47"S, 30°39'35.31"E	
D21		
GPS- coordinates	30°26'30.11"S, 30°39'37.43"E	
D22		
GPS- coordinates	30°26'0.72"S, 30°39'52.80"E	

Site	Upstream View	Downstream View
D25		
GPS- coordinates	30°24'10.57"S, 30°40'53.53"E	
D26		
GPS- coordinates	30°24'9.41"S, 30°40'34.25"E	
D27		
GPS- coordinates	30°24'4.19"S, 30°40'27.37"E	
D28		
GPS- coordinates	30°23'57.85"S, 30°40'24.93"E	

Site	Upstream View	Downstream View
D36		
GPS- coordinates	30°23'33.82"S, 30°39'48.90"E	
D47		
GPS- coordinates	30°23'20.03"S 30°38'45.76"E	
D49		
GPS- coordinates	30°23'11.89"S, 30°38'51.21"E	
D50		
GPS- coordinates	30°23'6.59"S, 30°39'4.98"E	

Site	Upstream View	Downstream View
D51		
GPS- coordinates	30°22'57.87"S, 30°38'38.25"E	
D52		
GPS- coordinates	30°22'57.49"S, 30°38'35.27"E	
Sezela EST 1		
GPS- coordinates	30°24'35.14"S, 30°39'58.56"E	
Sezela EST 2		
GPS- coordinates	30°24'28.36"S, 30°40'0.22"E	

Site	Upstream View	Downstream View
Sezela 3		
GPS- coordinates	30°23'41.78"S, 30°39'16.84"E	
Sezela 4		
GPS- coordinates	30°22'50.40"S, 30°36'55.47"E	
ST1		
GPS- coordinates	30°23'30.94"S, 30°39'28.18"E	
ST3		
GPS- coordinates	30°23'7.92"S, 30°37'4.27"E	

Site	Upstream View	Downstream View
M1		
GPS- coordinates	30°23'7.16"S, 30°39'50.00"E	
M2		
GPS- coordinates	30°24'7.67"S, 30°40'56.52"E	
U1		
GPS- coordinates	30°22'25.38"S, 30°37'37.88"E	
U2		
GPS- coordinates	30°22'29.72"S, 30°37'25.75"E	

Site	Upstream View	Downstream View
U4		
GPS- coordinates	30°22'30.60"S, 30°37'10.39"E	
U5		
GPS- coordinates	30°22'37.04"S, 30°37'8.63"E	
U6		
GPS- coordinates	30°23'32.62"S, 30°37'34.75"E	
U7		
GPS- coordinates	30°23'24.98"S, 30°37'20.84"E	

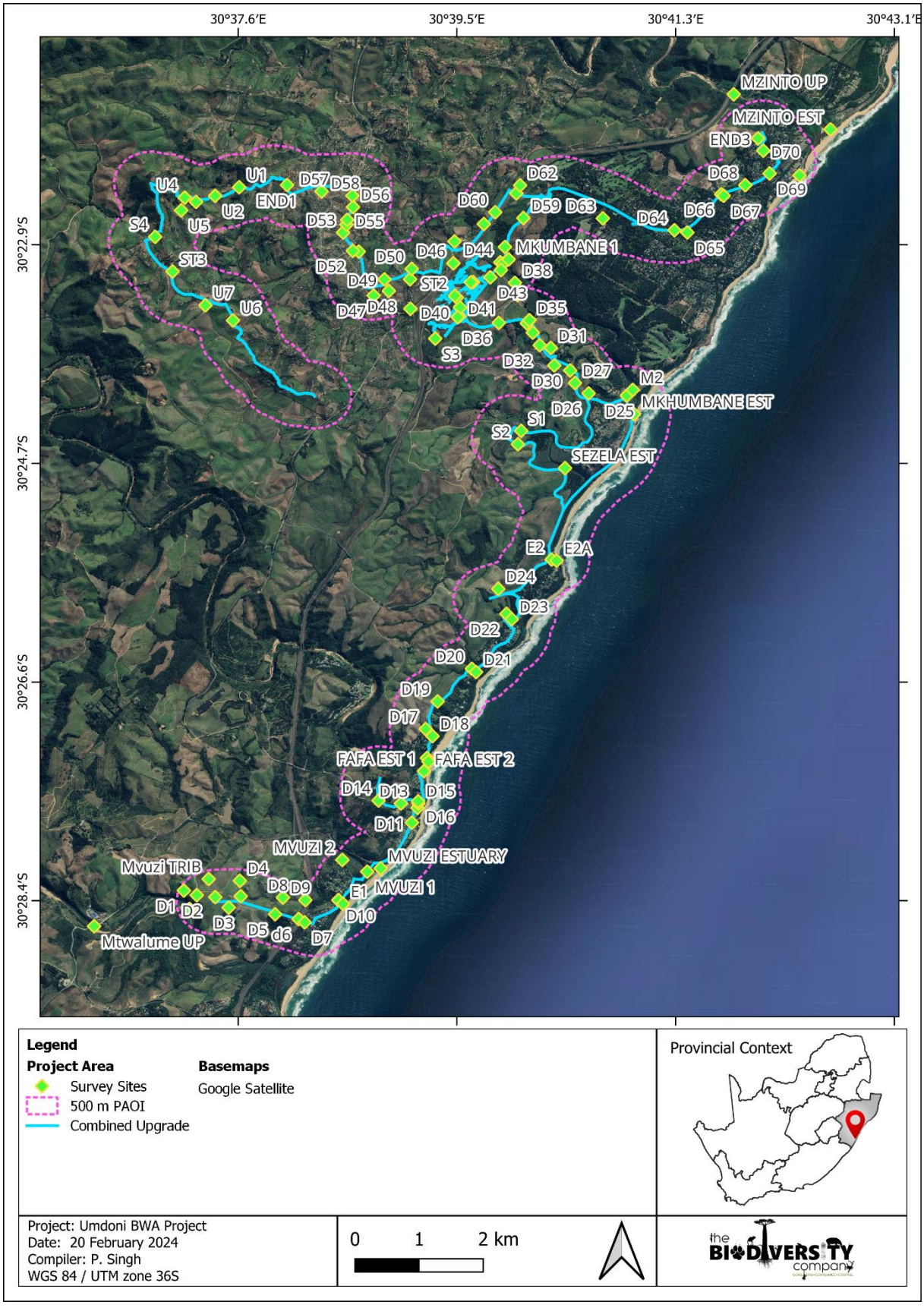


Figure 4-1 Study sampling/survey sites.

4.2 *In-situ* Water Quality

In-situ water quality analysis is typically conducted at each accessible sampling site along the watercourses in the project area which contained water. These results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996), DWA (2011), as well as Chapman and Kimstach (1996). The results of the September 2023 assessment are presented in Table 4-2.

Table 4-2 In-situ surface water quality results (September 2023).

Site	pH	Conductivity (µS/cm)	DO (mg/l)	DO (%)	Temperature (°C)
TWQR	6.5-9*	500 µS/cm***	>5.0**	80-120*	5-30*
Mtwalume (U80F)					
Mtwalume US	7.70	231	6.16	64.1	17.44
Mtwalume MS	6.66	517	5.94	67.8	21.62
D2.5	7.02	240	6.06	67.0	19.95
Mvuzi (U80G)					
Mvuzi2	6.86	2 539	4.04	46.2	21.18
D10	7.59	649	9.50	100.5	17.83
Mkhumbane (U80H)					
Mkhumbane 3	7.35	377	5.84	72.0	25.48
Mkhumbane 4	7.18	349	5.51	66.0	23.63
D25	7.70	378	7.56	83.3	19.44
Mkhumbane Est	6.97	8 336	6.72	77.7	21.22
Sezela (U80H)					
Sezela 4	6.93	481	6.33	72.4	21.32
Sezela Est	6.82	3 288	6.83	78.1	21.32
Drainage (U80H)					
D21 Micro-est	7.33	6 615	5.70	60.0	17.73
M2	6.90	370	6.21	70.1	22.04
U1	7.30	223	7.26	82.0	22.04

*TWQR (DWAF, 1996) | **Chapman and Kimstach (1996) | *** DWA (2011)
Parameters exceeding guideline limits are indicated in red.

The *in-situ* water quality indicated pH levels and water temperature fell within the TWQR limits for tolerant aquatic life in the catchment. Dissolved oxygen in mg/l was within the limits stipulated by Chapman and Kimstach (1996) at all but one site (Mvuzi2), whereas the saturation was below the TWQR at most sites but still within the minimum allowable values at >60% and >40%, which would permit the survival of sensitive taxa for a short period of time (DWAF, 1996).

The electrical conductivity (EC) was stable between most sites from upstream to downstream, except between Mtwalume US and Mtwalume MS, which presented a marked increase in EC, suggesting an influx in dissolved solids. This could be due to the evidence of sand mining observed adjacent to the river which can lead to a reduction in habitat, water quality and biodiversity. Sand mining can cause sedimentation in rivers, which was observed at site Mtwalume MS, this tends to limit habitat and therefore biodiversity, as well as deposit pollutants into the river (Rentier & Cammeraat, 2022). The EC

at sites within or adjacent to the Estuaries or Estuarine Functional Zones (D10, D21, Sezela Est, Mvuzi2 and Mkhumbane Est) was elevated, which was expected due to the possible tidal effects causing an influx of seawater and salts and/or the concentration of dissolved solids in closed estuaries. ECs at these levels may be considered normal for the assessed reach.

Overall, the water quality in this reach would not have a limiting effect on the local tolerant aquatic biota that are adapted to these systems at the time of the survey. It should be noted that *in-situ* water quality provides a simplistic overview of physical water quality parameters and aids in the interpretation of biological results.

4.3 Index of Habitat Integrity

The results for the instream and riparian Index of Habitat Integrity (IHI) assessment for the associated reaches are presented in Table 4-3.

Table 4-3 Results for the Instream Habitat Integrity assessment for the associated river reaches (September 2023).

Instream	Mtwalume River Reach	Mvuzi River Reach	Mkhumbane River Reach	Sezela River Reach	iFafa River Reach	Mdesingane River Reach
	Impact Score	Impact Score	Impact Score	Impact Score	Impact Score	Impact Score
Water abstraction	12	7	9	5	5	5
Flow modification	17	6	6	7	6	6
Bed modification	18	5	6	12	8	8
Channel modification	14	11	10	10	10	10
Phys-chem modification	7	13	10	10	10	10
Inundation	10	9	9	9	9	10
Alien macrophytes	5	6	5	3	5	4
Introduced aquatic fauna	0	0	0	2	2	2
Rubbish dumping	6	9	8	5	5	5
Total Instream	**41.0**	**63**	**71**	**67**	**72**	**72**
Category	**D**	**C**	**C**	**C**	**C**	**C**
Riparian	**Mtwalume River Reach**	**Mvuzi River Reach**	**Mkhumbane River Reach**	**Sezela River Reach**	**iFafa River Reach**	**Mdesingane River Reach**
	Impact Score	**Impact Score**	**Impact Score**	**Impact Score**	**Impact Score**	**Impact Score**
Vegetation removal	15	5	15	16	12	10
Exotic vegetation	10	10	16	10	10	10
Bank erosion	16	5	12	6	6	8
Channel modification	17	7	7	7	6	8
Water abstraction	9	5	7	5	5	5
Inundation	5	4	4	5	5	5
Flow modification	8	5	6	6	6	8
Phys-chem	5	7	5	7	6	5
Total Riparian	**31**	**76**	**39**	**57**	**65**	**70**
Category	**E**	**C**	**D/E**	**D**	**C**	**C**

According to the IHI results, the assessed reaches presented instream conditions that were considered Largely Modified (class D) to Moderately Modified (class C) and riparian habitat was rated as Seriously Modified (class E) to Moderately Modified (class C), indicating that the loss of natural habitat, biota and basic ecosystem functions is extensive. Examples of activities within the catchment that have contributed to the deteriorated state of the systems include indigenous vegetation clearing, extensive agricultural activities (mainly sugarcane farming), runoff (Figure 4-2), sand mining leading to sedimentation (Figure 4-4 and Figure 4-5), formal and informal settlements. These activities have resulted in habitat loss, encroachment of alien vegetation into the riparian habitat (Figure 4-3), flow modification, deterioration of water quality, and impacts to instream and riparian habitat.

Figure 4-2 Runoff from water truck flowing into river at site Mtwalume US

Figure 4-3 Invasive aquatic vegetation (Arundo donax) along the riparian area (Mtwalume River reach)

Figure 4-4 Evidence of sand mining adjacent to Mtwalume River

Figure 4-5 Sedimentation observed at site Mtwalume MS

4.4 Macroinvertebrate Community

Biological SASS5 assessments were completed at applicable and representative sites in the considered river reaches. The assessed reaches were classed as lower foothill river (slope class E) and lowland river (Class F) systems. The sampled reaches presented a combined low to moderate diversity of instream habitat that would not be able to support diverse aquatic macroinvertebrate assemblages. The habitat comprised limited stones and marginal vegetation in current with only finer substrates (sand and gravel) present. The present habitat would only support limited diversity and abundances of macroinvertebrate taxonomic orders such as Odonata (Dragon and Damselflies), Hemiptera (Bugs) and Coleoptera (Beetles) which are tolerable of estuarine characteristics such as elevated salts. These reaches are expected have a naturally lower biotope diversity as the systems are considered lower foothills and lowland river geoclass watercourses. The sampled habitat diversity was dominated by fast-shallow flow classes and slow-deep flow classes, which would limit the diversity and abundances of macroinvertebrate taxa with preferences for moderate to slow flowing water over stone biotopes. Overall, the sampled reach is considered to have habitat types capable of supporting a moderate diversity of macroinvertebrates suited to estuarine conditions.

4.4.1 South African Scoring System

The SASS5 score and SASS5 ecological classes obtained for the sampled system during the survey are presented in Table 4-4 presents the SASS5 results superimposed on the biological bands for the North Eastern Coastal Belt Lower Ecoregion (Dallas, 2007).

Table 4-4 SASS5 Macroinvertebrate assessment (September 2023).

Site	Mtwalume Reach	Mvuzi Reach	Mkhumbane Reach	Sezela Reach
SASS Score	77	50	63	48
No. of Taxa	12	8	12	8
ASPT*	6.4	6.3	5.3	6.0
Category (Dallas, 2007)	**C**	**C**	**D**	**C**

*ASPT: Average score per recorded taxon

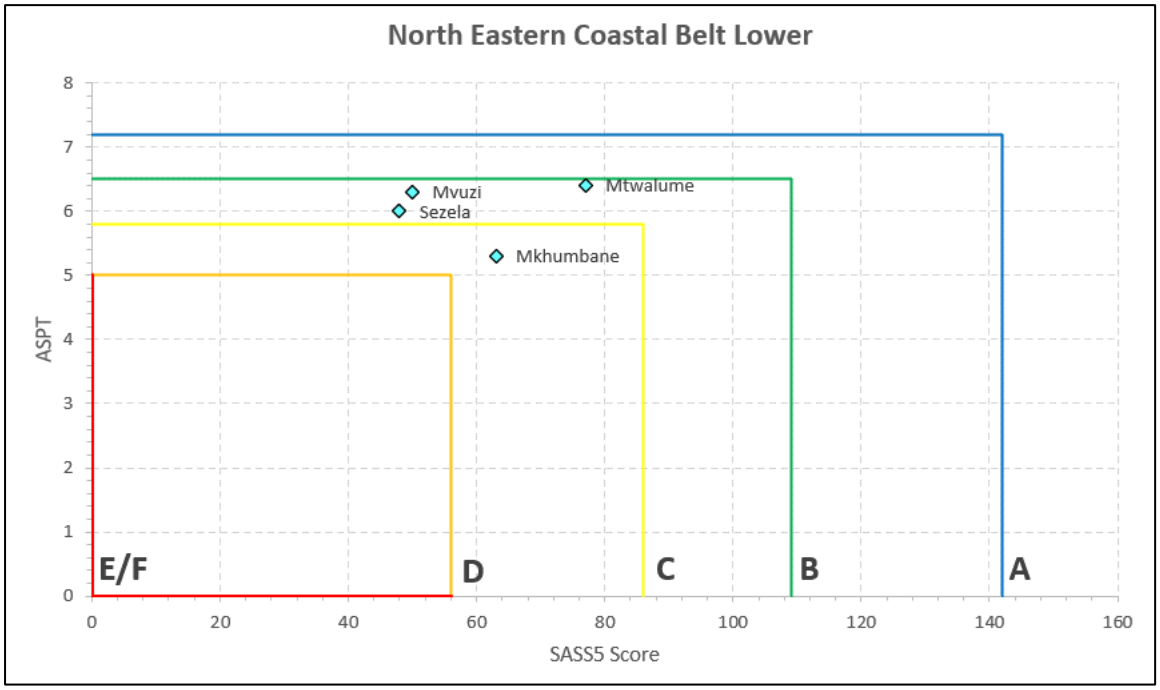


Figure 4-6 The SASS5-derived ecological categories based on Dallas (2007).

The Dallas biological bands established for the North Eastern Coastal Belt – Lower Ecoregion indicated that these sampled sites generated categories of a class C (moderately modified). This can be largely attributed to moderate and limited instream habitat, particularly the absence of aquatic and marginal vegetation in and out of current, as well as mud. This would limit the diversity of macroinvertebrates, restricting the available habitats to stones, bedrock, gravel and sand. Despite the moderate instream habitat diversity, a Heptageniid was sampled, which is an Ephemeroptera with very low tolerance to pollution (SASS score 11–15) (Dickens and Graham, 2001), suggesting that the water quality was sufficient for accommodating intolerant macroinvertebrate taxa.

4.5 Fish Community

An expected species list was generated from DWS (2014), and Skelton (2001) for the U80F-05258, U80G-05302, U80G-05097, U80H-05229, U80H-05202, U80H-05186 and U80H-05109 Sub-Quaternary Reaches (SQRs). Due to access and time constraints, fish were only sampled at some sites, which presented a total of 16 expected fish species for river reaches which are presented in Table 5 4. The conservational status of fish species was assessed against the IUCN database 2024 (IUCN, 2024). Three (3) of the expected 16 fish species (*Glossogobius callidus, Oreochromis mossambicus* and *Anguilla mossambica*) were sampled from the study areas (Table 7 6 and Figure 7 8).

Fish species have different sensitivities to physiochemical and flow modification and therefore this was considered for both the expected and present fish species assemblage. This indicated that the average

expected assemblage is moderately tolerant to changes in flow and tolerant to physiochemical modification. The average results for the sampled community indicated that the present community are moderately tolerant to changes in flow and physiochemical modifications.

Table 4-5 Expected and sampled fish community (September 2023).

Scientific name	Common name	IUCN Status (IUCN, 2024)	Mtwalume Reach	Sezela Reach	Mkhumbane Reach
***Acanthopagrus berda* (E)**	Riverbream	LC	No	No	No
Awaous aeneofuscus (Am)	Freshwater Goby	LC	No	No	No
Anguilla marmorata (C)	Giant Mottled Eel	LC	No	No	No
Anguilla mossambica (C)	Longfin Eel	LC	Yes	No	No
Enteromius gurneyi	Redtail Barb	VU	No	No	No
Enteromius viviparus	Bowstripe Barb	LC	No	No	No
Clarias gariepinus	Sharptooth Catfish	LC	No	No	No
Gilchristella aestuaria	Estuarine Round Herring	LC	No	No	No
Glossogobius callidus	River Goby	LC	Yes	Yes	Yes
Glossogobius giuris	Bareye Goby	LC	No	No	No
Labeobarbus natalensis	KwaZulu-Natal yellowfish	LC	No	No	No
Megalops cyprinoides	Oxeye Tarpon	-	No	No	No
Mugil cephalus	Flathead Mullet	LC	No	No	No
Myxus capensis	Freshwater Mullet	LC	No	No	No
Oreochromis mossambicus	Mozambique Tilapia	VU	No	Yes	Yes
Pseudocrenilabrus philander	Southern Mouth Brooder	LC	No	No	No
Total Exotic Species Sampled		-	**0**	**0**	**0**
Total Indigenous Species Sampled		-	**2**	**2**	**2**

NT: Nearly Threatened; VU: Vulnerable; LC: Least Concern
(C) Catadromous fish are born at sea, spends most of its life in freshwater, then returns to sea to spawn
(An) Anadromous fish are born in freshwater, spends most of its life in seawater, returns to freshwater to spawn
(Am) Amphidromous fish regularly migrate between freshwater and sea (in both directions), but not for the purpose of breeding
(E) Fish restricted to estuaries

Figure 4-7 Examples of the fish species sampled A) Glossogobius callidus and B) Anguilla mossambica.

The expected species are generated on a reach basis, and the occurrence of all species in the system is unlikely as different species are specialists in different habitats which are present along a reach. The river reaches have a moderate instream habitat and therefore a limited range of fish species is expected. The expected fish species list does includes the 'Vulnerable' *Enteromius gurneyi* and *Oreochromis mossambicus*.

5. Present Ecological State

The PES for the receiving environment(s) (i.e., the major rivers and estuaries) was determined using a combination of the findings from the National Biodiversity Assessment, Van Niekerk et al. (2015) and results from this study and are presented in Table 5-1 below.

Table 5-1 Present Ecological State of aquatic resources/features associated with the Umdoni Bulk Water Augmentation pipeline PAOI (September 2023).

Aquatic Resource/Feature	Ecological Indices/Database* - Class	Present Ecological State
Mtwalume River Reach	Instream Integrity – Class D (Largely Modified) Riparian Integrity – Class E (Seriously Modified) SASS5 – Class C (Moderately Modified)	**Class D/E – Largely to Seriously modified**
Mvuzi River Reach	Instream Integrity – Class C (Moderately Modified) Riparian Integrity – Class C (Moderately Modified) SASS5 – Class C (Moderately Modified)	**Class C – Moderately Modified**
Mkhumbane River Reach	Instream Integrity — Class C (Moderately Modified) Riparian Integrity – Class D/E (Largely to Seriously Modified) SASS5 – Class D (Largely Modified)	**Class D – Largely Modified**
Sezela River Reach	Instream Integrity – Class C (Moderately Modified) Riparian Integrity – Class D (Largely Modified) SASS5 – Class C (Moderately Modified)	**Class C – Moderately Modified**
iFafa River Reach	Instream Integrity – Class C (Moderately Modified) Riparian Integrity – Class C (Moderately Modified)	**Class C – Moderately Modified**
Mdesingane River Reach	Instream Integrity – Class C (Moderately Modified) Riparian Integrity – Class C (Moderately Modified)	**Class C – Moderately Modified**

*National Biodiversity Assessment (Van Deventer *et al.*, 2018).

6. Water Resource Delineations and Buffer Requirements

The ecology of the project area is considered highly sensitive to disturbance from a hydrological, biological, and conservational perspective. This includes several rivers, estuaries, associated buffer areas, and CBAs. Construction and operation activities must take cognisance of this and avoid any unnecessary disturbance of these areas. Development within these sensitive areas will lead to modifications to the present ecological state and ecosystem degradation.

The legal definition of the extent of a watercourse as defined in the amendment of the General Authorisation for section 21 (c) and (i) water uses in terms of GN4167 of 2023 (DWS, 2023). The extent of the watercourse is defined as "*A river, spring or natural channel in which water flows regularly or intermittently within the outer edge of the 1 in 100 year flood line or riparian habitat measures from the middle of the watercourse from both banks".* The watercourse, wetland and/or drainage extent was mapped with associated sensitivity assigned by identifying vegetation features on aerial imagery, conservation geospatial layers and confirmation through ground truthing during the survey. Water resource areas were delineated according to DWAF (2005), 5 m contour data, SAIIAE dataset (NBA National Wetland Map, 2018), and the latest Google Earth aerial imagery. The delineated sensitive areas are depicted in Figure 6-1 to Figure 6-6. All infrastructure, laydown areas and any construction phase related activities should avoid these sensitive areas, including the relevant buffer areas.

According to the buffer guidelines the maximum required buffer should be applied to a system (Macfarlane, et al., 2014). Riparian areas have high conservation value and can be considered the most important part of a watershed for a wide range of values and resources. They provide important habitat for a large volume of wildlife and often forage for domestic animals (livestock). The vegetation they contain are an important part of the water balance for the hydrological cycle through evapotranspiration. They are crucial for riverbank stability and in preventing erosion within the channel (Elmore and Beschta, 1987). The implementation of a buffer zone ensures the ecological requirements needed to maintain both the ecosystem functioning and services offered by the watercourses are maintained. Additionally, the watercourses potentially influenced by the project have sensitivity to further disturbance, requiring protection from the project activities.

Therefore, buffer areas are considered high priority areas and should be avoided at all costs. A minimum buffer zone strip of at least 32 meters wide is required for rivers as per NEMA (Act no. 107 of 1998). Despite this, Ezemvelo (2013) suggests a 30 m buffer from the edge of the riparian areas for rivers and a 20 m buffer for drainage lines within KwaZulu-Natal. Using this sensitivity, a conservative buffer zone of 30 m was suggested for the river riparian areas and 20 m for the associated tributaries/drainage lines as well as micro-estuaries. A 60 m buffer has also been delineated for the EFZ. These buffer areas serve as **No-go** zones for unauthorised activities. The site development plan should therefore be designed accordingly. Ensuring buffers are intact increases the resilience of a watercourse to future disturbances. These sensitivity buffers are presented in Figure 6-1 to Figure 6-6.

6.1 Legislated zones of regulation

Table 6-1 presents the legislated zones of regulation that would be applicable to the rivers in the project area and their tributaries. In accordance with GN 4167 of 2023 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means 100 m from the edge of a watercourse or a 500 m radius from the delineated boundary (extent) of any wetland or pan. Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation, which in this case is a 32 m zone of regulation. The main Mthwalume River, Mvuzi River, Mkhumbane River, Mdesingane River, Fafa River and Mzinto River reaches, their tributaries and associated estuaries traverse the PAOI, therefore the project falls within the NEMA Act 107 and GA

4167 regulated zones. The regulated areas have been applied to the delineations within the PAOI and presented in Figure 6-1 to Figure 6-6.

Table 6-1 The legislated zones of regulation

Regulatory authorization required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation (DWS)	Government Notice 4167 as published in the Government Gazette 49833 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998). In accordance with 4167 of 2023 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i) is defined as: • the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500 m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. Department of Environmental Affairs and Development Planning (DEA&DP)	Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) states that: The development of: (xii) Infrastructure or structures with a physical footprint of 100 square meters or more; Where such development occurs— a) Within a watercourse; b) In front of a development setback; or c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse. Excluding – …(dd) where such development occurs within an urban area… Activity 19 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA regulations, 2014 (as amended) states "The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse."

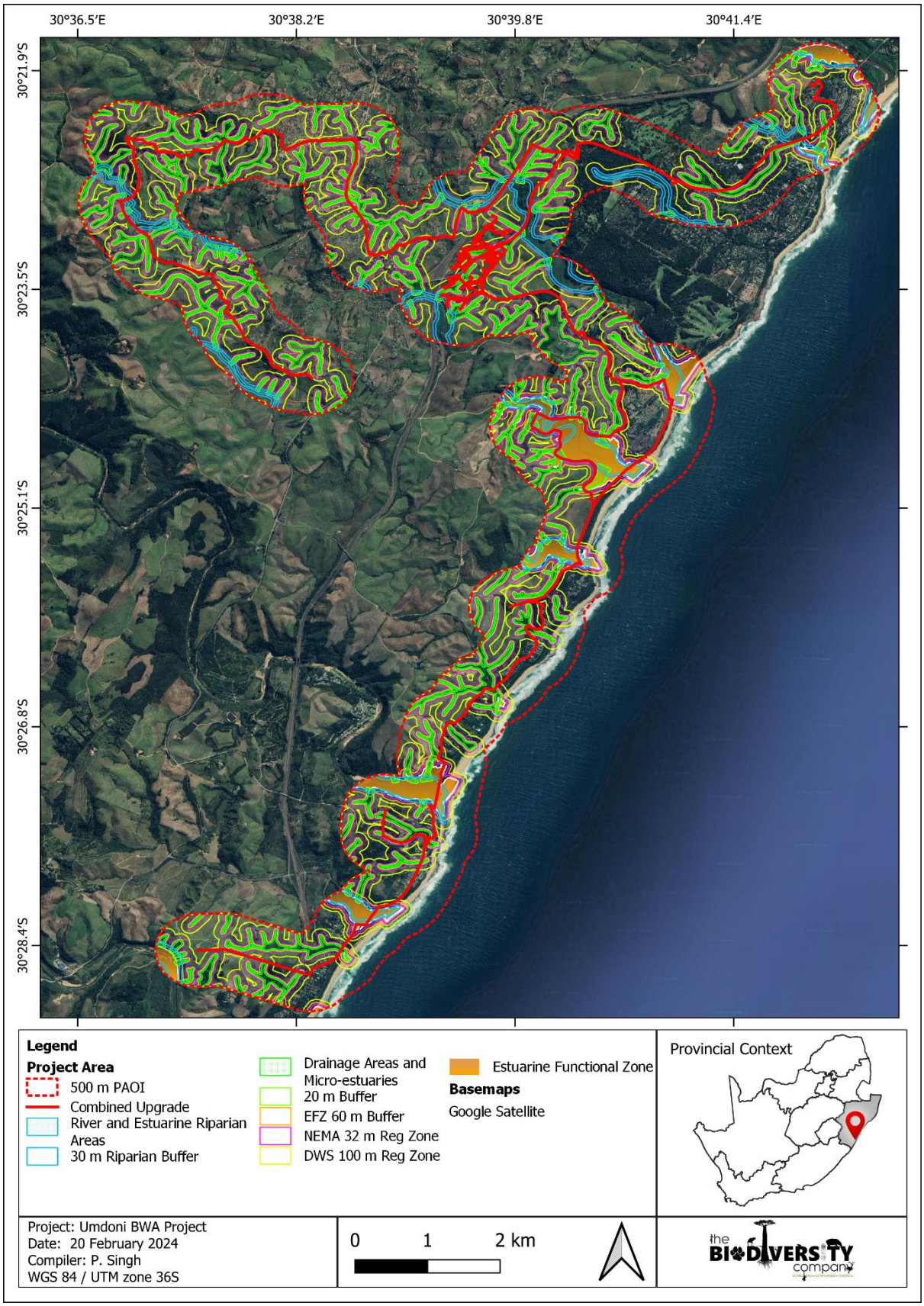


Figure 6-1 Water resources, sensitivity buffers and regulated areas (1 of 6).

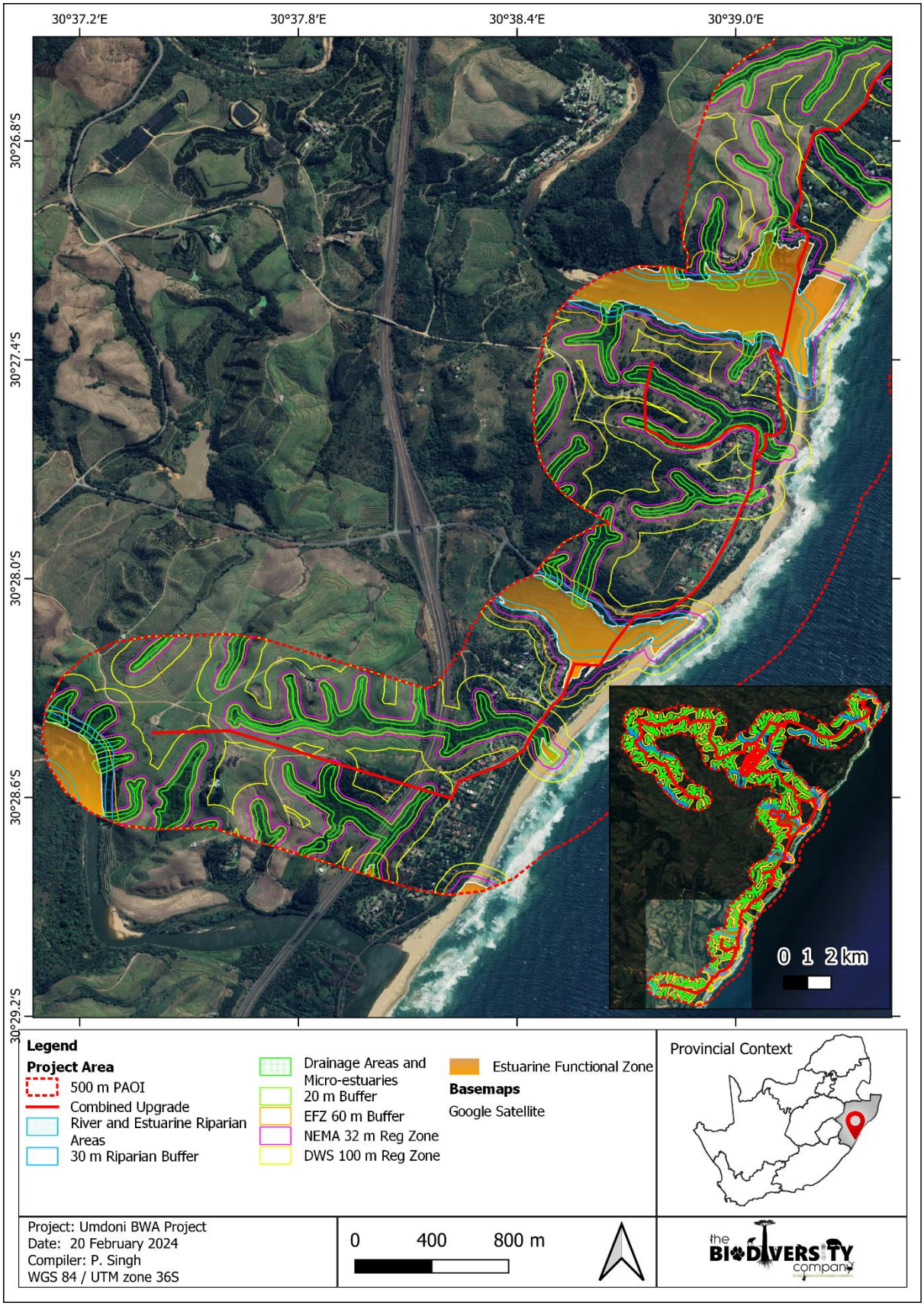


Figure 6-2 Water resources, sensitivity buffers and regulated areas (2 of 6).

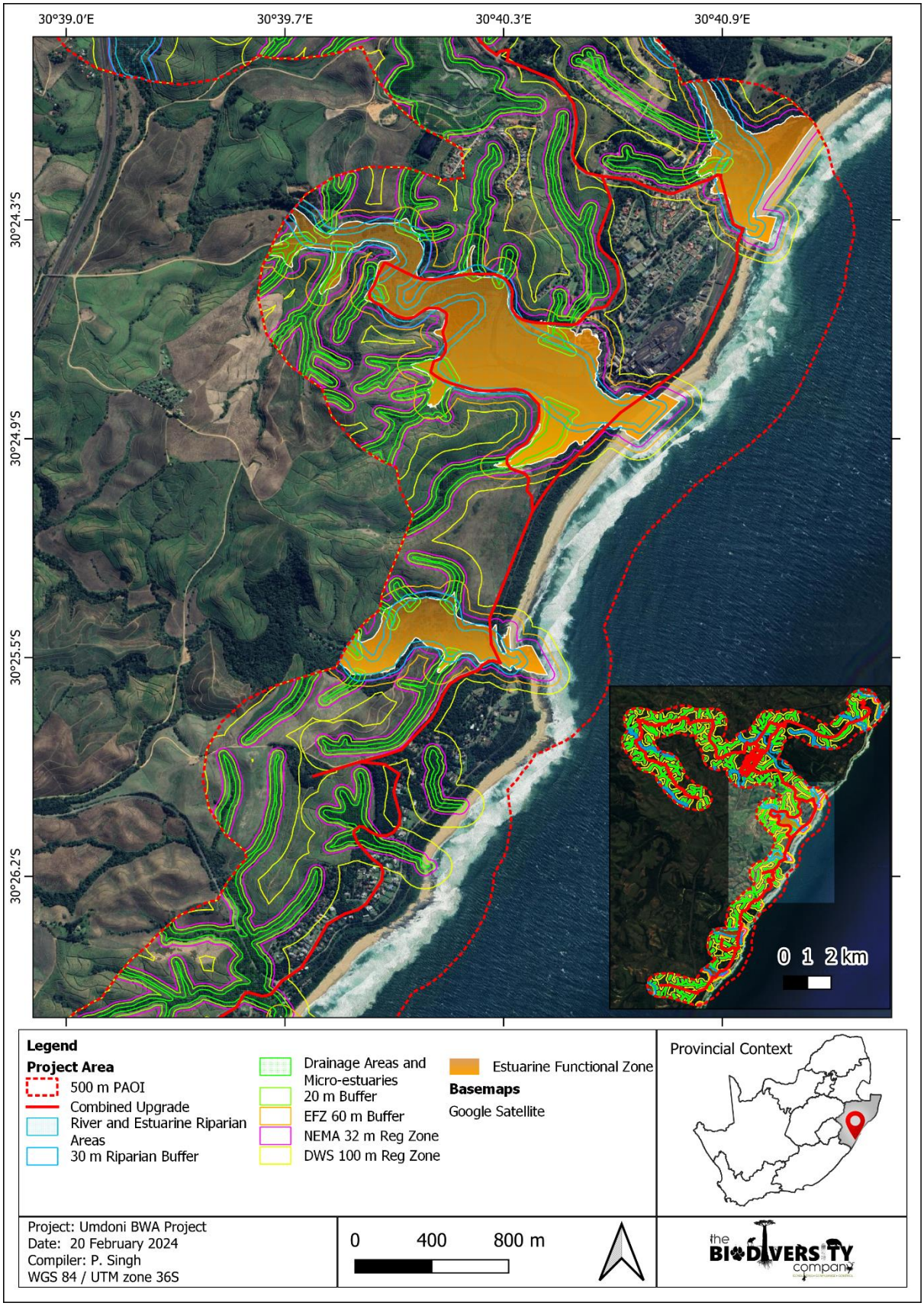


Figure 6-3 Water resources, sensitivity buffers and regulated areas (3 of 6).

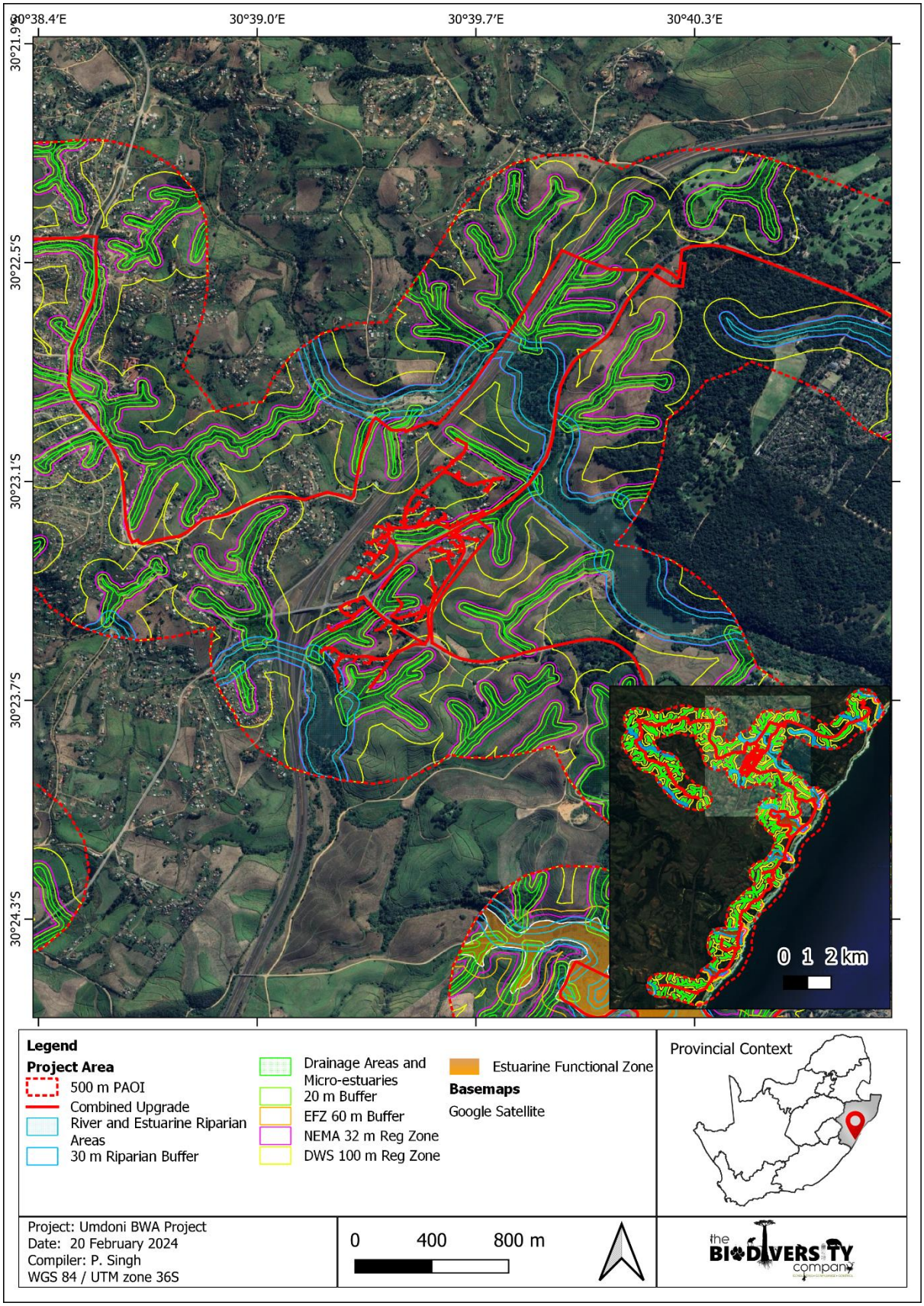


Figure 6-4 Water resources, sensitivity buffers and regulated areas (4 of 6).

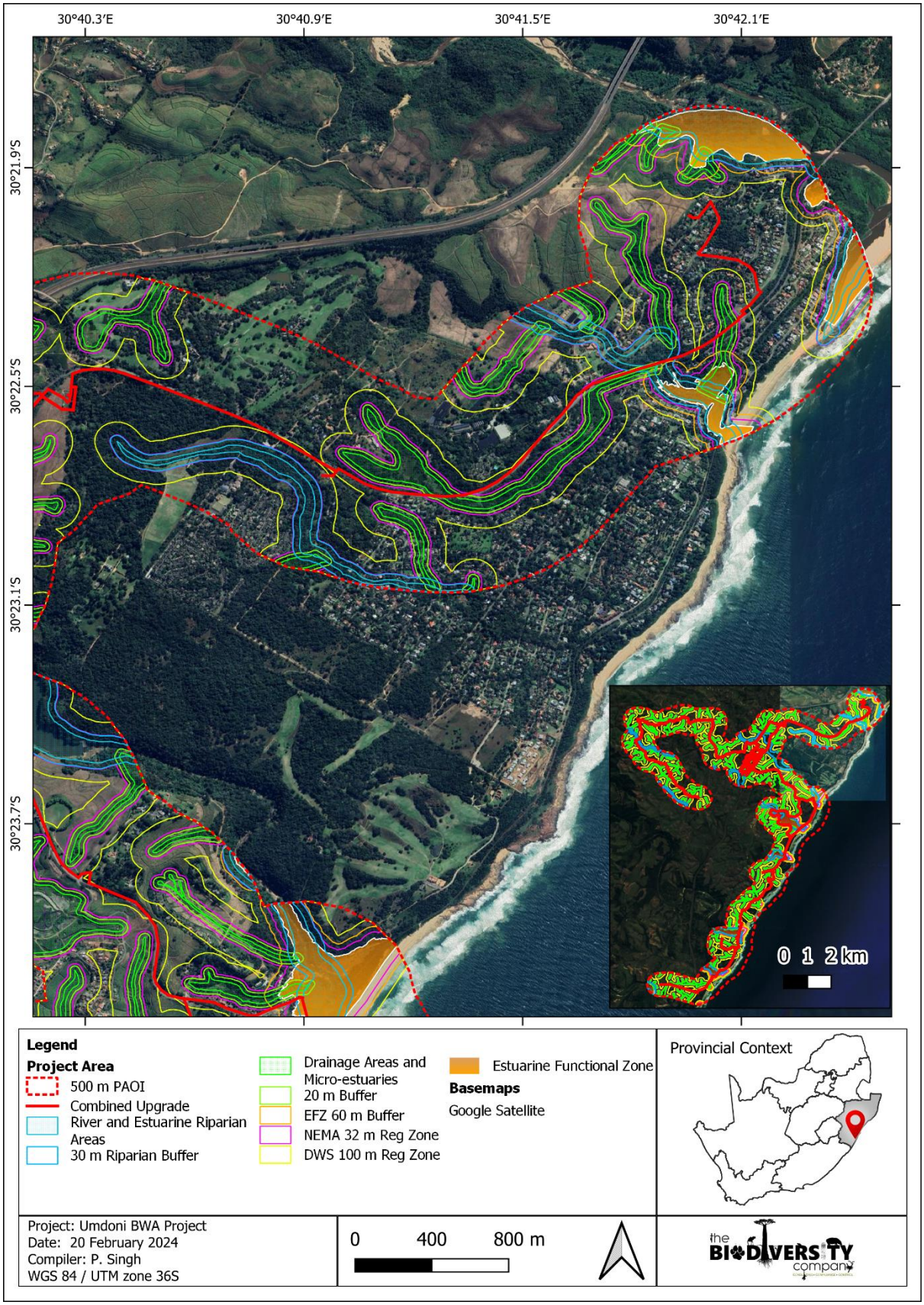


Figure 6-5 Water resources, sensitivity buffers and regulated areas (5 of 6).

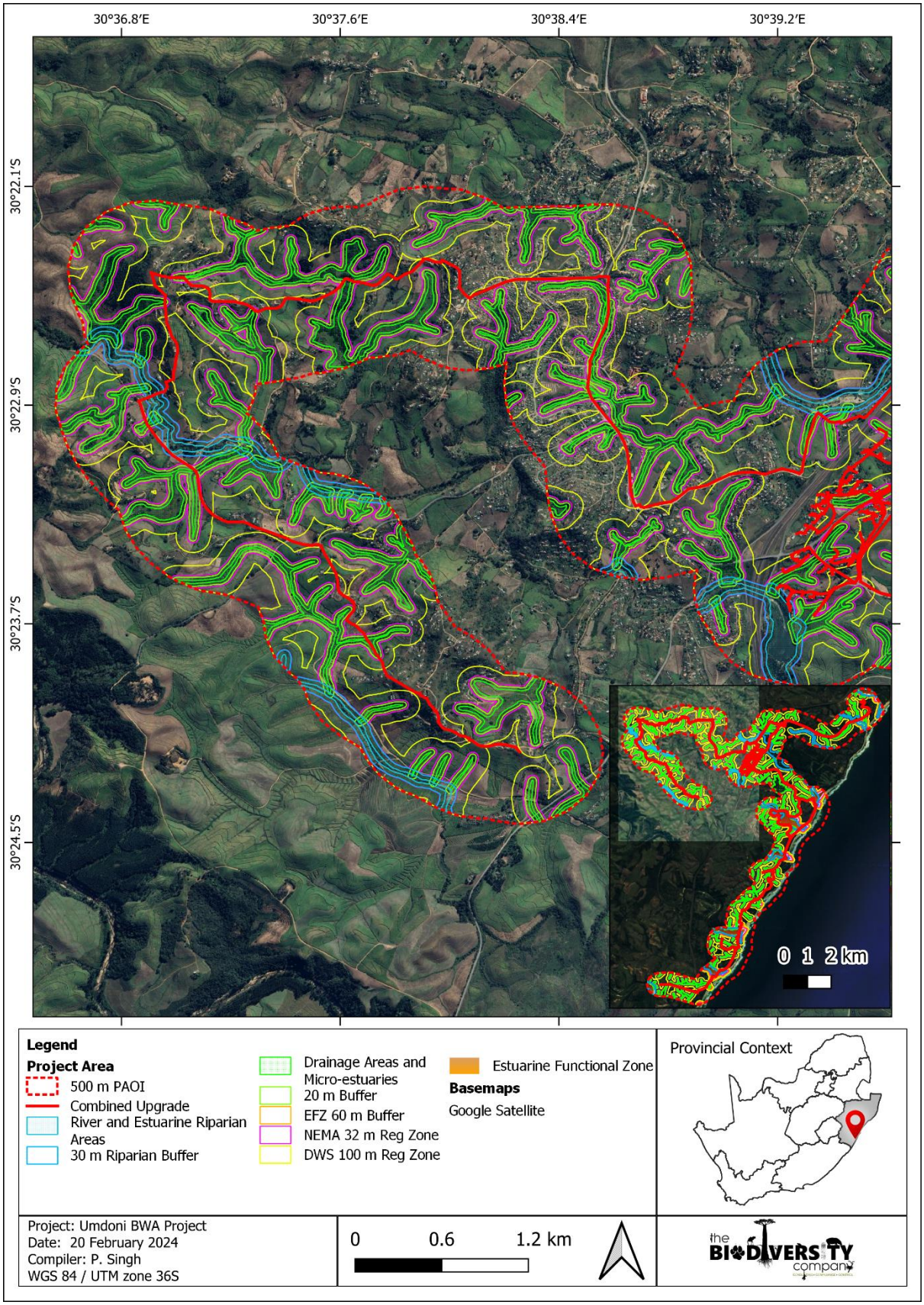


Figure 6-6 Water resources, sensitivity buffers and regulated areas (6 of 6).

7. Sensitivity and Environmental Screening Tool Validation

The National Web-based Environmental Screening Tool has characterised the aquatic sensitivity of the project area as "**Very High**" (Figure 3-4). This was due to numerous water resources and features within the project area. The desktop assessment and site visit agreed with the aquatic sensitivity however some amendments are recommended. This is discussed and validated in Table 7-1 below. The specialist-assigned sensitivity ratings are based largely on the functionality assessment processes followed in the previous section. Additional Very High Sensitivity habitats were determined to be present within the PAOI. Table 7-2 presents the general breakdown of sensitivities within the PAOI.

Table 7-1 Sensitivity features associated with Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

Sensitivity	Features	Specialist Verification
Low	Low sensitivity	**Yes**, Low sensitivity areas present, portions of the PAOI are not sensitive.
Very High	Estuary_iFafa	**Yes**, the iFafa estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_iSezela	**Yes**, the iSezela estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_Subtropical 69	**Yes**, the Subtropical 69 estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_Subtropical 70	**Yes**, the Subtropical 70 estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_Subtropical 73	**Yes**, the Subtropical 73 estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_uMdesingane	**Yes**, the uMdesingane estuary traverses the PAOI. These areas are determined to be very high in sensitivity
Very High	Estuary_uMkhumbane	**Yes**, the uMkhumbane estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_uMthwalume	**Yes**, the uMlthawlume estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_uMuziwezinto	**Yes**, the uMuziwezinto estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Estuary_uMvuzi	**Yes**, the uMvuzi estuary traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	FEPA Subcatchment	**Yes**, there is a FEPA catchment within the southern section of the PAOI, just south of the uMvuzi estuary. These areas are determined to be very high in sensitivity.
Very High	Rivers_AB	**Yes**, an A/B class river (Mtwalume River) traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Rivers_C	**Yes**, a C class river (iFafa River) traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Rivers_D	**Yes**, a D class river (Mzinto River) traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Rivers_Z	**Yes**, a few Z class rivers (Mvuzi, Mdesingane, Sezela, and Mkhumbane rivers) traverse the PAOI. These areas are determined to be very high in sensitivity.
Very High	Wetlands_(Estuary)	**Yes**, the estuaries as identified by the 2018 NBA traverse the PAOI. These areas are determined to be very high in sensitivity.
Very High	Wetlands_(River)	**Yes**, the rivers as identified by the 2018 NBA traverses the PAOI. These areas are determined to be very high in sensitivity.
Very High	Wetlands_Indian Ocean Coastal Belt Bioregion (Depression)	**Disputed,** these depressions have been modified with extensive sugar cane farms. Where a drainage area has replaced the wetland, the sensitivity will now be Medium, else Low.
Very High	Wetlands_Indian Ocean Coastal Belt Bioregion (Seep)	**Disputed,** these seeps have been modified with extensive sugar cane farms. Where a drainage area has replaced the wetland, the sensitivity will now be Medium, else Low.

Table 7-2 Specialist assigned sensitivity ratings.

Aquatic Sensitivity	Aquatic features
Very High	River and estuarine (including micro-estuarine) riparian areas
High	Unmodified tributaries/drainage areas
Medium	Modified tributaries/drainage areas, 60 m, 30 m and 20 m buffer areas
Low	All areas outside of delineated water resources and buffer areas

The reach is susceptible to further impacts, particularly on water quality and physical disturbances to instream and riparian habitat. The aquatic ecology of the immediate project area and further downstream areas is considered sensitive to disturbance from a hydrological and biological perspective. This will include the rivers, estuaries and associated tributaries/drainage lines which are considered sensitive due to the ecosystem services that these watercourse features provide. The construction and operational activities must take cognisance of this and avoid any unnecessary disturbance of the watercourse and riparian habitat. No wetlands were identified within the PAOI as those areas have been modified with extensive sugarcane farms.

8. Water Resource Impact Assessment

Anthropogenic activities drive habitat modification and destruction causing displacement of aquatic and terrestrial fauna and flora, and possibly direct mortality. Land clearing for development infrastructure (all inclusive) destroys local wildlife habitat and can lead to the loss of local breeding grounds, nesting sites and wildlife movement corridors such as rivers, streams and drainage lines and their associated riparian area, or other locally important features such as off channel wetlands. The removal of natural vegetation from these areas and their respective buffers will reduce the habitat available for fauna and may reduce ecological integrity and species diversity within the area depending on the intensity and footprint of clearing and associated destruction.

Any development corresponding with the Site Development Plan (SDP) within the delineated water resources, buffer zones, CBAs and ESAs are not supported by the specialist as these are **no-go areas** for development not authorized. The resultant impact significance of any activity in these areas will be categorised as **Moderate** due to impacts to aquatic ecosystems that need to be kept in a natural condition and the associated risks. Hence, this impact assessment section has focussed on a broad area and the assumption and recommendation that construction and operational phases of the proposed Umdoni Bulk Water Augmentation pipeline will occur within the Project Area and outside but proximal to the abovementioned sensitive areas.

The sections below and associated tables serve to indicate and summarise the significance of perceived impacts on the aquatic ecology of the project area. Potential impacts were evaluated against the data captured during the desktop and field assessment to identify relevance to the project area. The relevant impacts associated with the construction and operation of the proposed Umdoni Bulk Water Augmentation pipeline were then subjected to prescribed impact assessment methods by the Department of Water and Sanitation (DWS) Risk Assessment Matrix (Section 8.6).

8.1 Present Impacts to Aquatic Ecology

Considering the anthropogenic activities and influences within the landscape/catchment, several negative impacts to aquatic biodiversity were observed within the project area. These include:

- Historic land modification from reference conditions;
- Agricultural land impacts (commercial and subsistence farming, extensive sugarcane farming),
- Commercial industries, residential development, commercial and local sustenance fishing,
- Solid waste on instream and riparian habitats,

- Tarred and gravel roads (and associated altered surface hydrology and possible wash of hydrocarbons into watercourses/sensitive areas.
- Water quality modifications (nutrient enrichment, salinisation, toxic effluents),
- Sand mining adjacent to the river resulting in sedimentation,
- Encroachment of alien and invasive vegetation,
- Erosion from river banks; and
- Fences and associated maintenance resulting in habitat fragmentation.

8.2 Project Alternatives

No alternatives were provided for consideration for the proposed development. The purpose of this assessment was to determine the sensitivities within the Project Area/PAOI so that development does not impact on the sensitive areas. Hence it is assumed that the development footprint will not encroach and/or negatively impact the sensitive of areas.

8.3 Loss of Irreplaceable Resources

The aquatic ecology of the project area is considered highly sensitive to disturbance from a hydrological, biological and conservational perspective. This includes the numerous river and estuarine instream and riparian areas, all associated buffer areas, and CBAs. Construction and operation activities must take cognisance of this and avoid any unnecessary disturbance of these areas. Development within these sensitive areas will lead to modifications to the present ecological state and therefore ecosystem degradation.

8.4 Anticipated Impacts

The impacts anticipated for the proposed development activities are considered in order to predict and quantify these impacts and assess and evaluate the magnitude on the identified aquatic biodiversity (Table 8-1). As presented in Section 6 above, it is evident that the following project related activities may result in the loss or degradation of the watercourses/aquatic resources, most of which are functional and provide ecological services. Impacts would therefore be expected directly within the sensitive areas through damage to the watercourse/aquatic resource habitat, notably where construction disturbance will take place. Impacts have the potential for downstream impacts if left unmitigated.

Earthworks will expose and mobilise earth materials which could result in erosion and sedimentation of the receiving systems. A number of machines, vehicles and equipment will be required, aided by chemicals and concrete mixes for the project. Leaks, spillages or breakages from any of these could result in contamination of the receiving water resources. Contaminated water resources are likely to influence the associated biota and sensitive areas.

A negative shift in the biotic integrity of the watercourses within the PAOI would be expected based on the severity of baseline habitat alterations or losses. It should be taken into account that due to the proximity and transversal nature of the proposed development on major rivers, drainage lines and estuaries, the instream and riparian habitats are at potential risk of further degradation, which could potentially impact the downstream environment, highlighting the need to avoid disturbance of these areas.

These disturbances will be the greatest during the construction phase as the related disturbances could result in direct loss and/or damage, and to a lesser degree in the operational phase (i.e. as and when maintenance occurs). These construction and operational phase disturbances could also result in

further spread of alien vegetation which in turn would affect the functioning and integrity of the aquatic ecosystems.

Table 8-1 Anticipated impacts for the proposed activities on water resource habitat and biodiversity.

Phase	Activity	Aspect	Impact
Proposed Pipeline Upgrade	**Construction**	Clearing of vegetation to facilitate the water augmentation pipeline installation Stripping and stockpiling topsoil Operation of heavy machinery and equipment in close proximity to the watercourse Installation of pipelines (strapping) Excavations for pipelines Backfilling trench Shutter for concrete encasement for the pipe Compaction of backfilling material Ablution facilities Domestic and industrial waste Storage of chemicals, mixes and fuel	• Indirect loss of water resources habitat; • Erosion of water resources; • Loss of vegetation; • Establishment and proliferation of alien and invasive plants; • Decrease in functionality; • Water quality impairment; • Compaction; • Altering hydromorphic soils; • Drainage patterns change; • Altering overland flow characteristics; and • Deposition of dust, sediments and • Impacts to aquatic biodiversity associated with spills/leaks into aquatic resources
	Operation	Maintenance of pipelines Alteration of sub-surface flows Steel pipelines and services	
Compiled by:		**Prasheen Singh (Pr.Sci.Nat 116822)**	

8.5 Unplanned Events

Even though leaks and bursts on well-engineered water pipelines are unlikely, an action plan must be set in place for such an event.

The manager or any other responsible individual overseeing the proposed Umdoni Bulk Water Augmentation project must be tasked with reporting any damage or rusting along the route that might indicate leaks or bursts as well as any leaking pipes in general.

Stormwater measures and structures must be implemented to adequately manage storm events. These structures are assumed to be appropriate and for the demands of the project.

8.6 Assessment of Impact Significance – DWS Risk Assessment

A risk assessment was conducted in line with Section 21 (c) and (i) of the National Water Act, 1998, (Act 36 of 1998) to investigate the level of risk posed by proposed project. The risks posed by the proposed development to sensitive areas within the project areas are provided in Table 8-2.

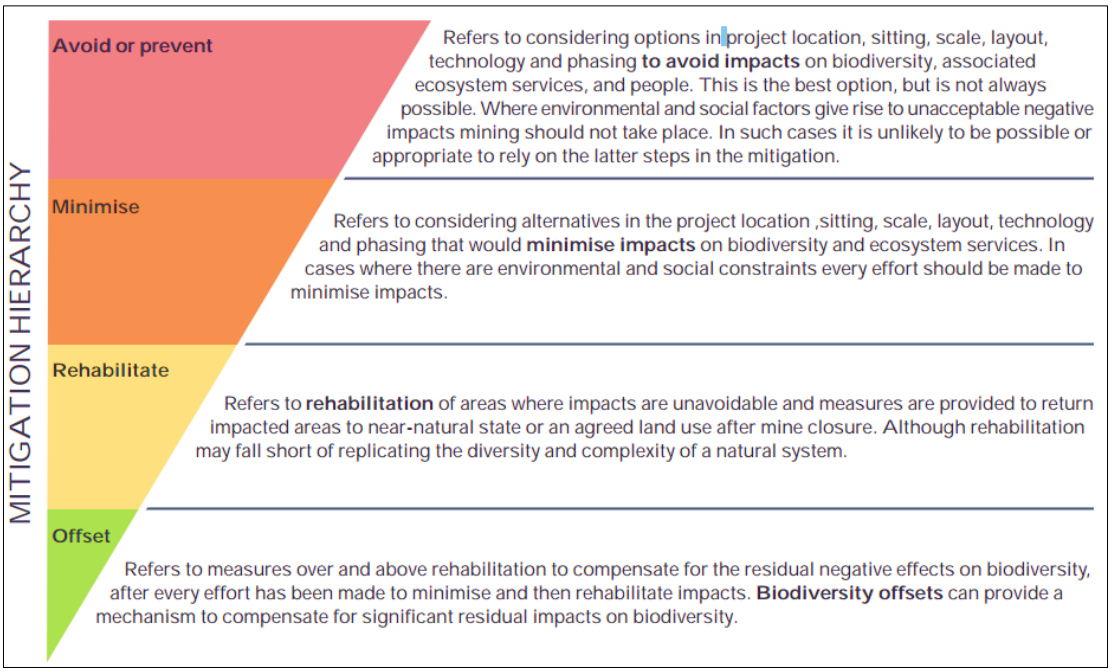


Figure 8-1 The mitigation hierarchy as described by the DEA (2013).

The following step in the mitigation hierarchy will be rehabilitation during and after construction. Given the large extent and the significance of the proposed pipeline's operational phase, it is the specialist's opinion that the rehabilitation of areas degraded from the construction of the proposed pipelines will be sufficient, given the application of the proposed mitigations.

Table 8-2 DWS Risk Impact Matrix summary for the proposed project. Compiled by Prasheen Singh (Pr.Sci.Nat. 116822)

Phase	Activity	Impact	Risk Rating	
			Without Mitigation	With Mitigation
CONSTRUCTION	Clearing of vegetation to facilitate the bulk pipeline installation	Indirect loss of aquatic resources	M	L
		Erosion of banks	M	L
		Loss of vegetation and establishment of alien and invasive plants	M	L
	Operation of heavy machinery and equipment in close proximity to the watercourse	Water quality impairment	M	L
		Compaction	M	L
		Altering hydromorphic soils	M	L
	Excavation, Installation of pipes, stripping and stockpiling of soil	Drainage pattern change	M	L
		Deposition of dust and sediments	M	L
	Concrete encasement of pipeline	Spills/leaks into aquatic resources	M	L
		Storage of chemicals, mixes and fuel	M	L
OPERATIONAL	Maintenance of pipelines	Spills/leaks into aquatic resources	M	L
	Alteration of sub-surface flows	Altering overland flow characteristics	M	L
	Water augmentation pipelines and services	Spills/leaks into aquatic resources	L	L

9. Mitigation Measures

In light of the expected impacts associated with the proposed Bulk Water Augmentation project, the following mitigation measures have been proposed to lower the intensity of the impacts on the ecological integrity of the watercourse catchment and its downslope watercourses features. Since no project description was provided, these mitigations should be considered to general mitigation measures for existing dams.

9.1 Mitigation Measures Objectives

Mitigation measures should aim to avoid or reduce potential negative impacts to air, water, land, ecology and humans, or to introduce positive aspects to the development/activity. The focus of mitigation measures should be to reduce the significance of potential impacts associated with the re-gravelling and crossing infrastructure, and thereby to:

- Prevent the unnecessary destruction of, and fragmentation, of the vegetation community (including the riparian area).
- Prevent the loss of the faunal community (including potentially occurring species of conservation concern) associated with these vegetation communities.
- Limiting the construction area to the defined project areas and only impacting those areas where it is unavoidable to do so otherwise.

9.1.1 Altered Surface Flow, & Hydrological Regime

The following water quality specific mitigation measures are provided:

- The recommended buffer zones (20 m and 30 m) should be strictly adhered to during the construction phase of the project. Any supporting aspects and activities not required to be within the buffer area should adhere to the buffer zone;
- All removed soil and material must not be stockpiled within the aquatic system or riparian area. Stockpiling should take place outside of the water resources. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- Only primary activities related to the alteration/ upgrade of discharge infrastructure to cater for increased flow volumes should be allowed within the watercourse area. All related construction activities related to the area must be restricted to have a minimum footprint of disturbance; and
- Contamination of watercourses with unset cement or cement powder should be negated as it is detrimental to aquatic biota

9.1.2 Impaired Water Quality

The following water quality specific mitigation measures are provided:

- All construction activities must be undertaken during the low flow (dry season) period as much as possible to limit surface flow transporting contaminants to the surrounding watercourse habitat;

- Construction areas, laydown yards, camps and storage areas should be located outside the demarcated buffer zones, and the riparian and watercourse areas must be marked as “restricted” in order to prevent the unnecessary impact too and loss of these systems;

- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;

- During construction contractors used for the project must have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;

- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;

- As much material must be pre-fabricated and then transported to site to avoid the risks of contamination associated with mixing, pouring and the storage of chemicals and compounds on site;

- All chemicals and toxicants during construction must be stored in bunded areas;

- All machinery and equipment should be inspected regularly for faults and possible leaks; these should be serviced off-site;

- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation and watercourse);

- No dumping of construction material on-site may take place;

- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported;

- A suitable stormwater plan must be compiled for the facility and implemented during the construction phase. This plan must attempt to displace and divert stormwater from the project area and discharge the water into adjacent areas without eroding the receiving areas. It is preferable that run-off velocities be reduced with energy dissipaters and flows discharged into the local watercourses. This plan must be ongoing and adaptive based on on-site conditions. All stormwater infrastructure must be monitored and maintained addressing areas on non-efficacy;

- During operation of the water pump stations, all the infrastructure must be properly and regularly managed, maintained and operated throughout the life of the project;

- Any leaks and failures of the waterage infrastructure must be fixed immediately and areas rehabilitated as needed; and

- The existing equipment must be brought up to full operational capacity.

9.1.3 Erosion & Sedimentation

The following water quality specific mitigation measures are provided:

- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the water resources. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Install sandbags around soil stockpiles to prevent soils washing into the system;
- Document the soil profile on removal and ensure the soil is backfilled in the same horizon order in which it was removed. Ensure that topsoil is appropriately stored and re-applied; and
- Make sure that the soil is backfilled and compacted to appropriate geotechnical specifications for the project area.
- Signs of erosion must be addressed immediately to prevent further erosion of the upgraded infrastructure;
- Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil; and
- Landscape and re-vegetate all cleared areas as soon as possible to limit erosion potential.

9.1.4 Alien Vegetation Establishment

The following alien vegetation establishment specific mitigation measures are provided:

- Quarterly vegetation rehabilitation surveys need to be conducted of the vegetation within the project footprint; and
- An alien invasive plant management plan needs to be compiled and implemented prior to construction to control and prevent the spread of invasive aliens. This is particularly applicable for the area beyond the perimeter fence at the discharge area, as access through the access gate was limited by dense alien vegetation that has not been maintained. Subsequently the monitoring of the discharge point and associated infrastructure cannot be conducted.

9.1.5 Water Reticulation and Bulk Pipeline

The following water augmentation pipeline specific mitigation measures are provided:

- The footprint area of the pipelines must be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas;
- Pipe bridges are preferred over underground trenched crossings (specifically for the bulk pipeline). In this regard, the number of piers/plinths established within the riverine / wetland habitat must be minimized and where possible the riverine / wetland habitat must be spanned. Where possible, such infrastructure should be accommodated alongside existing road networks. The footprint area must be aligned with the existing pipeline or existing road/railway reserves wherever possible. Disturbed areas should be sought as the preferred alignment area;
- Pipeline trenches and sandy bedding material may produce preferential flow paths for water across the project area perpendicular to the general direction of flow. This risk can be reduced by installing clay plugs at intervals down the length of the trench to force water out of the trench and down the natural topographical gradient;
- The pipeline should be buried at a sufficient depth below ground level such that the pipeline does not interfere with surface water movement or create obstructions, where flows can cause erosion;

- The excavated streambed, all the excavated material (such as stones) must be kept separate from the rest of the material and be placed back immediately after the completion of the construction process;
- Install sandbags as a temporary measure around key areas of soil loss to prevent soils washing into the local watercourse; and
- In instances where heavy machinery will be used, the areas where indigenous plants exist and are emerging should be avoided as far as possible.

9.1.6 River and Estuary Crossings

The following water resources crossings specific mitigation measures are provided:

- Where feasible, align the pipeline with existing infrastructure. This must include attaching the pipeline to bridges/causeways to span the watercourse;
- Prioritise and schedule construction of the pipeline across water resources during the low flow period;
- The time taken to construct in a wetland must be kept to a minimum (preferably < 24 hours), this will include excavation of the trench, pipe installation, backfill and restoration of the wetland. On completion of a crossing should work proceed to the next crossing;
- Only machinery, equipment and persons essential for the construction of the crossing through the aquatic resources are permitted. All non-essential aspects must adhere to the buffer width;
- Any temporary flow diversions must be removed after installation of the pipeline, and rehabilitation of the crossing;
- Construct crossings as close to perpendicular to the direction of flows through wetlands and drainage lines; and
- The pipeline must be buried below the elevation of the wetland surface. The profile of the wetland must not be permanently lowered during construction. Rehabilitation of the crossing must restore to the natural (or original) profile of the crossing.

9.1.7 Stripping and Stockpiling Topsoil

The following excavation and topsoil stockpiling specific mitigation measures are provided:

- The first 300 mm of soil must be stockpiled separate from the soil excavated deeper than 300 mm; and
- The proposed pipeline system must be divided up into 100 m intervals. Each interval's soil must be stockpiled and filled back up (in the correct order) to avoid long periods of stockpiling.

9.1.8 Rehabilitation and Revegetation of Aquatic Resources

- The rehabilitation and revegetation should be conducted in accordance with the approved Rehabilitation Plan (including Plant Species Plan) under supervision of a suitably qualified ECO and/or Ecologist;
- Pipeline trenches within/below aquatic resources and buffer areas must be rehabilitated as soon as the pipes have been laid so that ecological functions and natural flow paths can resume without further disruptions to the systems;

- Stream diversions should only occur where approved and licensed. Diversions must be supervised by a suitably qualified ECO and should be conducted for the minimum amount of time as required for the specific crossing;

- Stream diversions and crossings must take into account natural flow volumes and the River Continuum Concept;

- No heavy machinery shall be permitted within unauthorised water resource areas for any purpose, without the prior approval of the ECO (except emergency procedures). Clearing of vegetation shall be conducted by hand. All cleared and trimmed vegetation shall be removed from any watercourse to prevent flooding / snagging hazards being created;

- Re-vegetation of disturbed areas must be undertaken with site-specific indigenous species in accordance with biome-specific vegetation types. Rehabilitation of the vegetation component should also include resident, indigenous riparian and hydrophilic plant species that have established in the local area. This, to ensure survival and proliferation of site-specific vegetation that have already adapted to the current conditions and provide ecosystem services for other terrestrial and aquatic biota.

- The construction servitude must be identified and be clearly demarcated prior to the commencement of any construction activities on site and before the arrival of construction machinery. Vehicles must use a single route to enter and exit the construction site. This will ensure that the compacting of the soils of these areas is kept to a minimum. The compacting of the soil can lead to an increase in runoff that in return will lead to sedimentation of the aquatic ecosystems;

- The demarcations must stay in place for the entire construction phase and no personnel, construction machinery or construction material should move or be placed outside the demarcated construction servitude;

- The servitude must accommodate all construction related activities, including materials storage, access routes, soil stockpiles etc.;

- Areas where vegetation removal has taken place must be re-vegetated and monitored after construction has been completed;

- Dry seeding or hydro seeding may be used. If dry seeding is used it must be done at the end of the dry season and/or beginning of the wet season. This will ensure the seeds germinate and will not be washed away during high rainfall events;

- All present alien and invasive plant species in the project area should be eradicated if the project is approved. Therefore, as part of the rehabilitation plan, regular removal of alien and invasive plant species should take place;

- Habitat plays an integral role in species richness, hence any reduction/deviation from the optimal vegetation, stones, gravel, sand, mud, and/or differential flow availability may reduce biodiversity;

- Stabilisation of the riverbank should be implemented at sections of crossings with a high probability of being affected by the construction activities. The stabilisation methods should ensure that adequate marginal vegetation is available for aquatic biota;

- Re-vegetation with functional indigenous species on accessible margins of the river should be actioned during the rehabilitation process and will ensure adequate habitat availability for fish and macroinvertebrates. This will also ensure succession of indigenous species over alien species, when coupled with alien vegetation removal;

- Where applicable de-silting the benthic area of sand and soils from construction activities may aid in increasing the surface area of the stones biotope (in which many macroinvertebrates thrive) by reducing and limiting the distribution of the gravel/sand/mud (GSM) biotope to its natural zonation;

- No clearing of vegetation or construction activities to take place other than on the footprint of the activity; and

- Dedicated implementation of the Environmental Management Programme (EMPr), including compliance monitoring and auditing by an ECO.

9.1.9 General

The following mitigation measures are aimed at the conservation of the delineated wetlands and watercourses in general;

- The contractors used for the construction should have spill kits available prior to construction to ensure that any fuel, oil or hazardous substance spills are cleaned-up and discarded correctly;

- All construction activities must be restricted to the development footprint area. This includes laydown and storage areas, ablutions, offices etc.;

- During construction activities, all rubble generated must be removed from the site;

- Construction vehicles and machinery must make use of existing access routes;

- All chemicals and toxicants to be used for the construction must be stored in a bunded area;

- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;

- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;

- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);

- All removed soil and material stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;

- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;

- No dumping of construction material on site may take place; and

- All waste generated on site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

9.2 Recommendations

The following recommendation has been made to ensure the conservation of the river and estuaries;

- A competent Environmental Control Officer (ECO) must oversee the construction and rehabilitation phase of the project, with watercourse areas as a priority;
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase;
- Rehabilitation must be done following an approved Rehabilitation Plan and in consultation with a suitably qualified SACNASP professional;
- An alien invasive plant management plan needs to be implemented and conducted regularly to control current invaded riparian areas and prevent the growth of invasives on cleared areas. This will assist in improving the biotic integrity and ecosystem functioning of the delineated watercourses;
- Monitor water quality during the construction phase against baseline limits in this report, as well as any limits that will be stipulated in the water use license;
- Bi-annual biomonitoring of relevant aquatic systems; and
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase.

10. Conclusion

10.1 Baseline Ecology

The freshwater ecology of the project area is considered highly sensitive to disturbance from a hydrological, biological, and conservational perspective. This includes rivers, estuaries, tributaries/drainage areas and micro-estuaries, as well as all associated buffer areas, Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), associated with the project. Drainage lines within the Project Area of Influence (PAOI) did not qualify for standard aquatic sampling methods. The *in-situ* water quality indicated pH levels, dissolved oxygen and water temperature fell within the TWQR limits for freshwater ecosystems in South Africa, which would support sensitive aquatic biota. Electrical conductivities in riverine sections were below the recommended limit but surpassed the limit in estuarine areas, the latter is expected. According to the IHI results, the assessed reaches presented instream conditions that were considered Largely Modified (class D) to Moderately Modified (class C) and riparian habitat was rated as Seriously Modified (class E) to Moderately Modified (class C), indicating that the loss of natural habitat, biota and basic ecosystem functions is extensive. Despite the largely modified instream habitat, the SASS5 macroinvertebrate assessment presented a moderately modified (Class C) to largely modified (Class D) ecological categories, most likely maintained by the adequate water quality. The Present Ecological State (PES) of the river reaches ranged from Class C or Moderately Modified (Mvuzi River, Sezela River, iFafa River and Mdesingane River), to Class D or Largely Modified in the Mkhumbane River reach, to Class D/E or Largely to Seriously Modified in the Mtwalume River reach. This suggested that there has been a large loss of ecological integrity and function due to anthropogenic landuse impacts. These major river systems still have a high or very high ecological importance and sensitivity. The PAOI is currently modified as a result of residential development, industrial activities, formal and dirt roads, extensivesugarcane farming, commercial and subsistence fishing, among other anthropogenic landuse activities.

10.2 Impact Assessment

The findings from the risk assessment indicated that the majority of aspects involved with the construction and operation of the proposed water augmentation pipeline have been scored a “Moderate” risk rating without mitigation. These ratings are expected to decrease to “Low” with the application of mitigation measures in this document as well as implementation of the EMPr considering the fact that some of the proposed components are located within the servitude of an existing pipeline or the road servitude.

Rehabilitation, an imperative step in the mitigation hierarchy, is required during and after construction. Given the small extent and the significance of the proposed pipeline’s operational phase, it is the specialist’s opinion that the rehabilitation of areas degraded from the construction of the proposed pipelines will be sufficient. Implementation of the prescribed water resource mitigation measures, supplemented with rehabilitation of the crossings will result in a recovery of the functioning of these systems. The pipeline crossings should be installed to a depth of at least 200 – 300 mm below the surface so as to not disturb the natural slope of the benthic substrate, and then rehabilitated in order to avoid any long-term impacts to the system.

A conservative buffer zone of 30 m was suggested for the river riparian areas and 20 m for the associated tributaries/drainage lines as well as micro-estuaries. A 60 m buffer has also been delineated for the Estuarine Functional Zone (EFZ). These buffer areas serve as **No-go** zones for unauthorised activities. The site development plan should therefore be designed accordingly. Ensuring buffers are intact increases the resilience of a watercourse to future disturbances.

10.3 Specialist Opinion

Based on the survey findings, the specialist agrees with the “**Very High**” aquatic theme sensitivity per the National Web based Environmental Screening Tool as the PAOI overlaps with several riverine and estuarine riparian areas, estuarine functional zones, tributaries/drainage lines, conservation buffer areas, and CBA irreplaceable and ESA areas. In accordance with the General Authorisation (GA) in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA under Appendix D2 applies as the upgrade will be conducted by Ugu District Municipality. Furthermore, it is the specialist’s opinion that the proposed pipeline can proceed on condition that the recommendations made within this report as well as the prescribed mitigation measures be adhered to.

11. References

Adams, JB. 2019. Salt marsh at the tip of Africa: Patterns, processes and changes in response to climate change. *Estuarine, Coastal and Shelf Science*. Vol 237.

Barbour, M.T., Gerritsen, J. & White, J.S. 1996. Development of a stream condition index (SCI) for Florida. Prepared for Florida Department of Environmental Protection: Tallahassee, Florida.

Branch, G, M., Griffiths, C, L., Branch, M, L. & Beckley, L, E. 2007. Two Oceans: A Guide to the Marine Life of Southern Africa. 2nd Edition. Cape Town:Struik Publishers.

Coast KZN. 2024. Estuaries KZN Estuary Observer Programme. KZN Estuary Observer Programme - Coast KZN Date of access: 15 Feb. 2024.

Dallas, H.F. 2007. River Health Programme: South African Scoring System (SASS) Data Interpretation Guidelines. Report produced for the Department of Water Affairs and Forestry (Resource Quality Services) and the Institute of Natural Resources.

Department of Forestry, Fisheries and the Environment (DFFE). 2022. SACAD (South Africa Conservation Areas Database) and SAPAD (South Africa Protected Areas Database). http://egis.environment.gov.za.

Department of Water Affairs and Forestry (DWAF). 1996. South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems.

Department of Water Affairs and Forestry (DWAF). 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Pretoria: Department of Water Affairs and Forestry.

Department of Water and Sanitation (DWS). 2017. Classes of Water Resource and Resource Quality Objectives for the catchments of the Mvoti to Umzimkulu. Government Gazette No. 41306. Pretoria: Department of Water Affairs and Sanitation.

Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx. Accessed January 2024

Dickens, C. W. S. and Graham, P.M. 2002. The South African Scoring System (SASS) Version 5: Rapid bioassessment method for rivers. African Journal of Aquatic Science. 27 (1): 1 -10.

ENsync Engineers. 2024. Preliminary Design Report – Umdoni South Bulk Water Augmentation 03-2267-01-06-09-002: KwaZulu-Natal.

Fry C. 2022. A Field Guide to Freshwater Macroinvertebrates of Southern Africa. 2022. Jacana Media. ISBN: 9781431431052

Gerber, A. & Gabriel, M.J.M. 2002. Aquatic Invertebrates of South African Rivers Field Guide. Institute for Water Quality Studies. Department of Water Affairs and Forestry. 150pp

International Union for Conservation of Nature and Natural Resources (IUCN). 2024. Red list of threatened species – 2023-1. www.iucnredlist.org. (Accessed in January 2024).

Kleynhans, CJ. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo System, South Africa) Journal of Aquatic Ecosystem Health 5:41-54.

Kleynhans CJ. 2007. Module D: Fish Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2) Joint Water Research Commission and Department of Water Affairs and Forestry report.

Le Maitre, D.C., Seyler, H., Holland, M., Smith-Adao, L., Nel, J.L., Maherry, A. and Witthüser, K. (2018) Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria.

Lotter, M.C., Le Maitre, D. 2021. Fine-scale delineation of Strategic Water Source Areas for surface water in South Africa using Empirical Bayesian Kriging Regression Prediction: Technical report. Prepared for the South African National Biodiversity Institute (SANBI), Pretoria. 33p.

Macfarlane, D.M., Dickens, J. & Von Hase, F. 2009. Development of a methodology to determine the appropriate buffer zone width and type for developments associated with wetlands, watercourses and estuaries. Deliverable 1: Literature Review. INR Report No: 400/09

Nel JL, Murray KM, Maherry AM, Petersen CP, Roux DJ, Driver A, Hill L, Van Deventer H, Funke N, Swartz ER, Smith-Adao LB, Mbona N, Downsborough L and Nienaber S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Rentier, E.S. & Cammeraat, L.H. 2022. The environmental impacts of river sand mining. Science of the Total Environment 838 (1). 1-6.

Rowntree, K. and Ziervogel, G., 1999. Development of an Index of Stream Geomorphology for the Assessment of River Health. National Aquatic Ecosystem Biomonitoring Programme.

Rountree KM, Wadeson RA and O'Keeffe J. 2000. The Development of a Geomorphological Classification System for the Longitudinal Zonation of South African Rivers. South African Geographical Journal 82 (3): 163-172.

Thirion, C.A., Mocke, A. & Woest, R. 1995. Biological monitoring of streams and rivers using SASS4. A User's Manual. Internal Report No. N 000/00REQ/1195. Institute for Water Quality Studies. Department of Water Affairs and Forestry.

Van Deventer, H.; Smith-Adao, L.; Mbona, N.; Petersen, C.; Skowno, A.; Collins, N.B.; Grenfell, M.; Job, N.; Lötter, M.; Ollis, D.; Scherman, P.; Sieben, E.; Snaddon, K. 2018. South African Inventory of Inland Aquatic Ecosystems. South African National Biodiversity Institute, Pretoria. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.

Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E. & Snaddon, K. 2018. South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 October 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI): Pretoria, South Africa. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.

Van Niekerk, L., Taljaard, S., Adams, J., Lamberth, S. & Weerts, S. 2015a. Country-level ecosystems accounts for estuaries: South Africa's experience with a Transitional Realm. Environmental Science, Geography.

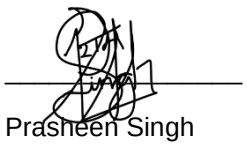
Van Niekerk, L., Taljaard, S., Adams, J.B., Fundisi, D., Huizinga, P., Lamberth, S.J., … Wooldridge, T.H. 2015b. Desktop Provisional Ecoclassification of The Temperate Estuaries of South Africa.

12. Appendices

12.1 Appendix A Specialist Declaration

I, Prasheen Singh, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Prasheen Singh

Aquatic Ecologist

The Biodiversity Company

February 2024

I, Innocent Makwela declare that:

- I act as the independent specialist in this study.
- 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 project.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the study.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the study.
- I undertake to disclose to the client 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 study 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.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Innocent Makwela

Aquatic Ecologist

The Biodiversity Company

February 2024

12.2 Appendix B – SASS Accreditation

NATIONAL AQUATIC ECOSYSTEM HEALTH MONITORING PROGRAMME

Water and Sanitation

Water Research Commission

GP2023/10/02

CERTIFICATE OF ACCREDITATION

This is to certify that

Innocent Makwela

has met the requirements of the
River Health Programme as a SASS5 Practitioner

COMPETENCY IN THE FOLLOWING AREAS HAVE BEEN DEMONSTRATED:

UNDERSTANDING OF THE SCOPE AND APPLICATION OF THE SASS5 METHOD.
DEMONSTRATION OF THE CORRECT SAMPLING PROTOCOLS
DEMONSTRATION OF THE CORRECT SAMPLE PREPARATION PROTOCOLS
IDENTIFICATION OF AQUATIC MACROINVERTEBRATES

COMPETENCY IS VALID FOR 3 YEARS FROM CERTIFICATE DATE

NATIONAL SASS5 AUDITOR

27 October 2023
DATE

12.3 Appendix C – Project Methodology (ENsync Engineers, 2023)

UMDONI SOUTH BULK WATER AUGMENTATION
BRIDGE CROSSING METHODOLOGY

Installing pipes on a bridge crossing involves strapping the pipes onto the bridge structure to ensure stability and secure attachment. Here is a step-by-step methodology for pipe installation on a bridge crossing:

Planning and Design

Determine the pipe diameter and material based on the water supply requirements and bridge specifications.

Review the bridge design and identify suitable locations for pipe installation, considering factors such as clearance, load-bearing capacity, and structural integrity.

Prepare detailed drawings and specifications for the pipe layout, including the type and placement of strapping materials.

Material Procurement

Procure high-quality pipes, fittings, and strapping materials based on the project specifications and requirements.

Ensure that the materials meet the relevant standards and certifications for water supply applications and bridge installations.

Bridge Assessment

Conduct a thorough assessment of the bridge structure to ensure its suitability for pipe installation.

Inspect the bridge for any signs of damage, deterioration, or structural weaknesses.

Consult with structural engineers or bridge experts to verify the bridge's load-bearing capacity and suitability for pipe installation.

Strapping Preparation

Determine the appropriate strapping material based on the bridge structure and pipe size.

Cut the strapping material into suitable lengths, allowing for proper attachment to the bridge and securing the pipes.

Prepare any necessary fasteners, such as bolts, nuts, or clamps, to secure the strapping to the bridge.

Pipe Alignment and Supports

Align the pipes according to the planned layout, ensuring proper clearance and alignment with other bridge components.

Install pipe supports, such as brackets or hangers, at regular intervals to provide additional stability and prevent excessive movement.

Strapping Installation

Attach the strapping material to the bridge structure, ensuring a secure and stable connection.

Wrap the strapping around the pipes, ensuring a tight fit without causing damage or deformation to the pipes.

Fasten the strapping using the prepared fasteners, ensuring proper tension to secure the pipes in place.

Testing and Inspection

Conduct a visual inspection of the installed pipes and strapping to ensure proper alignment, stability, and attachment.

Verify the integrity of the strapping and fasteners, checking for any signs of loosening or damage.

Conduct pressure testing of the installed pipes to ensure their integrity and identify any leaks or weaknesses.

Restoration and Commissioning

Restore any disturbed areas on the bridge, ensuring proper surface reinstatement and protection against corrosion or damage.

Install valves, meters, and other necessary components as per the project specifications.

Flush and disinfect the pipeline to ensure water quality compliance.

Commission the water supply system, ensuring proper functioning and flow.

NB: This is a general methodology for a bridge crossing and is not the final methodology for the crossings.

UMDONI SOUTH BULK WATER AUGMENTATION
PIPE LAYING METHODOLOGY

Laying steel pipes for water supply involves several steps and considerations to ensure a safe and efficient installation. Here is a general methodology for laying water supply steel pipes:

Planning and Design

- Determine the required pipe diameter and material based on the water supply demand and pressure requirements.
- Conduct a site survey to identify the route for the pipeline, taking into account factors such as existing infrastructure, terrain, and any potential obstacles.
- Prepare detailed drawings and specifications for the pipeline layout, including the location of valves, fittings, and other components.

Material Procurement

Procure high-quality steel pipes, fittings, valves, and other necessary materials based on the project specifications and requirements.

Ensure that the materials meet the relevant standards and certifications for water supply applications.

Pipe Laying

Digging the Trench

Mark the trench route based on the project plans and specifications.

Ensure that the trench is wide and deep enough to accommodate the steel pipe and any necessary backfilling material.

Take into account any required slope or gradient for proper water flow.

Follow proper safety procedures during excavation, including shoring and trench supports if needed.

Bedding Preparation

Prepare the trench bottom by removing any rocks, debris, or sharp objects that could damage the pipe.

Create a smooth and even bedding surface using suitable materials like sand or gravel.

Ensure that the bedding material is properly compacted to provide stable support for the steel pipe.

Pipe Placement

Lower the steel pipe into the trench carefully to avoid damage or misalignment.

Ensure proper alignment and grade of the pipe according to the project plans.

Use pipe supports or cradles, if required, to maintain the desired alignment and prevent sagging or stress on the pipe.

Pipe Connection

Connect the steel pipes using appropriate fittings, such as flanges or welded joints, following the manufacturer's instructions and industry best practices.

Use gaskets or sealing compounds to ensure leak-proof connections.

Ensure that the connections are properly tightened and secured.

Backfilling

Begin backfilling the trench with suitable material, such as sand or gravel, in layers.

Ensure that the backfill material is properly compacted around the pipe to provide support and prevent settling.

Backfill the trench gradually, ensuring that the pipe remains secure and aligned throughout the process.

Avoid using large rocks or sharp objects that could damage the pipe during backfilling.

Compaction:

Compact the backfill material using suitable equipment, such as a compactor or vibrating plate, to achieve proper density and stability.

Compact the backfill material in layers, gradually building up the trench to the desired level.

Pay attention to compaction around the pipe to prevent settling or damage.

Testing and Inspection

Conduct pressure testing of the installed pipeline to ensure its integrity and identify any leaks or weaknesses.

Inspect the entire pipeline for any defects, damage, or improper installation.

Make any necessary repairs or adjustments before proceeding to the next stage.

Restoration and Commissioning

Restore the excavated area, including proper compaction, grading, and reinstatement of any disturbed surfaces.

Install valves, meters, and other necessary components as per the project specifications.

Flush and disinfect the pipeline to ensure water quality compliance.

Commission the water supply system, ensuring proper functioning and flow.

UMDONI SOUTH BULK WATER AUGMENTATION
STREAM CROSSING METHODOLOGY

Installing pipes for river or stream crossings requires careful planning and execution to ensure a secure and reliable installation. Here is a step-by-step methodology for pipe laying on river or stream crossings:

Planning and Design

Determine the pipe diameter and material based on the water supply requirements, hydraulic calculations, and environmental considerations.

Conduct a site survey to assess the river or stream characteristics, including water flow, depth, and sedimentation.

Consider the bridge or crossing structure design, including the type of support required for the pipes.

Material Procurement

Procure high-quality pipes, fittings, and other necessary materials based on the project specifications and requirements.

Ensure that the materials meet the relevant standards and certifications for water supply applications and river/stream crossings.

Site Preparation

Clear the area around the crossing site, removing any vegetation, debris, or obstacles that may hinder the installation process.

Ensure proper access to the site for equipment and personnel.

Trenching:

Divert the stream where necessary

Excavate a trench on the river or stream, ensuring it is wide and deep enough to accommodate the pipe and any necessary backfilling material.

Protect the trench area to avoid the water from the stream coming into the trench

Take into account any required slope or gradient for proper water flow.

Consider environmental regulations and minimize disruption to the river or stream ecosystem.

Pipe Preparation and Assembly:

Prepare the pipes by cleaning and inspecting them for any defects or damage.

Pipe Installation:

Shutter for the concrete encasement of the pipe through out the length of the river

Use cranes, winches, or other appropriate equipment to carefully guide and position the pipes.

Connect the pipes using appropriate fittings, such as flanges or welded joints, following the manufacturer’s instructions and industry best practices.

Ensure proper alignment and tight connections to prevent leaks or failures.

Install supports, such as concrete anchors to secure the pipes in place, taking into account the hydraulic forces and potential scouring.

Pour concrete for the concrete encasement of the pipe

Allow concrete to dry and strip the shutters.

Backfilling and Compaction:

Backfill the trench with suitable material, such as sand or gravel, in layers, ensuring proper compaction to support the pipes and prevent settling or damage.

Consider using erosion control measures, such as geotextiles, to protect the crossing and prevent sedimentation.

Testing and Inspection:

Conduct pressure testing of the installed pipeline to ensure its integrity and identify any leaks or weaknesses.

Inspect the entire pipeline for any defects, damage, or improper installation.

Make any necessary repairs or adjustments before proceeding to the next stage.

Restoration and Commissioning:

Restore the excavated area, including proper compaction, grading, and reinstatement of any disturbed surfaces.

Allow the water flow back to the original position.

Flush and disinfect the pipeline to ensure water quality compliance.

Commission the water supply system, ensuring proper functioning and flow.

- End of report -