AQUATIC BIODIVERSITY IMPACT ASSESSMENT REPORT

Proposed Blikana Dam Bulk Water Supply Scheme within the Joe Gqabi District Municipality, Eastern Cape.

Report Prepared For

Abantu Environmental Services

ABANTU ENVIRONMENTAL SERVICES

Report Prepared by

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1	April 2026	Final Report	Zona Quvile

Executive Summary

This report presents the findings of an Aquatic Biodiversity Impact Assessment undertaken for the proposed Blikana Dam Bulk Water Supply Scheme (BWSS) within the Joe Gqabi District Municipality, Eastern Cape. The study was commissioned to inform the Environmental Authorisation process and to assess the potential impacts of the proposed development on rivers, drainage lines, riparian habitat and associated aquatic biodiversity. The assessment was undertaken in accordance with the Environmental Impact Assessment Regulations, 2014 (as amended) and the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (GN 320 of 2020).

The proposed BWSS includes a dam, abstraction infrastructure, a water treatment works (WTW), reservoirs and associated rising and gravity mains intended to improve bulk water supply to wards within the Senqu Local Municipality. From an aquatic perspective, the primary receiving environment is the Blikana River, together with associated tributaries and drainage lines that may be affected by the proposed infrastructure, particularly where components occur close to watercourses or at crossing points.

Desktop assessment and field verification indicate that the Blikana River is a perennial 2nd order river system occurring within a relatively natural landscape context. The desktop PESEIS data for the relevant sub-quaternary reach indicate a Present Ecological State (PES) of Category B (Largely Natural), with a High Ecological Sensitivity and a Moderate to High Ecological Importance, particularly in relation to fish rarity, connectivity and habitat integrity. Site-specific assessment further indicates that the river remains functional but is subject to localised pressures associated with erosion, grazing, rural access, roads and diffuse rural land-use impacts.

A provisional Index of Habitat Integrity (IHI) assessment indicates that the Blikana River is moderately modified, particularly in relation to riparian disturbance, localised erosion and water quality pressures, while still retaining important ecological function. The Ecological Importance and Sensitivity (EIS) of the river was assessed as High, and the inferred Recommended Ecological Category (REC) for the main channel is A/B, indicating that the river should ideally be protected and improved toward a near-natural condition where feasible.

Fish sampling undertaken by means of electroshocking recorded Labeobarbus aeneus and Enteromius anoplus, confirming the presence of an indigenous fish assemblage within the Blikana River. Based on the recorded assemblage, habitat condition and identified disturbance drivers, the fish community is interpreted as being in a moderately modified ecological condition, broadly consistent with a FRAI Category C assessment.

A 50 m aquatic buffer was applied to the Blikana River as a precautionary setback. While some BWSS components occur within this buffer, and two rising mains cross the river, these areas were treated as high-sensitivity aquatic interaction points. Infrastructure within the buffer is not preferred, but may be acceptable where unavoidable, provided that strict construction controls, stormwater management, erosion and sediment control, pollution prevention and rehabilitation measures are implemented.

The preferred WTW site is supported from an aquatic perspective over Alternative 1, even though both sites are outside the recommended river buffer. This is because the preferred site is not associated with drainage lines or dongas, whereas Alternative 1 is associated with drainage features that could provide more rapid hydrological connectivity to the Blikana River in the event of spills, sediment mobilisation or contaminated runoff.

The main construction-phase aquatic risks identified include vegetation and habitat disturbance, faunal disturbance, sediment mobilisation, hydrocarbon/chemical contamination and drainage alteration/erosion initiation. The main operational risks include water quality deterioration associated with poor WTW operation, contaminated runoff, sludge/process waste handling failures and altered stormwater runoff. With implementation of the recommended mitigation measures, most impacts are

expected to reduce to low or very low significance, while the cumulative impacts are similarly expected to remain low to low-moderate. A potentially important positive impact of the project is the improvement in bulk water supply reliability and more coordinated water resource management.

Overall, the proposed BWSS is considered acceptable from an aquatic biodiversity perspective, provided that the recommended mitigation measures, buffer controls, crossing design requirements, rehabilitation measures and monitoring commitments are fully implemented. No fatal flaw was identified from an aquatic perspective, but river crossings, within-buffer infrastructure and drainage-linked construction areas should be treated as environmentally sensitive components requiring enhanced management.

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Disclaimer

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Opinions presented in this report apply to the site conditions and features as they existed at the time of investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which Earthguard had no prior knowledge nor had the opportunity to evaluate. Therefore, the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although the authors exercised due care and diligence in rendering services and preparing documents, they accept no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

Definition of Terms

Alien species: The alien species are species which is originated from foreign country.

Assessment Criteria: The environmental impacts are assessed with mitigation measures (MM) and without mitigation measures (WMM).

Biodiversity: Biodiversity is the variety of plant and animal life in the world or in a habitat.

Biome: A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

Confidence: The confidence level can be classified as medium during the construction phase. However, the confidence level becomes low during the operational phase.

Conservation: Conservation is the management of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

Corridors: Have important functions as strips of a particular type of landscape differing from adjacent land on both sides. Habitat, ecosystems or undeveloped areas that physically connect habitat patches. Smaller, intervening patches of surviving habitat can also serve as "steppingstones" that link fragmented ecosystems by ensuring that certain ecological processes are maintained within and between groups of habitat fragments.

Degraded habitat/land: Land that has been impacted upon by human activities (including introduction of invasive alien plants, light to moderate overgrazing, accelerated soil erosion, dumping of waste), but still retains a degree of its original structure and species composition (although some species loss would have occurred) and where ecological processes still occur (albeit in an altered way). Degraded land is capable of being restored to a near-natural state with appropriate ecological management.

Delineation – the technique of establishing the boundary of an aquatic resource such as a wetland or riparian area.

Drain – In the context of wetlands, refers to a natural or artificial feature such as a ditch or trench created for the purpose of removing surface and sub-surface water from an area (commonly used in agriculture).

Duration: The period of time during which something continues.

Ecological Importance – An expression of the importance of an environmental resource for the maintenance of biological diversity and ecological functioning on local and wider scales.

Ecological Processes: Ecological processes typically only function well where natural vegetation remains, and in particular where the remaining vegetation is well-connected with other nearby patches of natural vegetation. Loss and fragmentation of natural habitat severely threatens the integrity of ecological processes. Where basic processes are intact, ecosystems are likely to recover more easily from disturbances or inappropriate actions if the actions themselves are not permanent. Conversely, the more interference there has been with basic processes, the greater the severity (and longevity) of effects. Natural processes are complex and interdependent, and it is not possible to predict all the consequences of loss of biodiversity or ecosystem integrity. When a region’s natural or historic level of diversity and integrity is maintained, higher levels of system productivity are supported in the long run and the overall effects of disturbances may be dampened.

Ecological Sensitivity – A system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred.

Ecosystem - A biological community of interacting organisms and their physical environment.

Ecosystem services: Activities that help to maintain an ecosystem but are not directly part of energy flows and nutrient cycles. Examples include pollination, dispersal, population regulation, and provision of clean water and the maintenance of liveable climates (carbon sequestration).

Ecosystem status: Ecosystem status of terrestrial ecosystems is based on the degree of habitat loss that has occurred in each ecosystem, relative to two thresholds: one for maintaining healthy ecosystem functioning, and one for conserving the majority of species associated with the ecosystem. As natural habitat is lost in an ecosystem, its functioning is increasingly compromised, leading eventually to the collapse of the ecosystem and to loss of species associated with that ecosystem.

EIS – Ecological Importance & Sensitivity.

Endangered: A taxon is endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Endemic: An 'Endemic Species' is one that is only found in that region and nowhere else in the world. As such they are of conservation concern because they are not widespread and may be confined to only one or two protected areas.

Environment: The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.

Exotic: a species introduced either accidentally or deliberately by human actions into places beyond its natural geographical range.

Fragmentation (habitat): Causes land transformation, an important current process in landscapes as more and more development occurs.

Geology (lithology): type of rock or sedimentary deposit underlying a particular area, forming a discrete and recognisable lithostratigraphic unit of reasonable homogeneity.

GIS – Geographical Information Systems.

GPS – Global Positioning System.

Gulley (or erosion gulley) - A gully (commonly called a "donga") is an erosion landform or feature, created by running water eroding sharply into soil. Gullies generally resemble small ditches that can be several meters in depth and width. Gullying or gully erosion is the process by which gullies are formed.

Habitat: The home of a plant or animal species. Generally, those features of an area inhabited by animal or plant which are essential to its survival.

HGM – Hydro-Geomorphic. Hydrogeomorphic (HGM) unit: a type of aquatic ecosystem distinguished primarily on the basis of, (i) landform (which defines the shape and localised setting of the ecosystem); (ii) hydrological characteristics (which describe the nature of water movement into, through and out of the ecosystem); and (iii) hydrodynamics (which describe the direction and strength of flow through the ecosystem). The Classification System recognises seven primary HGM Units (or HGM types) for Inland Systems.

Hydrological regime: the typical cycle of water movement in an aquatic ecosystem.

Indigenous: Native; occurring naturally in a defined area.

Intensity: The intensity of the development can be categorized as medium since the impacts of the activity will alter the environment due to increased disturbance of the site by heavy machinery.

IUCN: International Union for Conservation of Nature.

Mottles: as relates to wetland soils, spots of colour in the soil that contrast with the background (matrix) soil colour. Mottles occur where minerals in the soil that have been reduced under anaerobic conditions are re-oxidised.

NFEPA – National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2010).

Probability: Is a way of expressing knowledge or belief that an event will occur or has occurred.

Permanently inundated: with surface water present throughout the year, in most years.

Permanently saturated: of wetland soils, where all the spaces between the soil particles are filled with water throughout the year, in most years. This corresponds to the 'permanent (inner) zone' of a wetland, according the terminology used in the DWAF (2005) wetland delineation manual. • NOTE: In the Classification System, saturation is considered within the upper 0.5 m of the soil surface (which is the commonly accepted maximum depth to which soil saturation is considered for wetland delineation purposes).

PES – Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting change from its reference condition.

Red Data: A list of fauna and flora species that require environmental protection.

Riparian: Pertaining to, situated on or associated with a riverbank.

River corridors: River corridors perform several ecological functions such as modulating stream flow, storing water, removing harmful materials from water, and providing habitat for aquatic and terrestrial plants and animals. These corridors also have vegetation and soil characteristics distinctly different from surrounding uplands and support higher levels of species diversity, species densities, and rates of biological productivity than most other landscape elements. Rivers provide for migration and exchange between inland and coastal biotas.

RESERVE - The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Significance with and without mitigation: The significance without mitigation is medium; meaning that the impact of the development is of moderate importance and is considered to have a medium negative impact. The significance with mitigation is low, meaning that the negative impact of the operation is of importance but is reduced by the mitigation measures.

Species diversity: A measure of the number and relative abundance of species (see biodiversity).

Species richness: The number of species in an area or habitat.

Transformed Habitat/Land: Land that has been significantly impacted upon as a result of human interferences/disturbances (such as cultivation, urban development, mining, landscaping, severe overgrazing), and where the original structure, species composition and functioning of ecological processes have been irreversibly altered. Transformed habitats are not capable of being restored to their original states.

Seasonally inundated: with surface water present for extended periods during the wet season/s (generally between 3 to 9 months duration) but drying up annually, either to complete dryness or to saturation.

Seasonally saturated: of wetland soils, with all the spaces between the particles filled with water for extended periods (generally between 3 to 9 months duration), usually during the wet season/s, but dry for the rest of the year. This corresponds to the 'seasonal zone' of a wetland, according to the terminology used in the DWAF (2005) wetland delineation manual. • NOTE: In the Classification

System, saturation is considered within the upper 0.5 m of the soil surface (which is the commonly accepted maximum depth to which soil saturation is considered for wetland delineation purposes).

Vulnerable: Vulnerable terrestrial ecosystems have lost some (more than 60% remains) of their original natural habitat and their functioning will be compromised if they continue to lose natural habitat.

Water table: the upper surface of groundwater or that level below which the soil is completely saturated with water.

Weed: An indigenous or non-indigenous plant that grows and reproduces aggressively, usually a ruderal pioneer of disturbed areas. Weeds may be unwanted because they are unsightly, or they limit the growth of other plants by blocking light or using up nutrients from the soil. They can also harbour and spread plant pathogens.

Wetlands: A collective term used to describe lands that are sometimes or always covered by shallow water or have saturated soils, and where plants adapted for life in wet conditions usually grow.

List of Abbreviations

ADM – Amathole District Municipality

BA – Basic Assessment

CBA – Critical Biodiversity Area

DEA/DEFF/DFFE – Department of Environment, Forestry and Fisheries / Department of Forestry, Fisheries and the Environment

DEDEAT – Department of Economic Development, Environmental Affairs and Tourism (Eastern Cape)

DWS – Department of Water and Sanitation

EA – Environmental Authorisation

ECBCP – Eastern Cape Biodiversity Conservation Plan

ECO – Environmental Control Officer

EIA – Environmental Impact Assessment

EIS – Ecological Importance and Sensitivity

EMPr – Environmental Management Programme

ESA – Ecological Support Area

FEPA / NFEPA – (National) Freshwater Ecosystem Priority Area

GN – Government Notice

HGM – Hydrogeomorphic

IHI – Index of Habitat Integrity

kmz/KMZ – Keyhole Markup Zip (spatial file format)

miniSASS – Mini South African Scoring System

NEMA – National Environmental Management Act (Act 107 of 1998)

NWA – National Water Act (Act 36 of 1998)

PES – Present Ecological State / Present Ecological Status

PAOI – Project Area of Influence

RQO – Resource Quality Objective

SANBI – South African National Biodiversity Institute

SASS5 – South African Scoring System Version 5

SWSA – Strategic Water Source Area

WQMP – Water Quality Management Plan

WMA – Water Management Area

WTW – Water Treatment Works

WUL / WULA – Water Use Licence / Water Use Licence Application

Declaration of Independence

I, **Zona Quvile**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being a member of the general public;
- This document and all information contained herein is and will remain the intellectual property of Earthguard Consulting and the specialist investigator responsible for conducting the study. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigator;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- As a registered member of the Environmental Assessment Practitioners Association of South Africa, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on the information provided to me by the project proponent, and in addition to information obtained during this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

______________ 2026.04.08

Specialist Details

This Aquatic Biodiversity Specialist Assessment Report has been prepared in accordance with the Environmental Impact Assessment Regulations, 2014 (as amended) and the gazetted Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (GN 320 of 2020), as applicable to activities requiring environmental authorisation. The details of Specialist are as follows –

Mrs Zona Quvile

PhD Candidate (Environmental Science)- Rhodes University- Makanda

Main areas of specialisation

- Ecological Reserve Determination (ERD) and Ecological Water Requirement (EWR) studies.
- Wetland delineation, classification, and functional assessment.
- Surface water hydrology and catchment process analysis.
- Assessment of aquatic habitat integrity and ecological condition (PES, EIS).
- Design and implementation of aquatic rehabilitation and restoration plans.
- Preparation of Water Use Licence Applications (WULAs) in terms of Section 21 of the National Water Act (Act 36 of 1998).
- Environmental Impact Assessments (EIAs) for aquatic systems and watercourse-related developments.
- Geographical Information Systems (GIS) mapping and spatial analysis of aquatic ecosystems.
- Specialist consultant for environmental management and compliance monitoring of water-related projects.

Summary of Expertise

Qualifications:	Med (Environmental Education), Rhodes University
	Biodiversity and Conservation Honours, Rhodes University
	BSc Environmental Studies, Walter Sisuslu University
	Tools for Wetland Assessment Course, Rhodes University
	Hydropedology & Wetlands Course (WETREST; Digital Soils Africa)
	The mini stream assessment scoring system (miniSASS), GroundTruth
Professional Affiliation:	SACNASP 115598
	EAPASA 2019/1039
	South African Wetland Society (SAWS) (Member)
	The Land Rehabilitation Society of Southern Africa (LaRSSA) (Member)

Experience with aquatic/wetland assessments: 10 years

Employment

Jan 2020 – present	Earthguard Consulting, Director, Senior Environmental Scientist
Aug 2017 – Dec 2019	SRK Consulting (Pty) Ltd, Environmental Scientist
Feb 2015 – Jul 2017	Sazi Environmental Consulting, Environmental Consultant

Sep 2014 & Aug 2015	Coastal and Environmental Services, Part-time Junior Environmental Consultant
Mar 2011 – Aug 2011	Walter Sisulu University, Research Assistant

Specialist Report Requirement Checklist (as per gazetted 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.)

Requirement	**Report Section**
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Specialist details, page xv
2.7.2. a signed statement of independence by the specialist;	Declaration of Independence, page xiii
2.7.3. 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 4
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Section 2
2.7.5. a description of the assumptions made, any uncertainties or gaps in knowledge or data;	Section 1.8
2.7.6. the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant	Section 5.2, Section 6.13
2.7.7. additional environmental impacts expected from the proposed development;	Section 6
2.7.8. any direct, indirect and cumulative impacts of the proposed development on site;	Section 6, 6.11
2.7.9. the degree to which impacts and risks can be mitigated;	Section 6
2.7.10. the degree to which the impacts and risks can be reversed;	Section 6
2.7.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	Section 6
2.7.12. a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	Section 5.2
2.7.13. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	Section 6
2.7.14. a motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate;	Section 8.1
2.7.15. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and	Section 8; 8.1
2.7.16. any conditions to which this statement is subjected.	N/A

1 Introduction

Earthguard Consulting (Pty) Ltd (Earthguard), was appointed by Abantu Environmental Services to undertake an aquatic biodiversity assessment as part of an Environmental Authorisation (EA) process for the proposed Blikana Dam Bulk Water Supply Scheme (BWSS).

The purpose of this specialist assessment is to confirm the aquatic biodiversity sensitivity identified by the Screening Tool and to assess and mitigate potential project impacts on aquatic ecosystems to inform the Environmental Authorisation process. This report presents the aquatic biodiversity assessment findings for the development.

1.1 Project Background

The Joe Gqabi District Municipality (JGDM) is proposing the development of a bulk water supply using the eastern and western tributaries of the Blikana river. The proposed development entails construction of a dam, reservoirs, abstraction points, water treatment works and pipelines to supply water within wards 2, 3, 4, 5 and 6 within Senqu Local Municipality (SLM). The proposed development entails:

- The Blikana river's eastern and western tributaries will supply water for this development
- A dam will be constructed upstream of abstraction point C-B1.
- The required water will be released from the dam and then abstracted from a pick-up weir located at C-B2.
- A water treatment works (WTW) (7.5Mℓ/d) will be constructed downstream of the abstraction point CB2, where water will be treated, stored and pumped to the various reservoirs

The reservoir supply areas and sizes are indicated below:

- Command Reservoir 1 (CR1) (9Mℓ) – Supplies water to Ward 2 and Ward 3 (Northern Portion)
- CR2 (2Mℓ) – Supplies water to Ward 4 (Western Side) & 5
- CR3 (2.5Mℓ) – Supplies water to Ward 4 (Eastern Side)

Pipelines for this option include the following:

- Rising main from WTW to CR1 & SR 1
- Rising main from WTW to Era village, 5164.42m (5.16km) long, 200mm-400mm steel pipe
- Rising main middle portion from Era village through Tlakaneng to Musong village, 2015.97m (2.02km) long, 150mm-400mm steel pipe
- Rising main at Musong tying to SR1, 2048.33m (2.05km) long, 150mm-400mm steel pipe
- Rising main from WTW to CR2, 200mm-400mm steel pipe
- Rising main from WTW to CR3, 200mm-400mm steel pipe
- Rising main from CR3 to Emqheyen village, 6731.99m (6.73km) long, 150mm-400mm steel pipe
- Rising main from WTW to SR2, 7179m long (7.18km), 150mm-400, steel pipe
- Rising main from WTW to SR2, 4064.89m (4.06km) long, 150mm-400mmsteel pipe
- Gravity main from Henge village to Magalagaleni village, 2005.86m (2.01km) long,
- Gravity main from Abstraction point 2, 1101.48m (1.10km) long, 50mm to 400mm pipes (Steel/PVC/HDPE)
- Gravity main from CR2 to Blikana village, 1665.73m (1.67km) long, 50mm to 400mm pipes (Steel/PVC/HDPE)

Gravity main from CR3 to Ntubeni village, 2837.39m (2.84km) long, 50mm to 400mm pipes (Steel/PVC/HDPE)

1.2 Project Location

The proposed bulk water supply is located in the area of Blikana, within wards 2, 3, 4, 5 and 6 within Senqu Local Municipality (SLM) (Figure 1-1).

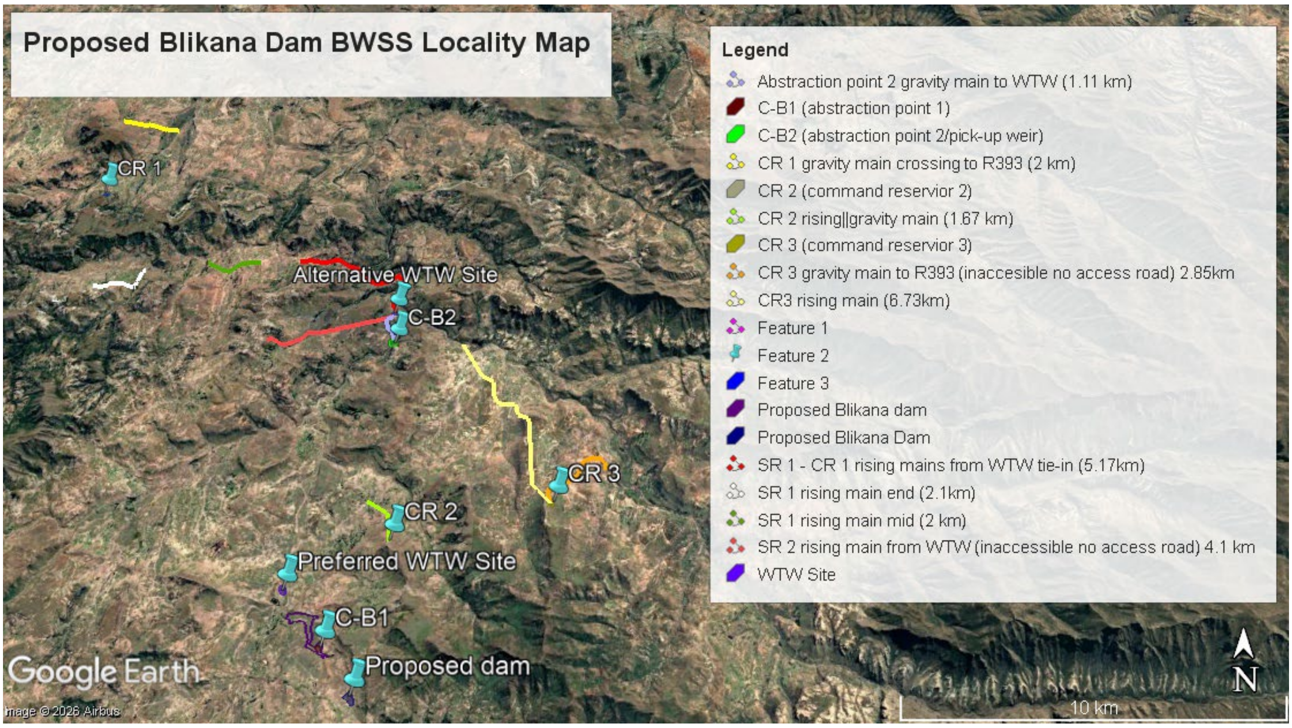


Figure 1-1: Blikana BWSS locality

1.3 Project Area of Influence

The Project Area of Influence (PAOI) is defined according to important ecosystem processes and functions that may be plausibly affected by the proposed development and its associated activities. The PAOI sets the minimum spatial extent of the study area, and the assessment will be focused within this area. The following site descriptors were used to delineate each PAOI.

PAOI Area Description Probability of impact:

- **Primary PAOI**: The Primary PAOI includes all proposed infrastructure and internal roads within the boundary of the development site. This is the area directly impacted by the proposed development and includes all permanent footprints. The PAOI for the BWSS is defined as the spatial extent within which project activities may reasonably affect watercourses through direct disturbance (e.g., crossings and instream works) and indirect pathways (sediment-laden runoff, bank disturbance, and pollution/spill risk). The PAOI therefore includes: (i) all BWSS components occurring on or near watercourses, namely the Blikana River.
- **Secondary PAOI**: The secondary PAOI includes a 500m buffer area (orange buffer) of the proposed development (Figure 1-2). The 500m area has been demarcated around the proposed infrastructure for the project to facilitate the identification of water resources within the regulatory zone. These areas are not directly impacted by the development unless temporary footprints like site camps, laydown areas and stockpiles are placed in them. Assessing this PAOI will not only result in identifying potential indirect and cumulative impacts but will also allow for micro-movement of infrastructure.
- **Tertiary PAOI**: All areas outside the 500m of the proposed development is considered as tertiary PAOI. These areas will not be impacted by the proposed development but are included as there may be indirect impacts.

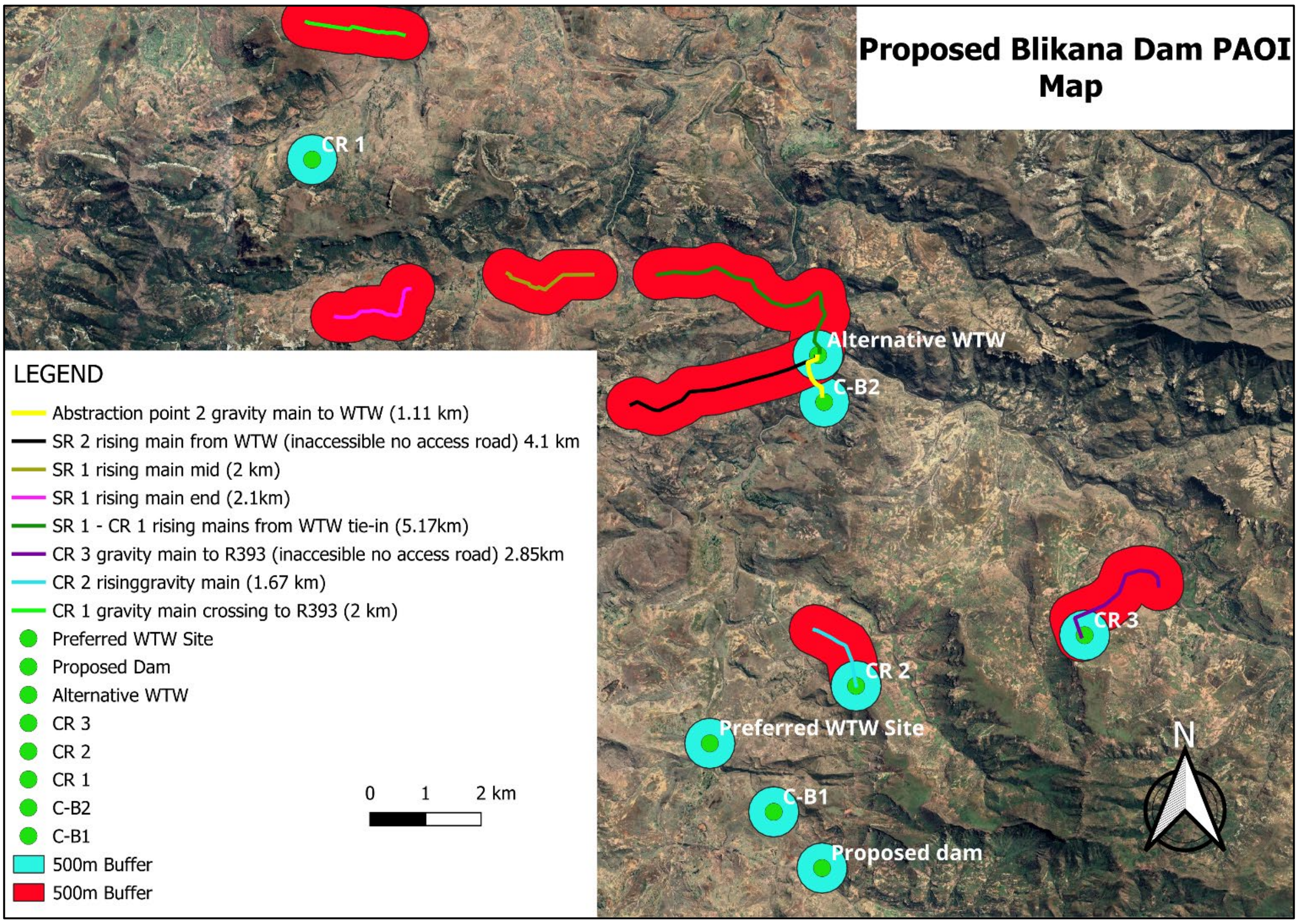


Figure 1-2: PAO

1.4 Legislative Context

According to the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (GN 320; Government Gazette 43110 of 20 March 2020), published under the National Environmental Management Act (NEMA; Act No. 107 of 1998), the assessment and reporting requirements for aquatic biodiversity are linked to the aquatic biodiversity sensitivity rating generated by the National Web-Based Environmental Screening Tool ("screening tool").

An applicant intending to undertake an activity identified within the scope of this protocol on a site identified by the screening tool as being of:

- Very High sensitivity for aquatic biodiversity must submit an Aquatic Biodiversity Specialist Assessment; or
- Low sensitivity for aquatic biodiversity must submit an Aquatic Biodiversity Compliance Statement.

The screening tool classified the aquatic biodiversity theme for the study area as **Very High sensitivity,** with mapped sensitivity features including CBA2, ESA1, ESA 2, Wetlands_Seep, FEPA Sub catchment, Rivers and SWSA (sw) the Eastern Cape Drakensberg.

In accordance with the protocol, prior to commencing with the specialist assessment, a site sensitivity verification (SSV) must be undertaken to confirm the current land use and the environmental sensitivity indicated by the screening tool, and the outcome must be recorded in a report and submitted with the relevant assessment report.

Where the SSV findings differ from the screening tool sensitivity designation:

- If the screening tool indicates Very High sensitivity but the SSV verifies the site as Low sensitivity, an Aquatic Biodiversity Compliance Statement must be submitted.
- If the screening tool indicates Low sensitivity but the SSV verifies the site as Very High sensitivity, an Aquatic Biodiversity Specialist Assessment must be submitted.

If any part of the proposed development footprint falls within an area of Very High sensitivity, the assessment and reporting requirements for Very High sensitivity apply to the entire footprint (subject to the protocol's limited linear-activity exception).

The following legislation is directly relevant when assessing the aquatic environment relating to the proposed project:

Table 1-1: Legislation applicable to the project

Legislation / guideline	Application to the project	Competent/lead authority (or custodian)
National Environmental Management Act (NEMA) (Act 107 of 1998), as amended	Framework environmental management principles and duty of care informing avoidance/mitigation and sustainable development decision-making.	DFFE (national) / DEDEAT (EA competent authority in EC)
EIA Regulations, 2014 (as amended) and Listing Notices (as amended)	Project triggers listed activities requiring Environmental Authorisation; prescribes public participation and specialist report requirements.	DFFE (publisher) / DEDEAT (competent authority)
GN 320 (2020): Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	Governs aquatic biodiversity specialist assessment process and minimum report content, including Screening Tool sensitivity-driven outputs and site sensitivity verification.	DFFE (publisher) / DEDEAT (implementation for EA)
GN 509 (2016) / EIA Regulations definitions (watercourse / riparian / 100 m / 500 m)	Defines the "watercourse" and associated regulated distances used to determine proximity triggers, sensitivity screening and buffer considerations.	DFFE/DEDEAT (EIA regulatory framework)
National Water Act (Act 36 of 1998)	Determines whether the works trigger Section 21 water uses (commonly 21(c) and/or 21(i) for in-channel/riparian works; and potentially discharge-related uses where applicable); includes pollution prevention duty (Section 19).	DWS
General Authorisations / WULA requirements (where applicable)	Confirms whether water uses may be authorised under GA or require WULA, and informs licence/GA conditions relevant to aquatic protection.	DWS
NEM: Biodiversity Act (NEMBA) (Act 10 of 2004)	Provides for protection of listed threatened/protected species and invasive species management relevant to aquatic/riparian habitats.	DFFE
Eastern Cape Biodiversity Conservation Plan (ECBCP)	Spatial biodiversity planning layer identifying CBAs/ESAs guiding avoidance and mitigation in sensitive areas.	SANBI / EC conservation authorities (custodian)
National Freshwater Ecosystem Priority Areas (NFEPA)	Freshwater ecosystem priority mapping to contextualise ecological importance and support sensitivity/risk motivation.	SANBI (custodian)

1.5 Alternatives

Alternatives were considered for the Water Treatment Works (WTW) site only, as the remaining BWSS components (dam, abstraction points, reservoirs and pipeline corridors) are largely constrained by hydraulic requirements, terrain, and constructability in a mountainous landscape. The purpose of assessing the WTW site alternative was to identify the most feasible and least environmentally risky location for construction and operation.

WTW site alternatives considered (Figure 1-3)

Two WTW location options were identified:

- WTW Preferred site (near Fort Hook).
- WTW Alternative 1.

Description and evaluation of the alternatives

WTW Preferred site was selected because it is located on gentler terrain and is more accessible than the alternative site. From a practical and environmental perspective, gentler slopes and improved access reduce construction risk and typically allow:

- smaller and more controlled earthworks and site preparation;
- reduced likelihood of slope instability and erosion during construction;
- improved placement and effectiveness of erosion/sediment controls; and
- reduced potential for sediment-laden runoff to enter nearby drainage lines and rivers.

In contrast, WTW Alternative 1 is comparatively less suitable due to steeper terrain and/or more constrained access, which increases the likelihood of broader disturbance footprints, greater earthworks requirements, and higher erosion/sedimentation risk.

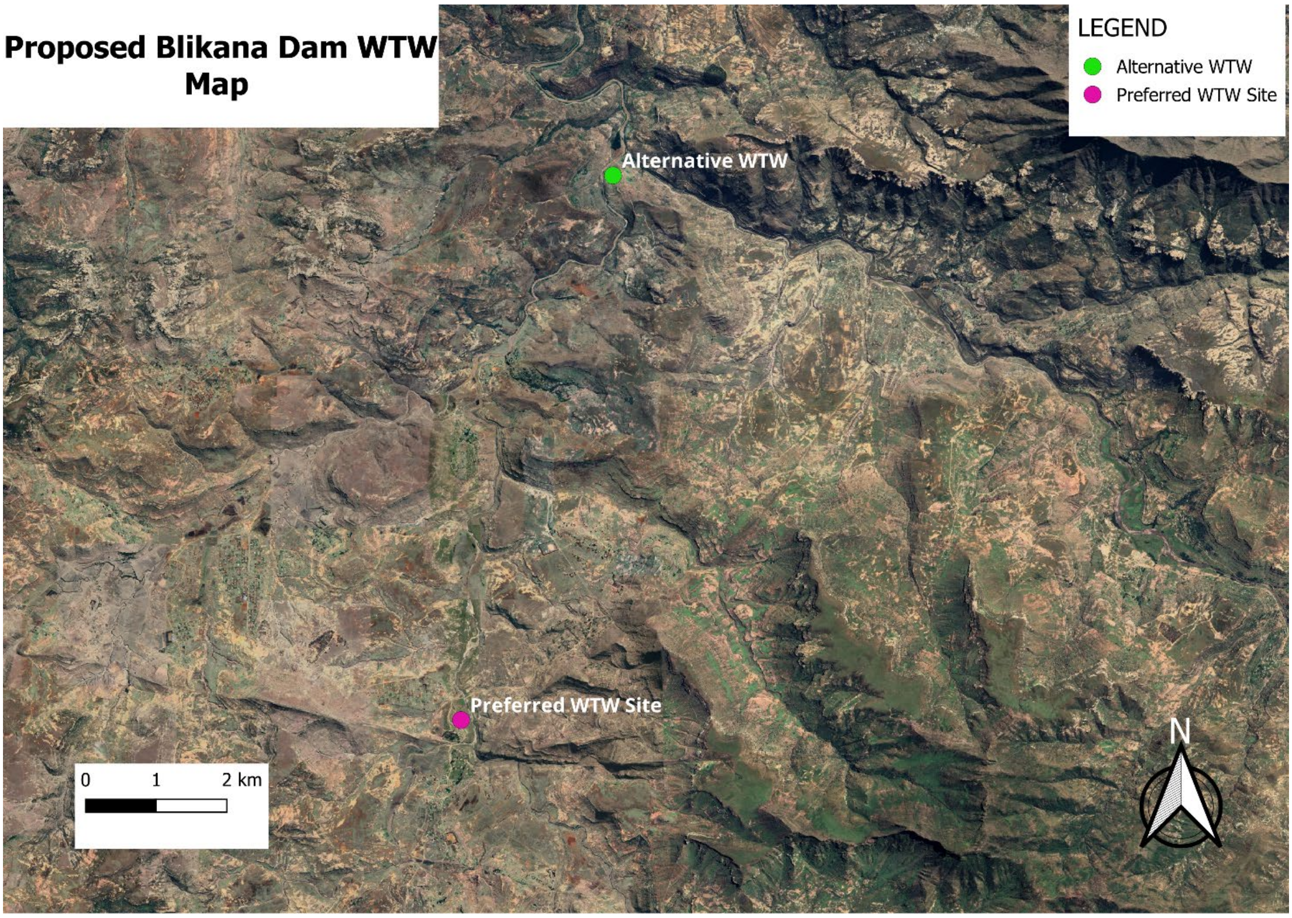
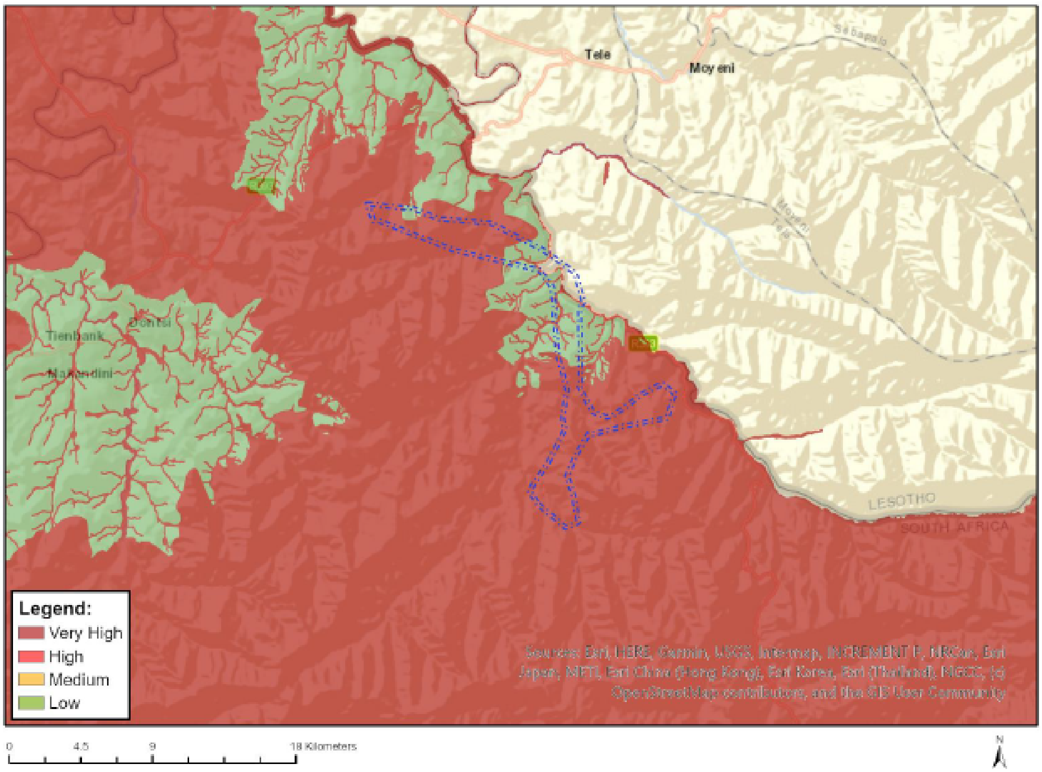


Figure 1-3: Preferred and alternative sites for WTW

1.6 Environmental Screening Tool

The proposed development area environmental sensitivity for the aquatic biodiversity theme is identified as Very High sensitivity (Figure 1-4).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	CBA 2
Very High	ESA 1
Very High	ESA 2
Very High	Wetlands_Seep
Very High	FEPA Subcatchment
Very High	Rivers
Very High	SWSA (sw)_Eastern Cape Drakensberg

Figure 1-4: DFFE Screening Tool map of the aquatic biodiversity theme sensitivity.

1.7 Terms of Reference

These Terms of Reference are informed by the specialist protocol requirements identified by the DFFE Screening Report (GN 320: Aquatic Biodiversity Protocol) and are tailored to the proposed Blikana BWSS and associated infrastructure:

The Aquatic Biodiversity Specialist Assessment will:

- Undertake a Site Sensitivity Verification (SSV) to verify the aquatic biodiversity sensitivity indicated by the National Web-Based Environmental Screening Tool (Very High), and record the verified outcome for submission with the specialist assessment.

- Define an aquatic Project Area of Influence (PAOI) that is pathway-linked and reach-based, including upstream and downstream reaches relevant to: (i) the Blikana River dam/abstraction/WTW cluster and (ii) each watercourse crossing or near-water interface.
- Describe the receiving aquatic environment (baseline) prior to construction, focusing on aquatic habitat units and aquatic/riparian features relevant to river integrity (channel type, habitat diversity, connectivity, barriers, riparian condition, erosion susceptibility).
- Identify and map aquatic biodiversity features and constraints, including rivers/streams, drainage lines, riparian zones, wetlands/seeps where present, and relevant aquatic biodiversity planning layers (e.g., FEPA sub-catchment, rivers, wetlands/seeps, SWSA context), and show the development footprint in relation to these features.
- Undertake an ichthyofauna assessment, including:
    - desktop review of likely fish species for the Blikana River context and conservation status;
    - field verification of fish habitat (riffle/run/pool sequences, refuge pools, spawning substrates, cover, barriers, connectivity); and
    - assessment of potential fish sensitivity and habitat dependence at/near dam, abstraction works, and crossings.
- Assess the nature, extent and significance of impacts on aquatic habitat for construction and operation phases, including impacts associated with:
- Confirm fatal flaws / no-go constraints (if any) from an aquatic biodiversity perspective, including areas where impacts cannot be acceptably mitigated.
- Apply the mitigation hierarchy (avoid, minimise, rehabilitate, offset if required) and provide project-specific mitigation and design recommendations for protecting aquatic integrity (buffers, crossing controls, erosion/sediment management, spill prevention, rehabilitation, operational access controls).
- Recommend monitoring and management measures relevant to aquatic protection, including construction-phase compliance monitoring.
- Comment on cumulative impacts in the affected sub-catchments and how additional disturbance, access creep and erosion could contribute to incremental change in river integrity over time.
- It should be noted that only datasets and baseline information relevant to the study area and affected aquatic environmental features are discussed in this report.

1.8 Assumptions, Limitations and Gaps in Knowledge

This Aquatic Biodiversity Specialist Assessment was prepared using currently available information, desktop datasets and site observations, and is supported by ichthyofauna context as an additional line of evidence. The following assumptions, limitations and knowledge gaps apply:

- This report is based on information available at the time of assessment, including information provided by the Client/EAP and the design team. Any material changes to the final design, construction methodology, footprint or programme may require the assessment to be reviewed and updated.
- Desktop mapping and sensitivity layers (including FEPA sub-catchment context and river/wetland layers) were used to inform planning and interpretation. Desktop datasets may contain classification errors or may be generalised at broad scales; field observations were used to verify and refine interpretations where access allowed.
- Access to some portions of the watercourses and key biotopes may have been constrained by land access, water depth, or physical barriers. As a result, not all microhabitats could be sampled or observed in detail.

- The assessment focuses on aquatic biodiversity within the project footprint and likely zone of influence and considers the broader catchment context using available desktop information. Detailed field verification on neighbouring properties was not undertaken unless access was available; adjacent areas were considered primarily at a desktop level.
- The ichthyofauna section provides a desktop and habitat-based indication of fish species likely to occur and fish habitat sensitivity within the FEPA catchment context. Absence of recorded fish species during fieldwork is not treated as proof of absence, as detectability is influenced by season, flow, sampling method and site access.
- GPS coordinates were captured using a handheld unit (Garmin eTrex). Handheld GPS accuracy is subject to environmental conditions and may introduce small positional errors. For design finalisation or servitude pegging, a formal survey may be required.
- Impact significance ratings and risk conclusions were determined on the assumption that the recommended mitigation measures and management controls will be implemented. Residual risk may increase if mitigation is not implemented or if construction deviates from the recommended controls.
- The assessment is primarily focused on surface water aquatic ecosystems (rivers/streams, wetlands/riparian areas, and where relevant estuarine interface features). Groundwater-related impacts were not assessed in detail unless specifically required by the EAP or triggered by the design.
- Specialist assessment tools and techniques applied are rapid assessment approaches that rely on qualitative/quantitative indicators and expert judgement. While widely used, these methods have inherent uncertainty and may be refined as improved methods and data become available.
- Resource Quality Objectives (RQOs) for the catchment within which the watercourses of focus occur were not available at the time of writing, therefore the RQOs referred to in this report are those for the adjacent Integrated Unit of Analysis (IUA) 5 (Upper Orange River and tributaries) within the resource unit III.
- Earthguard Consulting (Pty) Ltd is an independent environmental consulting firm and as such, all processes and attributes of the EIA are addressed in a fair and unbiased fashion. It is believed that through the running of a transparent and participatory process, risk associated with assumptions, uncertainties and gaps in knowledge can be, and were, minimised.

2 Approach and Methodology

The aim of this assessment is to identify areas of aquatic importance and to evaluate these in terms of their conservation importance. To do so, the aquatic sensitivity of the area is assessed. The study sites and surrounding areas were assessed using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current biodiversity programmes and plans (listed further below).

Further to the above, a site visit was conducted on the 31 January 2026. The site visit served to inform potential impacts associated with the proposed project and how significantly it would impact on the surrounding environment. The aim of this study is to identify areas of high sensitivity and those that may be subject to significant impacts from the project.

2.1 Desktop Assessment

A desktop assessment of the site was conducted in terms of current biodiversity programmes and plans. Prior to conducting the site visit, an initial level 1 (desktop) assessment was done using Google Earth Pro map timeline function to detect changes in visible vegetation conditions. Possible ecological sensitive features were identified, and GPS coordinates were retried for informing field work.

2.2 Literature Review

A summary of the main information sources used in this assessment are provided in Table 2-1 below:

Table 2-1: The databases utilised in the identification of environmental features

Data / Information	Source	Date	Type	Description
Satellite imagery	Google Earth	May 2002 to Sep 2020	Spatial	Recent history of aerial imagery for the site
Eastern Cape Biodiversity Conservation Plan (ECBBP)	Eastern Cape Department of Economic Development, Environmental Affairs and Tourism	2016	Report and Spatial	Spatial conservation planning units and associated management recommendations for the Eastern Cape province
National Biodiversity Assessment	South African National Biodiversity Institute (SANBI)	2018	Report and Spatial	Latest assessment of South African biodiversity and ecosystems, including wetlands and rivers.
National Vegetation Map	SANBI	2018	Report and Spatial	Latest national vegetation type mapping
South African Atlas of Climatology and Agrohydrology	R.E. Schulze	2012	Spatial	Climate data

Data / Information	Source	Date	Type	Description
Aquifer classification and Groundwater Resource Assessment information	Department of Water and Sanitation	2005, 2012 and 2013	Spatial	Mapping of aquifer class, type, yields, susceptibility and Vulnerability as well as depths, recharge and quality
National Soil types	ENPAT		Spatial	Mapping of soil types
National Freshwater Ecosystem Priority Areas (FEPA)	CSIR	2011	Report and Spatial	Mapping of areas of aquatic ecosystem conservation importance
Strategic Water Source Areas for Surface Water	SANBI	2017	Report and Spatial	Surface Water Strategic Water Source Area (SWSAS) are defined as areas of land that supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The Sub-National Water Source Areas (WSAS) are not Nationally Strategic as defined in the report but were included to provide a complete coverage.
National Protected Area Expansion Strategy (NPAES)	SANBI	2018		South Africa's National Protected Area Expansion Strategy (NPAES) 2018 guides the cost-effective, target-driven expansion of land-based and marine protected areas to improve ecological sustainability, climate resilience, and biodiversity representation. It identifies 42 focus areas, including key coastal and inland sites, aiming for ecosystem-specific targets rather than just area targets.
National River Present Ecological Status, Ecological Importance	DWA	2012	Spreadsheets and spatial	River reach assessments of ecological importance, sensitivity and condition

Data / Information	Source	Date	Type	Description
and Ecological Sensitivity				
National Wetland Map 5	CSIR and SANBI - South African National Biodiversity Assessment 2018	2018	Spatial	Mapping of wetland habitats

2.3 Classification of Aquatic Systems

The following datasets were used to identify, delineate, and classify any surface water bodies found within the study site or within 500 m of the study site (Table 2-2).

Table 2-2. Legislation relevant to the identification, delineation, and classification of surface water bodies

Relevant legislation	Discussion
Department of Water Affairs and Forestry (DWAF) (2008): A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones.	Describing and delineating all watercourses with the study site.
GN 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998)	Delineation of watercourses within 500 m of the study area.
Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis et al., 2013)	Classification of all identified watercourses
Technical Report for the National Freshwater Ecosystem Priority Areas project (Nel et al., 2011)	Identification of FEPAs freshwater ecosystems.

The following definitions, as per the National Water Act, 1998 (Act No. 36 of 1998) are of relevance to this study:

Watercourse means:

a) A river or spring;
b) A natural channel in which water flows regularly or intermittently;
c) A wetland, lake or dam into which, or from which water flows; and
d) Any collection of water, which the Minister may, by notice of the Gazette, declare a watercourse.

Wetland means:

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

Riparian habitat includes:

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

2.4 Wetland Delineation and Assessment

Verification of wetland boundaries was undertaken on site according to the Department of Water and Sanitation (DWS, previously known as the Department of Water Affairs and Forestry -DWAF) guideline, (2005): A practical guideline procedure for the identification and delineation of wetlands and riparian zones. The guideline indicates that wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil profile.

In order to delineate the wetland associated with the study site, the respective area was traversed. The types of vegetation present were also used as a guideline to interpret current moisture levels and likely degrees of disturbance. Soil forms were identified and separated into terrestrial soil forms and hydric soil forms (although several soil forms have to be utilised with caution as several soil forms could exhibit a high degree of variation with regards to hydric properties). Specific attention was given to the following redoxmorphic features used to identify and delineate wetland, as discussed by Richardson and Vepraskas (2001):

- **A reduced matrix**. Identified as having relative grey colours with a low chroma of less than or equal to 4 (Soil Classification working group, 1991). This is due to the presence of Fe^{2+} (the absence of Fe^{3+}), meaning that the soil has been reduced for significant periods of time;
- **Redox depletions**. Bodies of soil with a low chroma grey colour, indicating that the Fe and Mn oxides in the soil have been stripped out. Redox depletions occur in the form of iron depletions and clay depletions. In structured soils, soil peds indicative of redox depletions have a low chroma on their surfaces, while the matrix of the ped has a higher chroma. In structureless soils, grey mottles are indicative of iron depletions. Clay depletions occur when silicate clay minerals are decomposed, and the elementary chemical components are removed by leaching. These areas then contain less iron, manganese and clay than the adjacent soils; and
- **Redox concentrations**. An accumulation of iron and manganese oxides that occur as Fe-Mn concretions, mottles and pore linings. Fe-Mn concretions that are indicative of hydric soils are firm to extremely firm irregularly shaped bodies with diffuse boundaries. Mottles are soft bodies of irregular shape within a soil matrix, recognised as blotches or spots of high chroma (usually red or yellow for iron and black for manganese). Pore linings are zones of Fe and Mn accumulation along the route of plant roots. They can occur as coatings on a pore surface or impregnations of the matrix adjacent to the pore linings.

The Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013) is the most widely used system in South Africa. The system relies on hydrogeomorphic (HGM) principles that were first proposed by Brinson (1993). Brinson (1993) explains how hydrology and geomorphology (hydrogeomorphic) are two fundamental features that determine the way in which a wetland functions, which can lead to an understanding of the relationship between organisms and the environment. Sieben et al. (2018) reason that the hydrogeomorphic classification is most useful for water resource planning as it provides information about how the wetland is connected to the drainage network, identifies how water moves through the wetland, and can be used to superficially derive the ecosystem services that a wetland unit provides at a broad-scale.

Figure 2-1 below indicates the hydro-geomorphic setting of inland wetlands in South Africa, as well as the wetland classification applied to wetlands for assessment (Ollis *et al*., 2013).

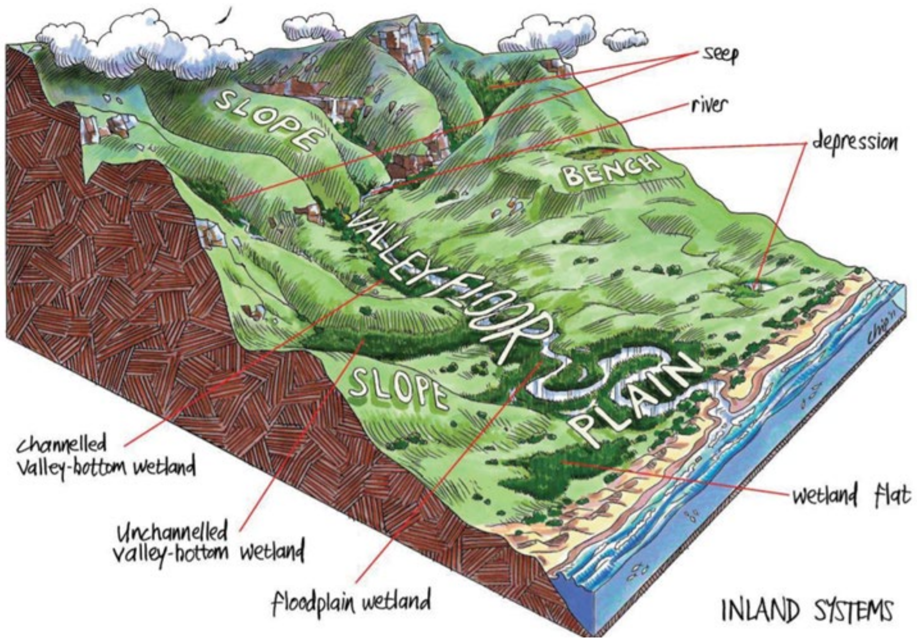
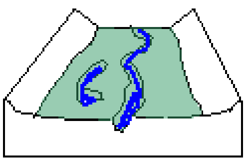
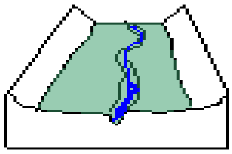
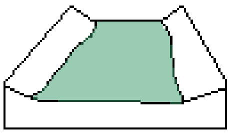
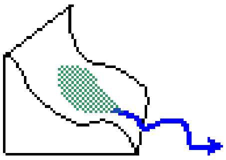
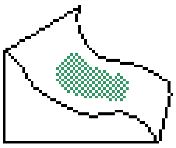
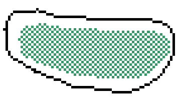


Figure 2-1: Hydrogeomorphic setting (Ollis *et al*., 2013)

The Table 2-3 below provides illustrations for major inland HGM types that are recognised for the purposes of classification assessment (after Kotze *et al*., 2008; and Ollis *et al*., 2013).

Table 2-3: Wetland Hydrogeomorphic Units (after Kotze et al., 2008; and Ollis *et al*., 2013)

Wetland Hydro- geomorphic type	**Description**	**Source of water maintaining the wetland1**	
		Surface	**Sub-surface**
Floodplain 	Valley bottom areas with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Channelled valley bottom	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of	***	*/***

Wetland Hydro- geomorphic type	Description	Source of water maintaining the wetland1	
		Surface	Sub-surface
	sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.		
Unchannelled valley bottom 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seepage with channelled outflow 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Hillslope seepage without channelled outflow 	Slopes on hillsides, which are characterized by the colluvial movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

2.4.1 Wetland Present Ecological State (PES) Assessment

This assessment was made in accordance with the level 2 Wet-Health method to describe the Present Ecological Status (PES) (Macfarlane, et al. 2008). The method utilises geomorphology, hydrology and vegetation to determine the health of a wetland, where the wetlands “health” is a measure of the extent to which it currently deviates from its pre-anthropogenic reference condition.

The hydrology module assesses the land use descriptors (irrigation, level of reduction or increase in flows, hydro-geomorphic setting of the wetland and extent of canalisation and gully formations). The geomorphology module captures deviations in the sedimentary inputs and outputs to and from wetlands that are consequence of human activities. The vegetation module assesses the level of vegetation transformation, which is indicated by level of alien species invasion, terrestrial species encroachment and encroachment by indigenous invasive species.

Values range from Class A (largely natural) to Class F (critically modified). Table 2-4 below describes the overall HGM health categories and their scores. **This is calculated as an impact score between 0 and 10 to get the overall impact score.**

Table 2-4: Health categories used by WET-Health for describing the integrity of wetlands

HEALTH CATEGORY	DESCRIPTION	Min Score
A	Unmodified, natural.	0 – 0.9
B	Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1 – 1.9
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2 – 3.9
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10

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

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

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

2.4.2 Wetland Ecological Importance and Sensitivity (EIS)

An assessment of the importance and sensitivity of wetland systems was performed using the Department of Water and Sanitation Reserve tool. Data input was populated using the outcomes of the WET-Health assessment and other valuable information gathered in the field as well as available desktop information. Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a wetland in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits.

The scoring assessment incorporates:

- EIS score derived using aspects of the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999);

- Hydro-function importance score derived from the WET-EcoServices tool for the assessment of wetland ecosystem services Kotze *et al.* (2009); and
- Direct human benefits score derived from the WET-EcoServices tool for the assessment of wetland ecosystem services Kotze *et al.* (2009).

Using the Rountree et al., method (2013), the highest score of the three derived scores (each with range 0 – 4) is then used to indicate the overall importance category of the wetland (Table 2-5).

Table 2-5: Ranking scales for impact assessment

ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORIES	RANGE OF EIS SCORE
Very high: Wetlands that are considered ecologically important and sensitive on a **national or even international** level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

2.4.3 Wetland Buffers

The “Buffer Zone Guidelines for Wetlands, Rivers and Estuaries. Part 1: Technical Manual” (Macfarlane & Bredin, 2017a) will be used to determine the appropriate buffer zone for the proposed activity.

Buffer zones are natural areas around the watercourse boundaries, which are requested to protect the watercourse from developmental or land use changes. Protection may also extend to peak runoff/flood flows and the buffer zone may also provide feeding/breeding areas for wetland or river fauna and accordingly enhance the corridor function of drainage lines.

2.5 Aquatic Biodiversity

Critical Biodiversity Areas (CBAs) are features critical for the conservation of biodiversity and maintenance of ecosystem functioning and should remain in a natural state as far as possible. CBAs also include freshwater components. To assist in the development of these CBAs, each planning unit was classified by C-plan and Marxan based on a combination of factors including vegetation type, connectivity, habitat condition and presence of Red List Threatened species.

All features were grouped into the following Aquatic CBA categories as listed in the Eastern Cape Biodiversity Conservation Plan (ECBCP, 2019):

Table 2-6: Critical biodiversity area category as per the (ECBCP, 2019)

Critical Biodiversity Area Category	Critical Biodiversity Area Name
Protected areas (PA)	All formal PA that are recognized in terms of the National Environmental Management: Protected Areas Act 57 of 2003, which include:
Critical Biodiversity Area (CBA)	Any terrestrial, freshwater or aquatic areas required to meet biodiversity pattern and/or process thresholds. a) Any area that is required for meeting biodiversity pattern thresholds, namely: b) Critically Endangered and Endangered habitat from listed Threatened Ecosystems in terms of the NEM: Biodiversity Act and underlying conservation plans. c) Any area that is required for meeting ecological process thresholds, including: d) Ecological or landscape corridors (comprising upland-lowland corridors, coastal corridor and river corridors). e) Hydrological process areas (important catchments, including rivers, wetlands, estuaries and their buffers). f) All 'best design' sites (largest, most intact, least disturbed, connected and/or adjacent) in terms of meeting pattern and process thresholds. 'Best design' refers to an identified network of natural sites that meet pattern and process thresholds in all vegetation types in a spatially efficient and ecologically robust way, and aim to avoid conflict with other activities (e.g. economic activity) where it is possible to achieve biodiversity thresholds elsewhere. *It should be noted that some areas within a CBA are degraded but are still required to meet the national biodiversity thresholds.*
Ecological Support Area (ESA)	Supporting zone required to prevent degradation of Critical Biodiversity Areas and Protected Areas. ESA comprise: a) Areas required to prevent the degradation of Critical Biodiversity Areas and formal Protected Areas. b) Other catchment and process areas (rivers, wetlands, estuaries and their buffers) that are required to prevent degradation of Critical Biodiversity Areas and formal Protected Areas. c) Areas that are already transformed or degraded, but which are currently or potentially still important for supporting ecological processes e.g. transformed or alien plant infested areas that have transformed or degraded the natural buffer area of an estuary, wetland or river. These areas are a focus for rehabilitation, and the intensification of land-use should be avoided.
Other Natural Areas (ONA)	Natural areas not included in the above categories. These areas include degraded natural areas. *It is important to note that in the future, if there is a loss of CBA or ESA, ONA may eventually be reclassified as CBA. Consequently, the precautionary principle needs to be applied in all decision-making.*
No Natural areas Remaining (NNR)	These areas include cultivated areas (intensive agriculture), afforested areas (plantation forestry), farmland (areas that have been farmed in the past), mined areas (quarries) (currently or in the past), urban areas, infrastructure and dams.

Critical Biodiversity Area Category	Critical Biodiversity Area Name
	➢ *NNAR are therefore areas that (i) have been irreversibly transformed through development (e.g. urban development, agriculture), (ii) contain no natural areas; and* *(iii) are not required as ESA.* They no longer contribute to the biodiversity of the area and are favoured areas for development.

2.6 Present Ecological State

Drainage lines and rivers are natural channels in which water flows permanently or intermittently following rainfall. These are assessed using the Index of Habitat Integrity (IHI; Kleynhans, 1996) which measures the impact of human disturbance on riparian and instream habitats. The IHI is a rapid assessment of the severity of impacts affecting habitat integrity within a defined segment of a watercourse. The method can be applied to both perennial and non-perennial watercourses. The instream impacts considered were: water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; and rubbish dumping. The riparian impacts assessed were: vegetation removal; exotic vegetation; bank erosion; channel modification; water abstraction; inundation; flow modification; physico-chemistry. Each of the impacts was given a score based on their degree of modification (Table 2-7), along with a confidence rating based on the level of confidence in the score.

Table 2-7: Descriptive classes for assessment of habitat modifications (Kleynhans, 1996)

Impact Class	Description	Score
None	No discernible impact or the modification is located in a way that 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 are 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 limited	6-10
Large	The modification is generally present with a clearly 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 affected.	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

An IHI class is then determined based on the resulting score which is shown in Table 2-8. These results provide an indication of the site-specific PES which can be used as a baseline from which to monitor impacts in the future.

Table 2-8: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Natural	> 90
B	Largely Natural	80 – 90
C	Moderately Modified	60 – 79
D	Largely Modified	40 – 59
E	Seriously Modified	20 – 39
F	Critically Modified	0 – 19

2.7 Ecological Importance and Sensitivity

The screening tool has identified species and ecosystem spatial triggers likely to indicate environmental sensitivity associated with a particular proposed development site, which in turn determined the necessity and requirements for conducting an Aquatic Biodiversity Assessment.

The Ecological Importance and Sensitivity (EIS) for the watercourse was derived using the methods developed by Department of Water Affairs and Forestry (DWAF; 1999). Ecological Importance of a system is defined as the expression of its importance to the maintenance of ecological diversity and functioning on local as well as broader scales. Ecological sensitivity relates to the system's resilience to disturbance, or its ability to recover from disturbance that has occurred. The EIS rating does not incorporate the PES and therefore indicates the potential importance or sensitivity of a system as could be expected under unimpaired conditions.

These parameters are scored individually and the median score of all variables is calculated to derive an EI and ES category as defined in Table 2-9.

Table 2-9: Ecological Importance and Sensitivity Categories

Ecological Importance and Sensitivity Categories	General Description
Very High (> 3 and < 4)	Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.
High (> 2 and < 3)	Quaternaries/delineations that are considered unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.
Moderate (> 1 and < 2)	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.
Low/Marginal (> 0 and < 1)	Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.

2.8 Aquatic Ecology

2.8.1 Field Survey

The aquatic field assessment was undertaken on 31 January 2026 over the course of a single field day. The survey was conducted during the summer wet season, which is considered appropriate for identifying active watercourses, hydrological connectivity, riparian condition, erosion features, sediment movement and general aquatic habitat expression. This improved the ability to verify aquatic features and assess likely impact pathways associated with the proposed development. However, the survey represents a season-specific snapshot of site conditions, and smaller tributaries and drainage lines may display different hydrological and habitat characteristics during the dry season. The season of survey was therefore considered appropriate for the purposes of the present assessment, although seasonal variability should be taken into account when interpreting the findings.

This section provides a brief description of the aquatic biodiversity study approach and methodologies utilised during the field surveys and the locations wherein the assessments were undertaken.

To enable an adequate description of the aquatic environment and the determination of the PES, the habitat and response indicators were evaluated:

Habitat Indicators

- General habitat assessment including site location (GPS coordinates), site photographs (for future identification of major changes and documentation of habitat conditions); and surrounding features such as land uses, potential sources of pollution, erosion etc;
- Index for Habitat Integrity (IHI): a rapid, visual assessment of modifications to a number of pre-selected biophysical drivers and used to determine the PES or Ecological Category of associated instream and riparian habitats

Response Indicators

- Ichthyological assessment, including the evaluation of reference conditions and determination of ecological condition; and

2.8.2 Monitoring Sites

The selection of monitoring sites was based on the proposed location of infrastructure relative to the aquatic ecosystems likely to be impacted. The sites were strategically selected based on ease of accessibility and availability of suitable habitat.

A total of four sites were selected within the Project's AOI (Figure 2-3). Site names, GPS coordinates and brief descriptions are provided in Table 2-10.

Table 2-10: Location of the sampling points and brief descriptions

River	Site	GPS	Site Description
Blikana River	BK1	30°36'58.04"S, 27°37'17.52"E	Located within the Upper Orange catchment. Site is located upstream of the proposed dam site. Site serves as sampling point to determine any impacts resulting from the dam and associated infrastructure located within the proposed project area.
	BK2	30°36'48.40"S, 27°37'12.78"E	Located within the Upper Orange catchment. Site located downstream of the proposed dam site. Site serves as sampling point to determine any impacts

River	Site	GPS	Site Description
			resulting from the dam and associated infrastructure located within the proposed project area.
	BK3	30°30'29.38"S, 27°37'4.42"E	Located within the Upper Orange catchment. Site is located upstream of the proposed alternative WTW site (including SR 2 rising main from WTW and Abstraction point 2 gravity main to alternative WTW). Site serves as sampling point to determine any impacts resulting from the alternative WTW and associated infrastructure as well as impacts resulting from SR 2 rising main from WTW and Abstraction point 2 gravity main to WTW that are proposed to cross the river located within the proposed project area.
	BK4	30°30'20.06"S, 27°37'12.01"E	Located within the Upper Orange catchment. Site is located downstream of the proposed Alternative WTW site (including proposed crossing for SR 1 rising mains from Alternative WTW tie in). Site serves as sampling point to determine any impacts resulting from the WTW and associated infrastructure located within the proposed project area.
	BK5	30°35'27.70"S, 27°35'57.23"E	Located within the Upper Orange catchment. Site is located upstream of the preferred WTW site. Site serves as sampling point to determine any impacts resulting from the WTW.
	BK6	30°35'2.11"S, 27°35'50.11"E	Located within the Upper Orange catchment. Site is located downstream of the preferred WTW site. Site serves as sampling point to determine any impacts resulting from the WTW.

2.9 Impact Assessment Framework and Methodology

The impacts that may result from the planning and design phase, construction phase, operation phase of the proposed development were assessed according to several criteria to arrive at an overall significance rating. The criteria used were as follows (based on DEAT 2002 - Impact Significance, IEM Information Series 5; and DEAT 2006 - Assessment of Alternatives and Impacts in support of the EIA Regulations, IEM Guideline Series 5) (Table 2-11):

Table 2-11: Criteria used in determining significance ratings to potential impacts

ASPECT	IMPACT RATING
Status of the Impact	A statement of whether the impact is positive (a benefit), negative (a cost), or neutral
Direct impact	Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

<table>
<tr><th>ASPECT</th><th>IMPACT RATING</th></tr>
<tr><td>Indirect Impacts</td><td>Indirect impacts are not a direct result of the project but are often produced away from or because of a complex impact pathway related to the project.</td></tr>
<tr><td>Cumulative Impacts</td><td>Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of the past, present, or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.</td></tr>
<tr><td>Nature of the Impact</td><td>The evaluation of the nature is impact specific. Most negative impacts will remain negative, however, after mitigation, significance should reduce to:
Positive
Negative</td></tr>
<tr><td>Extent</td><td>A description of whether the impact would occur on a scale limited to within the study area (local), limited to within 5 km of the study area (area) on a regional scale. i.e. the Chris Hani District Municipality & Eastern Cape (Region); or would occur on a national or international scale.
<table>
<tr><td>Local</td><td>1</td></tr>
<tr><td>Area</td><td>2</td></tr>
<tr><td>Regional</td><td>3</td></tr>
<tr><td>National</td><td>4</td></tr>
<tr><td>International</td><td>5</td></tr>
</table></td></tr>
<tr><td>Duration</td><td>A prediction of whether the duration of the impact would be immediate and once-off (less than one month), more than once, but short term (less than one year), regular, medium term (1 to 5 years), long term (6 to 15 years), project life/permanent (> 15 years, with the impact ceasing after the operational life of the development or should be considered as permanent).
<table>
<tr><td>Immediately</td><td>1</td></tr>
<tr><td>Short term</td><td>2</td></tr>
<tr><td>Medium term</td><td>3</td></tr>
<tr><td>Long term</td><td>4</td></tr>
<tr><td>Project life/permanent</td><td>5</td></tr>
</table></td></tr>
<tr><td>Intensity</td><td>This provides an order of magnitude of whether or not the intensity (magnitude/size/frequency) of the impact would be negligible, low, medium, high or very high. This is based on the following aspects:
An assessment of the reversibility f the impact (permanent loss of resources, or impact is reversible after project life)
Whether or not the aspect is controversial
An assessment of the
The level of alteration to the natural system, process or systems.
<table>
<tr><td>Negligible</td><td>The impact does not affect physical, biophysical or socio-economic functions and processes.</td><td>1</td></tr>
<tr><td>Low/potential harmful</td><td>The impact has limited impacts on physical, biophysical or socio-economic functions and processes.</td><td>2</td></tr>
<tr><td>Medium/slight harmful</td><td>The impact has an effect on physical, biophysical or socio-economic functions and processes, but in such a way that these processes can still continue to function albeit in a modified fashion.</td><td>3</td></tr>
<tr><td>High/harmful</td><td>Where the physical, biophysical or socio-economic functions and processes are impacted on in such a way as to cause them to temporarily or permanently cease.</td><td>4</td></tr>
<tr><td>Very high/disastrous</td><td>Where the physical, biophysical or socio-economic functions and processes are highly impacted on in such a way as to cause them to permanently cease.</td><td>5</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>ASPECT</th><th>IMPACT RATING</th></tr>
<tr><td>Frequency</td><td>This provides a description of any repetitive, continuous or time-linked characteristics of the impact: Once-off (occurring any time during construction or operation); intermittent (occurring from time to time, without specific periodicity); periodic (occurring at more or less regular intervals); continuous (without interruption).
<table>
<tr><td>Once-off</td><td>Once</td><td>1</td></tr>
<tr><td>Rare</td><td>1/5 to 1/10 years</td><td>2</td></tr>
<tr><td>Frequent</td><td>Once a year</td><td>3</td></tr>
<tr><td>Very frequent</td><td>Once a month</td><td>4</td></tr>
<tr><td>Continuous</td><td>≥Once a day/per shift</td><td>5</td></tr>
</table></td></tr>
<tr><td>Probability of occurrence</td><td>A description of the chance that consequences of that selected level of severity could occur during the exposure.
<table>
<tr><td>Highly unlikely</td><td>The probability of the impact occurring is highly unlikely due to its design or historic experience.</td><td>1</td></tr>
<tr><td>Improbable</td><td>The probability of the impact occurring is low due to its design or historic experience.</td><td>2</td></tr>
<tr><td>Probable</td><td>There is a distinct probability of the impact occurring.</td><td>3</td></tr>
<tr><td>Almost certain</td><td>It is most likely that the impact will occur</td><td>4</td></tr>
<tr><td>Definite</td><td>The impact will occur regardless of any prevention measures.</td><td>5</td></tr>
</table></td></tr>
<tr><td colspan="2">Incidence (frequency + probability)</td></tr>
<tr><td>Risk rating</td><td>The risk rating is calculated based on input from the above assessments. The incidence of occurrence is calculated by adding the extent of the impact to the duration of the impact. The severity of the impact is calculated based on input from the extent of the impact, the duration and the intensity.

Risk = Severity (extent + duration + intensity) x Incidence (frequency + probability)

Significance: The significance of the risk based in the identified impacts has been expressed qualitatively as follows:

Low – the impact is of little importance/insignificant but may/may not require minimal management.
Medium – the impact is importance; management is required to reduce negative impacts to acceptable levels.
High – the impact is of great importance, negative impacts could render development options or the entire project unacceptable if they cannot reduce to acceptable levels and/or if they are not balanced by significant positive impact, management of impacts is essential.
</td></tr>
</table>

Based on a synthesis or combination of the information contained in the above-described criteria; and drawing on legal policies and guidelines as well as the status of the impacts and potential risks, the overall significance was determined as follows (Table 2-12):

Table 2-12: Definition of significance ratings (positive and negative)

Significance	Description
Very high (VH) (150+)	An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options.
High (H) (101-149)	An impact of high significance which could influence a decision about whether to proceed with the proposed project, regardless of available mitigation options.
Medium (M) (51-100)	If left unmanaged, an impact of medium significance could influence a decision about whether to proceed with a proposed project.
Low (L) (25-50)	An impact of low significance would have little effect on decision making and only a small influence on project design or alternative motivation.

Significance	Description
Very low (VL) (1-24)	An impact of very low significance is likely to contribute to positive decisions about whether to proceed with the project. It will have little effect and is unlikely to have an influence on project design or alternative motivation.
Negligible / zero impact	There will be no impact, or any impact identified can be viewed as negligible. This rating will be unlikely to have an influence on project design or alternative motivation.
Positive impact (+)	A positive impact is likely to result in a positive consequence/effect and is likely to contribute to positive decisions about whether to proceed with the project.

3 Description of the Receiving Environment

Understanding the context of the study area and surrounding landscape is important as it informs decision making regarding the significance of the area to be affected. This chapter provides baseline information at the regional scale.

3.1 Topography

The topography of Blikana is characterised by a rugged and undulating landscape typical of the eastern interior highlands (Figure 3-1). The topography consists of rolling hills, dissected valleys, and elevated plateaus, with steep slopes occurring along river corridors and tributaries. Rocky outcrops and shallow soils are common, particularly on hilltops and upper slopes, while deeper alluvial soils occur along drainage lines. The landscape is largely open and expansive, shaped by erosion processes, seasonal water flow, and long-term grazing activities, resulting in a mosaic of grass-dominated areas, scattered shrubs, and exposed rock surfaces.

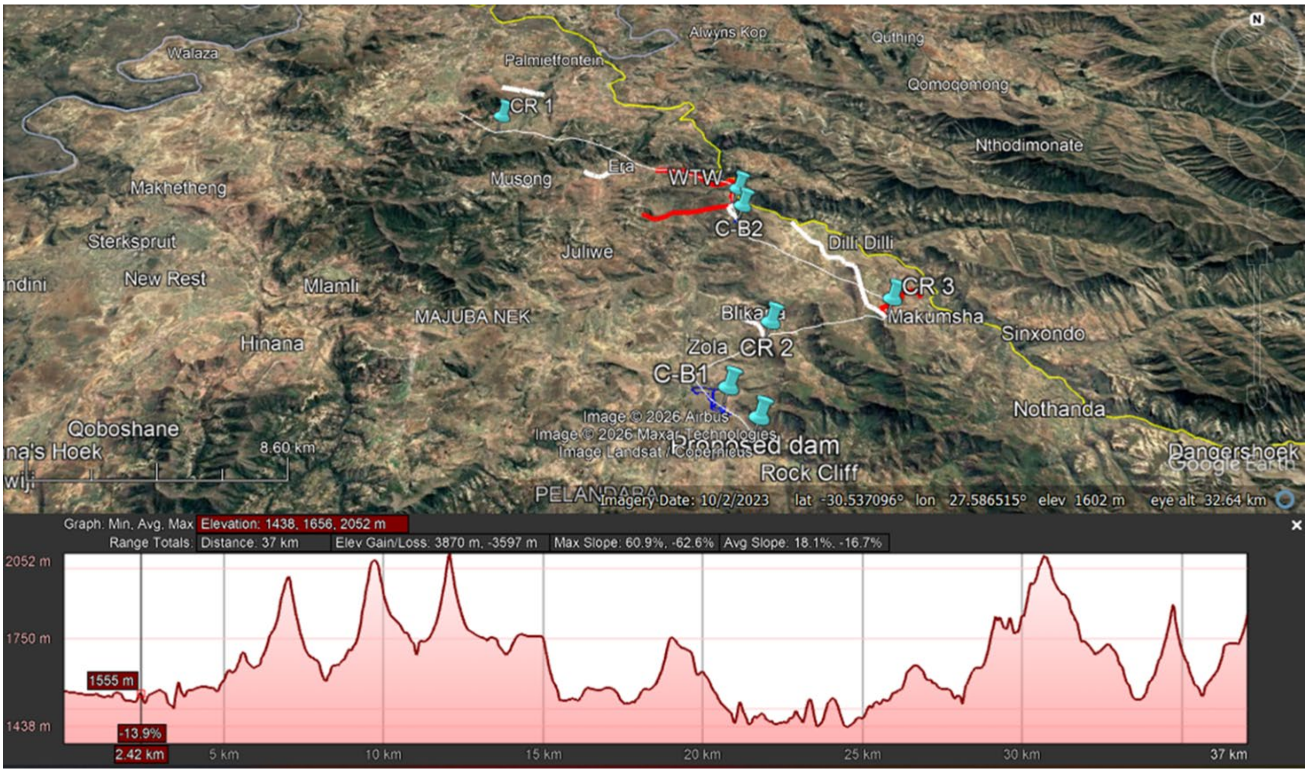


Figure 3-1: Topographic profile of study site

3.2 Climate

The Blikana River area, located near Sterkspruit in the Eastern Cape, experiences a semi-arid to temperate interior climate. Summers (October–March) are warm to hot, with average daytime temperatures ranging between 25–32°C and occasional thunderstorms contributing most of the annual rainfall. Winters (May–August) are cold and dry, with temperatures frequently dropping below 5°C at night and frost common in low-lying areas. Annual rainfall generally ranges between 400–600 mm, occurring mainly in summer, while winters are typically dry with clear skies and strong winds. The climate is characterised by high evaporation rates, seasonal rainfall variability, and periodic droughts, all of which influence river flow patterns and water resource availability in the Blikana catchment.

3.3 Geology and Soils

Blikana geology is underlain predominantly by sedimentary rocks of the Karoo Supergroup, mainly sandstones and mudstones, with occasional dolerite intrusions that form resistant ridges and rocky outcrops (Figure 3-2). These geological formations contribute to the undulating to rugged terrain and influence drainage patterns within the catchment. Soils are generally shallow, stony, and moderately to poorly developed on upper slopes and hilltops, while deeper, more fertile alluvial soils occur along valley bottoms and drainage lines. Due to the semi-arid climate and grazing pressure, soils in many areas show signs of compaction and erosion, particularly where vegetation cover is sparse.

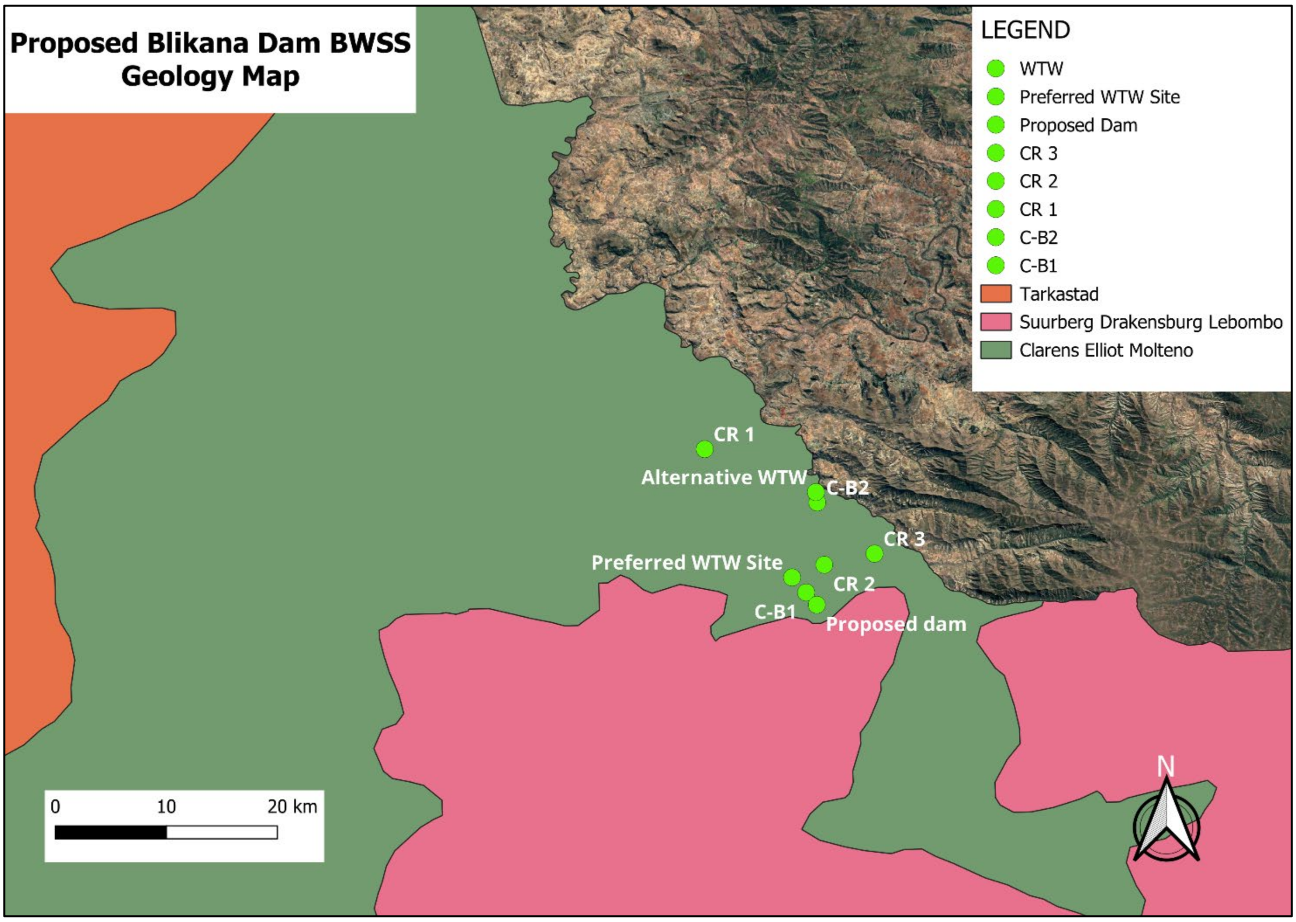


Figure 3-2: Geology map of study site

3.4 Land Use

The dominant land use in the general area is best described as:

- Rural communal land / rangeland used mainly for subsistence livestock grazing (typically sheep/goats/cattle) on montane grassland; with
- Dispersed rural settlements/villages and associated access tracks; and
- Localised small-scale cultivation/home gardens (on valley floors and near drainage lines/riparian areas, where soils and moisture are better).

3.5 Vegetation

According to SANBI VEGMAP 2018 (Vegetation Map of South Africa, Lesotho and Swaziland 2018), the BWSS footprint occurs in the Grassland Biome, within Zastron Moist Grassland and Senqu Montane Shrubland.

<u>Zastron Moist Grassland</u>

General character: A mesic (moist) Highveld grassland type dominated by a tussock grass layer, with a diverse suite of forbs that are typically most evident in the growing season. It generally occurs in a summer-rainfall climate and supports relatively continuous grass cover where not transformed.

Landscape position: Typically associated with rolling plains and gentle slopes rather than steep mountainous scarps, although it can interface with drainage features and local rocky patches depending on terrain.

Conservation context: In the national ecosystem threat status assessment (Terrestrial Red List of Ecosystems), it is treated as Least Concern (LC) (i.e., not a listed threatened ecosystem type at national scale), although local condition can vary widely with grazing pressure, erosion and fragmentation.

<u>Senqu Montane Shrubland</u>

General character: A montane grassland–shrubland mosaic occurring in cooler, higher-lying and more rugged terrain, where rocky substrates, shallow soils and slope exposure favour a more patchy vegetation pattern. It typically includes a grass layer with a stronger presence of low shrubs on rocky slopes and protected niches, and can transition into cliff/rock microhabitats.

Landscape position: Commonly associated with mountain slopes, rocky ridges and escarpment-associated terrain, where ecological processes (erosion control, slope stability, runoff regulation) and habitat heterogeneity are important.

Conservation context: Also treated as Least Concern (LC) in the national ecosystem threat status assessment, but this does not imply low ecological importance—montane grassland–shrubland systems often play a key role in catchment function and connectivity, especially in strategic headwater landscapes.

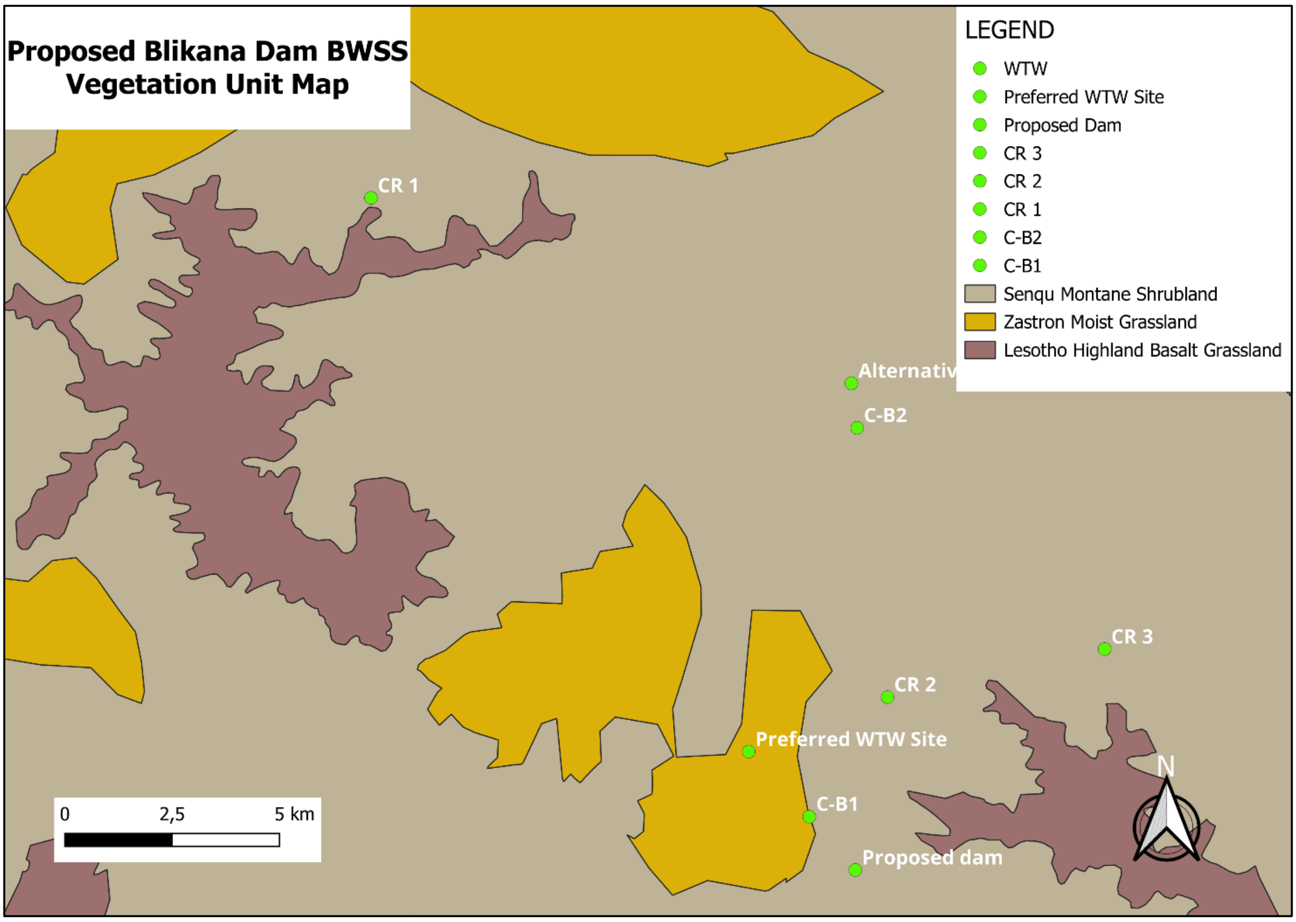


Figure 3-3: Vegetation of the study area

3.6 Biodiversity Conservation Plans- Eastern Cape Biodiversity Conservation Plan, 2019

The Eastern Cape Biodiversity Conservation Plan (ECBCP) (2019) replaces the ECBCP (2007) in its entirety and provides a map of important biodiversity areas, outside of the Protected Areas network, which must be used to inform land use and resource-use planning and decision making. The objectives of the ECBCP (2019) are to:

1) Identify the minimum spatial requirements needed to maintain a living landscape that continues to support all aspects of biodiversity and retain/maintain essential ecological infrastructure. This is achieved through the selection of areas, based on achieving targets, which represent important biodiversity pattern AND ecological processes;

2) Serve as the primary source of biodiversity information for land use planning and decision making; and

3) Inform conservation and restoration action in important biodiversity areas.

The aim of the ECBCP (2019) was to map biodiversity priority areas through a systematic conservation planning process. The main outputs of the ECBCP include Protected Areas (PA), Critical Biodiversity Areas (CBA), Ecological Support Areas (ESA), Other Natural Areas (ONA) and No Natural Habitat Remaining (NNR) for both terrestrial and aquatic ecosystems. The ECBCP (2019) has been adopted by DEDEAT as a systematic biodiversity plan for the Eastern Cape Province.

According to the ECBCP (2019), the proposed Blikana bulk water supply works are located within ESA 1 Figure 3-4).

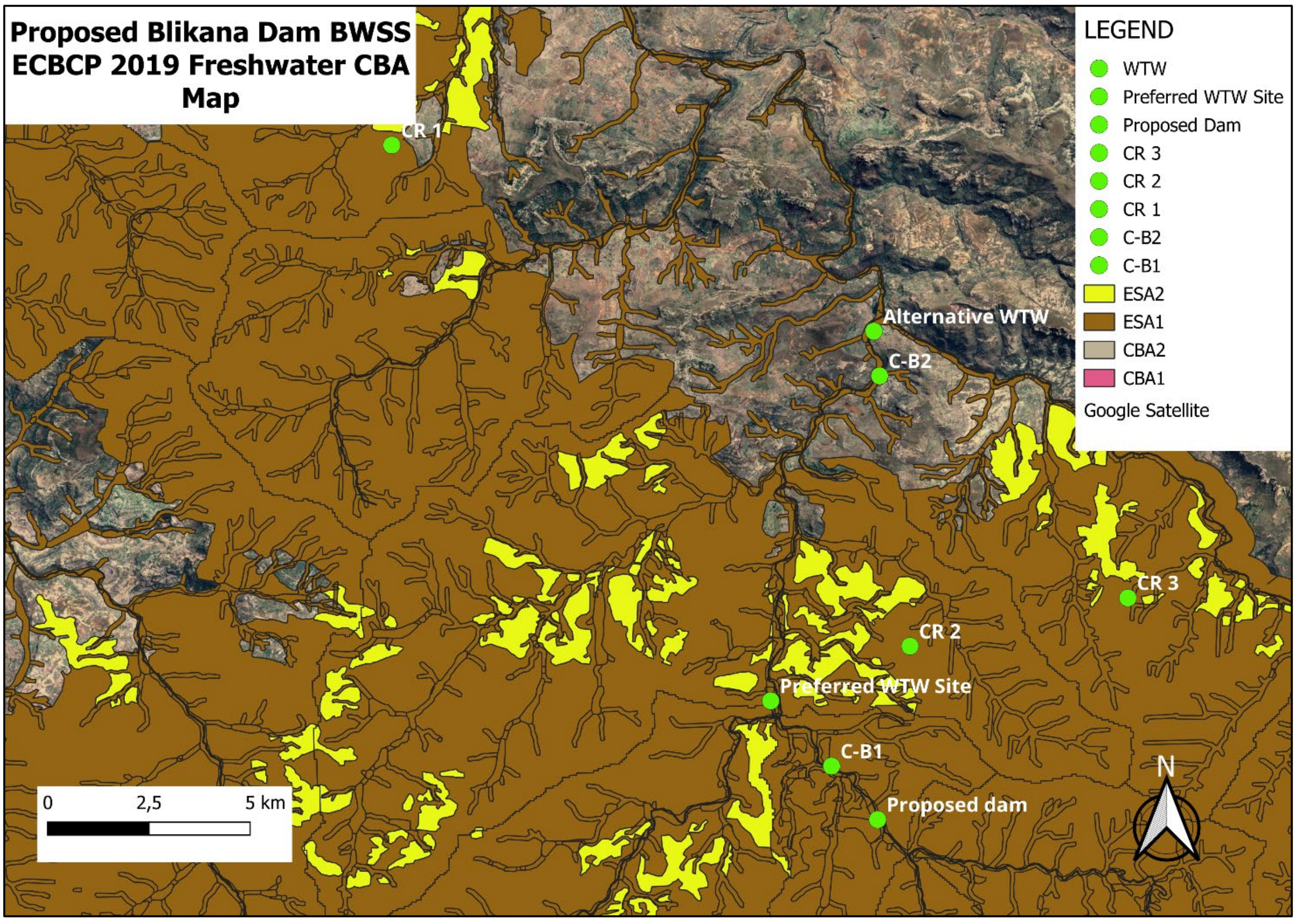


Figure 3-4: ECBCP (2019) Map

3.7 Quaternary Catchment

The proposed Blikana Water Supply Scheme (BWSS) and associated infrastructure occur within the Upper Orange (Orange–Senqu) catchment, specifically within the D18K and D18L quaternary catchments (Figure 3-5). In terms of the current national Water Management Area (WMA) framework (new nine WMAs), the project area falls within the Orange Water Management Area (which includes the South African portions of tertiary drainage region D18). The BWSS is associated with tributaries of the Orange–Senqu system, with the principal watercourses relevant to the project including the Blikana River and the Tele River, together with smaller tributaries and drainage features (including the Kwa Bangindlala stream and an unnamed Orange–Senqu tributary crossing). Table 3-1 summarises the water resources in the catchment (Nel *et al.*, 2011).

Table 3-1: Summary of water resources

DESCRIPTION	QUATERNARY CATCHMENT	MAIN RIVERS
Blikana BWSS	D18K D18L	Tele River, Blikana River, Tele River (Lesotho border area)

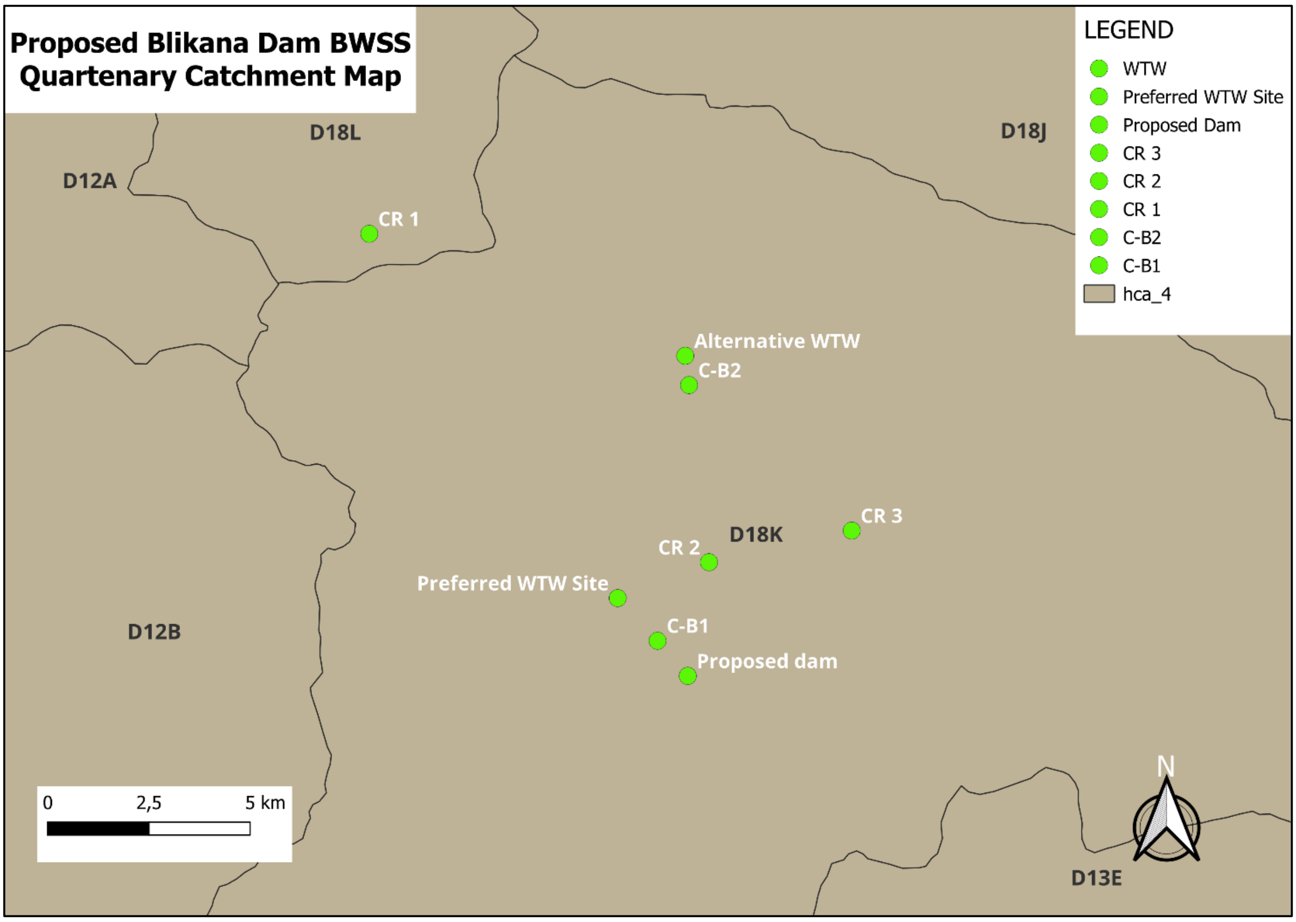


Figure 3-5: Quaternary Catchments associated with the proposed Project

3.8 National Freshwater Ecosystem Priority Areas (NFEPA)

The Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel et al, 2011a) (The Atlas) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources.

Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (NWI Wetlands) (SANBI, 2011) to provide information on the distribution and extent of wetland areas. River, wetland and estuarine FEPAs should be regarded as significant water resources and should be regarded as ecologically important and as generally sensitive to changes in water quality and quantity, owing to their role in protecting freshwater ecosystems and supporting sustainable use of water resources.

3.8.1 River FEPAs

River FEPAs are often tributaries that support hard-working mainstem rivers, and are an essential part of an equitable and sustainable water resource strategy. This does not mean that FEPAs need to be fenced off from human use, but rather that they should be supported by good planning, decision-making and management to ensure that human use does not impact on the condition of the ecosystem.

River FEPAs achieve biodiversity targets for river ecosystems and threatened/near threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. For river FEPAs the whole sub-quaternary catchment is shown in dark green (Figure 3-6), although FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach. It is important to note that river FEPAs currently in an A or B ecological category may still require some rehabilitation effort, e.g. clearing of invasive alien plants and/or rehabilitation of riverbanks. From a biodiversity point of view, rehabilitation programmes should therefore focus on securing the ecological structure and functioning of FEPAs before embarking on rehabilitation programmes in Phase 2 FEPAs or other areas.

Figure 3-6 below shows that SR 1 rising main end and the SR 1 rising main mid are within a River FEPA and associated sub-quaternary catchment.

NFEPA Rivers (National Freshwater Ecosystem Priority Areas) refers to a South African spatial dataset and strategic framework used to identify and protect the country's most critical river ecosystems. The project provides guidance on which rivers should remain in a natural or near-natural condition to support water resource protection goals under the National Water Act. Figure 3-7 shows rivers identified by NFEPA within the study area with the Blikana River being the river that would be impacted by the development.

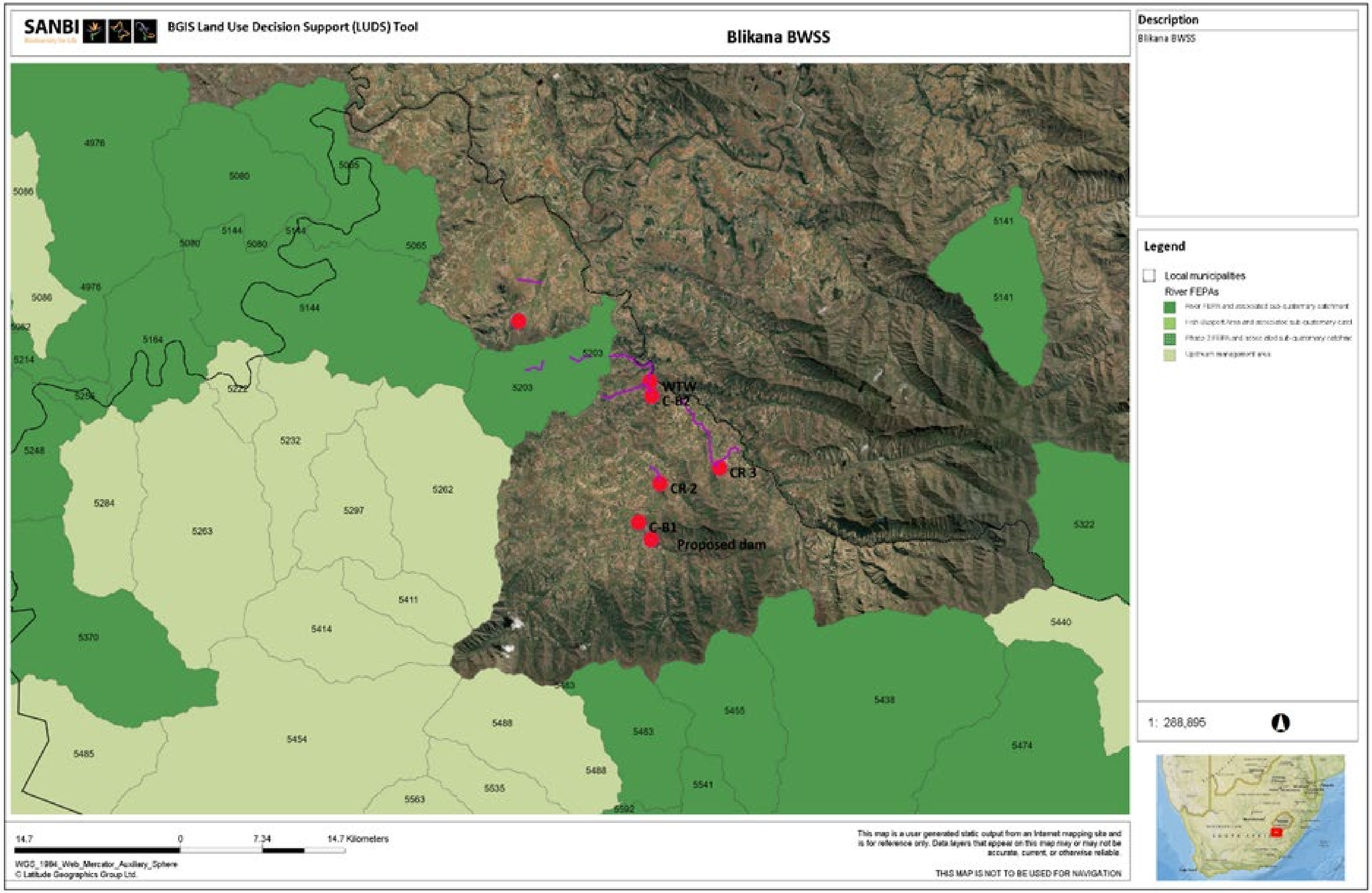


Figure 3-6: Riverine Freshwater Ecosystem Priority Area map

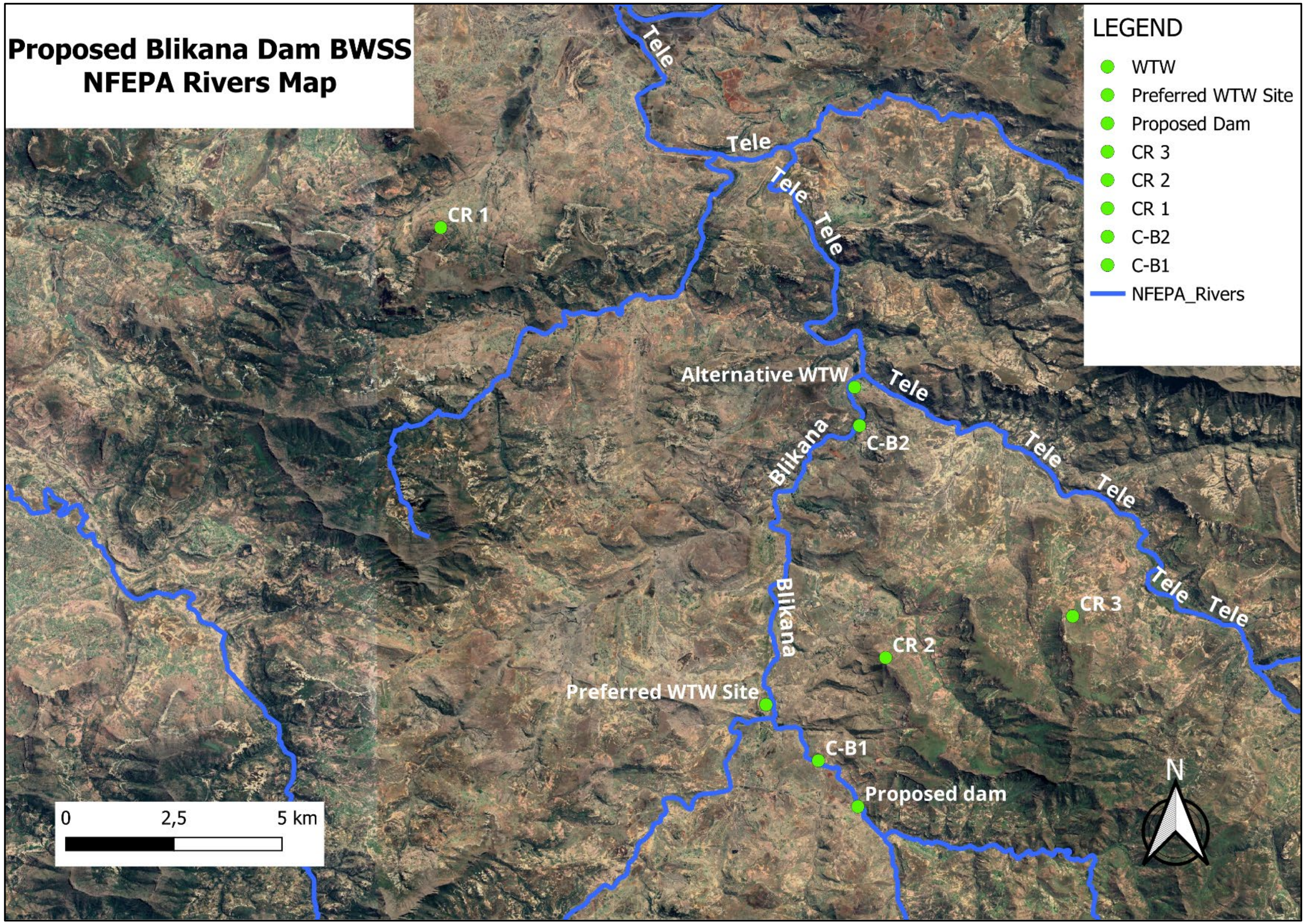


Figure 3-7: Rivers within the study area

3.8.2 Wetland FEPAs

In the context of the National Freshwater Ecosystem Priority Areas (NFEPA) project in South Africa, Wetland FEPAs are specific wetlands identified as strategic priorities for conserving the country's freshwater biodiversity. A wetland required to meet national biodiversity targets. These are selected because they represent a specific ecosystem type or support threatened species. They should be maintained in a natural or near-natural condition (Ecological Category A or B). If a designated Wetland FEPA is currently in a condition lower than A or B, it is prioritized for rehabilitation to the best attainable state. Many are identified based on their role as sightings or breeding areas for threatened species, such as the Wattled Crane, Grey Crowned Crane, and Blue Crane. NFEPA maps distinguish between individual wetlands and broader clusters:

- Wetland FEPAs: Individual wetland units selected for their biodiversity importance.
- Wetland clusters are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts. An orange outline is shown around groups of wetlands that belong to a wetland cluster. Wetlands do not have to have FEPA status to belong to a wetland cluster (although clusters with a high proportion of wetland FEPAs were favoured in identifying wetland clusters).

Wetland FEPAs identified were a Channelled Valley Bottom Wetland (CVB) and a floodplain both of which are not with the PAOI (Figure 3-8). With regards to the wetland clusters, none were identified within or outside the POAI.

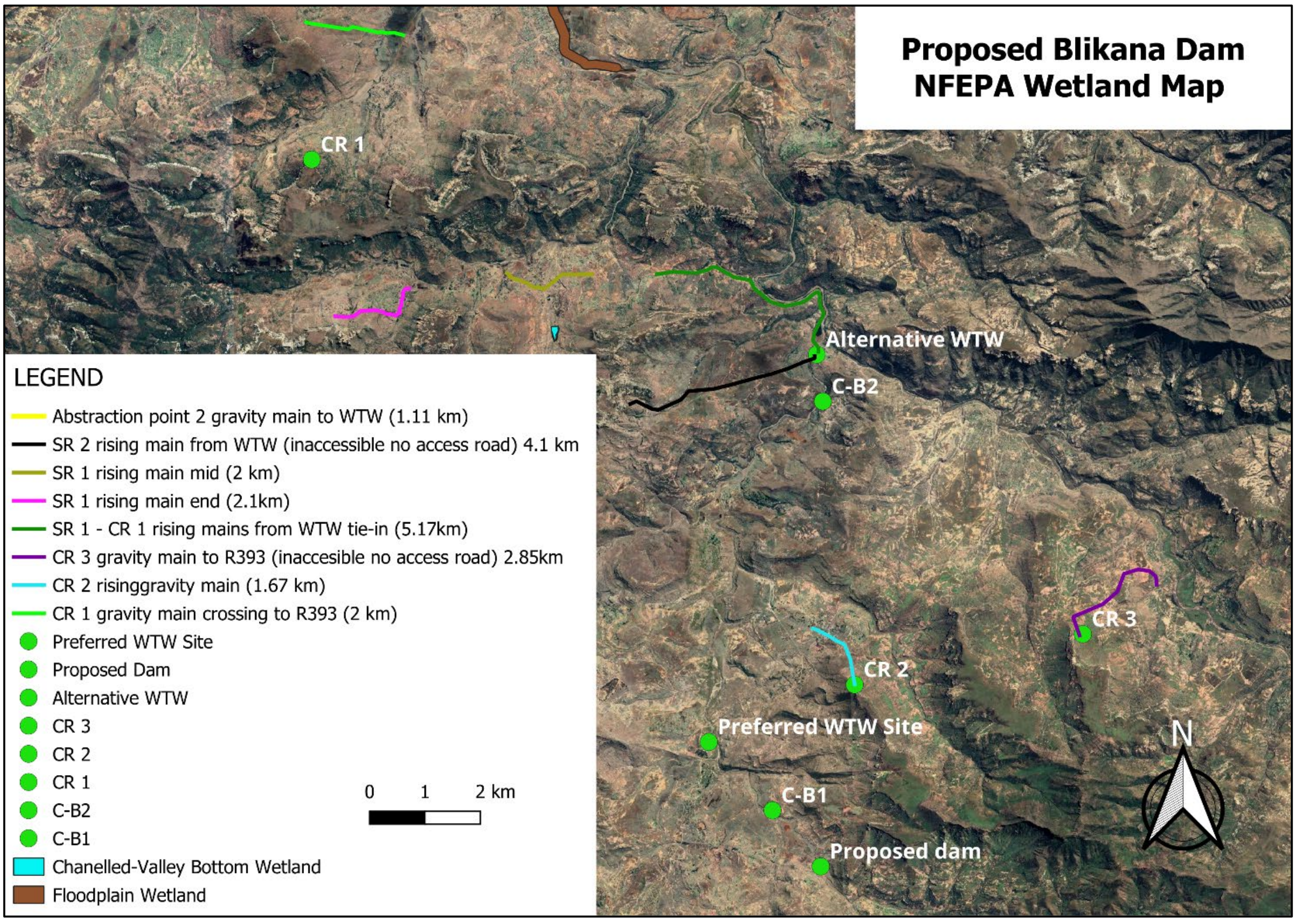


Figure 3-8: NFEPA wetlands

3.9 National Wetland Map 5 (NWM5)

The National Wetland Map version 5 (NWM5) shows the distribution of inland wetland ecosystem types across South Africa and includes estuaries and the extent of some rivers. A confidence map was compiled to identify areas where wetland extent and hydrogeomorphic (HGM) units (which contributed to defining the inland wetland ecosystem types together with the regional setting) attained at a higher level of certainty compared to other areas.

Higher levels of certainty are associated [code 5 in field Confidence_nr] with areas that have been visited in-field by a wetland specialist(s) over multiple seasons and cycles of the wetland hydroperiod and are therefore more accurately represented in the dataset. Codes 4 to 1 indicate lower levels of confidence that the extent and HGM unit are represented well.

The National Wetland Map version 5 (NWM5) shows no inland wetland ecosystems or estuaries, but shows the extent of a River, the Blikana River (Figure 3-9). The level of confident for the study area is low, illustrating a very low confidence (Figure 3-10).

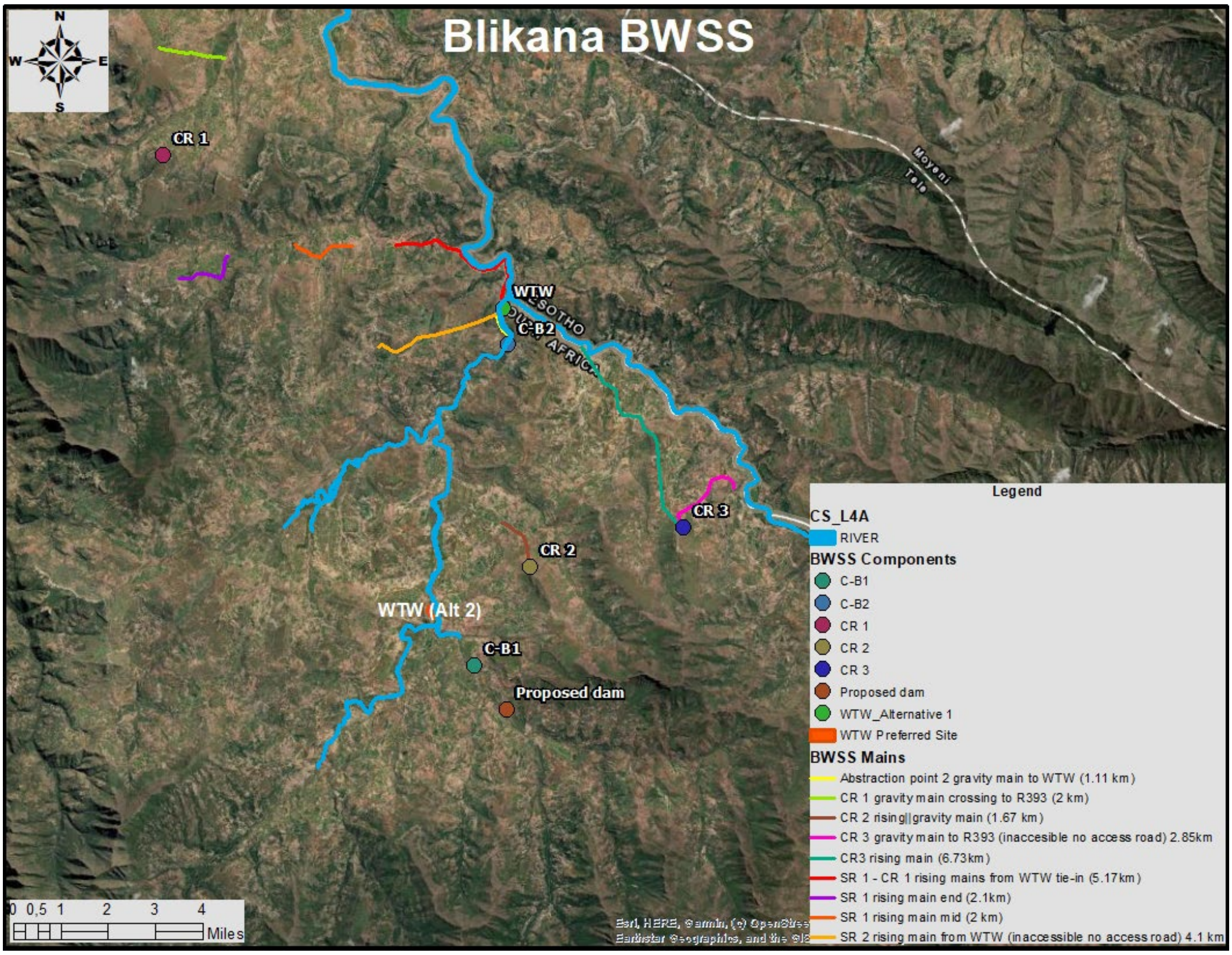


Figure 3-9: National Wetland Map version 5 (NWM5)

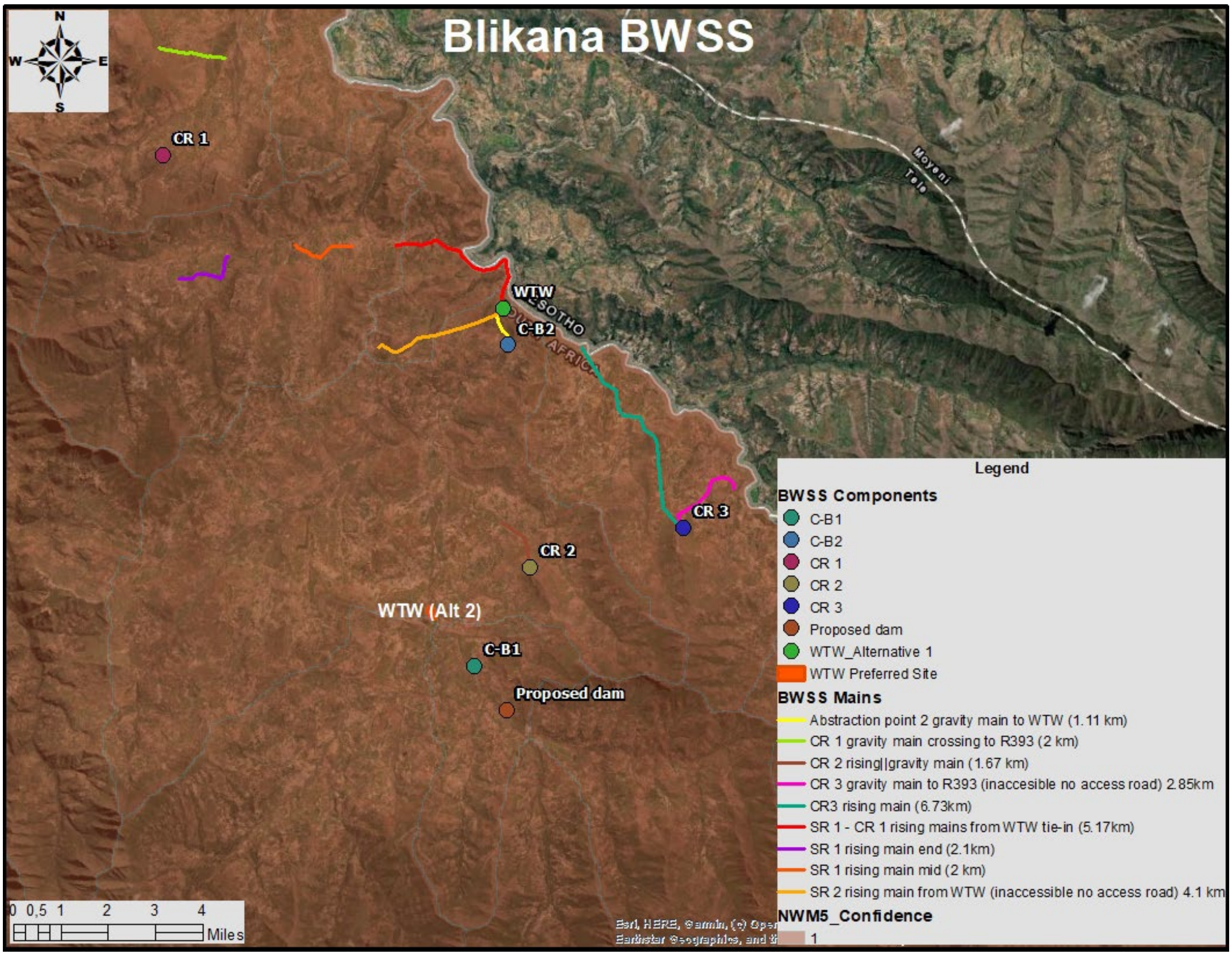


Figure 3-10: The National Wetland Map version 5 (NWM5) Confidence Map

3.10 Fish Sanctuary and Associated Sub-Quaternary Catchment

Fish sanctuaries are rivers that are essential for protecting threatened and near threatened freshwater fish that are indigenous to South Africa. The associated sub-quaternary catchment is marked with a red or black fish symbol on the map. A red fish indicates that there is at least one population of a critically endangered or endangered fish species within that sub-quaternary catchment. A black fish indicates the presence of vulnerable and near threatened fish populations. Some fish sanctuaries are FEPAs, with their associated sub-quaternary catchments shown in dark green; others are Fish Support Areas, with their associated sub-quaternary catchments shown in medium green (see explanation of Fish Support Areas below). A goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened or near threatened from going extinct. In order to achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment. Fish management plans need to be developed for all fish sanctuaries to protect the fish they contain, with priority given to those fish sanctuaries containing critically endangered or endangered fish species. These plans should address issues such as management of a particular stretch of river habitat within the sub-quaternary catchment, the construction of weirs to keep invasive alien fish species to a minimum (following an environmental impact assessment) and managing aquaculture and angling to ensure no further introduction of invasive alien fish species.

- Fish Support Area and associated sub-quaternary catchment: Fish sanctuaries in a good condition (A or B ecological category) were identified as FEPAs, and the whole associated sub-quaternary catchment is shown in dark green. The remaining fish sanctuaries in lower than an A or B ecological condition were identified as Fish Support Areas, and the associated sub-quaternary catchment is shown in medium green. Fish Support Areas also include sub-quaternary catchments that are important for migration of threatened or near threatened fish species – these are not marked with a fish symbol.

Fish sanctuaries are sub-quaternary catchments that are essential for protecting threatened and near-threatened freshwater fish populations that are indigenous to South Africa. Fish sanctuaries were identified at the scale of sub-quaternary catchments. The SAIAB/Albany fish data were used to guide the choices. This shapefile provides a summary of what the sub-quaternary catchment status is in terms of being selected as a FEPA, Fish Support Area, Fish Relocation & Translocation Area, Fish Rehabilitation Area and Migration Corridors for threatened and near-threatened fish indigenous to South Africa. The Blikana BWSS does not fall within any of the fish sanctuary categories (Figure 3-11).

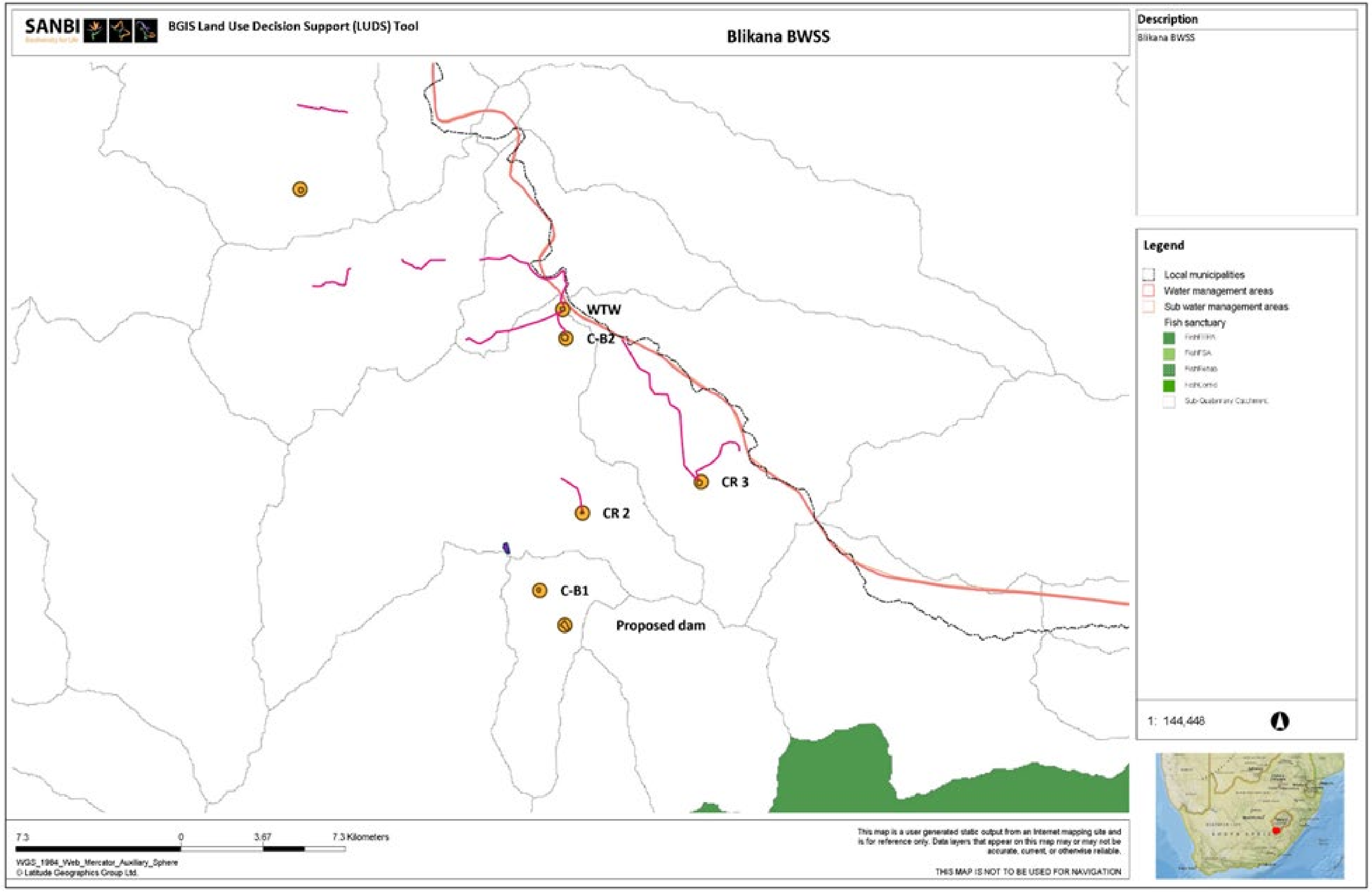


Figure 3-11: Fish Sub-quaternary catchment

3.11 Strategic Water Source Area (SWSAS, 2017)

Strategic Water Source Areas (SWSAs) are now defined as areas of land that either: (a) supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or (b) have high groundwater recharge and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b). They include transboundary Water Source Areas that extend into Lesotho and Swaziland. All surface water SWSAs are located in high rainfall areas where baseflow is at least 11 25 mm/a, which is evidence of a strong link between groundwater and surface water in the SWSAs. The aquifers sustain baseflow, contribute to runoff and, especially, contribute to dry season flows. Sustained river flows are important as they support people and communities who depend directly on rivers for their water, especially during the dry season and droughts.

The Blikana BWSS project lies within the Eastern Cape Drakensberg SWSA (2017) (Figure 3-12).

The Eastern Cape Drakensberg SWSA

The Eastern Cape Drakensberg Strategic Water Source Area is a nationally important high-altitude catchment identified by the South African National Biodiversity Institute as a priority water-producing landscape. Located along the Drakensberg–Maloti escarpment near the Lesotho border, it comprises montane grasslands, wetlands, and headwater streams that generate a disproportionate share of surface water feeding major river systems such as the Orange River (Senqu system) and the Mzimvubu River. Although covering a relatively small land area, it plays a critical role in national water security, biodiversity conservation, and climate resilience, and is highly sensitive to land degradation, overgrazing, invasive species, and inappropriate development.

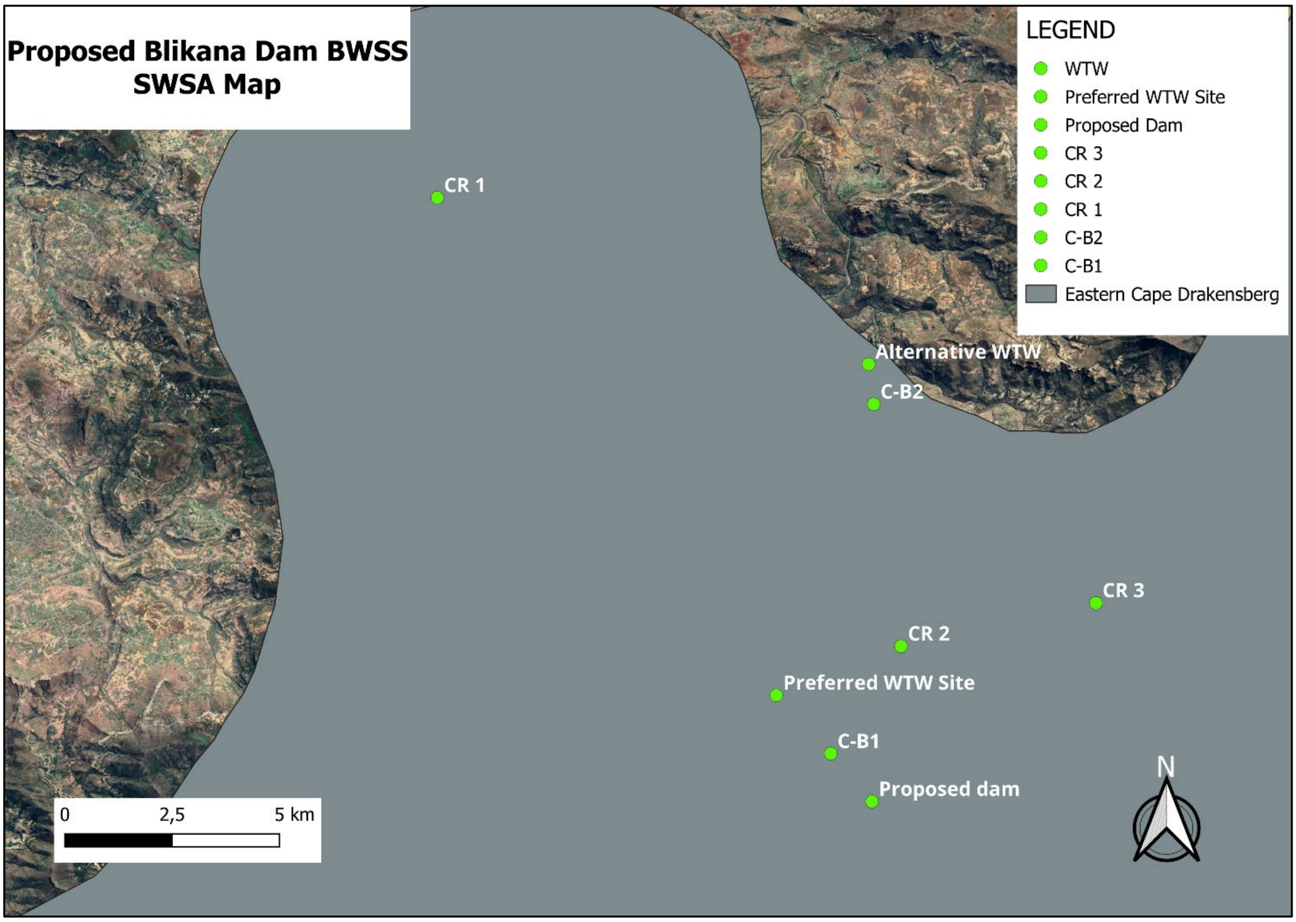


Figure 3-12: SWSA associated with the proposed Blikana BWSS project area

3.12 Desktop Present Ecological State, Importance and Sensitivity

The BWSS infrastructure and components are within the Blikana SQ Reach. The Blikana river is a perennial river that remains relatively natural at catchment and corridor scale, despite some localised disturbance pressures. Below is a description of the desktop Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES).

Table 3-2: Summary of desktop PES, EI and ES for the Blikana River SQ Reach

Aspect	Summary result	Key findings / interpretation
Reach description	Blikana SQ Reach	The BWSS infrastructure and components fall within the Blikana SQ Reach. The Blikana River is a perennial system that remains relatively natural at catchment and corridor scale, despite localised disturbance.
Present Ecological State (PES)	Category B – Largely Natural	The reach is considered largely natural, with small to moderate modification. Main pressures include subsistence agriculture, settlements, grazing, erosion, and roads/access crossings.
PES confidence	Average confidence = 3	Desktop confidence is moderate.
Ecological Importance (EI)	Mean EI = Moderate; Maximum EI = Very High	The reach has a mixed importance profile, with some indicators rating high to very high.
Fish EI	Representivity = Moderate; Rarity = Very High	Fish assemblages contribute strongly to the ecological importance of the reach, especially due to rarity.
Macroinvertebrate EI	Representivity = Low; Rarity = High	Macroinvertebrate importance is lower in terms of representivity, but rarity remains significant.
Other ecological features	13 species in SQ; 0 special species	Main habitats include incised channel, surface water, grassy edges, riparian trees, alluvial sand banks, shallow areas, and mountainous terrain. Main adverse conditions include agriculture, erosion, and rural effluent.
Habitat and connectivity	Habitat diversity = Low; Habitat size = Very Low; Instream migration link = Very High; Instream habitat integrity = High	Although habitat diversity and size are limited, the reach appears to function as an important connected river corridor.
Ecological Sensitivity (ES)	Mean ES = High; Maximum ES = High	The reach is highly sensitive overall.
Fish ES	Physico-chemical sensitivity = Moderate; No-flow sensitivity = High	Fish are particularly sensitive to reduced or altered flow conditions.

Aspect	Summary result	Key findings / interpretation
Macroinvertebrate ES	Physico-chemical sensitivity = Moderate; Velocity dependence = High	Macroinvertebrates are sensitive to hydraulic changes and water quality impacts.
Flow/water level sensitivity	High	The reach is sensitive to water level and flow changes.
Stream size sensitivity	High	The system is sensitive to modified flow and water level changes.
Integrated EIS	High	Overall, the reach is both ecologically important and sensitive.
Default Ecological Category (DEC)	B	The default ecological category for the reach is Category B.

Desktop Present Ecological State, Ecological Importance and Ecological Sensitivity

The desktop assessment indicates that the Blikana River SQ Reach is a largely natural perennial system with a PES Category B and a High integrated EIS. Although the average Ecological Importance is Moderate, several indicators, particularly fish rarity, connectivity, and habitat integrity, are rated High to Very High, indicating that the reach performs an important ecological function. The Ecological Sensitivity of the reach is High, particularly in relation to flow modification, water level change, velocity alteration, and water quality deterioration. These findings indicate that the Blikana River is a sensitive aquatic receptor and that the proposed BWSS infrastructure should be carefully managed to avoid or minimise impacts associated with abstraction, impoundment, pipeline crossings, sedimentation, and effluent-related disturbances.

This SQR is expected to host a total of 15 aquatic macroinvertebrates taxa (Table 3-3) and only three fish species (Table 3-4). It should be noted that the DWS (2016) PESEIS database lists expected biota at catchment level and with the species richness in headwater streams known to be lower compared to downstream reaches (Richardson, 2019), not all the biota was expected at the sampled sites. This was taken into consideration in the determination of biotic integrity in the latter sections of the report.

Table 3-3: Expected aquatic biota for the Blikana River SQR (DWS, 2016)

Family names		
Hirudinea	Gerridae	Gyrinidae
Potamonautidae	Oligochaeta	Ceratopogonidae
Hydracarina	Notonectidae	Chironomidae
Baetidae (2 species)	Veliidae / Mesoveliidae	Culicidae
Corixidae	Naucoridae	Muscidae

Table 3-4: Desktop-estimated fish assemblage for Blikana River (D18K-05268)

Scientific name	Common name	IUCN Status
Austroglanis sclateri	Rock-catfish	Least Concern
Labeobarbus aeneus	Smallmouth yellowfish	Least Concern
Barbus anoplus	Chubbyhead barb	Least Concern

4 Aquatic Ecology - Site Specific Findings

Aquatic field verification was undertaken on 30–31 January 2026, which falls within the summer rainfall season; however, low-flow conditions were observed at the time of assessment. The low-flow conditions were beneficial for clearly observing channel morphology and habitat units (riffle/run/pool structure), substrate composition, bank stability, riparian condition and potential crossing constraints, and for interpreting fish refuge habitat and potential barriers. These observations support a defensible habitat- and pathway-based aquatic assessment. A limitation is that low flow does not represent high-flow/storm conditions when sediment mobilisation and downstream turbidity impacts are typically greatest; therefore, erosion and sediment risks were assessed conservatively, and management measures were designed to remain effective under higher-flow events.

4.1 Physical Stream Conditions

The proposed Project area predominantly occurs within a mountainous area, and as such the geomorphological zonation of the river's ranges from Mountain Headwater streams to Lower Foothill streams. The geomorphological zone of a river influences the physical structure, the material from which the channel is formed, the shape of the channel, the hydraulic conditions, and in turn the fauna and flora which inhabits the river reach (Rowntree et al., 2000). Descriptions of the geomorphological zones found in the current study are provided in Table 4-1 and photographs taken during the field survey are provided in Figure 4-1.

In terms of the geomorphological zonation framework of Rowntree et al. (2000), the Blikana River and associated tributaries are interpreted as falling predominantly within the mountain stream to upper foothill zone. This interpretation is based on the high-altitude mountainous setting, narrow to moderately confined valley forms, coarse channel substrate, bedrock influence, limited floodplain development and the predominance of erosional and sediment transport processes. The Blikana River is characterised by a relatively narrow active channel with gravel-, cobble- and boulder-dominated bed material, local bedrock control, shallow flow conditions and limited but evident alluvial deposition in lower-energy sections. Smaller tributaries are similarly steep, coarse-bedded and confined, with active sediment transfer and localised incision. These characteristics are typical of upper catchment systems that are geomorphologically dynamic and sensitive to physical disturbance. The assessed channels therefore represent relatively natural upper catchment river forms, but are likely to be vulnerable to impacts such as bank destabilisation, sedimentation, altered flow concentration and channel disturbance associated with construction and operation of the proposed bulk water supply scheme.

Table 4-1: Geomorphological zonation of the assessed river channels (Rowntree et al., 2000)

Zone	Feature	Key characteristics
Mountain stream to upper foothill	A	Moderately confined, coarse-bedded, shallow active channel with local bedrock control and limited depositional areas
Mountain stream	A	Narrow, steep, coarse-bedded, locally incised and strongly controlled by hillslope inputs
Upper foothill	D	Slightly wider and less confined, with local bars and depositional pockets

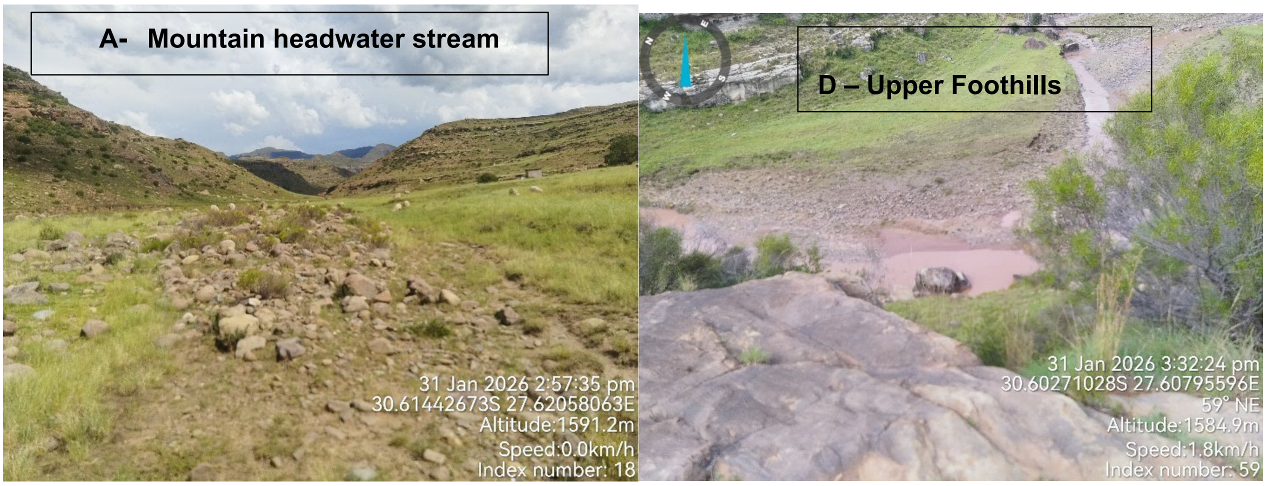


Figure 4-1: Representative photos of the riverine geomorphological zones and physical conditions of rivers within the project area. Letters A and D represent the zone classes

4.2 Habitat Assessment

Habitat quality and availability play a critical role in the occurrence of aquatic biota. For this reason, habitat evaluation is conducted simultaneously with biological evaluations in order to facilitate the interpretation of results (Ollis et al., 2006). The quality of the instream and riparian habitat influences the structure and function of the aquatic community in a stream; therefore, assessment of the habitat is critical to any assessment of ecological integrity. In the current study, the instream and riparian habitat assessment was based on the Index of Habitat Integrity (IHI).

4.3 Present Ecological States

4.3.1 Index of Habitat Integrity

Given the evidence available for Blikana — namely the desktop PES result of Category B (Largely Natural), the relatively high natural land cover around the reach, the identified pressures of subsistence farming, villages, overgrazing, erosion and roads, and a largely intact coarse-bedded upper-catchment channel with localised disturbance — the instream and riparian condition are shown in the tables below.

Table 4-2: Instream habitat integrity

Instream impact	Score (0–25)	Weight	Weighted impact (%)
Water abstraction	5	14	2.80
Flow modification	6	13	3.12
Bed modification	10	13	5.20
Channel modification	8	13	4.16
Water quality modification	9	14	5.04
Inundation	0	10	0.00
Alien macrophytes	0	9	0.00
Exotic fauna	0	8	0.00
Solid waste disposal	2	6	0.48
Total weighted impact			20.80
IHI Instream = 79.20%	79.20%		
Integrity class:	C – Moderately Modified		

Table 4-3: Riparian habitat integrity

Riparian impact	Score (0–25)	Weight	Weighted impact (%)
Indigenous vegetation removal	9	13	4.68
Exotic vegetation encroachment	4	12	1.92
Bank erosion	12	14	6.72
Channel modification	7	12	3.36
Water abstraction	4	13	2.08
Inundation	0	11	0.00
Flow modification	5	12	2.40
Water quality modification	8	13	4.16
Total weighted impact			25.32
IHI Riparian	74.68%		
Integrity class	C – Moderately Modified		

Index of Habitat Integrity (IHI) assessment for the Blikana River indicates that both the instream and riparian components fall within Integrity Class C (Moderately Modified). The instream habitat score of 79.20% suggests that the channel remains functional and largely intact, but shows moderate modification associated with water abstraction, flow-related disturbance, bed and channel modification, and water quality impacts. The riparian habitat score of 74.68% indicates a somewhat greater level of disturbance, mainly linked to vegetation removal, bank erosion, localised channel disturbance, and water quality-related pressures. Overall, the reach is therefore interpreted as moderately modified, which is consistent with the observed rural disturbance context and the desktop PES/EIS findings for the Blikana River.

4.4 Ecological Importance and Sensitivity

The Blikana River is considered to have a High ecological importance and sensitivity, with a mean site EIS score of 3.13. This reflects the fact that the river remains a relatively natural perennial upper catchment system that performs important ecological and geomorphological functions, while also being sensitive to disturbance. The most important drivers of the high rating are its role as a migration and dispersal corridor, its hydrological and geomorphological functioning, and its sensitivity to water quality and flow modification. Although confirmed site-specific species of conservation concern are not strongly evident from the available desktop data, the reach retains notable biodiversity value and ecological connectivity. Overall, the Blikana River has a highly important and sensitive aquatic receptor. The Blikana River found within the Secondary PAOI, is categorized as High (Table 4-4), which is ecologically important and sensitive on provincial/local scale.

Table 4-4: Ecological Importance and Sensitivity of the Blikana River

Criterion	**Description / site-relevant interpretation**	**Score (0–4)**	**Rating**
Biodiversity support	The Blikana River is a perennial upper catchment system supporting instream and riparian habitat, including coarse-substrate channel habitat, shallow flowing water, marginal vegetation and refuge areas for fish and macroinvertebrates. Biotic information indicates ecological support for fish and invertebrate assemblages typical of the reach.	3.0	Moderate
Habitat rarity / representativeness	The river is representative of a relatively natural upper catchment mountain stream to upper foothill system in the region. Although not exceptionally rare in form, it retains notable ecological value due to its relatively intact river corridor and natural channel character.	3.0	Moderate
Species of conservation concern (SCC)	No confirmed SCC records were identified from the desktop species information for the assessed reach itself, but the reach shows elevated ecological value through fish rarity and corridor function. SCC relevance is therefore considered present at a system level rather than strongly confirmed at site level.	2.5	Moderate
Migration / dispersal corridors	Data indicates very high instream migration linkage, suggesting that the reach functions as an important longitudinal movement corridor and contributes to connectivity within the broader catchment.	3.5	High
Hydrological / geomorphological function	The Blikana River maintains upper catchment flow conveyance, sediment transport, local channel-riparian exchange and downstream ecological processes. Its mountain stream to upper foothill character indicates a functional and physically dynamic river system.	3.5	High
Water quality sensitivity	The reach is sensitive to water quality deterioration, with information indicating pressure from rural effluent and a high sensitivity of aquatic biota to physico-chemical changes. Sediment and pollutant inputs would likely affect ecological functioning.	3.5	High
Hydrological sensitivity	ES results indicate high sensitivity to altered flow, water level changes, and no-flow conditions, especially for fish and macroinvertebrate assemblages. This is particularly relevant in the context of abstraction and impoundment.	3.5	High
Recovery potential	Recovery potential is moderate. The system remains relatively natural and functional, so localised impacts may recover if disturbance is controlled, but recovery may be slower where bank erosion, channel disturbance or flow alteration become chronic.	2.5	Moderate
Mean EIS score		3.13	High

4.5 Recommended Ecological Category for the Blikana River

Below is a summary of the aquatic ecological condition, ecological importance and sensitivity and recommended ecological category as well as the sensitivity for the aquatic features, based on the field assessment. The recommended ecological category (REC) is used to inform future management objectives for an aquatic ecosystem. The REC can be determined by using the PES (Present Ecological State) and EIS (Ecological Importance and Sensitivity) scores of the system (see table below; DWAF 2007). However, it is also important to consider the feasibility to realistically either maintain or improve the current condition of the water resource.

The Recommended Ecological Category (REC) for the Blikana River was determined using the DWAF (2007) PES–EIS matrix. Based on a Present Ecological State (PES) of Category B and an Ecological Importance and Sensitivity (EIS) rating of High, the river attains a recommended ecological category of A/B, (Table 4-5) with an associated management objective to improve the system where feasible. This indicates that, although the Blikana River is currently considered to be in a largely natural condition, its relatively high ecological importance and sensitivity warrant a management approach aimed at maintaining existing ecological functioning and improving the system toward a near-natural state wherever possible.

Table 4-5: Blikana River Recommended Ecological Category

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

In addition to the theoretical REC derived from the PES–EIS matrix, it is also necessary to consider the practical feasibility of maintaining or improving the current state of the resource. Factors such as existing land use, catchment pressures, erosion, access roads, grazing, and settlement-related disturbance may influence the extent to which ecological improvement is realistically achievable. As such, the REC should be interpreted as both a desired ecological objective and a management tool for guiding mitigation and conservation actions.

For the Blikana River, the available desktop and field-informed assessment indicates a PES of Category B and an EIS rating of High. Based on the DWAF (2007) PES–EIS matrix, this corresponds to a theoretical REC of A/B, with a management objective to improve the system. This indicates that, while the river is currently considered to be in a largely natural condition, its relatively high ecological importance and sensitivity justify a management objective aimed at protecting the current state and promoting improvement toward a near-natural condition where feasible.

Table 4-6: Recommended Ecological Category for the Blikana River and associated aquatic features

Aquatic feature / site	PES	EIS	Theoretical REC (DWAF, 2007)	Management objective	Practical interpretation
Blikana River main channel	B	High	A/B	Improve	Maintain the current largely natural condition and improve disturbed sections where feasible
Main tributaries associated with the BWSS	B/C	Moderate–High	B/C to B	Improve / Maintain	Maintain existing ecological functionality and avoid further degradation at crossings and disturbed reaches
Smaller drainage lines / ephemeral channels	C	Moderate	C	Maintain	Maintain channel stability and prevent erosion, incision and sedimentation
Abstraction point / weir interaction areas	B	High	A/B	Improve	Minimise direct channel disturbance and maintain flow-related ecological functioning
Dam footprint / impoundment-affected reach	B	High	A/B	Improve	Apply strict mitigation to reduce transformation of channel and riparian habitat
Pipeline crossing points	B/C	Moderate–High	B/C to B	Improve / Maintain	Maintain channel integrity during construction and rehabilitate disturbed crossings
Reservoir-related drainage interaction areas	C	Moderate	C	Maintain	Control runoff, erosion and sediment delivery to adjacent watercourses

The Blikana River main channel is therefore regarded as having a theoretical REC of A/B, which reflects the need for an improvement-oriented management objective despite the system already being in a relatively good ecological condition. In practical terms, the most realistic and defensible objective for the proposed project is to maintain at least a Category B condition in the main river channel, while seeking localised improvement in areas where riparian disturbance, bank erosion, or water quality impacts are already evident. This approach is consistent with the river's high ecological importance and sensitivity, as well as its role as a perennial upper catchment system that provides important habitat, connectivity, and geomorphological functioning.

The associated tributaries, smaller drainage lines and project interaction points are generally of lower ecological importance than the main Blikana River channel, but they remain sensitive to physical disturbance, sedimentation, erosion and hydrological alteration. These features should therefore be managed to maintain their present ecological functioning and to prevent further degradation during both construction and operation. Particular attention should be given to river and drainage line crossings, abstraction-related infrastructure, impoundment effects, and runoff management around reservoir and pipeline areas.

Overall, the REC assessment indicates that the Blikana River system should be managed conservatively, with an emphasis on maintaining current ecological functioning, avoiding unnecessary habitat transformation, and implementing mitigation measures that support the protection and, where feasible, improvement of aquatic habitat integrity within the study area.

4.6 Ichthyofauna – Ecological Condition

Fish sampling undertaken by means of electroshocking recorded two indigenous fish species in the Blikana River, namely smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*). Both species are consistent with perennial river habitat and indicate that the river remains capable of supporting indigenous fish assemblages typical of an upper catchment system.

Labeobarbus aeneus is generally associated with flowing river habitat of reasonable ecological quality and connectivity, while *Enteromius anoplus* is a widespread indigenous cyprinid commonly found in streams and rivers of moderate ecological condition. The presence of these species indicates that the Blikana River retains functional instream habitat and longitudinal connectivity, despite the localised pressures identified during the assessment.

The Fish Response Assessment Index (FRAI) was used to interpret the ecological integrity of the fish assemblage. FRAI assesses the deviation of the observed fish community from the expected reference assemblage for the site or reach. Based on the capture of *Labeobarbus aeneus* and *Enteromius anoplus*, together with the absence of a fuller expected assemblage and the presence of localised disturbance pressures such as erosion, grazing, road crossings and rural land-use impacts, the fish community of the Blikana River is interpreted as Ecological Category C (Moderately Modified).

This category indicates that the system remains ecologically functional and continues to support indigenous fish species, but that the fish assemblage has been modified from natural reference condition. The likely drivers of this modification include localised sedimentation, disturbance of channel and riparian habitat, and water quality or flow-related pressures. Overall, the ichthyofaunal condition of the Blikana River is therefore considered to be moderately modified, but still of ecological significance.

Table 4-7: Fish species recorded in the Blikana River

Species	Common name	Ecological interpretation
Labeobarbus aeneus	Smallmouth yellowfish	Indicates perennial flowing habitat with reasonable connectivity and fair ecological condition
Enteromius anoplus	Chubbyhead barb	Common indigenous species tolerant of some disturbance, but still indicative of functional river habitat

Table 4-8: FRAI-based interpretation of fish ecological condition for the Blikana River

Component	Interpretation
Fish species recorded	*Labeobarbus aeneus*, *Enteromius anoplus*
Assemblage type	Indigenous perennial river assemblage
Key pressures	Erosion, grazing, road crossings, rural land use, localised water quality impacts
Likely FRAI ecological category	**C – Moderately Modified**
Overall condition	Functional but modified fish assemblage

5 Site Sensitivity Verification

The findings of the site sensitivity verification exercise, based on the data gathering activities conducted to date (review and consolidation of available desktop data, site sensitivity verification site visits) are summarised below.

Table 5-1: Site sensitivity verification results

Theme	Screening Tool Sensitivity	Site-based sensitivity	Motivation
Aquatic Biodiversity	Very High	Very High	• Presence of perennial and non-perennial riverine systems with functional ecosystems. • Presence of systems within the project area including systems in a largely natural condition and including systems highlighted as FEPA Rivers. • CBA 2 and ESA 1 broader area.

5.1 Wetland Classification and Delineation

No wetlands were delineated and assessed for this assessment.

5.2 Recommended Buffer for Aquatic Features

A 50 m buffer was applied to the Blikana River as a precautionary ecological setback to protect the perennial river channel and its associated riparian habitat. The buffer is intended to minimise risks such as vegetation disturbance, bank instability, erosion, sedimentation and water quality impacts. As far as practicable, project infrastructure should be located outside this buffer.

However, it is recognised that some BWSS components fall within the 50 m buffer (the proposed dam, C-B1 (abstraction point 1; C-B2 and SR 1 rising main end), , and that two rising mains are required to cross the river (SR 1 – CR 1 rising main from Alternative WTW tie-in and SR 2 rising main from Alternative WTW) (Figure 5-1 to 5-3). These within-buffer components are therefore regarded as high-sensitivity impact points requiring strict control. In particular, the river crossings should be aligned as close to perpendicular to the channel as possible, and disturbance to the banks, channel bed and riparian vegetation should be minimised. All infrastructure within the buffer should be subject to strict mitigation, including demarcation of work areas, erosion and sediment control, stormwater management, controlled handling of hazardous materials, and rehabilitation of disturbed areas. While infrastructure within the buffer is not preferred, it may be acceptable where it is unavoidable and where impacts can be adequately minimised and managed.

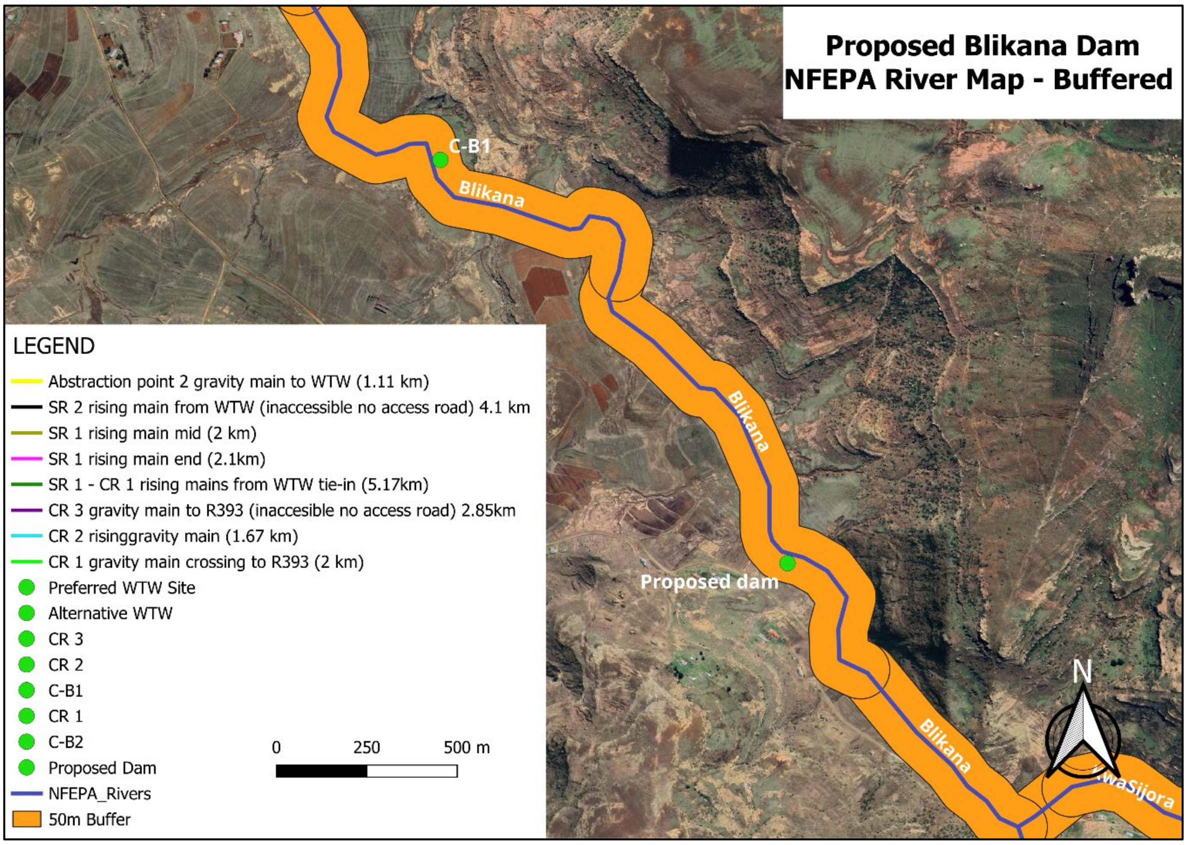


Figure 5-1: Proposed dam and Abstraction Point 1 (C-B1) within 50m buffer

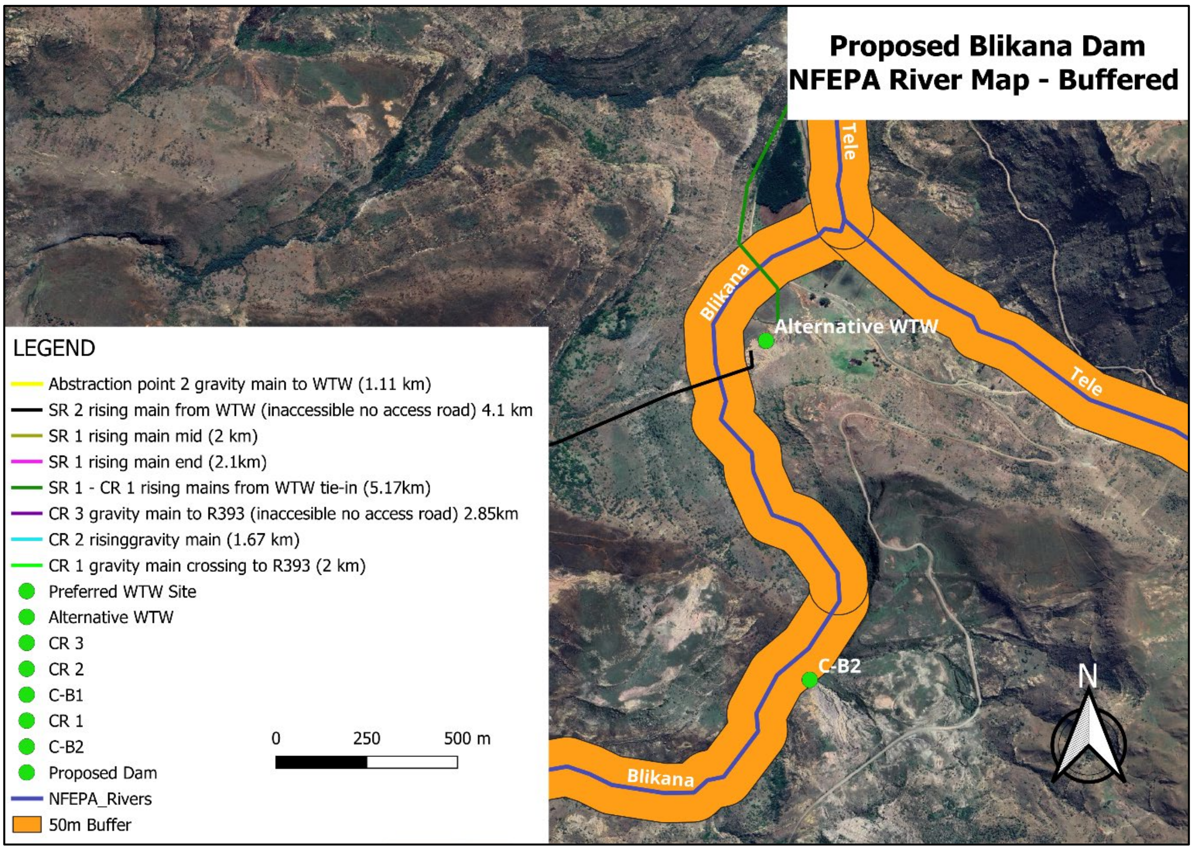


Figure 5-2: Abstraction point 2 (C-B2) and SR 2 rising main from WTW and SR 1 – CR 1 rising mains from Alternative WTW tie-in within buffer

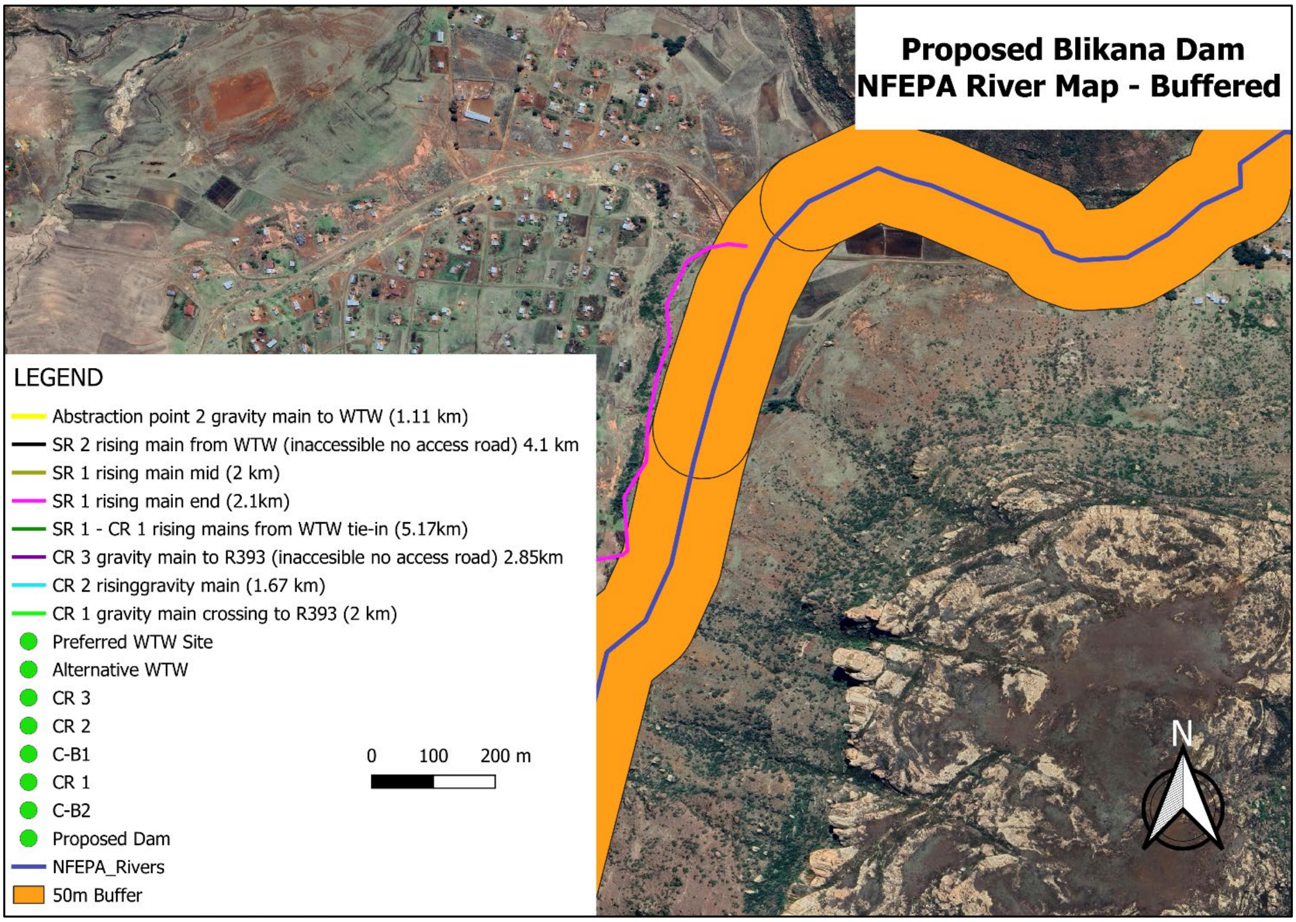


Figure 5-3: SR 1 rising main end within buffer zone

6 Impact Significance & Risk Assessments

The following key ecological and aquatic-related issues were identified during the assessment of the proposed Blikana BWSS development areas (Table 6-1).

Table 6-1: Ecological issues identified during the assessment

#	Activity causing impact (Issue)	Description of impact
1	Non-compliance with environmental and water legislation	**1.1** Legal compliance Development commencement without the required environmental approvals and water use authorisation (where applicable) may result in legal non-compliance, project delays, and possible enforcement action against the municipality and contractors. Some work is proposed to cross watercourses, water-related authorisation requirements may apply depending on final design and effluent/wastewater management arrangements.
2	Vegetation clearing and site establishment	**2.1** Loss/disturbance of vegetation and habitat within the development footprint Vegetation clearing and ground disturbance for the proposed Blikana BWSS may cause local habitat loss, faunal disturbance and reduced buffering capacity against runoff and sediment movement. The aquatic relevance of this impact is greatest at the sites, where disturbed areas may be hydrologically connected to the Blikana River system. Clearing should be confined to the minimum feasible footprint and no-go areas must be demarcated.
3	Earthworks, trenching and construction activities	**3.1** Increased runoff generation and sediment mobilisation Earthworks, trenching, stockpiling and exposed soils may reduce infiltration and increase runoff and sediment delivery to drainage pathways during rainfall events. This may indirectly affect the Blikana River and associated tributaries, particularly from the proposed WTW, abstraction points, gravity mains crossing the river, and proposed dam works. Strict erosion and sediment controls are required.
		3.2 Hydrocarbon, chemical and concrete-related contamination of soils and runoff. Construction plant, machinery, fuel storage, refuelling and concrete works may result in spills or contaminated runoff that could reach aquatic receptors indirectly via drainage pathways. This impact is avoidable with bunding, spill kits, concrete washout controls and proper site housekeeping.
		3.3 Local drainage alteration and erosion initiation Temporary drainage diversions, concentrated runoff from disturbed surfaces, and poorly managed stormwater during construction may initiate erosion and increase sediment transport toward the river system.
4	Operation of the proposed Blikana BWSS and associated infrastructure.	**4.1** Non-compliant effluent or poor treatment performance at the WTW If the proposed WTW does not consistently achieve required effluent quality standards, nutrient, microbial and organic loading may affect the river and downstream water quality and ecological functioning. This is a major long-term aquatic risk and requires strong operational controls and compliance monitoring.
		4.2 Operational stormwater runoff and outlet erosion. Permanent hard surfaces and runoff concentration at the Bulk Water Supply System components may increase local erosion and sediment transport if stormwater is not attenuated and discharged in a controlled manner. The aquatic consequence is highest where runoff pathways connect toward the Blikana River system.
		4.3 Positive impact: improved water infrastructure and performance. The proposed Blikana Bulk Water Supply System as a whole are intended to address existing water provision constraints. If properly constructed and operated and maintained, the system is expected to provide much needed clean water supply, reduce chronic pollution risk, improve treatment reliability.

All impacts identified above were assessed as per the assessment methodology described in Chapter 2 of this report. Each impact was described on how it will impact within a specific phase of the project.

6.1 Legal Compliance

Table 6-2: Impact Assessment of legal compliance for the planning and design phase

Issue:	**Non-compliance to existing legislation**		
Consequence of Issue	Non-compliance with environmental and aquatic legislation may result in delays, stop-work instructions, administrative penalties or legal action against the Municipality and contractors. It may also lead to avoidable impacts on the Blikana River and tributaries if activities commence without approved controls and conditions.		
Number of impacts identified associated with this issue	Only 1 (Impact 1.1 only)		
Field	**Detail**		
Phase of project	Planning and Design Phase		
Nature of impact	Failure to obtain required environmental and water-related approvals before construction may lead to legal non-compliance and uncontrolled aquatic risks.		
Cumulative impact	Delays and unmanaged construction risks may increase cumulative impact on the river system.		
Indirect impacts	Potential uncontrolled sediment, stormwater and wastewater impacts if works commence without approved conditions.		
Residual impacts	None, if approvals are secured and conditions implemented.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	5	2	Could affect all project phases if approvals are not in place; reduced once compliance is achieved.
Extent of impact	3	1	Can affect project implementation at municipal/regulatory level; reduced to local administrative compliance.
Intensity of impact	5	2	High due to legal consequences and potential stop-work orders.
Severity	**13**	**5**	**Duration + Extent + Intensity**
Probability of impact occurring	4	1	Probable if approvals are not obtained; unlikely after mitigation.
Frequency	4	1	Can recur across project activities if unmanaged; once-off when managed.
Incidence	**8**	**2**	**Frequency + Probability**
Degree of reversibility	High		— can be corrected, but with time/cost implications.
Irreplaceability	Low		no direct resource loss
Mitigations	**Mitigatory potential**		**Recommended Mitigations**
	High		- Obtain all required environmental and water-related approvals prior to any site works. - Include all approval conditions in contract documentation. - Appoint an ECO before construction. - Induct contractors on aquatic no-go areas and buffer requirements.
Significance of impact (Severity x Incidence)	Pre-mitigation significance		Post-mitigation significance
	High negative (104)		Very low negative (10)

6.2 Habitat / Vegetation Disturbance

Table 6-3: Habitat/vegetation disturbance

Issue 2:	**Vegetation clearing and site establishment**		
Consequence of Issue	Vegetation clearing and site establishment for the proposed dam, abstraction point 1, abstraction point 2, associated pipeline infrastructure including rising mains and gravity mains, and sections of infrastructure located within or near the recommended aquatic buffer, may result in local habitat loss, temporary faunal disturbance, and reduced buffering capacity against runoff, erosion and sediment movement toward the Blikana River and associated tributaries/drainage lines. This is particularly relevant where infrastructure occurs close to the river, within the 50 m buffer, or at river crossing points. The preferred WTW site contributes a lower aquatic risk in this regard, as it is located outside the 50 m buffer and is not associated with drainage lines, whereas Alternative 1 is associated with dongas and drainage features that may increase hydrological connectivity to the Blikana River..		
Number of impacts identified associated with this issue	2 (Impact 2.1 and 2.2)		
Impact 2.1: Legal/Impact name	Loss/disturbance of vegetation and habitat within the development footprint		
Phase	**Construction Phase**		
Nature of impact	Vegetation clearing and ground disturbance associated with the construction of BWSS infrastructure may reduce vegetation cover, disturb local habitat and weaken the buffering function of vegetation where works occur close to drainage pathways, tributaries or the Blikana River. This impact is most relevant to the dam footprint, abstraction works, river crossing points, and pipeline sections within or close to the 50 m aquatic buffer, where disturbed surfaces are more likely to connect directly or indirectly to the river system. The preferred WTW site presents a comparatively lower aquatic risk because it is located outside the recommended buffer and is not associated with drainage lines, while Alternative 1 presents a higher risk due to the presence of dongas and drainage features that could facilitate runoff and pollutant movement toward the river.		
Cumulative impact	Incremental habitat loss and reduction in local buffering capacity within a catchment already affected by grazing, erosion, roads and broader rural land-use disturbance..		
Indirect impacts	Reduced infiltration and interception, increased erosion susceptibility, greater runoff concentration, and increased potential for sediment delivery to nearby aquatic features.		
Residual impacts	Permanent habitat transformation will remain within the built footprint, although temporary disturbance areas may be rehabilitated.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	4	3	Long-term within the permanent development footprint; reduced in temporary work areas through rehabilitation.
Extent of impact	1	1	Localised to the project footprint and immediate surroundings.
Intensity of impact	3	2	Moderate habitat disturbance if the footprint is not controlled; reduced where footprint and no-go areas are demarcated.
Severity	**8**	**6**	**Duration + extent + intensity**
Probability of impact occurring	4	2	Likely during clearing and site establishment; reduced with footprint demarcation and controls.
Frequency	4	2	Repeated during construction activities; reduced once the footprint is fixed and clearing is complete.
Incidence	**8**	**4**	**Frequency + Probability**
Degree of reversibility	Medium		reversible in temporary work areas through rehabilitation, but permanent within the infrastructure footprint.
Irreplaceability	Low		Low to Medium — local habitat value may be lost, but impacts are avoidable/reducible through buffers and footprint control.
Mitigations	**Mitigatory potential**		**Recommended mitigations**

	High	- Demarcate the minimum construction footprint and all aquatic no-go areas prior to clearing. - Maintain the recommended 50 m buffer around the Blikana River wherever feasible. - Restrict stockpiling, laydown areas, parking and construction camp activities to designated areas outside sensitive aquatic zones. - Strip and stockpile topsoil separately for use in rehabilitation. - Minimise clearing within the buffer and at river crossings to the minimum extent required. - Rehabilitate all temporary disturbed areas progressively during construction. - Avoid unnecessary disturbance of riparian vegetation and drainage line margins. - Use the preferred WTW site rather than Alternative 1 from an aquatic perspective, as it is not associated with drainage lines or dongas.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**	**Post-mitigation significance**
	Medium negative (64)	**Very low negative (24)**

6.3 Faunal disturbance

Table 6-4: Faunal disturbance impacts

Issue 2:	Vegetation clearing and site establishment		
Consequence of Issue	Vegetation clearing and site establishment for the proposed am, abstraction point 1, abstraction point 2, SR 2 rising main from alternative WTW , SR 1 – CR 1 rising mains to WTW tie in and the SR 1 rising main end may result in local habitat loss, temporary faunal disturbance, and reduced buffering capacity against runoff and sediment movement toward the River. The aquatic consequence is mainly associated with these components as they are within the buffer zone and others cross the Blikana River while the proposed preferred WTW site, Alternative WTW site and other components is a lower aquatic-risk component due to their distance from mapped watercourses.		
Number of impacts identified associated with this issue	2 (Impact 2.1 and 2.2)		
Impact 2.2: Legal/Impact name	Construction-related faunal disturbance and temporary displacement		
Phase	Construction Phase		
Nature of impact	Noise, vibration, vehicle movement and human activity may temporarily displace fauna and reduce abundance of disturbance-sensitive species near active work areas. The rating reflects disturbance across all construction sites, but aquatic receptor sensitivity is highest for works associated with the components within the buffer zone.		
Cumulative impact	Repeated disturbance may reduce habitat use during the construction period.		
Indirect impacts	Temporary reduction in foraging and shelter use.		
Residual impacts	Minor short-term disturbance only.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	2	1	Mainly limited to the construction period.
Extent of impact	1	1	Localised to active work areas.
Intensity of impact	2	1	Low to moderate behavioural disturbance.
Severity	**5**	**3**	**Duration + extent + intensity**
Probability of impact occurring	4	2	Likely during construction; reduced with controls.
Frequency	4	2	Frequent while works are active.
Incidence	**8**	**4**	**Frequency + Probability**
Degree of reversibility	High		fauna typically return after disturbance ceases.
Irreplaceability	Low		Low — no permanent fragmentation expected.
Mitigations	**Mitigatory potential**		**Recommended mitigations**
	High		- Limit works to daylight hours where practical.- Keep footprint as small as possible.- Prohibit unnecessary vegetation clearing.- Enforce no-hunting/no-harassment and site speed limits.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**		**Post-mitigation significance**
	Low negative (40)		**Very low negative (12)**

6.4 Sediment mobilisation / turbidity

Table 6-5: Sediment mobilisation and turbidity leading to altered drainage pathways

Issue 3.1:	Earthworks, trenching and construction runoff pathways		
Consequence of Issue	Earthworks, trenching and site preparation may increase runoff, mobilise sediments and contaminants, and alter drainage pathways connected to the river.		
Number of impacts identified associated with this issue	3 (Impact 3.1, 3.2 and 3.3)		
Impact 3.1: Legal/Impact name	Sediment mobilisation and turbidity in the receiving river system		
Phase	Construction Phase		
Nature of impact	Exposed soils, stockpiles and trenching may generate sediment-laden runoff during rainfall, increasing turbidity and fine sediment deposition downstream. This rating is driven mainly by the proposed dam, abstraction point 1 and abstraction point 2, SR 2 gravity mains from Alternative WTW site and SR 1 to CR1 rising mains from the Alternative WTW crossing the river and the SR 1 rising main end because these occur within the recommended aquatic buffer of the Blikana River.		
Cumulative impact	Repeated sediment pulses can progressively degrade habitat quality.		
Indirect impacts	Smothering of benthic habitats, reduced light penetration and aquatic habitat quality.		
Residual impacts	Low if erosion and sediment controls are implemented and maintained.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	3	2	Medium-term during construction; reduced with staged works and rehabilitation.
Extent of impact	2	1	Can extend beyond site via drainage pathways if unmanaged.
Intensity of impact	4	2	High if sediment reaches river; reduced with controls.
Severity	**9**	**5**	**Duration + extent + intensity**
Probability of impact occurring	4	2	Likely during rainfall and earthworks if unmanaged; reduced with controls.
Frequency	4	1	Frequent during construction/rainfall events; low after mitigation.
Incidence	**8**	**3**	**Frequency + Probability**
Degree of reversibility	Medium	— turbidity is reversible, but repeated deposition can delay recovery.	
Irreplaceability	Medium	Medium — aquatic habitats are locally important and connected to estuarine condition.	
Mitigations	**Mitigatory potential**		**Recommended mitigations**
	High		- Prepare and implement an erosion and sediment control plan before earthworks. - Phase clearing and minimise exposed areas. - Stabilise stockpiles and protect from runoff. - Install silt fences/sediment traps/diversion berms where needed. - Rehabilitate disturbed areas progressively. - Avoid high-risk earthworks during heavy rainfall where practical.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**		**Post-mitigation significance**
	Medium negative (72)		**Very low negative (15)**

6.5 Hydrocarbon/chemical contamination

Table 6-6: Hydrocarbon/chemical contamination

Issue 3.2:	Earthworks, trenching and construction runoff pathways		
Consequence of Issue	Earthworks, trenching and site preparation may increase runoff, mobilise sediments and contaminants, and alter drainage pathways connected to the Blikana River.		
Number of impacts identified associated with this issue	3 (Impact 3.1, 3.2 and 3.3)		
Impact 3.2: Legal/Impact name	Hydrocarbon / chemical / cement contamination of runoff and receiving waters.		
Phase	Construction Phase		
Nature of impact	Leaks/spills of fuels, oils, lubricants, chemicals and concrete wash water may contaminate soils and runoff, with indirect transport to aquatic receptors. Although this risk applies to all construction areas, the aquatic consequence score is primarily influenced by the proposed dam, abstraction point 1 and abstraction point 2, SR 2 gravity mains from Alternative WTW site and SR 1 to CR1 rising mains from the Alternative WTW crossing the river and the SR 1 rising main end WTW due to their closer hydrological connectivity to the river system.		
Cumulative impact	Repeated small spills can elevate contamination risk over time.		
Indirect impacts	Soil contamination, water-quality deterioration and toxicity risk.		
Residual impacts	Low with bunding and spill response controls.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	2	1	Short-term, incident-driven impact.
Extent of impact	2	1	Can spread via runoff if unmanaged.
Intensity of impact	4	2	High if contaminants reach river.
Severity	**8**	**4**	**Duration + extent + intensity**
Probability of impact occurring	3	1	Possible during construction; low with controls.
Frequency	3	1	Intermittent during active works.
Incidence	**6**	**2**	**Frequency + Probability**
Degree of reversibility	Medium to High		Spill effects can often be contained if response is immediate.
Irreplaceability	Low to Medium		Depends on whether contamination reaches aquatic habitats.
Mitigations	**Mitigatory potential**		**Recommended mitigations**
	High		- Store fuels and chemicals in bunded areas away from drainage routes. - Use drip trays under parked plant and refuelling points. - Provide a designated lined concrete washout area. - Keep spill kits on site and train personnel. - Remove contaminated soil immediately to an approved facility.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**		**Post-mitigation significance**
	Low negative (48)		**Very low negative (8)**

6.6 Drainage Alteration / Erosion Initiation

Table 6-7: Impact assessment for drainage alteration/ erosion initiation

Issue 3:	Earthworks, trenching and construction runoff pathways		
Consequence of Issue	Earthworks, trenching and site preparation may increase runoff, mobilise sediments and contaminants, and alter drainage pathways connected to the Blikana River.		
Number of impacts identified associated with this issue	3 (Impact 3.1, 3.2 and 3.3)		
Impact 3.3: Legal/Impact name	Local drainage alteration and erosion initiation at construction outlets/pathways		
Phase	Construction Phase		
Nature of impact	Temporary drainage changes and concentrated runoff from disturbed areas may initiate erosion and increase sediment transfer toward the river corridor. The higher aquatic relevance of this impact is associated with the proposed WTW, where poorly managed runoff pathways could connect to the Blikana River or drainage routes.		
Cumulative impact	Repeated runoff concentration may establish persistent erosion features.		
Indirect impacts	Local bank-edge instability and downstream sedimentation.		
Residual impacts	Low if temporary drainage and outlet protection are properly managed.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	3	2	Can persist through construction if not corrected.
Extent of impact	2	1	Site and immediate drainage pathways.
Intensity of impact	3	2	Moderate if runoff becomes concentrated.
Severity	**8**	**5**	**Duration + extent + intensity**
Probability of impact occurring	4	2	Likely during earthworks/rainfall if unmanaged.
Frequency	3	1	Intermittent, rainfall-linked.
Incidence	**7**	**3**	**Frequency + Probability**
Degree of reversibility	Medium		erosion can be repaired if addressed early.
Irreplaceability	Low		provided erosion is contained before affecting aquatic systems.
Mitigations	Mitigatory potential		Recommended mitigations
	High		- Install temporary stormwater controls before major earthworks - Prevent concentrated discharge onto bare slopes. - Use energy dissipation at outlets. - Inspect and repair erosion after rainfall events. - Stabilise disturbed drainage features immediately.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**		**Post-mitigation significance**
	Medium negative (56)		**Very low negative (15)**

6.7 WTW malfunction, leakage or contaminated runoff

Table 6-8: Impact assessment of malfunctioning or poorly operated water treatment infrastructure

Issue 4:	Operation of WTW		
Consequence of Issue	The infrastructure may either support or degrade aquatic ecosystem condition depending on operational performance. Key aquatic risks are associated with the proposed WTW. If the proposed WTW does not operate efficiently, or if process water, sludge, chemicals, wash water, or other waste streams are not adequately contained and managed, contaminated runoff or poorly managed discharges may enter connected drainage pathways and ultimately the Blikana River. This could result in reduced water quality, increased pollutant loading, and adverse effects on aquatic ecosystems and downstream users.		
Number of impacts identified associated with this issue	4 (Impact 4.1, 4.2, 4.3 and 4.4)		
Impact 4.1: Legal/Impact name	Malfunctioning or poorly operated water treatment infrastructure.		
Phase of expansion	Operation Phase		
Nature of impact	This is a primary project-specific aquatic risk associated with the proposed WTW, and infrastructure linked to the WTW, including both the preferred and alternative sites. Operational failure, equipment malfunction, poor maintenance, chemical handling failures, sludge/process waste leakage, or uncontrolled contaminated runoff could result in pollutants reaching aquatic receptors via drainage pathways. Where drainage lines, dongas, or hydrological pathways are present, such releases may be conveyed rapidly toward the Blikana River, increasing the risk of water quality deterioration and associated ecological impacts.		
Cumulative impact	Repeated operational failures, leakage incidents, or contaminated runoff events may cumulatively contribute to chronic degradation of river condition over time.		
Indirect impacts	Water quality deterioration, increased suspended solids or chemical loading, localised habitat stress, ecological disturbance to aquatic biota, and reduced suitability of the receiving environment for downstream users.		
Residual impacts	Residual emergency and operational failure risk remains and must be managed throughout the operational life of the WTW.		
Classification of impact	Before mitigating	After mitigating	Consequence of Impact
Duration of impact	5	3	Can have lasting effects if repeated; reduced if incidents are rapidly contained and corrected.
Extent of impact	3	2	Can extend through connected drainage pathways to the Blikana River.
Intensity of impact	5	3	Very high if pollutants are released and reach aquatic systems.
Severity	**13**	**8**	**Duration + extent + intensity**
Probability of impact occurring	4	2	Likely without safeguards; reduced with proper operation, containment and monitoring.
Frequency	4	2	Can recur during failures or poor management; reduced with maintenance and operational controls.
Incidence	**8**	**4**	**Frequency + Probability**
Degree of reversibility			Medium —water quality may recover, but repeated events may cause cumulative ecological damage.
Irreplaceability			Medium to High — affects a perennial river system of relatively high ecological importance and sensitivity.
Mitigations	**Mitigatory potential**		**Recommended mitigations**
	High		- Ensure efficient operation and preventative maintenance of all WTW systems. - Provide backup power where required to reduce risk of failure-related incidents. - Install appropriate telemetry, alarms and operational monitoring systems. - Provide adequate containment and bunding for chemicals, sludge/process waste and wash water. - Implement routine inspections, maintenance and housekeeping of drainage and containment systems. - Maintain an incident response protocol for spillages, leaks or treatment failures. - Prevent contaminated runoff from leaving the site uncontrolled.

			- Train operators in pollution prevention, emergency response and environmental compliance.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**		**Post-mitigation significance**
	High negative (104)		Low negative (32)

6.8 Water quality deterioration

Table 6-9: Impact assessment of water quality deterioration associated with WTW operation

Issue 4:	Operation of BWSS infrastructure		
Consequence of Issue	The operation of the BWSS infrastructure may either support or degrade the aquatic ecological condition of the Blikana River and associated tributaries/drainage lines, depending on operational performance, maintenance and environmental management. Key aquatic risks are associated mainly with the WTW, abstraction infrastructure, reservoirs and associated pipeline infrastructure, particularly where these components are located close to the Blikana River or connected drainage pathways. The WTW is an important contributor to potential water quality risk where poor operational performance, leakage, spillages, sludge handling failures, or contaminated stormwater could affect nearby aquatic systems.		
Number of impacts identified associated with this issue	4 (Impact 4.1, 4.2, 4.3 and 4.4)		
Impact 4.2: Legal/Impact name	Water quality deterioration due to poor WTW operation, chemical spillages, sludge/process waste and contaminated runoff.		
Phase	Operation Phase		
Nature of impact	This is a project-specific aquatic risk associated primarily with the proposed WTW and its related operational areas. If treatment systems are not properly operated and maintained, or if chemicals, sludge, process water, wash water or contaminated runoff are not effectively contained and managed, pollutants may enter nearby drainage lines, tributaries, or the Blikana River. Potential contaminants may include treatment chemicals, suspended solids, sludge-related material, hydrocarbons, and other pollutants associated with WTW operation and maintenance. Such releases could degrade water quality, reduce habitat suitability for aquatic biota, and contribute to a decline in the ecological condition of the receiving environment. This impact is likely to be most significant where the WTW site or associated drainage pathways have hydrological connectivity to the Blikana River system.		
Cumulative impact	Long-term water quality deterioration and reduced ecological resilience may occur where operational pollution events are repeated or chronic, particularly when added to existing rural runoff, erosion, and localised water quality pressures in the catchment.		
Indirect impacts	Localised contamination of tributaries and drainage lines, reduced water quality, habitat degradation, ecological stress to aquatic biota, and downstream decline in river condition.		
Residual impacts	Moderate residual risk requiring ongoing compliance monitoring, effective operational controls and maintenance.		
Classification of impact	**Before mitigating**	**After mitigating**	Consequence of Impact
Duration of impact	5	4	Can persist through operation if unmanaged.
Extent of impact	3	2	Can affect connected drainage pathways and downstream sections of the Blikana River
Intensity of impact	4	3	High before mitigation; reduced with proper containment, operation and monitoring
Severity	**12**	**9**	**Duration + extent + intensity**
Probability of impact occurring	4	2	Likely without robust operation and maintenance; reduced through operational controls.
Frequency	5	2	Could be recurrent or continuous where poor management persists; reduced when properly managed.
Incidence	**9**	**4**	**Frequency + Probability**
Degree of reversibility		Medium	recovery is possible, but repeated contamination may result in longer-term degradation.
Irreplaceability		High	affects a perennial river system of relatively high ecological importance and sensitivity
Mitigations	**Mitigatory potential**		**Recommended mitigations**
		High	- Operate and maintain the WTW so that all treatment and associated operational systems function efficiently and reliably. - Ensure that all chemicals, sludge, process waste, wash water and other waste streams are properly contained, handled and disposed of.

		- Prevent leaks, spillages, uncontrolled discharges and contaminated runoff from entering drainage lines or the Blikana River. - Implement routine compliance and operational monitoring, including inspection of drainage systems, bunded areas, sludge handling areas and stormwater controls. - Establish trigger levels, incident reporting procedures and corrective actions for pollution events. - Ensure operator training, preventive maintenance and rapid response to operational failures. - Separate clean and dirty water systems where relevant and maintain effective stormwater management around the WTW site.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance** **High negative (108)**	**Post-mitigation significance** **Low negative (36)**

6.9 Operational stormwater / erosion

Table 6-10: Impacts on operational stormwater / erosion

Issue 4:	Operation of BWSS infrastructure		
Consequence of Issue	The operation of the BWSS infrastructure may either support or negatively affect the aquatic ecological condition of the Blikana River and associated tributaries/drainage lines, depending on the effectiveness of operational management, maintenance and stormwater control. Key aquatic risks are associated mainly with the WTW, abstraction-related infrastructure, reservoirs and associated pipeline infrastructure, particularly where these components are located close to the Blikana River or connected drainage pathways. The main operational aquatic risks relate to contaminated runoff, erosion, sediment delivery, and localised water quality deterioration.		
Number of impacts identified associated with this issue	4 (Impact 4.1, 4.2, 4.3 and 4.4)		
Impact 4.3: Legal/Impact name	Altered stormwater runoff and local erosion during operation		
Phase	Operation Phase		
Nature of impact	Permanent hard surfaces, compacted areas and operational footprints associated with the WTW, reservoirs, abstraction infrastructure and associated access areas may increase runoff concentration and erosion risk during rainfall events. This may result in sediment-laden runoff entering nearby tributaries, drainage lines and ultimately the Blikana River, particularly where infrastructure is located within close proximity to aquatic features. The impact is relevant to all BWSS components, but aquatic sensitivity is highest where infrastructure is situated close to the main Blikana River channel, associated tributaries, or at infrastructure interaction points such as crossings and abstraction areas.		
Cumulative impact	Repeated runoff concentration and poorly controlled discharge may progressively increase erosion, channel instability and sediment loads in connected aquatic systems over time.		
Indirect impacts	Localised gullying, bank erosion, sediment pulses into downstream channels, reduced instream habitat quality, and degradation of riparian habitat condition.		
Residual impacts	Low if stormwater systems are appropriately designed, implemented and maintained throughout the operational phase.		
Classification of impact	**Before mitigating**	**After mitigating**	**Consequence of Impact**
Duration of impact	4	3	Long-term operational risk if unmanaged; reduced by engineered controls.
Extent of impact	2	1	Site and connected drainage pathways.
Intensity of impact	3	2	Moderate before controls; low after attenuation and outlet protection.

Severity	**9**	**6**	**Duration + extent + intensity**
Probability of impact occurring	3	2	Probable if unmanaged; reduced with design and maintenance.
Frequency	4	2	Frequent during rainfall events; reduced by stormwater controls.
Incidence	**7**	**4**	**Frequency + Probability**
Degree of reversibility	Medium to High		erosion and outlet issues can be corrected if addressed early.
Irreplaceability	Low to Medium		pathway-related but can affect sensitive downstream systems.
Mitigations	**Mitigatory potential**		**Recommended mitigations**
	High		- Design and implement an appropriate stormwater management system for the WTW, reservoirs and associated operational platforms. - Separate clean and dirty water systems where relevant. - Install attenuation measures and ensure controlled discharge of runoff. - Protect outlets and discharge points using energy dissipators, erosion protection and stabilisation measures. - Prevent direct discharge of concentrated runoff into the Blikana River, tributaries or drainage lines. - Inspect and maintain stormwater infrastructure regularly during operation. - Monitor and repair erosion features promptly. - Maintain vegetative cover on exposed areas and rehabilitate disturbed ground where required.
Significance of impact (Severity x Incidence)	**Pre-mitigation significance**		**Post-mitigation significance**
	Medium negative (63)		**Very low negative (24)**

6.10 Operation benefit (positive)

Table 6-11: Operation of the Blikana BWSS associated infrastructure

Issue 4:	Operation of BWSS infrastructure		
Consequence of Issue	The operation of the Blikana Bulk Water Supply Scheme (BWSS) may either benefit or adversely affect the aquatic environment, depending on operational performance and maintenance. If properly operated, the BWSS has the potential to provide a positive benefit through improved water supply reliability, more controlled abstraction and conveyance, and reduced pressure on existing informal or suboptimal water supply practices that may affect the surrounding environment. The positive outcome is mainly associated with the proper functioning of the dam, abstraction infrastructure, water treatment works (WTW), reservoirs and associated pipeline network.		
Number of impacts identified associated with this issue	4 (Impact 4.1, 4.2, 4.3 and 4.4)		
Impact 4.4: Legal/Impact name	Positive operational impact — improved water supply reliability and reduced environmental pressure associated with uncoordinated or inefficient water provision.		
Phase of expansion	Operation Phase		
Nature of impact	This positive impact is driven by the proper operation of the BWSS infrastructure, including the abstraction works, dam-related infrastructure, WTW, reservoirs and associated pipelines. The scheme is intended to improve the reliability and efficiency of potable water supply within the area, thereby reducing dependence on less reliable or potentially environmentally damaging water access practices. Where water abstraction, treatment and distribution are properly managed, the BWSS may reduce pressure associated with uncontrolled water collection, localised disturbance at informal abstraction points, leakage losses, and inefficient water conveyance systems. Improved operational control and maintenance may also support more predictable water resource use and better protection of the receiving environment than would occur under poorly coordinated or failing supply systems. The WTW contributes a secondary positive benefit by ensuring that abstracted water is properly treated for supply, but the main aquatic benefit is associated with improved system-wide management of water abstraction, conveyance and distribution.		
Cumulative impact	Positive cumulative benefit through improved water supply security, reduced strain on local water access points, and better long-term management of water abstraction and conveyance infrastructure.		
Indirect impacts	Reduced localised disturbance at informal water collection points, improved service delivery, reduced risk of environmentally harmful emergency water supply measures, and potential improvement in catchment-scale water resource management.		
Residual impacts	Positive residual benefit retained if the BWSS is operated efficiently, abstractions remain within authorised limits, and all infrastructure is properly maintained.		
	Before Mitigating	After Mitigating	
Classification of impact	**Rating**		**Consequence of Impact**
Duration of impact	5		Benefit expected throughout operational life.
Extent of impact	3		Benefit extends to the receiving river system.
Intensity of impact	4		Strong positive effect if system performs as intended.
Severity	12		Duration + extent + intensity
Probability of impact occurring	4		Likely if operation and maintenance are effective.
Frequency	5		Continuous operational benefit.
Incidence	**9**		**Frequency + Probability**
Degree of reversibility			Positive / not applicable (benefit depends on continued performance).
Irreplaceability			High positive value — improves condition of a sensitive receiving system.
Mitigations / Enhancements	**Potential**		**Recommended actions**
	High		- Ensure that all abstraction and operational activities remain within authorised limits and licence conditions. - Maintain infrastructure proactively through routine inspection and preventive maintenance. - Implement operator training and operational monitoring at the WTW and abstraction infrastructure. - Monitor leakage, losses and system efficiency regularly.

			- Maintain telemetry, backup systems and rapid-response procedures for operational failures. - Apply adaptive management where environmental monitoring identifies flow or water-quality concerns in the Blikana River system. - Ensure that environmental flow considerations are incorporated into operational decision-making where relevant.
Significance of impact (Severity x Incidence)	**Positive significance**		
	Positive impact (+108)		

6.11 Cumulative Impacts

Cumulative impacts refer to the combined and incremental effects of the proposed development when considered together with the effects of past, current and reasonably foreseeable future activities within the same catchment or receiving environment. For the proposed Blikana Bulk Water Supply Scheme (BWSS), cumulative impacts were assessed with reference to the manner in which project-related disturbances and operational risks may interact with existing and future pressures within the Blikana River catchment, including erosion, grazing, road and crossing infrastructure, disturbed surfaces, stormwater runoff pathways, abstraction-related pressures, and broader rural land-use activities. The assessment considered both direct and indirect interactions over spatial and temporal scales, using the same criteria applied to individual impacts, namely extent, duration, intensity, probability, reversibility, irreplaceability and mitigatory potential. Cumulative effects may arise where the impacts of the BWSS combine with existing and future catchment pressures such as livestock access to watercourses, informal riverbank disturbance, agricultural activities, infrastructure maintenance, and future service-related upgrades.

Table 6-12: Possible cumulative impacts

Impact description	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Mitigatory potential	Significance (Pre-mitigation)	Mitigation measures	Significance (Post-mitigation)
Incremental sediment mobilisation from vegetation clearing, trenching, excavation, river crossings and earthworks, when added to existing catchment erosion sources, livestock disturbance, roads and unstable drainage pathways, may cumulatively increase turbidity and sediment delivery to the **Blikana River** and associated tributaries during rainfall events.	Local–Regional	Short- to Medium-term	Medium–High	Probable	High	Medium	High	Moderate–High	• Implement a site-specific erosion and sediment control plan before construction. • Phase clearing and trenching to minimise exposed areas. • Install and maintain silt fences, berms and sediment traps. • Stabilise stockpiles and exposed surfaces immediately. • Avoid high-risk works during heavy rainfall where feasible. • Rehabilitate disturbed areas progressively.	Low–Moderate
Incremental construction-phase water quality contamination risk from hydrocarbons, cement wash water, contaminated runoff and waste handling, when added to existing diffuse pollution and rural runoff inputs in the catchment, may cumulatively increase short-term pollutant loading to connected drainage lines and downstream aquatic habitats.	Local–Regional	Short-term	Medium	Possible–Probable	Medium–High	Medium	High	Moderate	• Store fuels and chemicals in bunded areas away from drainage routes. • Use drip trays and designated refuelling areas. • Provide lined concrete washout areas. • Keep spill kits on site and train personnel. • Remove contaminated soils promptly. • Conduct frequent site inspections, especially after rainfall.	Low
Incremental loss of riparian and terrestrial vegetation and associated buffering capacity within BWSS footprints, when added to historical and ongoing land transformation, grazing and access disturbance in the Blikana catchment, may cumulatively reduce filtration,	Local	Long-term	Medium	Probable	Medium	Low–Medium	High	Moderate	• Demarcate minimum footprints and no-go areas before clearing. • Maintain recommended buffers around the Blikana River and tributaries. • Restrict laydown, parking and stockpiling. • Stockpile topsoil for rehabilitation.	Low

Impact description	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Mitigatory potential	Significance (Pre-mitigation)	Mitigation measures	Significance (Post-mitigation)
bank stability, infiltration and erosion resistance in drainage-linked areas.									• Rehabilitate temporary disturbance with indigenous vegetation.	
Incremental local drainage alteration and runoff concentration caused by construction activities and permanent hard surfaces, when added to existing and future stormwater pressures from roads, settlements and service infrastructure, may cumulatively increase erosion and sediment transport toward the **Blikana River system**.	Local–Regional	Long-term	Medium	Probable	Medium	Low–Medium	High	Moderate	• Implement temporary and permanent stormwater controls. • Prevent concentrated discharge onto bare slopes or directly into channels. • Use energy dissipators and outlet protection. • Maintain attenuation and controlled discharge measures. • Inspect and repair erosion regularly.	Low
Incremental abstraction and flow alteration risk, when added to existing dry-season low flows, upstream/downstream water use pressures and climate variability, may cumulatively reduce flow availability, habitat connectivity and ecological functioning in the **Blikana River**, particularly during low-flow periods.	Regional	Long-term	Medium–High	Possible–Probable	Medium	High	Medium–High	Moderate–High	• Ensure abstraction remains within authorised limits and environmental flow requirements. • Monitor abstraction volumes and river response. • Avoid unnecessary abstraction during critical low-flow periods where possible. • Apply adaptive management where flow stress is detected.	Low–Moderate
Incremental operational water quality risk from the WTW, if poorly operated or maintained, when added to existing rural water-quality pressures such as erosion, runoff and localised effluent contamination, may cumulatively degrade water quality and aquatic habitat condition in the **Blikana River** and connected tributaries.	Local–Regional	Long-term	Medium	Possible	Medium	Medium–High	High	Moderate	• Operate and maintain the WTW efficiently. • Contain and manage sludge, chemicals and waste streams appropriately. • Prevent leaks, spillages and uncontrolled discharges. • Monitor water quality and site drainage regularly.	Low

Impact description	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Mitigatory potential	Significance (Pre-mitigation)	Mitigation measures	Significance (Post-mitigation)
									• Implement corrective action rapidly where failures occur.	
Incremental operational stormwater runoff and outlet erosion from permanent BWSS infrastructure, when added to broader catchment hardening and runoff from roads and settlements, may cumulatively increase local flow flashiness, erosion and sediment pulses to aquatic features linked to the Blikana River.	Local–Regional	Long-term	Medium	Probable	Medium–High	Low–Medium	High	Moderate	• Implement attenuation-based stormwater design. • Separate clean and dirty water systems where relevant. • Protect outlets with energy dissipation measures. • Maintain stormwater systems and vegetative cover. • Monitor and repair erosion at discharge points.	Low
Positive cumulative impact: improved water supply reliability and more controlled water abstraction, treatment and conveyance, when added to broader service delivery improvements and proper operational management, may cumulatively reduce pressure associated with unreliable or inefficient water provision and support improved long-term management of water resources in the area.	Regional	Long-term	High (Positive)	Probable	N/A (Positive)	High (Positive)	High	Positive (Moderate–High)	• Maintain abstraction, treatment and conveyance infrastructure through preventative maintenance. • Monitor system efficiency, leakage and compliance. • Maintain backup systems and trained operators. • Apply adaptive management where environmental monitoring identifies problems.	Positive (High)

The most important cumulative risks for the Blikana BWSS relate to sediment mobilisation, water quality deterioration, loss of buffering vegetation, local drainage alteration and flow-related impacts, particularly where infrastructure is located close to the Blikana River and associated tributaries. With the implementation of appropriate mitigation and operational controls, these cumulative impacts are expected to reduce to low or low–moderate significance. A potentially important cumulative positive impact is the improvement of water supply reliability and more coordinated management of abstraction and conveyance infrastructure, provided that the scheme is operated within environmental and authorisation limits.

6.12 Impacts Associated with Climate Change Projections

The following potential impacts may arise as a result of climatic changes in the future, which would possibly affect the watercourses and surrounding environment:

- Increase in extreme weather events such as powerful rain/thunderstorms, strong winds, intense heat waves, severe coldness and increased lightning strikes;
- The risk of contamination of watercourses would increase due to significantly greater volumes of runoff, which may lead to disease outbreaks and human health problems;
- The changing environmental conditions could potentially increase the invasion of alien plants species within and surrounding watercourses due to newly suitable temperature and weather conditions; and
- Alien vegetation uses more water than indigenous vegetation, therefore reducing natural water supplies / choking natural watercourses. Alien plants have the ability to overpower indigenous vegetation and becoming overgrown watercourses.

6.13 Assessment of WTW Site Alternatives

Although both the preferred WTW site and Alternative 1 are located outside the recommended 50 m buffer of the Blikana River, the preferred site is considered more suitable from an aquatic perspective. This is because the preferred site is not associated with drainage lines or dongas, whereas Alternative 1 is associated with such features, which may facilitate the rapid conveyance of spills, contaminated runoff or sediment toward the Blikana River during rainfall events. The preferred site therefore presents a lower risk of indirect aquatic impact and is recommended as the preferred alternative.

7 Freshwater Ecosystem Monitoring and Resource Management Context

7.1 Resource Class and RQO Context

A review of available Department of Water and Sanitation (DWS) Water Resource Classification System (WRCS) documentation indicates that the Blikana River falls within Integrated Unit of Analysis (IUA) 5: Upper Orange River. The broader IUA-scale resource class context is relevant to the interpretation of the aquatic environment, although it should not be treated as a substitute for site-specific ecological assessment.

The current WRCS documentation indicates that IUA 4 (Kraai River) is associated with a Class II management objective, while IUA 5 (Upper Orange River) and IUA 6 (Gariep Dam) are associated with Class III management objectives. These class descriptions provide broad regional context regarding the desired condition and level of use of water resources at the catchment scale. However, they do not constitute site-specific ecological categories for the assessed Blikana River reach, which was evaluated separately in this specialist assessment using desktop PES/EIS information and field-based interpretation.

No site-specific published Resource Quality Objectives (RQOs) were identified for the Blikana River during the review of available documentation. The broader resource class context is therefore used only as a regional management reference, while the specialist findings presented in this report provide the primary basis for evaluating the condition, sensitivity and management requirements of the assessed aquatic features.

Table 7-1: Adjacent IUA resource class objectives relevant to Blikana

IUA	Unit	Preliminary proposed class	Resource class objective
IUA 4	Kraai River	Class II	Manage the resource as a moderately used system, with the aim of retaining a moderately altered condition and broadly supporting an ecological state around Category C.
IUA 5	Upper Orange River *(includes Blikana)*	Class III	Manage the resource as a heavily used system, recognising a more developed water-use context and a target condition broadly aligned with Category D.
IUA 6	Gariep Dam	Class III	Manage the system as a heavily used strategic storage/resource area, with a target condition consistent with a heavily altered but managed system.

7.2 Freshwater Ecosystem Monitoring System

A freshwater ecosystem monitoring programme is recommended for the Blikana Bulk Water Supply Scheme in order to verify the effectiveness of mitigation measures, detect any deterioration in aquatic condition, and inform adaptive management during construction and operation. Monitoring should focus on those components of the project that interact directly or indirectly with the Blikana River, associated tributaries, drainage lines, river crossings, abstraction points, and infrastructure located within or near the recommended aquatic buffer. The purpose of the monitoring programme is to:

- confirm that the condition of the Blikana River and associated aquatic features is not deteriorating as a result of project activities;
- identify erosion, sedimentation, bank instability, stormwater failures, or pollution incidents at an early stage;
- assess the effectiveness of rehabilitation at disturbed areas and river crossings; and
- support corrective action and adaptive management where negative trends are detected.

  Monitoring should include, as a minimum, regular inspection of:

- river crossing points and within-buffer infrastructure;

- erosion and sediment control measures;
- rehabilitated riparian and riverbank areas;
- stormwater discharge points;
- abstraction and WTW-related operational areas where runoff or spillages could affect aquatic systems; and
- basic water quality indicators where relevant.

The monitoring programme should be implemented during both the construction phase and the operational phase, with higher frequency inspections during active construction and following major rainfall events. Any evidence of erosion, sedimentation, uncontrolled runoff, pollution, riparian degradation or bank instability should trigger immediate corrective action.

Table 7-2 outlines the aquatic monitoring methods to be undertaken at the monitoring points set out above (see section 2.8.2) by a suitably qualified ecologist. The annual aquatic programme comprises of biannual surveys (in summer and winter) during the construction phase and annual surveys during the operations phase (in summer). Aquatic monitoring should continue for at least two years or until there is no noticeable deviation in ecological condition from the first monitoring that determines the baseline findings. Water quality assessment should be undertaken before construction occurs in order to determine a baseline.

Table 7-2: Proposed aquatic monitoring programme

Method and Aquatic Component of Focus	Details	Resource Quality Objective
	Rivers	
Water Quality: In situ water tests focusing on: • Temperature; • pH; • Conductivity; • Dissolved oxygen.	In situ water quality should be tested by means of portable meters at each monitoring site.	First assessment to be undertaken before construction to determine baseline. Results must be compared to baseline results to determine the extent of change.
Habitat Quality: Instream and riparian habitat integrity by means of the Index for Habitat Integrity (IHI)	the IHI must be applied at the same sites as in this report.	IHI to be maintained.
Fish: Fish assessments must be carried to species level where possible	Sampling of fish must be undertaken by means of the standard electro-narcosis technique at sites presenting suitable fish habitat.	Results must be compared to the baseline results from this study.

7.3 Water Quality Management Plan

Considering the likely development-related impacts, the following measures are proposed to manage Water Quality for the proposed Blikana BWSS:

- Construction materials must be stored and maintained away from aquatic features, drainage pathways and watercourses (minimum **100 m buffer**, or as otherwise specified by the approved layout and method statements). This will reduce the risk of sand, cement, steel, bricks or rubble being washed into downstream drainage systems linked to the Blikana River.
- Any demolition or removal of existing materials must be undertaken with careful control of runoff and debris, particularly where disturbed areas may drain toward aquatic features. Rubble, concrete and other waste material must not be allowed to enter drainage routes or be left where it can be washed downstream.
- Any material removed from the footprint must not be stockpiled within **100 m** of any drainage pathway, aquatic feature or watercourse, and must be removed from site or placed in an approved designated area within **72 hours**.
- Construction vehicles, plant and machinery must not be parked, serviced or refuelled within **100 m** of a watercourse or drainage line, unless required for approved works and under controlled conditions. Drip trays must be used under parked machinery and refuelling areas.
- Appropriate ablution facilities and adequate waste collection bins must be provided for all construction workers, and these must be serviced regularly. This is necessary to prevent contamination of soils and runoff by sewage, greywater and litter.
- Concrete mixing and handling must take place in controlled areas on impermeable surfaces (e.g., plastic sheeting or a lined mixing area) within the approved footprint. Cement wash water and concrete residues must not be discharged onto bare ground or into drainage pathways.
- Fuels, oils, lubricants, chemicals and hazardous substances must be stored in bunded areas located away from drainage pathways and aquatic features. Spill kits must be available on site at all times, and all staff must be trained in spill response procedures.
- A spill response procedure must be implemented during construction and operation. Any spill or leak must be contained immediately, contaminated material must be removed and disposed of at an authorised facility, and the incident must be recorded and reported to the ECO/site manager.
- Erosion and sediment control measures (e.g., silt fences, berms, sediment traps, stormwater diversion measures and stabilisation of exposed soils) must be installed before major earthworks begin and maintained throughout construction, especially before and during rainfall periods.
- Disturbed areas must be rehabilitated progressively to reduce exposed soil and runoff generation. Topsoil must be stripped and stockpiled for reuse in rehabilitation.
- Clean and dirty water must be separated during both construction and operation. Stormwater from potentially contaminated work areas must be managed so that it does not enter natural drainage pathways untreated.
- During operation, the WTWs must be operated and maintained to consistently meet applicable effluent quality standards. Routine monitoring of effluent quality and receiving water quality (where required) must be undertaken, and corrective action must be implemented immediately where non-compliance is detected.

8 Conclusion

The aquatic biodiversity assessment for the proposed Blikana Dam Bulk Water Supply Scheme indicates that the project area is associated primarily with the Blikana River, a perennial upper catchment river system of relatively good ecological condition and elevated ecological sensitivity. Desktop and field-informed assessment indicate that the river is currently in a largely natural to moderately modified condition, with important ecological value linked to habitat integrity, connectivity, fish assemblages and riverine function. The river and its associated tributaries and drainage lines are therefore regarded as sensitive aquatic receptors.

The proposed BWSS will result in direct and indirect interactions with the aquatic environment, particularly where the proposed dam, abstraction infrastructure, rising mains and associated pipeline corridors occur close to or cross watercourses. Some infrastructure occurs within the recommended 50 m buffer of the Blikana River, and two rising mains cross the main channel, increasing the sensitivity of those project interfaces. In addition, construction-related disturbances such as vegetation clearing, erosion, sediment mobilisation, contaminated runoff and drainage alteration present meaningful aquatic risks if not properly managed.

Operational phase risks are primarily associated with the WTW, stormwater management, and infrastructure located close to drainage pathways. These risks include potential deterioration in water quality, erosion at discharge points, and disturbance linked to poor containment or maintenance of chemicals, process water, sludge and contaminated runoff. However, these impacts are considered manageable where the recommended mitigation measures are effectively implemented.

The preferred WTW site is supported from an aquatic perspective because, although both WTW alternatives fall outside the recommended river buffer, the preferred site is not associated with dongas or drainage lines, whereas Alternative 1 has drainage-linked features that increase the risk of rapid pollutant conveyance toward the Blikana River. The preferred site is therefore considered the lower-risk option from an aquatic and hydrological perspective.

Based on the findings of this assessment, the project is considered acceptable from an aquatic biodiversity perspective, provided that all recommended mitigation measures, aquatic buffers, no-go restrictions, crossing controls, rehabilitation measures and monitoring requirements are incorporated into the EMPr and implemented during construction and operation. The most sensitive project components are the river crossings, within-buffer infrastructure, abstraction-related interfaces and drainage-linked works areas, and these should be subject to strict environmental control.

No fatal flaw was identified from an aquatic perspective. The project may therefore proceed, subject to appropriate authorisation and the implementation of the specialist recommendations contained in this report.

8.1 Specialist Opinion

In my specialist opinion, the proposed Blikana Dam Bulk Water Supply Scheme is acceptable from an aquatic biodiversity perspective, provided that the development is undertaken in accordance with the mitigation measures, aquatic buffer requirements, crossing design principles, rehabilitation measures and monitoring commitments set out in this report.

The aquatic receiving environment, particularly the Blikana River, is considered to be of moderate to high ecological importance and high ecological sensitivity, and the river remains in a relatively good ecological condition despite evidence of localised rural disturbance. The project therefore has the potential to result in negative aquatic impacts if poorly designed, located or managed. This is especially relevant in relation to infrastructure within the 50 m aquatic buffer, the two rising main river crossings, abstraction-related infrastructure and drainage-linked operational areas.

Notwithstanding these sensitivities, the identified impacts are considered to be capable of effective mitigation, and no impact of such magnitude was identified that would render the project fundamentally unacceptable from an aquatic perspective. The preferred WTW site is also supported over Alternative 1 from an aquatic perspective, as it presents a lower risk of hydrological connectivity to the Blikana River in the event of spills, contaminated runoff or erosion.

The project should therefore only be authorised subject to the following key conditions:

- the 50 m buffer for the Blikana River must be retained as the preferred aquatic setback, with only unavoidable infrastructure permitted within it;
- all river crossings must be designed and implemented to minimise disturbance to the channel, banks and riparian habitat;
- strict erosion and sediment control, stormwater management, pollution prevention and rehabilitation measures must be implemented;
- no unnecessary laydown, stockpiling, batching, refuelling or temporary construction infrastructure should be permitted within the river buffer;
- all within-buffer works and river crossing points must be managed as high-sensitivity aquatic interaction areas;
- the WTW must be operated and maintained to prevent leaks, spillages, contaminated runoff and uncontrolled discharges;
- disturbed riparian and riverbank areas must be rehabilitated immediately after construction;
- and the proposed monitoring programme should be implemented to verify compliance and detect any deterioration in aquatic condition over time.

Subject to these conditions, I am of the opinion that the proposed development can proceed without resulting in unacceptable aquatic biodiversity impacts.

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