Department of Water and Sanitation
Infrastructure Management Branch
Chief Directorate: Strategic Infrastructure Asset Management

PROPOSED REHABILITATION OF CASTEEL DAM

EIA Specialist Report:
Aquatic Biodiversity Specialist Assessment

Field Survey: 22nd August 2022
Draft Report V1.0: 9th October 2022

Casteel Dam [22nd August 2022].

Prepared for:

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Disclaimer

This report was based on the author's best scientific and professional knowledge and information available at the time of writing. Although Nepid Consultants has tried to ensure that all information contained within this report is accurate, Nepid does not warrant or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of the information presented in this report.

ACKNOWLEDGMENTS

The following are gratefully acknowledged for assisting with the information presented in this report:

- Marissa Botha, Naledzi Environmental Consultants (Pty) Ltd, Polokwane.
- Duncan McKenzie, Digital Earth (Pty) Ltd, Nelspruit.

TERMS OF REFERENCE

Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation (Government Notice No 320, 20th March 2020, National Environmental Management Act (No 107 of 1998).

1. Site sensitivity verification and minimum report requirements	
1.3 The outcome of the site sensitivity verification must be recorded in the form of a report that-	
(a) Confirms or disputes the current use of land and the environmental sensitivity as identified by the screening tool; such as new developments or infrastructure, the change in vegetation cover or status etc;	Section 5.3
(b) contains a motivation and evidence (e.g. photographs) of either the verified or different use if the land and environmental sensitivity	Section 5.3

Biodiversity. Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	
2.7.1. contact details of the specialist	Robert William Palmer Cell: +27(0)82 574 4486 Email: rob@nepid.co.za
their SACNASP registration number,	No. 400108/95 (Appendix A)
their field of expertise	Biological Scientists Accredited biomonitoring practitioner (Appendix B)
and a curriculum vitae;	Appendix C
2.7.2. a signed statement of independence by the specialist;	Appendix D
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 3.2
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Chapter 3
2.7.5. a description of the assumptions made, any uncertainties or gaps in knowledge or data;	Section 3.9
2.7.6. the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;	n/a
2.7.7. additional environmental impacts expected from the proposed development;	Chapter 7
2.7.8. any direct, indirect and cumulative impacts of the proposed development on site;	Chapter 7
2.7.9. the degree to which impacts and risks can be mitigated;	Chapter 7
2.7.10. the degree to which the impacts and risks can be reversed;	Section 8.1
2.7.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	Section 8.1
2.7.12. a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	n/a
2.7.13. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	Chapter 7
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 5.3
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 8.1
2.7.16. any conditions to which this statement is subjected.	Disclaimer

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
MAR	Mean Annual Runoff
PES	Present Ecological State
SANBI	South African National Botanical Institute

GLOSSARY OF TERMS

Riparian Habitat — *the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.*

[National Water Act (Act No. 36 of 1998)].

Watercourse

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

[National Water Act (Act No. 36 of 1998)].

1. INTRODUCTION

1.1 Background

Casteel Dam is an earth-filled embankment dam that was built by then Department of Water Affairs and Forestry to supply water to the Dingley Dale Irrigation Scheme, a government water scheme. The dam was completed in 1965 and raised in the late 1980s (Agterkamp 2009). A dam safety inspection conducted in January 2001 identified the dam as a safety risk because of slope instability and defective outlet works (Agterkamp 2009). An emergency temporary siphon pipe was then installed to provide drinking water for downstream communities (Palmer and Rogatschnig 2006). In 2022 the Department of Water & Sanitation (DWS), Chief Directorate: Strategic Asset Management, initiated steps to rehabilitate the dam (Naledzi 2022). This specialist report forms part of the environmental authorisation process for the proposed rehabilitation. The report based on a review of available information and a field survey conducted by Nepid Consultants CC.

1.2 Project Description

The proposed rehabilitation comprises the following (Figure 1-1):

- *construction of chimney and toe drains to intercept seepage from the dam wall;*
- *refurbishment of the dam outlet works;*
- *stabilising the downstream slope which is currently unstable;*
- *raising the Non-overspill embankment (NoC) to accommodate safety evaluation flood;*

(Naledzi 2022).

- *expand the dimensions of the concrete intake tower to 5m x 5m, currently, the dimensions are roughly 1.5m x 1.5m;*
- *expand the Intake Tower, we must construct a temporary coffer dam around the Tower to create a safe working space;*
- *Environmental Authorization to replace the existing 3 x 250 mm diameter pipes with up to 1 000 mm diameter pipe is required;*
- *all the reeds/vegetation on the spillway approach channel must be removed. This promotes the free flow of water and prevents spillway blockages, resulting in the overtopping of the earth-fill embankment;*
- *all reed/vegetation along the upstream slopes will be removed during the placement of slope protection material;*
- *Slope protection will be provided on both sides of the spillway return channel;*
- *a 6 000 mm wide access road (gravel) is required from R40 extending along the toe of the dam. This is for construction vehicles during rehabilitation and operational stuff during maintenance of the dam after the rehabilitation;*

[Email from Marissa Botha 2022-08-29].

- *rehabilitation of the donga below the spillway;*
- *DWS will not stop the current water release to the downstream irrigation users (Dingley Dale Irrigation Scheme);* and
- *during the rehabilitation of outlet works, one out of the existing three pipes will always be available to release water*

[Email from Marissa Botha 2022-09-26].

- *termites will be controlled.*

[Telephone Discussion with Marissa Botha ~2022-09-26].

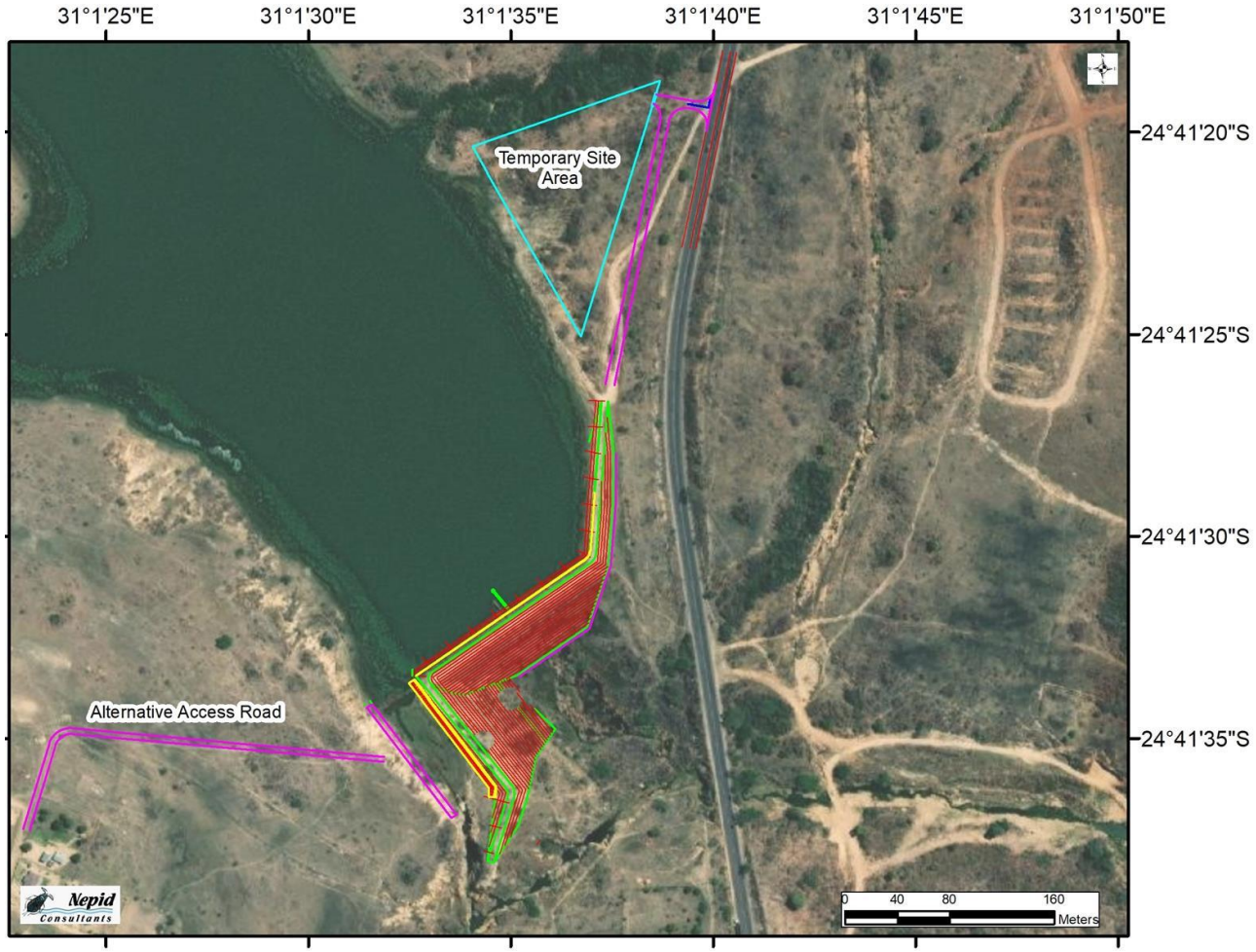


Figure 1-1. Proposed Layout

[Source: BA.kmz sent by email by Marissa Botha 2022-08-29].

1.3 Legal Context

National Environmental Management Act, 1998 (Act 107 of 1998)

The proposed rehabilitation triggers the following activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) EIA Regulations of 2014 (GNR 326 of 7 April 2017) (Naledzi 2022):

Listing Notice 1 (GN 327)

- ***Activity 19.*** *Infilling or depositing of any material of more than 10m^3 into or dredging, excavation, removal or moving of soil, sand shells, shell grit, pebbles or rock of more than 10m3 from a watercourse;*
- ***Activity 27.*** *Clearance of 1 ha or more but less than 20 ha of indigenous vegetation, except where such clearance of indigenous vegetation is required for – (i) undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance plan.*

Listing Notice 3 (GN 324)

- ***Activity 12.*** *Clearance of an area of 300 m^3 or more of indigenous vegetation except where such clearance of indigenous vegetation is for maintenance purposes undertaken in accordance with a maintenance management plan. (f) Mpumalanga (ii) within a critical biodiversity area identified in bioregional plans*
- ***Activity 14.*** *The development of – (xii) infrastructure or structures with a physical footprint of 10m2 or more – where such development occurs – (a) Within a watercourse (f) Mpumalanga (i) Outside urban areas (bb) National Protected Area Expansion Strategy Focus Area (ff) Critical Biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans*

National Water, 1998 (Act 36 of 1998)

The proposed rehabilitation does not trigger the need for a Water Use Licence in terms of the National Water Act (Act 36 of 1998), because new and existing government waterworks which require construction or refurbishment do not need a further Water Use Licence if ownership remains with the Department of Water & Sanitation (Letter from Margaret-Ann Diedericks, Director General Water & Sanitation, to Regional Heads, dated 21st Dec 2015).

1.4 Aims of This Report

The aims of this report were:

- **Baseline:** to describe the aquatic ecosystems that could be affected by the proposed rehabilitation, against which the likely impacts can be evaluated, and future changes compared (i.e., to collect baseline data);
- **Impacts:** assess the potential impacts of the proposed rehabilitation to aquatic ecosystems; and
- **Recommendations**: provide a reasoned opinion as to whether the proposed rehabilitation should be authorised in terms of potential impacts on aquatic ecosystems; and to recommend appropriate mitigation, management and monitoring measures to minimise the detrimental impacts of the proposed works on aquatic ecosystems, and enhance positive impacts, where appropriate.

2. STUDY AREA

2.1 General

Casteel Dam is on the farm Kasteel 231JU at S24.692 211 º, E31.026 424º. The dam is on an unnamed tributary of the Thulandziteka (Sand) River (Figure 2-1). The dam is ~9 km south of Acornhoek and ~12 km north of Dwarsloop, within the Bushbuckridge Local Municipality, Ehlanzeni District, Mpumalanga Province. The Study Area for this report considered all aquatic ecosystems within 500 m of the proposed rehabilitation works, as required in terms of Government Notice 509 (26th August 2016). The Study Area for this report covered an area of ~140 hectares (Figure 2-2).

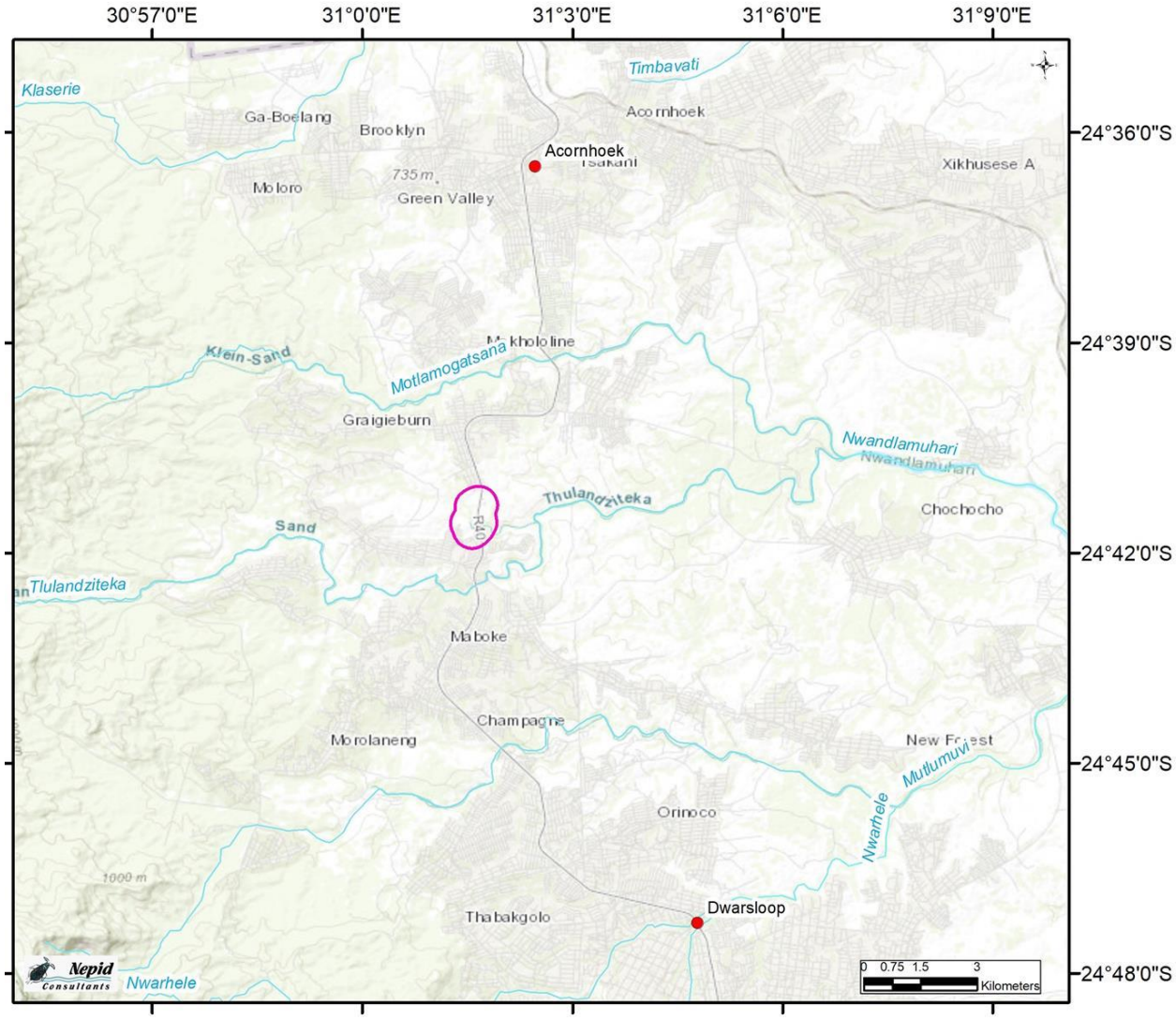


Figure 2-1. General Locality Map

[Source: World Topo Map].

2.2 Areas of Influence

The proposed rehabilitation could impact aquatic ecosystems in the following areas:

- **Direct Area of Influence.** The proposed rehabilitation could impact directly on aquatic ecosystems within the proposed work areas that comprise the dam wall, spillway and immediate surroundings (Figure 2-2); and

- **Indirect Area of Influence.** The proposed rehabilitation is likely to have measurable indirect impacts on aquatic ecosystems downstream of the dam to the confluence with the Thulandziteka River, a distance of ~1.8 km (Figure 2-2). Water level in the impoundment would need to be lowered during the works. However, lowering of the water level is expected to be within the operating levels of the impoundment and so this was not treated as a potential indirect impact.

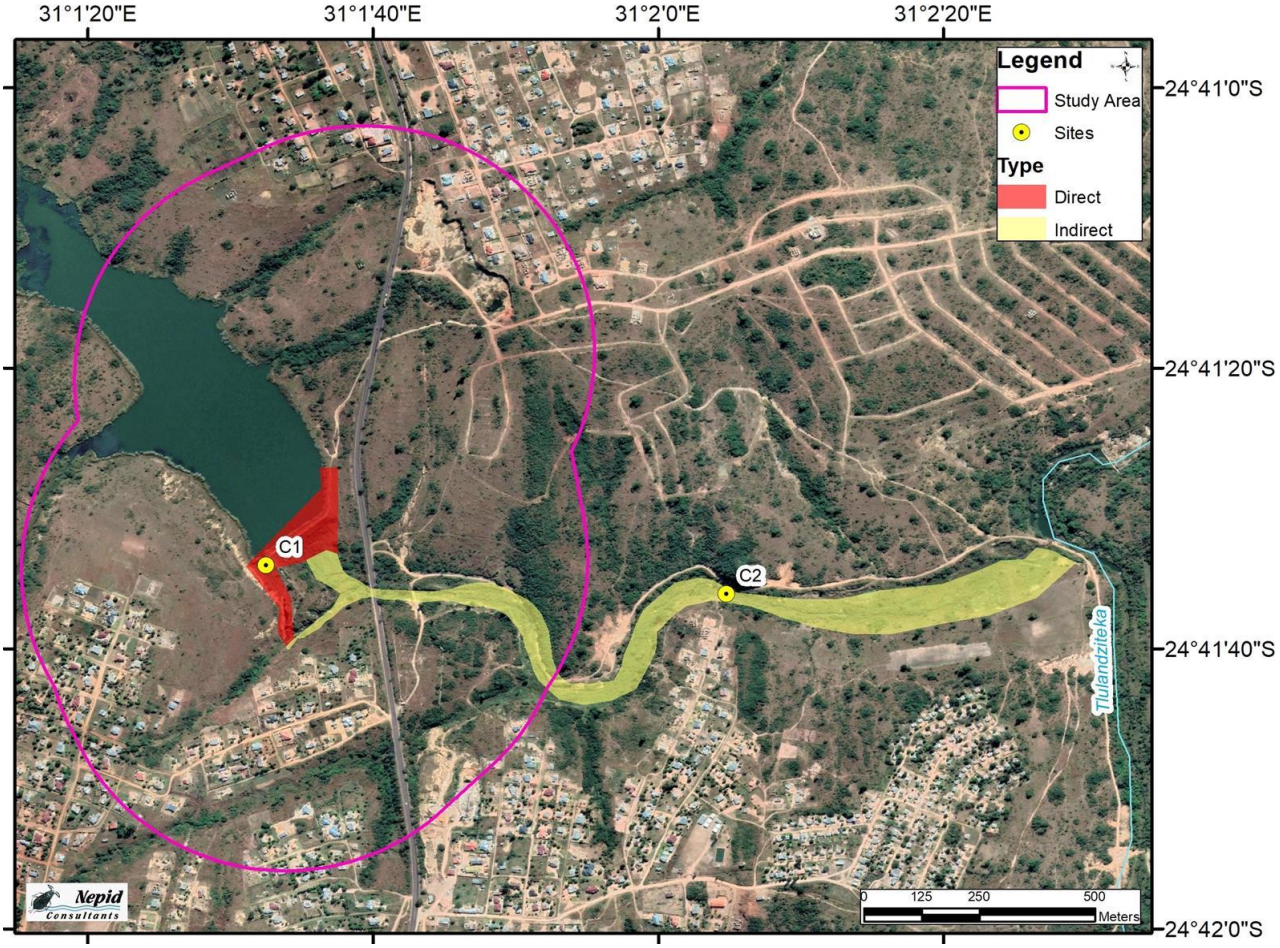


Figure 2-2. Areas of Potential Direct and Indirect Influence on Aquatic Ecosystems

[Source: Google Earth: 2022-06].

2.3 Aquatic Survey Sites

Two sites were surveyed for the purposes of this report as follows (Figure 2-2):

- **C1** (S24.69337; E31.03466), at the dam spillway, within the Potential Area of Direct Influence. This site was sampled for fish only; and
- **C2** (S24.692801; 31.02568912), ~1 km downstream of Casteel Dam, within the Potential Area of Indirect Influence. This site was sampled for field water quality, aquatic macroinvertebrates and fish.

3. METHODS

3.1 Review

A review of available ecological data pertaining to the proposed development area revealed the following important sources of information:

- Mpumalanga Biodiversity Sector Plan: Freshwater Assessment (MTPA 2011),
- Google Earth™ images (various dates); and
- Environmental Screening Tool (https://screening.environment.gov.za).

3.2 Field Survey

Date:	22nd August 2022
Duration:	4 hrs
Season:	Winter (dry)
Timing:	The field survey was conducted following good summer rains such that the dry season flow is likely to have been higher than average.
Data Quality:	The quality of data presented in this report is considered to be appropriate for the purposes of this report.

3.3 Aquatic Ecosystem Classification

Aquatic ecosystems were classified according to hydrogeomorphic units, as described by Ollis *et al*. (2013).

3.4 Aquatic Ecosystem Delineation

Wetlands were delineated according to the method detailed by the Department of Water Affairs and Forestry (DWAF 2008). The method is based on a combination of plant species composition and soil features within 50 cm of the soil surface. A soil auger was used to locate the outer boundaries of the wetlands.

3.5 Present Ecological State

3.5.1 Hydrology

Naturalised hydrology was based on monthly time series generated for the period 1920 to 2004 and presented in the Inkomati Water Availability Assessment for Quinary Catchment X32A-2 (DWAF 2009). The Present Hydrological State of the tributary was based on the Hydrological Driver Assessment Index (Hughes *et al*. 2005). The index classifies results into one of six Present State Categories, from Category A (*Natural*) to Category F (*Critically Modified*).

3.5.2 Habitat Integrity

The Present Ecological State of wetlands that could be impacted directly by the proposed development was assessed using a rapid visual protocol that was developed for floodplain wetlands by Duthie (DWAF 1999). The modified method involves rating ten parameters on a numerical scale between 0 (*Critically Modified)* and 5 (*Natural*). The mean score was expressed as a percentage, and results were classified into one of six categories, ranging from *Natural* (Category A), to *Critically Modified* (Category F) (Table 3-1).

Table 3-1. Classification of Present Ecological State. [Based on DWAF 1999]

Category	Description	Score (% of Total)
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.*	< 20

3.5.3 Aquatic Macroinvertebrates

Aquatic macroinvertebrates were sampled according to the SASS5 biomonitoring method (Dickens and Graham (2002). Instream habitats were unsuitable for application of the SASS5 method, so data were interpreted qualitatively only.

3.5.4 Fish

Fish were sampled using a portable, battery operated pulsed direct current portable electro-fisher (Samus 725M), with a fine-meshed net attached to a 30 cm anode ring. This equipment allowed unrestricted access to shallow areas and is less prone than other methods to biased sampling. The Present Ecological State of the fish assemblage at each site was assessed using the species intolerance component of the Fish Assemblage Integrity Index (FAII) (Kleynhans 1999). The intolerance values for each species recorded at each site were added to obtain a total intolerance score (Kleynhans 2003). The total score was expressed as a percentage of the total intolerance score for all species that were expected to have been caught at each site under the prevailing river conditions and with the sampling equipment used. Species known to occur in the area but with a low likelihood of occurrence, such as eels, were therefore excluded from the analysis. The results were classified using a six-point scale, as shown in Table 3-2. The full list of fish species expected at each site under natural conditions was based on a database of the reference frequency of occurrence of fish species (Kleynhans *et al.* 2007). This information was extrapolated spatially, where necessary, and provided the universe of species from which expected species were selected. The comparative abundance of each species caught at each site was expressed as the total number that would have been caught had sampling been conducted for one hour (i.e. Catch per Unit Effort). Fish species were identified using the guide Freshwater Fishes of Southern Africa (Skelton 2001). Specimens were returned to the river after identification.

3.6 Ecological, Functional and Social Importance

Ecological, Functional and Social Importance of aquatic ecosystems was assessed using a rapid method described by Rountree *et al.* (2012). The method involves rating various parameters on a numerical scale between 0 (*Zero)* and 4 (*Very High*).

3.7 Ecological Reserve

The Ecological Reserve for Casteel Dam was based on the value quantified for the Tlulandziteka (Sand) River at EWR S7, as gazetted for the Inkomati Water Management Area in Government Notice No. 998, July 2019.

3.8 Impacts Evaluation

The likely environmental impacts of the proposed development were evaluated using the following criteria:

***I* =** Intensity: **Positive** +7=very good; +6=good; +5=widespread benefits; +4=moderate to high; +3=moderate; +2=minor; +1=negligible;
Negative -1=negligible damage; -2=minor damage; -3=moderate damage; -4=large damage; -5=serious; -6=critical; -7=complete destruction.

D = Duration: 1=immediate (<1 month); 2=short-term (1 month to 2 years); 3=medium-term (2 to 5 years); 4=long-term (6-15 years); 5=project life; 6=beyond project life; 7=permanent.

E = Extent: 1=footprint; 2=site; 3=local; 4=municipal; 5=provincial; 6=national; 7=international

P = Probability: 1=highly unlikely; 2=improbable; 3=unlikely; 4=probable; 5=likely; 6=highly probably; 7=definite.

***S* = Significance**: The significance of each impact was assessed by combining the consequence of the impact and the probability of occurrence i.e.: Significance = Consequence (intensity + duration + extent) x Probability. Negative impacts were assessed before and after mitigation. Scores were interpreted as follows:

Total Score	Rating
-1 to -35	Negligible (-)
-36 to -72	Minor (-)
-73 to -108	Moderate (-)
<-108	Major (-)

3.9 Assumptions and Limitations

3.9.1 Report Focus

This report focusses on aquatic ecosystem classification, delineation, Present Ecological State, and Ecological, Functional and Social Importance. The report but does not address various aspects related to aquatic ecosystems, such as hydrology, water abstraction, hydraulics, amphibians, reptiles, waterbirds or fish. However, the level of detail presented is considered appropriate for the purposes of this report.

3.9.2 Spatial Resolution

The wetland boundaries are considered accurate to about 5 m, as they were based on available Google Earth imagery and a standard, hand-held GPS. Higher resolution delineation would need more detailed assessment of soils, differential GPS and boundaries pegged in the field, but this is not considered necessary for the purposes of this report.

3.9.3 Temporal Resolution

Baseline data for this report were based on a single survey conducted in August 2022, so seasonal variation in baseline conditions were not quantified. However, the primary data collected is considered appropriate for the purposes of this report.

4. ECOLOGICAL CONTEXT

4.1 Geology

The Study Area is underlain by **Cunning Moor Tonalite** of the Swazian Era. Tonalite is a medium to coarse grained rock comprising quartz, plagioclase, microcline, biotite and poikilitic crystals of sphene (Schutte 1986).

4.2 Soils

Soils within the Study Area are classified according to the World Reference for soil resources as **Haplic Acricols** (Jones *et al.* 2013). Haplic acrisols are described as "*very acid with a clay-rich subsoil*" (Jones *et al.* 2012). Soils in the area are characterised by course sandy texture and low pH. The risk of erosion in the area is classified as "*high"* (Schulze and Horan 2006).

4.3 Aquatic Ecoregion

The Study Area is located within the **Lowveld** Level I Aquatic Ecoregion (*sensu* Kleynhans *et al.* 2005).

4.4 Aquatic Ecosystem Threat Status

According to the National Freshwater Ecosystems Priority Assessment the Study Area is classified a **Fish Sanctuary** for two species of fish as follows (Nel *et al.* 2011):

- ***Amphilius natalensis*** *s.l.,* a complex comprising six species (Mazungula and Chakona 2021), one of which, *Amphilius engelbrechti*, could potentially occur in the Study Area. This species was first described in 2021 and its conservation status has not been determined. However, the conservation status of *A. natalensis s.l.* is classified regionally and globally as *Least Concern;* and

- ***Enteromius brevipinnis***. This species is classified regionally and globally as *Near-Threatened.* This species is threatened by sedimentation caused by forestry activities, predation by alien trout and Bass (*Micropterus* spp.), dams and water abstraction (http://speciesstatus.sanbi.org).

According to the National Reference Frequency of Occurrence Project, the two species listed above are not expected within the upper Thulandziteka River Catchment (Kleynhans *et al.* 2007). Furthermore, the South African Institute of Aquatic Biodiversity fish database indicates that there are no records of these two species in the upper Thulandziteka River Catchment. The inclusion of these two species in the Study Area by the National Freshwater Ecosystems Priority Assessment appears to be associated with the larger spatial scale that was used for the national assessment.

4.5 Ecological Importance and Sensitivity

No information was available on the Ecological Importance and Sensitivity of aquatic ecosystems at Casteel Dam. However, Ecological Importance and Sensitivity of the Thulandziteka River in Reach X32A-00583, was rated by the Department of Water Affairs and Sanitation as **Very High** (DWS 2014).

4.6 Strategic Water Source Areas

The Study Area is not located within a Strategic Water Source Areas (Le Maitre *et al.* 2018).

4.7 Drainage

Casteel Dam is in an unnamed seasonal tributary of the Thulandziteka (Sand) River, in the upper reaches of **Quinary Catchment X32A-2**, in the Nkomati Water Management Area (Figure 4-1). The catchment area of Casteel Dam covers 1,430 hectares (14.3 km^2).

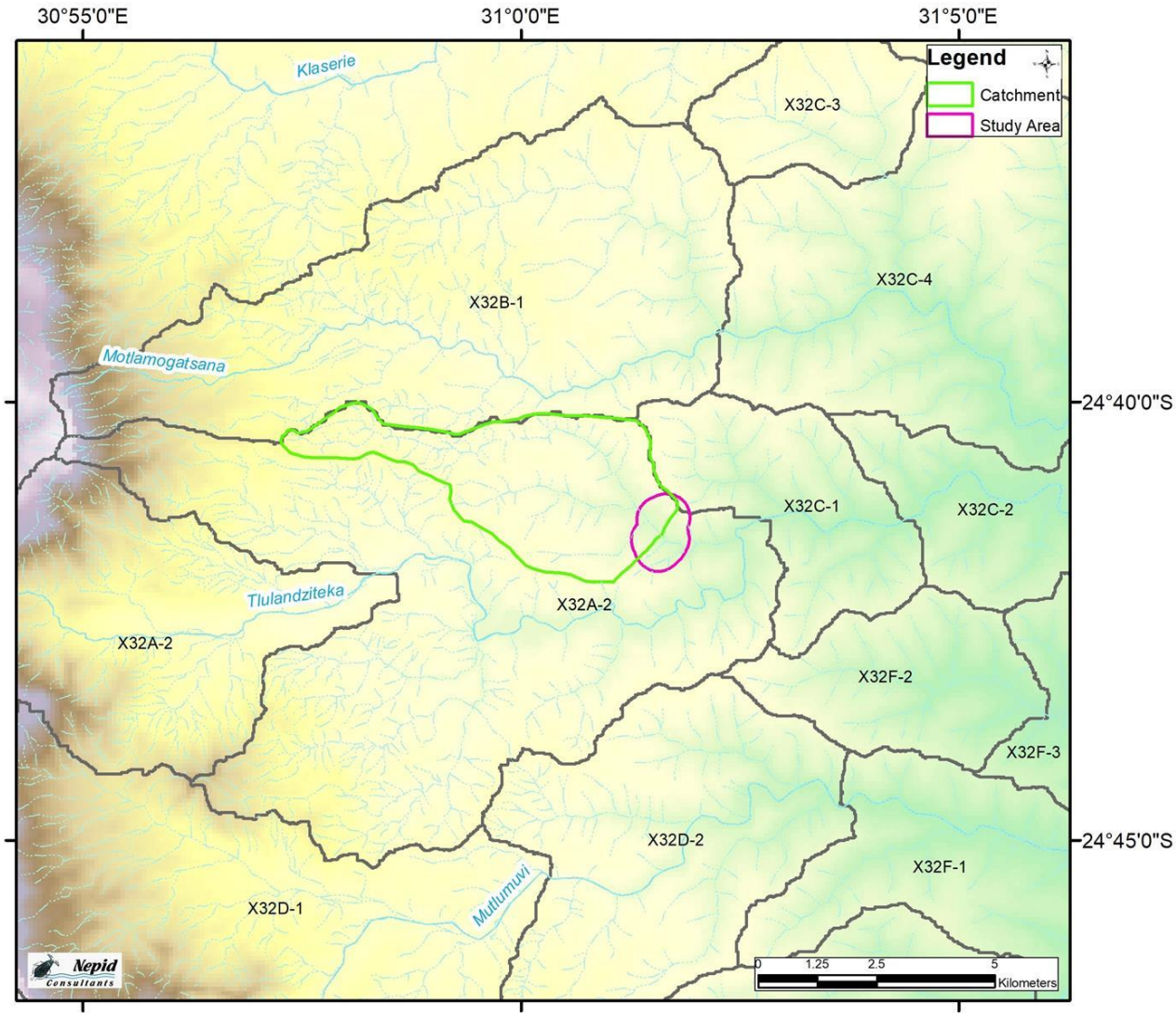


Figure 4-1. Quinary Catchments

4.8 Aquatic Ecosystem Provincial Priority Status

The Mpumalanga Biodiversity Sector Plan Freshwater Assessment of 2019 classified the proposed work areas as follows: (Figure 4-2):

- **Critical Biodiversity Area: Aquatic River**. The land use objective for these areas is to "*be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate*" (MTPA 2014);
- **Ecological Support Area: Important Subcatchments**; and
- **Ecological Support Area: Wetlands**.

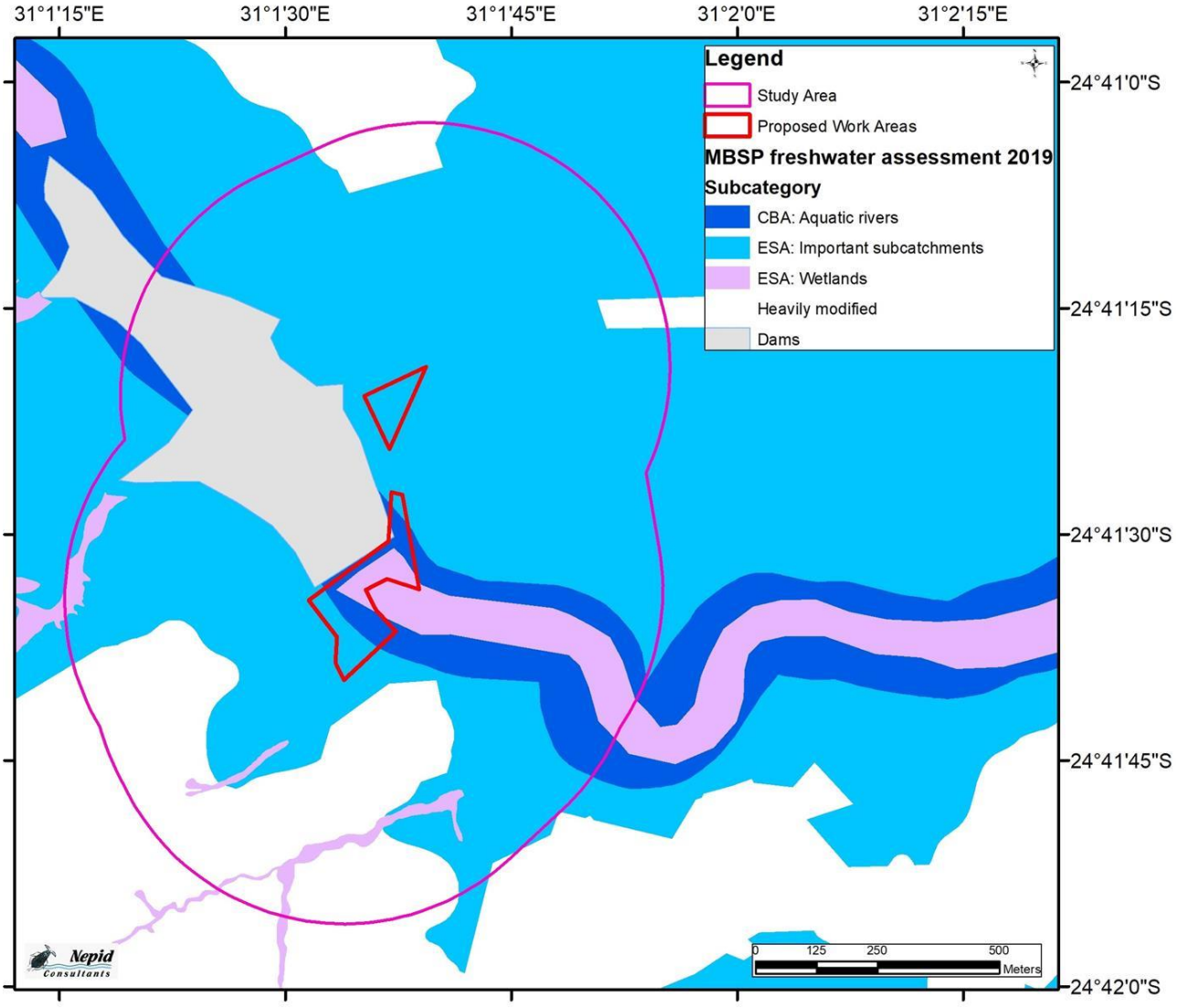


Figure 4-2. Mpumalanga Biodiversity Sector Plan

[Source: MTPA 2019].

4.9 Land Use

Land use in the Study Area in August 2022 comprised the following (Figure 2-2):

- undeveloped land, including wetlands and undeveloped veld used for cattle grazing (65%);
- rural-residential small holdings (23%);
- open water created by Casteel Dam (12%);
- sand mining (<1%); and
- road network, including paved and unpaved roads.

5. SITE SENSITIVITY VERIFICATION

5.1 Screening Tool Assessment

The National Environmental Screening Tool indicated that the aquatic biodiversity sensitivity within the potential Area of Influence on aquatic ecosystems was **Very High** (Figure 4-1). The very high sensitivity was attributed to:

- *"Aquatic CBAs",*
- *"Wetlands and Estuaries"; and*
- *"Freshwater ecosystems priority area quinary catchments".*

Figure 5-1. Aquatic Biodiversity Theme Sensitivity.

[Source: Environmental Screening Tool (https://screening.environment.gov.za).]

5.2 Aquatic Species Identified by the Screening Tool

The Screening Tool did not list any sensitive aquatic species as potentially occurring in the Study Area. However, the following sensitive terrestrial plant species were listed as potentially occurring in the Study Area:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Sensitive species 575

5.3 Field Survey Verification

The field survey in August 2022 confirmed that at a quinary catchment scale the sensitivity of aquatic biodiversity of the site is **High** because of the high diversity and abundance of fish species recorded (see Figures 5-12 & 5-13). The implication of this in terms of the Protocol for Specialist Assessments is that an Aquatic Biodiversity Specialist Assessment was required (GN 320, 20th March 2020).

6. BASELINE ASSESSMENT

6.1 Aquatic Ecosystem Delineation

The delineation of aquatic ecosystems within the Study Area is shown in Figure 6-1. Detailed delineation of aquatic ecosystems at the proposed works is shown in Figure 6-2.

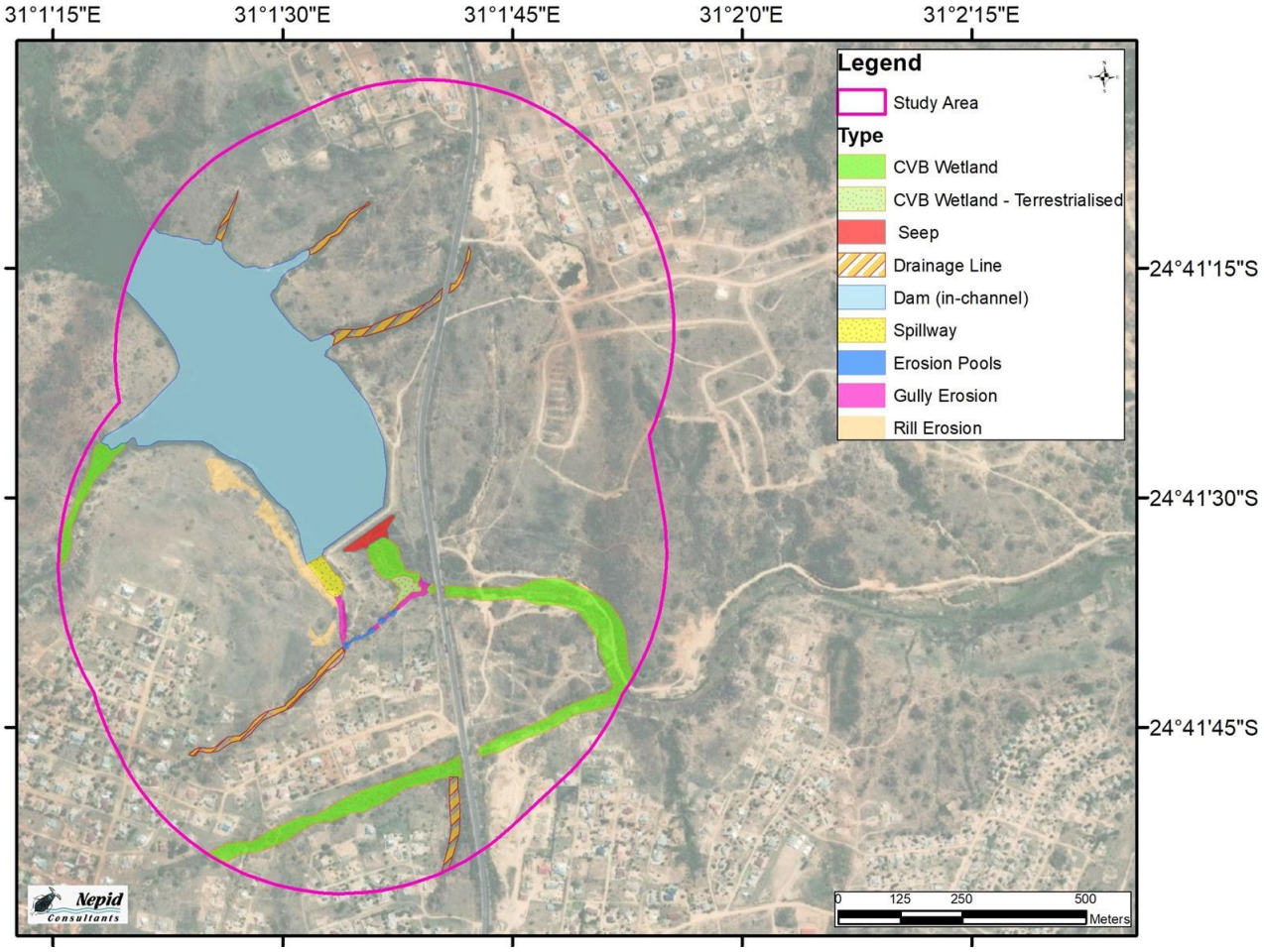


Figure 6-1. Delineation of Aquatic Ecosystems in the Study Area

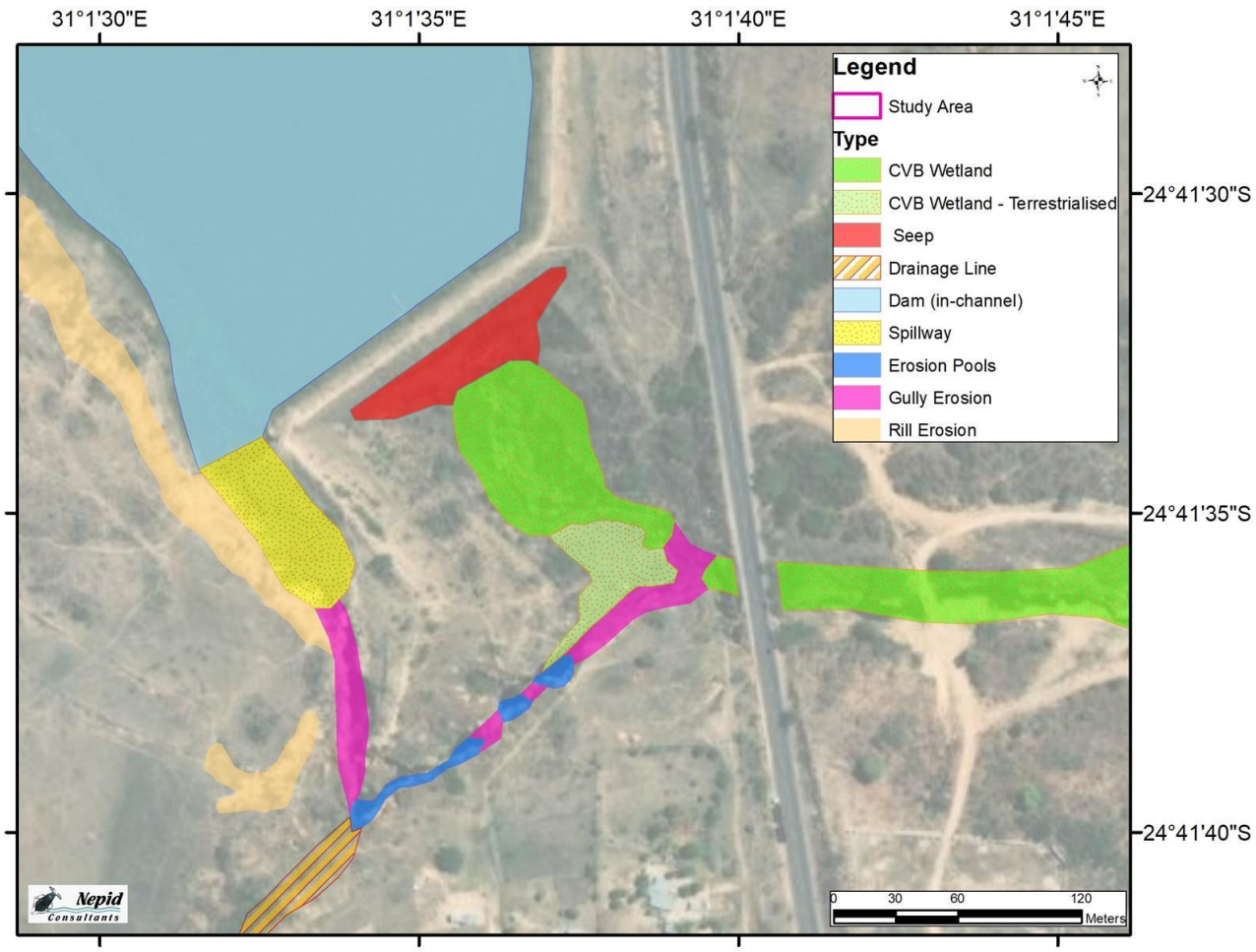


Figure 6-2. Delineation of Aquatic Ecosystems at the Proposed Work Area

6.2 Natural Aquatic Ecosystem Types

One natural hydro-geomorphic aquatic ecosystem type was identified within the potential Areas of Influence as follows:

> **Valley Bottom Wetland with Channel.** Examination of an aerial photograph taken in 1944, before the construction of Casteel Dam, shows that the watercourse at the dam site comprised a Valley Bottom Wetland (Figure 6-3). The wetland was wider upstream of the R40 road crossing, which suggests a natural hydraulic control near the road crossing. A geological fault line runs through the site where the dam is now located (Figure 6-3). The field survey for this report found that the wetland downstream of the dam comprised a Channelled Valley Bottom Wetland characterised by the Lowveld Reed *Phragmites mauritianus* and the grass *Leersia hexandra.* Photographs of this wetland are shown in Figure 6-4. The wetland was about 70 m wide and extended to the confluence with the Thulandziteka River, a distance of ~1.8 km. The size of this wetland downstream of Casteel Dam was ~12.6 hectares.

The Study Area also contained several **Episodic Drainage Lines.** These are classified as "watercourses" in term of the National Water Act (No. 36 of 1998), but they did not support aquatic or riparian biota and are therefore not considered to be aquatic ecosystems. The drainage lines are important for stormwater management and were mapped, as shown in Figure 6-1, but they were not considered further for the purposes of this report.

Figure 6-3. Aerial Photograph of Casteel Dam Area in 1944
[Source: Survey General Job 56; Strip 33; Photograph 3363.

Figure 6-4. Photographs of Channelled Valley Bottom Wetland Downstream of Casteel Dam in August 2022

6.3 Artificial Aquatic Ecosystems

Other aquatic ecosystem types within the potential Areas of Influence of the proposed rehabilitation comprised various artificial aquatic ecosystems as follows:

- **Impoundment.** The impoundment created by Casteel Dam inundated ~1 km of watercourse and covered an area of ~20 hectares at Full Supply (Figure 6-5A). In August 2022 the impoundment was fringed mainly by lowveld Reed *Phragmites mauritianus*, Bulrush *Typha capensis* and Cape Water Lily *Nymphaea nouchali.*
- **Seepage Wetland.** This wetland was on the dam wall and was maintained by uncontrolled seepage from the wall (Figure 6-5B). This wetland covered an area of ~0.2 hectares. The central zone of this wetland was characterised by growth of the yellow-green algae *Vaucheria* sp., known as "water felt", which is indicative of permanent saturation. The margins of this wetland were indicated by the presence of *Imperata cylindrica,* which is typically associated with seasonal saturation;
- **Spillway Apron**. The spillway apron created what appeared to be a seasonal to permanent pool (Figure 6-5C). In August 2022 the pool was up to ~40 cm deep and was characterised by concrete overhangs that provided cover for fish; and
- **Gully Erosion and Pools in Spillway**. The spillway was actively eroding and had created an erosion gully that was incised by ~8 m (Figure 6-5E). The erosion gully extended for a distance of ~200 m, of which the upper ~90 m was within the dam spillway. The lower ~110 m of this erosion gully was within what was formerly an Episodic Drainage Line (Figure 6-2). Erosion in the spillway created what appeared to be permanent pools (Figure 6-5F).

Figure 6-5. Photographs of Artificial Aquatic Ecosystem Types

[A) Impoundment (Casteel Dam); B) Seepage Wetland on Casteel Dam Wall; C) Spillway apron; D) Gully erosion in spillway; E) Pool in spillway].

6.4 Soils

6.4.1 Wetland Soils

Soils within the Valley Bottom Wetland downstream of Casteel Dam comprised a grey bleached orthic horizon over deep alluvial sands which was identified according to the method of the Soils Classification Working Group (2018) as **Dundee Soil Formation** (Figure 6-6). Soils within the terrestrialised portion of the wetland showed oxidized rhizomes, indicative of temporary saturation (Figure 6-6A).

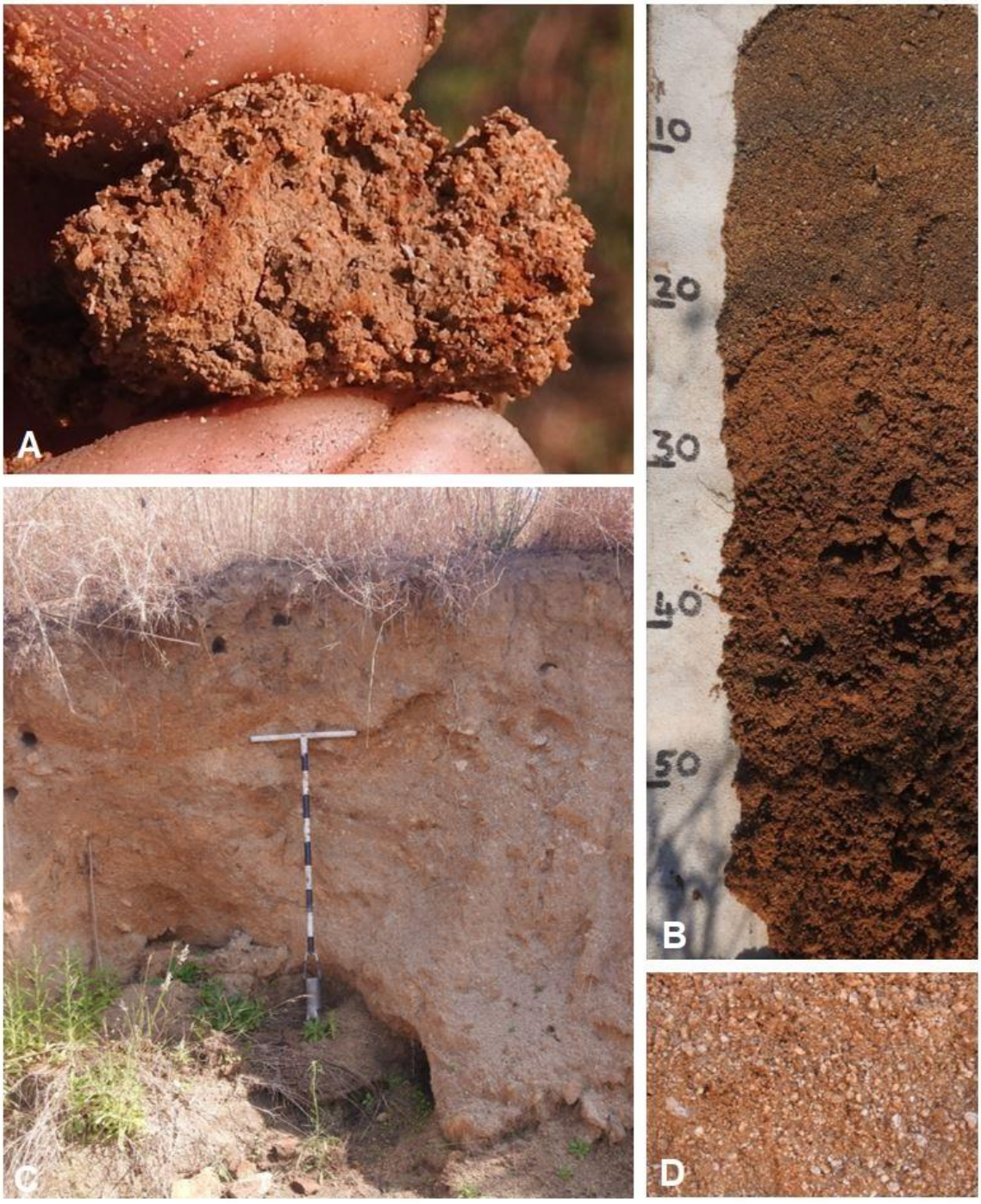


Figure 6-6. Dundee Soil Form

6.4.2 Rill Erosion

The western (right) bank of Casteel Dam was geomorphologically unstable and characterised by extensive areas of rill erosion (Figure 6-7). The extent of the rill erosion is shown in Figure 5-1.

Figure 6-7. Rill Erosion

6.5 Termites

Casteel Dam wall was colonised by fungus growing termites comprising the genus *Macrotermes* sp. (Figure 6-8). The presence of termites in the wall has significant implications for the structural stability of the wall.

Figure 6-8. *Macrotermes* sp. (Termitidae) on Casteel Dam

6.6 Wetland Plant Species

Plant species typically associated with wetlands and which were recorded in the Study Area in August 2022 comprised the following:

- *Agathisanthemum bojeri bojeri*
- *Ageratum conyzoides**
- *Bulbostylis hispidula pyriformis*
- *Centella asiatica*
- *Chamaecrista mimosoides*
- *Christella dentata*
- *Coleus livingstonei*
- *Commelina diffusa scandens*
- *Crystallopollen angustifolium*
- *Cynodon dactylon*
- *Cyperus denudatus*
- *Cyperus dives*
- *Cyperus melanospermus*
- *Cyperus polystachyos*
- *Dicliptera clinopoda*
- *Erigeron sumatrensis **
- *Gomphocarpus physocarpus*
- *Gomphocarpus tomentosus*
- *Gymnanthemum coloratum*
- *Helichrysum nudifolium*
- *Hilliardiella oligocephala*
- *Imperata cylindrica*
- *Ipomoea obscura obscura*
- *Laggera crispata*
- *Leersia hexandra*
- *Ludwigia adscendens diffusa*
- *Mesosphaerum pectinata**
- *Nidorella podocephala*
- *Nitella furcata*
- *Nymphaea nouchali caerulea*
- *Persicaria decipiens*
- *Persicaria lapathifolia**
- *Persicaria senegelansis albotomentosa*
- *Phragmites mauritianus*
- *Potamogeton crispus*
- *Ranunculus multifidus*
- *Schoenoplectus corymbosus*
- *Sesbania bispinosa bispinosa*
- *Sesbania punicia**
- *Setaria sphacelata sphacelata*
- *Thelypteris confluens*
- *Typha capensis*
- *Vaucheria sp.*
- *Ziziphus mucronata mucronata*

(= Alien species)*

The plant species composition indicated that the wetland was permanently saturated. However, a small portion of this wetland upstream of the R40 road crossing was terrestrialised because of gully erosion caused by the dam spillway. The terrestrial portion of the wetland was characterised by terrestrial plant species such as *Dichrostachys cinerea ssp. africanus, Annona senegalensis ssp. senegalensis, Hoslundia opposita, Gymnosporia marangensis* and *Rotheca myricoides.* Photographs of selected wetland plant species are shown in Figure 5-9.

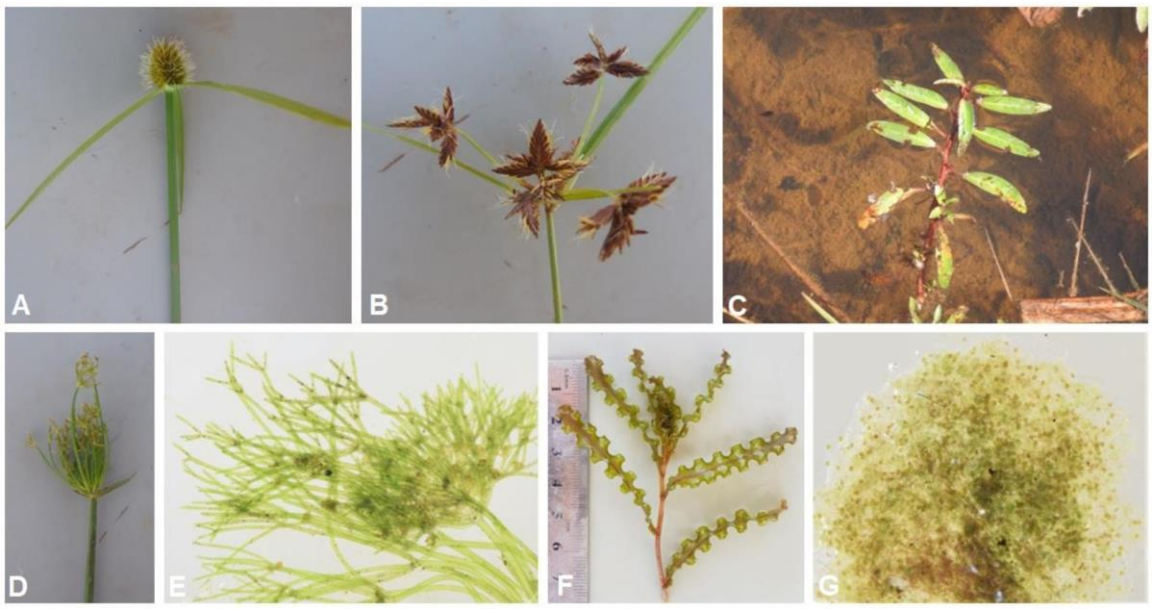


Figure 6-9. Selected Wetland Plant Species

[A) *Cyperus melanospermus* (Cyperaceae)*;* B) *Cyperus mundii* (Cyperaceae)*;* C) *Ludwigia adscendes ssp. diffusa* (Onagraceae)*;* D) *Cyperus denudatus* (Cyperaceae)*;* E) *Nitella furcata* (Characaea)*;* F) *Potamogeton crispus* (Potamogetonaceae)*;* G) *Vaucheria sp.* (Vaucheriaceae)].

6.7 Hydrology

Mean Annual Runoff

Data extracted from the Inkomati Water Availability Study (DWAF 2009), indicates that the natural Mean Annual Runoff (nMAR) at Casteel Dam is ~2.76 Mm^3, but there is significant variation between years, with values ranging between ~0.67 Mm^3 in 1991, and ~13.26 Mm^3 in 1939.

Low Flows - Dry Season

Examination of natural monthly flows shows that the dry season usually occurs between May and November (Figure 6-10). Median monthly flows in September were estimated at ~0.089 Mm^3, equivalent to ~34 ℓ/s.

Wet Season

Examination of natural monthly flows shows that the wet season usually occurs between December and April (Figure 6-10). Wet season low flows cannot be reliably calculated from monthly data because the data include both low and high (peak) flow, but a rough estimate of the likely range of wet season low flows was based on the assumption that half the flow during the wet season was attributed to peak flows, and the remaining half to low (base) flows. As such, the data indicate that the median natural low flow at the height of the wet season (February) at the dam was ~45 ℓ/s and ranged between ~23 and ~285 ℓ/s at the 10th and 90th percentiles respectively.

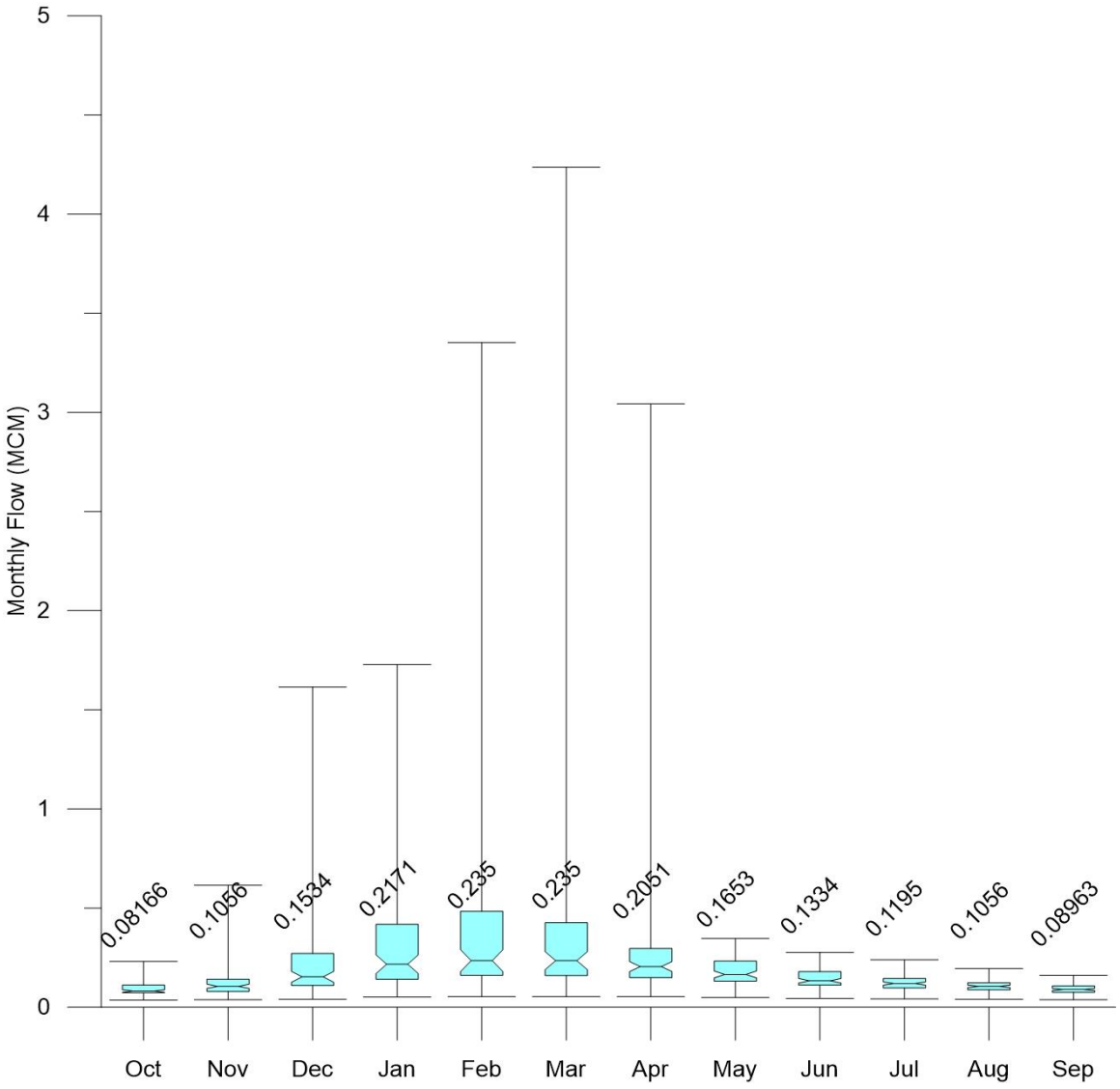


Figure 6-10. Naturalised Monthly Flows at Casteel Dam

[Note: Data simulated for the period 1920 to 2004. Values shown are median monthly values. Data extracted the Inkomati Water Availability Study (DWAF 2009)].

6.7.1 Observed Flow

There are no flow gauges in the tributary where Casteel Dam is located. The dam was not spilling at the time of the field survey in August 2022, but the water level was close to Full Supply. The spillway comprised a series of pools, with little to no surface flow between the pools. Water was flowing into the dam and water was flowing out of the dam via the siphon outlet as well as via uncontrolled seepage at about the same rate. The flow rate was not measured but classified qualitatively as "Low".

6.7.2 Present Hydrological State

The Present Hydrological State of the watercourse downstream of Casteel Dam was classified in August 2022, with a moderate level of confidence, as **Category C** (Table 6-1). This classification was based on the following lines of evidence:

- **Low Flows.** Low flows are likely to be elevated compared to natural flows because of uncontrolled seepage from Casteel Dam and releases for downstream users;
- **Zero Flow Duration.** Zero flow duration is likely to be much the same as under natural conditions because of uncontrolled seepage and releases for downstream users;
- **Seasonality**. Seasonality of flows downstream of Casteel Dam are almost certain to be delayed because of the storage capacity of Casteel Dam. The gross storage of Casteel Dam is estimated at ~1.18 Mm^3, whereas the average naturalised runoff is estimated at ~2.76 Mm^3. The storage capacity of Casteel Dam is therefore 0.4 times that of the average naturalised runoff, and as such, the dam is comparatively small. The extent to which present day Mean Annual Runoff has changed because of catchment development is unknown. What is known is that water from the dam is underutilised because of the faulty outlet, and as such, drawdowns are minimal and so the delay in seasonality is likely to be small.
- **Moderate Events.** Moderate events are likely to have been significantly modified, partly because of the storage capacity of Casteel Dam which would serve to dampen moderate events, and partly because of the increased road network in the catchment, which is certain to have increased the rainfall-runoff response for moderate events.
- **High Flows.** Casteel Dam is likely to have had a small impact on high flows because of its small size compared to the runoff.

Table 6-1. Hydrological Driver Assessment Index

COMPONENTS	1. Rank	2. %wt	3. RATING	WEIGHT	Weighed score	CONFIDENCE
LOW FLOWS	1	100	2.00	0.34	0.69	4.00
ZERO FLOW DURATION	2	80	0.00	0.28	0.00	4.00
SEASONALITY	5	20	1.50	0.07	0.10	3.00
MODERATE EVENTS	3	50	3.00	0.17	0.52	4.00
EVENT HYDROLOGY(HIGH FLOWS-FLOODS)	4	40	0.50	0.14	0.07	4.00
TOTALS		**290**	**7.00**	**1.00**	**1.38**	
Driver status:(%)					**72**	
HABITAT DRIVER CATEGORY					**C**	

6.7.3 Ecological Reserve

The gazetted Ecological Reserve for the Tlulandziteka (Sand) River at EWR S7 for a Category C ecological state is specified as 32.67% of the nMAR. The nMAR for Casteel Dam is estimated at ~2.76 Mm^3, so the annual Ecological Reserve from Casteel Dam is estimated at ~0.90 Mm^3. The average Ecological Reserve for the driest month (October) is estimated at ~0.027 Mm^3, equivalent to ~10 ℓ/s, whereas the average Ecological Reserve for the wettest month (February) is estimated at ~0.077 Mm^3, equivalent to ~32 ℓ/s (Figure 6-11). This means that the minimum flows released from Casteel Dam should vary seasonally between 10 ℓ/s in October and 32 ℓ/s in February during periods of normal rainfall or high rainfall. During drought years, the recommended average monthly flows were based on the 90% time of exceedance, and during these periods, the minimum flows released from Casteel Dam should vary seasonally between 8 ℓ/s in October and 16 ℓ/s in February (Figure 6-11).

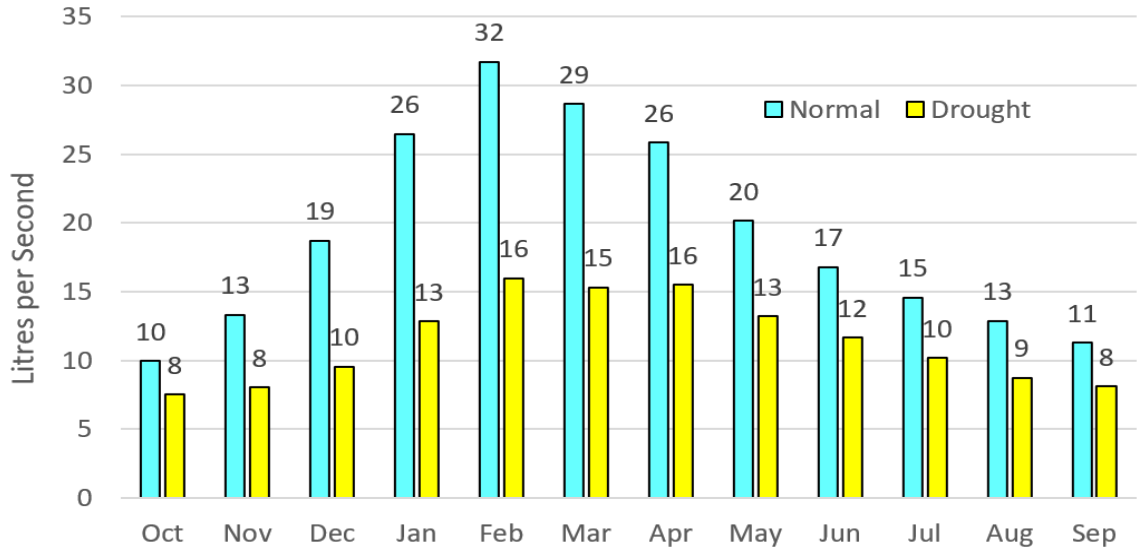


Figure 6-11. Average Monthly Ecological Reserve for Casteel Dam for Normal and Drought Years

6.8 Field Water Quality

Field water recorded downstream of Casteel Dam at Site C2 on 22nd August 2022 indicated slightly alkaline conditions with a pH of 8.2, moderately low electrical conductivity of 14 mS/m, and very low turbidity at 3 NTU. There was no evidence of eutrophication as benthic algae was present in low abundance (<5% cover), and there was no evidence of free-floating aquatic macrophytes.

6.9 Habitat Integrity

Habitat Integrity of the Valley Bottom Wetland downstream of Casteel Dam was classified in August 2022, with a moderate level of confidence, as Category C (Table 5-2).

Table 6-2. Habitat Integrity

Criteria	Rate	Comment
Flow Modification	3	Moderate change, as described in Section 7.6.2
Inundation	5	None (Excluding Casteel Dam)
Water Quality Modification	4	Largely Natural
Sediment Load Modification	2	Largely Modified (Casteel Dam; Erosion; Roads)
Channel Modification	1	Seriously Incised
Topographical Alteration	1	Serious Erosion and Sand Mining
Terrestrial Encroachment	3	Moderately Modified
Vegetation Removal	2	Largely Modified
Alien Vegetation	2	Largely Modified
Alien Fauna	2	*Cherax quadricarinatus*
Present Ecological State Mean:	**2.5**	**C: Moderately Modified**

Rating (0-5):
0 = Critically Modified (F)
1 = Serious (E)
2 = Largely Modified (D)
3 = Moderately Modified (C)
4 = Largely Natural (B)
5 = Natural (A)

6.10 Aquatic Macroinvertebrates

A total of 20 SASS5 taxa was recorded downstream of Casteel Dam at Site C2 on 22nd August 2022. Detailed results are presented in Appendix E. Habitats were unsuitable for application of the SASS method as the watercourse comprised a Channelled Valley Bottom Wetland. The biota was characterised by taxa that are tolerant to water quality deterioration. Three sensitive taxa were recorded, namely Atyidae (*Caridina africana*), Hydracarina and Baetidae (3 spp), including the highly tolerant *Baetis harrisoni.* Functional feeding groups were dominated by Gatherers. Filter-feeders were present, but in low abundance. Filter-feeders included the blackfly species *Simulium hargreavesi* and *S. nigritarse,* both of which are typically associated with impoundment outlets and seasonal flow. The abundance of air-breathing taxa was *moderate* (26%), which suggested that oxygen may have been partially limited. The proportion of sediment sensitive taxa was *low* (30%), which suggested elevated sedimentation. Three notable macroinvertebrate species were recorded, namely:

- *Biomphalaria pfeirreri* (Figure 5-12A), an intermediate hosts of *Schistosoma mansoni, a* parasitic flatworm that causes rectal bilharzia;
- *Bulinus natalensis* (Figure 5-12B), an intermediate hosts of *Schistosoma haematobium, a* parasitic flatworm that causes urinary bilharzia; and
- *Cherax quadricarinatus*, the Australian redclaw crayfish (Figure 5-12C).

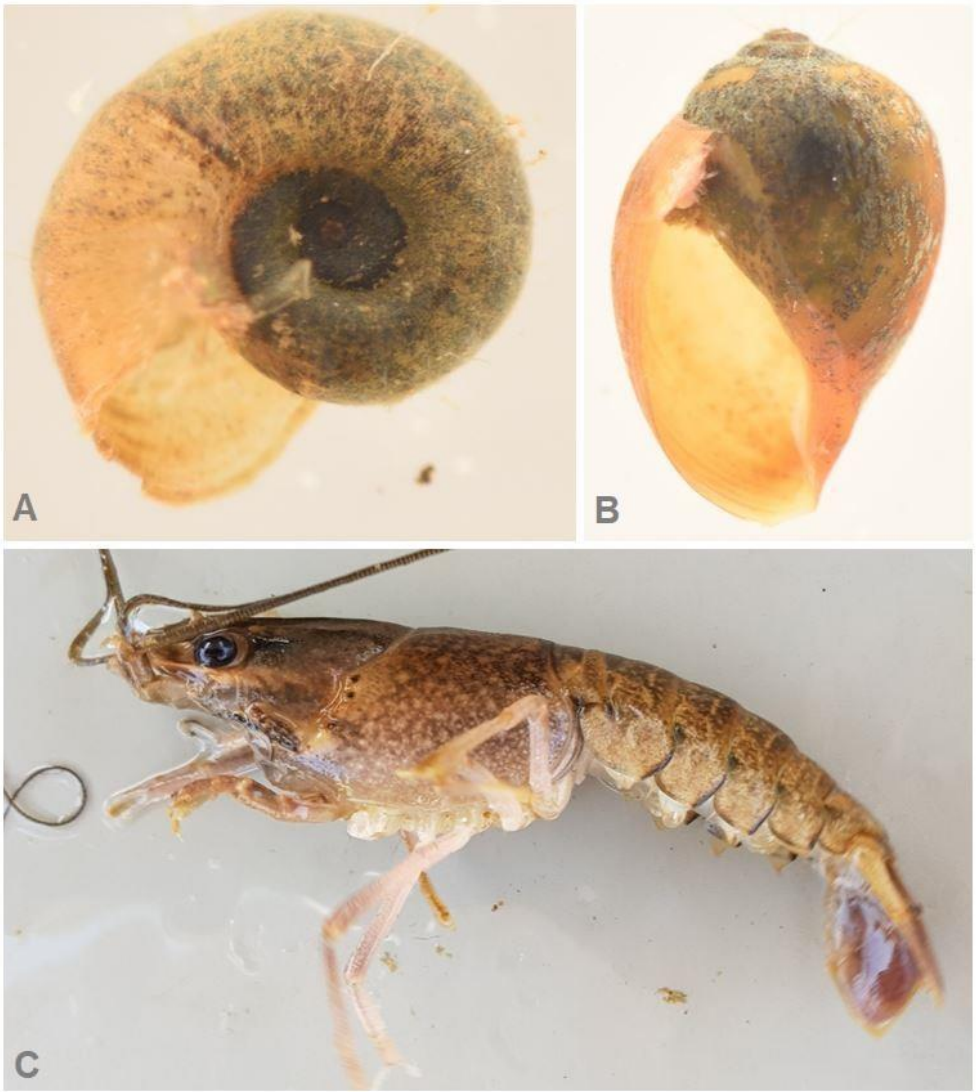


Figure 6-12. Photographs of Selected Macroinvertebrate Species

[A) *Biomphalaria pfeifferi* (Planorbidae)*;* B) *Bulinus natalensis* (Bulinidae); C) *Cherax quadricarinatus** (Parastacidae)].

6.11 Fish

6.11.1 Reference Conditions

Twenty-eight species of fish are listed as potentially occurring in the Thulandziteka River (Kleynhans et al 2007). Aquatic habitats at both sites during the field survey for this report comprised Slow-Shallow conditions with marginal vegetation that provided moderate cover. There was no fast-flowing or deep water at the two sites surveyed. The expected composition of fish downstream of Casteel Dam was therefore likely to exclude all larger species and all species that are flow-dependant because of the limited diversity of instream habitats. A total of seven species of fish was expected at C1, and a total of eight species was expected at C2 (Appendix F).

6.11.2 Fish Species Observed

Site C1

The Present Ecological State of Fish at Casteel Dam spillway apron, Site C1, in August 2022, was rated as Category C (Appendix F). A total of forty-three fish comprising six species was recorded in 12 minutes of electro-fishing. Photographs of the six species of fish are shown in Figure 6-13. The results indicted a Catch per Unit Effort of 215 per Hour, which is considered *moderate.* The composition was dominated numerically by *Enteromius viviparus* and *Oreochromus mossambicus,* which each comprised 43% of the catch. In terms of biomass the composition was dominated by *Clarias gariepinus* and *Oreochromis mossambicus*, the largest of which had total lengths of 20 to 25 cm. No alien fish species was recorded.

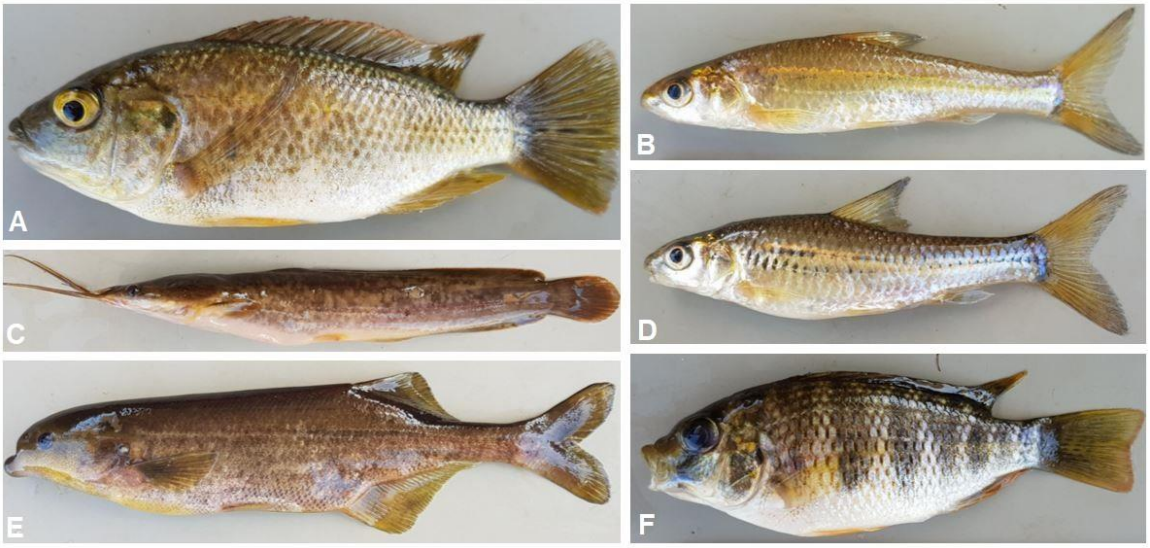


Figure 6-13. Photographs of Fish Species at C1

[A) *Oreochromis mossambicus;* B) *Enteromius paludinosus;* C) *Clarias gariepinus;* D) *Enteromius viviparus;* E) *Marcusenius pongolensis;* F) *Coptodon rendalli].*

Site C2

The Present Ecological State of fish at Site C2 in August 2022 was rated as Category B (Appendix F). A total seven species of fish was recorded in 9 minutes of electro-fishing. Photographs of the seven species of fish are shown in Figure 6-14. The number of fish was not recorded because of high numbers of small individuals and the limited time available. The Catch per Unit Effort was therefore not calculated but is likely to have been over 1,000 per hour, which is considered *very high.* The composition was dominated numerically by *Micralestes acutidens, Enteromius annectens* and *Oreochromus mossambicus.* All individuals recorded were small (<6 cm). The most sensitive species recorded was *Enteromius eutaenia*, which was present in moderate abundance. No alien fish species was recorded.

Figure 6-14. Photographs of Fish Species at C2

[A) *Labeobarbus marequensis;* B) *Coptodon rendalli;* C) *Micralestes acutidens;* D) *Oreochromis mossambicus;* E) *Enteromius trimaculatus;* F) *Enteromius annectens;* G) *Enteromius eutaenia*].

6.11.3 Fish Species of Conservation Concern

Two species of fish of conservation concern are listed as potentially occurring in the Thulandziteka River (Kleynhans et al 2007), namely:

- ***Serranochromis meridianus*** (Endangered). This species has been recorded ~20 km downstream of Casteel Dam, in the Sand River and in Edinburgh Dam, on a tributary of the Sand River (SAIAB database). This species prefers sandy substrates with pools >1 m, and is therefore not expected to occur within the Study Area; and

- ***Oreochromis mossambicus*** (Vulnerable). This species was confirmed within the Study Area during the field survey in August 2022 (Figure 6-13A). This is threatened by hybridisation with the alien *O. niloticus.*

6.12 Ecological and Functional Importance

Ecological Importance

The Ecological Importance of the Channelled Valley Bottom Wetland downstream of Casteel Dam was rated as *Moderate*. The assessment was based on the following lines of evidence (Figure 6-15):

- **Red Data Species.** No aquatic plant or animal species classified by SANBI as *Endangered* or *Critically Endangered* are expected or observed in the wetland downstream of Casteel Dam (http://posa.sanbi.org). However, one species that is classified as *Vulnerable* was confirmed at Site C1, namely *Oreochromis mossambicus.* The importance of Red Data Species was therefore rated as *Low* (1/4).

- **Unique Species.** The field survey did not identify any unique wetland species. The importance of Unique Species was therefore rated as *None* (0/4).

- **Migration/Breeding/Feeding.** The wetland downstream of Casteel Dam is likely to provide foraging habitat for a range of species throughout the year, but these wetlands are not important as migration corridors because of their location in the upper catchment. The importance of migration, breeding and feeding was therefore rated as *Moderate* (2/4).

- **Protection Status of Wetland.** Aquatic ecosystems in the Study Area have no formal protection status. The field survey identified two terrestrial plant species that are protected in terms of the Mpumalanga Nature Conservation Act, and one species that is protected in terms of the National Forest Act (No 84 of 1998). The protection status was therefore rated as *Low* (1/4).

- **Protection Status of Vegetation Types.** Terrestrial vegetation within the Study Area is classified as **Granite Lowveld** (SVI 3) (Mucina and Rutherford 2006). This vegetation type is not listed as threatened (Notice 1002 of Government Gazette 34809, 9 December 2011). The Protection Status of Vegetation Types was therefore rated as *None* (0/4).

- **Regional Context.** The Mpumalanga Biodiversity Plan classifies part of the area as a "Critical Biodiversity Area" (MTPA 2018). The regional context of ecological integrity of the wetland downstream of Casteel Dam was therefore rated as *High* (3/4).

- **Size and Rarity**. The proposed works could have indirect impacts on the Valley Bottom wetland downstream of Casteel Dam to its the confluence with the Thulandziteka River, a distance of ~1.8 km. This type of wetland is common and widespread in the lowveld ecoregion. The importance of size and rarity was therefore rated as *Low* (1/4).

- **Diversity of Habitats.** The Valley Bottom Wetlands downstream of Casteel dam had a moderate diversity of pool depths and hydraulic conditions, so the diversity of wetland habitats was rated as *Moderate* (2/4).

- **Sensitivity to Floods.** Valley bottom wetlands are generally not driven by high flow events, but the composition and diversity of fish species recorded downstream of Catseel Dam suggested that high flow events do play an ecological role, so the sensitivity to changes in floods was rated as *Moderate* (2/4).

- **Sensitivity to Low Flows.** The valley bottom wetland downstream of Casteel Dam is likely to be naturally perennial, but no species that are sensitive to water quality deterioration were recorded, so the sensitivity of the wetland to changes in low flow was rated as *Moderate* (2/4).

- **Sensitivity to Water Quality.** Soils in the Seepage Wetland are likely to be reasonably well buffered because of the high clay content, and therefore able to tolerate change in water quality. Sensitivity to changes in water quality was therefore rated as *Low* (1/4).

Functional Importance

The Functional Importance of the Channelled Valley Bottom Wetland downstream of Casteel Dam was rated as *High*. The assessment was based on the following lines of evidence (Figure 6-15):

- **Flood Attenuation.** The Valley Bottom Wetland downstream of Casteel Dam is likely to play a significant role in terms of flood attenuation because of the vegetation structure comprising extensive beds of *Phragmites mauritianus* reeds. The importance of flood attenuation was therefore rated as *High* (3/4).

- **Streamflow Regulation.** The wetland is likely to contribute to streamflow regulation, so the importance of this aspect was rated as *Moderate* (2/4).

- **Sediment Trapping.** The wetland downstream of Casteel dam is fundamentally associated with the accumulation of sediments. The importance of sediment trapping was therefore rated as *High* (3/4).

- **Nutrient and Toxicant Assimilation**. The wetland downstream of Casteel damn is likely to play an important role in assimilating nutrients from livestock that use the wetland for grazing. The wetland is also likely to provide moderate assimilation of toxins, particularly during the wet season, when aquatic vegetation growth is elevated. The potential for nutrient and toxin assimilation by the wetland was therefore rated as *High* (3/4).

- **Erosion Control.** The risk of erosion in the wetland downstream of Casteel Dam is very high because of the steep gradient, confined topography and erodible soils. The importance of the wetlands in controlling erosion was therefore rated as *Very High* (4/4).

- **Carbon Storage.** The wetland downstream of Casteel Dam supported scarred woody vegetation and little to no accumulation of organic material in the soils. The importance of the wetland for carbon storage was therefore rated as *Low* (1/4).

Direct Human Benefits

Direct human benefits of the Channelled Valley Bottom Wetland downstream of Casteel Dam was rated as *High* (Figure 6-15). The assessment was based on the following lines of evidence:

- **Water for Human Use.** Casteel Dam provides irrigation water for the Dingley Dale Irrigation Scheme, so the importance of the wetland for direct human use was rated as *Very High* (4/4).

- **Harvestable Resources.** The wetland downstream of Casteel Dam provided an important area for subsistence fishing and was grazed by livestock, so the importance of this parameter was rated as *Very High* (4/4).

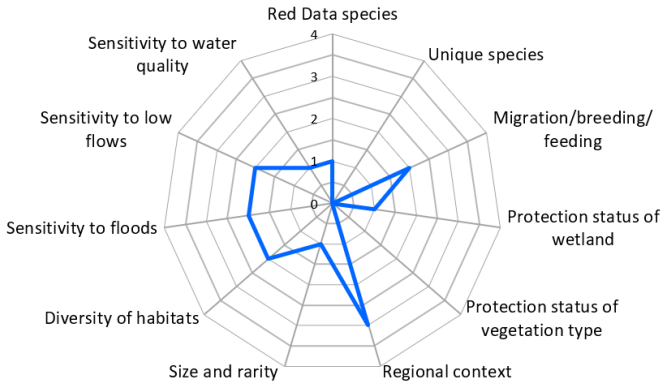
- **Cultivated Foods.** There was no evidence of subsistence cultivation within the Seepage Wetlands in the Study area, so this parameter was rated as *Zero* (0/4).

- **Cultural Heritage.** The importance of the wetland to cultural heritage is unknown, but there was evidence that the wetland is used for ceremonial purposes, so the important of this parameter was rated as *High* (3/4).

- **Tourism and Recreation.** The importance of the wetland downstream of Casteel Dam to tourism and recreation is unknown, but likely to be *Low* (1/4).

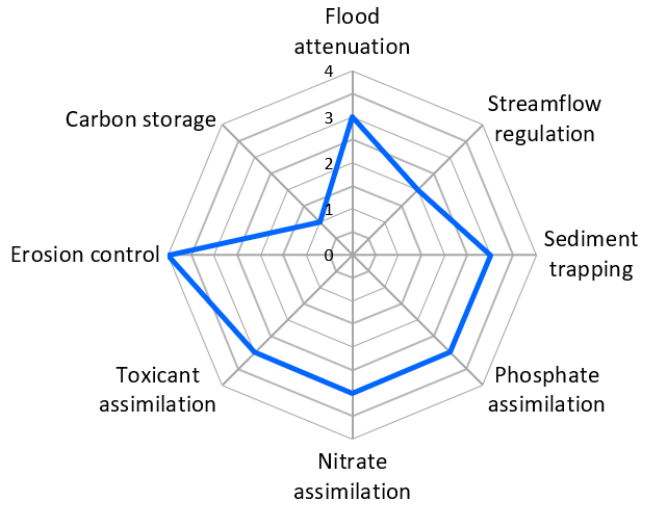
- **Education and Research.** The importance of the wetland downstream of Casteel Dam to education and research is unknown, but likely to be *Low* (1/4).

Ecological Importance



Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Functional Importance



Direct Human Benefits (Subsistence)

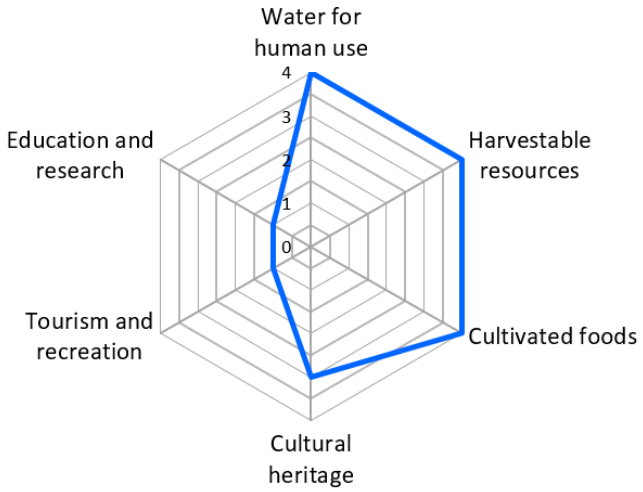


Figure 6-15. Ecological and Functional Importance.

7. POTENTIAL IMPACTS AND MITIGATION

This section details the potential impacts of the proposed works on the Valley Bottom Wetland downstream of Casteel Dam, and suggests mitigation measures, where feasible. A summary and rating of the main potential impacts is shown in Table 7-1. Potential impacts on artificial wetlands within the Area of Influence were not assessed for the purposes of this report as they are not considered to be Ecologically Important or Sensitive.

Table 7-1. Summary and Rating of the Potential Impacts of the Proposed Works on Aquatic Ecosystems, Before and After Mitigation

Potential Impact	Impacts Before Mitigation						Impacts After Mitigation					
	I	D	E	P	TOTAL	Significance	I	D	E	P	TOTAL	Significance
Pre-Construction Phase												
Destruction of Wetland Habitat	-2	7	2	7	**-77**	**Moderate (-)**	-2	7	1	7	**-70**	**Minor (-)**
Increased Alien Invasive Vegetation	-5	5	3	7	**-91**	**Moderate (-)**	-2	5	1	7	**-56**	**Minor (-)**
Water Quality Deterioration	-4	2	3	5	**-45**	**Minor (-)**	-2	2	3	4	**-28**	**Negligible (-)**
Increased Solid Waste	-3	4	3	5	**-50**	**Minor (-)**	-1	4	3	4	**-32**	**Negligible (-)**
Altered Hydrology	-4	2	3	5	**-45**	**Minor (-)**	-1	2	3	2	**-12**	**Negligible (-)**
Dam Failure	-6	6	3	4	**-60**	**Minor (-)**	-6	6	3	2	**-30**	**Negligible (-)**

7.1 Destruction of Wetland Habitat

Bulk earthworks associated with the proposed rehabilitation will have a direct impact on a small portion of the Valley Bottom Wetland immediately downstream of Casteel Dam. This area is estimated to cover no more than 0.1 hectares. This area is already affected by the existing wall, so the intensity of the impact was rated as *Minor* (-2/7). This area will be permanently covered by fill, so duration was rated as *Permanent* (7/7). The spatial extent of disturbance could extend to the *Site* (2/7). However, the area of disturbance could be reduced by appropriate zoning and rehabilitation such that the residual area of disturbance would be limited to the *Footprint* (1/7). The residual significance of bulk earthworks on the Valley Bottom Wetland habitat downstream of Casteel Dam was rated, with high confidence, as **Minor (-).**

Mitigation

1a **Environmental Compliance Officer (ECO).** An independent ECO must be appointed by DWS to monitor compliance with the RoD during construction. The ECO must be appointed prior to commencement of construction and be involved in all aspects of project planning that can influence environmental conditions on the site. Where possible, the ECO must attend relevant project meetings, conduct inspections to assess compliance with the RoD and relevant Health and Safety regulations, and be responsible for providing feedback on potential environmental problems associated with construction. The ECO must be vigilant for any impacts that were unforeseen and take appropriate steps to avoid or minimise any such impacts.

1b **Demarcate Work Areas**. Construction activities in the Seepage Wetland downstream of Casteel Dam must be minimised. All support operations should be done outside the wetland. A buffer zone of at least 50 m from the edge of the wetland is recommended for all activities that are not needed within the wetland.

1c **Rehabilitate Disturbed Areas.** All portions of the Valley Bottom Wetland downstream of Casteel Dam that are disturbed during construction but not covered by fill for the extended wall must be rehabilitated. The aim of the rehabilitation must be to recreate the same mix of habitats, including natural topography and substrates that were present prior to disturbance.

7.2 Increased Alien Invasive Vegetation

Clearing of vegetation associated with the proposed rehabilitation is certain to disturb soils and create conditions suitable for the establishment and spread of alien invasive vegetation. The level of alien invasive vegetation recorded during the baseline survey in August 2022 was *Moderate*. The proposed works could cause *Serious* infestation of alien invasive vegetation (-5/7). Implementing a long-term programme to control alien vegetation could reduce the intensity of this impact to *Minor* (-2). The duration of this potential impact could extend into the duration of the *Project* (5/7). The spatial extent of alien invasion is likely to extend for some distance downstream and was therefore rated as *Local* (3/7). Implementing a long-term programme to control alien vegetation could reduce the spatial extent to the *Footprint* (1/7). The probability of that the work will increase the spread of alien invasive vegetation was considered *Highly Probable* (6/7). The residual significance of increased alien invasive vegetation associated with the proposed works was therefore rated, with high confidence, as **Minor (-).**

Mitigation

2a Control Alien Invasive Vegetation. Declared alien invasive vegetation within all areas disturbed by site preparation and construction should be controlled at the end of construction, and at annual intervals during operation. Personnel tasked to control alien vegetation should receive appropriate training in the following: methods and control measures; equipment and techniques; types of herbicides and dosages applied; mixing techniques; storage of chemicals and equipment; health and safety issues; plant identification; procedures for equipment washing; equipment maintenance; record keeping, *inter alia.*

7.3 Water Quality Deterioration

The proposed rehabilitation has the potential to contaminate surface in and downstream of Casteel Dam. Potential sources of contamination include concrete batching, washing of equipment, refuelling, spills and leaks, ablutions and sediment mobilisation. The pre-mitigation intensity of this potential impact was rated as *Large* (-4/7). The duration of this impact is expected to be *Short-Term* (2/7). The spatial extent of water quality contamination could extend to the confluence with the Tlulandziteka (Sand) River and was therefore rated as *Local* (3/7). The probability of water quality contamination during the proposed rehabilitation works was considered *Likely* (5/7). Mitigation measures should reduce the potential intensity of this impact from *Large* (-4/7) to *Minor* (-2/7). Furthermore, mitigation measures should reduce the probability of this impact from *Likely* (5/7) to *Probable* (4/7). The residual significance of the proposed rehabilitation to surface water quality deterioration was rated, with moderate confidence, as **Negligible (-).**

Mitigation

3a Schedule. The proposed works must be scheduled to take place during the dry season (i.e. May to November, inclusive).

3b Demarcate Work Areas. Same as 1b above.

3c Washing. No washing of vehicles or equipment should be undertaken within 50 m from the Full Supply Level of the dam, or within 50 m from the wetland. Washing and maintenance of vehicles and equipment should be conducted in the areas designated for this purpose.

3d Refuelling. No refuelling should be allowed within 50 m from the Full Supply Level of the dam, or within 50 m from the wetland. Diesel/fuel should be stored on an impermeable surface.

3e Accidental Spills. Provide drip pans for generators, or any machinery that will be in position for longer than one day. Provide bunding around all diesel tanks, oil drums and generators.

Where oil and fuel spills are expected, parking is to be on an impervious surface with adequate pollution control mechanisms in place. Accidental spills must be attended to immediately and details recorded in an on-site logbook. The details will include date and locality of spill, distance to the nearest watercourse, type of material, estimated quantity of spill, contact details of the people involved, mitigation steps taken and results of any subsequent monitoring. Small quantities of soils contaminated by hydrocarbons should be treated *in situ* using bioremediation. Large quantities of contaminated soil or other materials should be removed and treated as hazardous waste in an appropriate manner. Contractors should be responsible for the bioremediation of their own soil until the following standards are met: i) there is no hydrocarbon odour; ii) soil particles do not coagulate because of hydrocarbon contamination; iii) there is no visual evidence of hydrocarbons in the soil. Where there is uncertainty, the soil shall be sent for analysis.

3f Ablutions. Temporary (mobile) on-site toilet facilities should be available and properly maintained. Provision shall be made for at least one toilet per 10-15 personnel on site. Staff shall not be permitted to use the natural environment as a toilet.

3g Stormwater Management Plan. A plan to manage stormwater runoff must be developed and implemented. The aims of this plan should be: 1) to minimise the transport of sediments from the proposed work area; 2) minimise the risks of erosion; and 3) minimise the contamination of stormwater.

7.4 Increased Solid Waste

Discard of excess building materials and general household waste during construction could impact negatively on the wetland downstream of Casteel Dam. The pre-mitigation intensity of this potential impact was rated as *Moderate* (-3/7). The duration of this impact was rated as *Long-Term* (4/7). The spatial extent of this impact was rated as *Local* (3/5). The probability of increased solid wastes during the proposed rehabilitation works was considered to be *Likely* (5/7). Mitigation measures should reduce the potential intensity of this impact from *Moderate* (-3/7) to *Negligible* (-1/7). Furthermore, mitigation measures should reduce the probability of this impact from *Likely* (5/7) to *Probable* (4/7). The residual significance of the proposed rehabilitation to increased solid waste was rated, with moderate confidence, as **Negligible (-).**

Mitigation

4a House-Keeping. Standard good practise for environmental management, including pollution control, solid waste management, and other issues related minimising impacts of construction activities. Work sites should be kept tidy and free of scrap metals, wire, bitumen, excess concrete, and other litter. Litter bins must be present and emptied regularly. No solid waste or bitumen may be burnt on site. Inert rubble and waste rock must be stored in appropriately. Contractors must be responsible for the removal and appropriate disposal of all solid wastes generated during construction.

7.5 Altered Hydrology

The proposed rehabilitation has the potential to alter the flow patterns downstream of Casteel Dam, and this could have negative consequences for aquatic biota. The pre-mitigation intensity of this potential impact was rated as *Large* (-4/7). The duration of this impact was rated as *Short-Term* (2/7). The spatial extent of altered hydrology could extend to the confluence with the Tlulandziteka (Sand) River and was therefore rated as *Local* (3/7). The probability that flow patterns could be altered was considered *Likely* (5/7). Implementing the ecological Reserve should reduce the potential intensity of this impact from *Large* (-4/7) to *Negligible* (-1/7). Furthermore, implementing the ecological Reserve should reduce the probability of this impact from *Likely* (5/7) to *Improbable*

(2/7). The residual significance of the proposed rehabilitation to altered hydrology was rated, with moderate confidence, as **Negligible (-).**

Mitigation

5a Ecological Reserve. The average monthly ecological Reserve should be released from Casteel Dam, as specified in Figure 6-11.

7.6 Dam Failure

Casteel Dam is at risk of failure because of gully erosion that is working its way towards the spillway (Figure 6-5D), and because the wall is compromised by infestation of termites (Figure 6-8). Furthermore, the structural stability of the wall is potentially compromised by woody vegetation that has colonised the wall. The project description available when this report was prepared provided no details on these aspects other than the "*the spillway donga will be rehabilitated*" and that "*termites will be controlled*". The current donga is ~8 m deep and would need significant civil works to ensure that further erosion is adequately controlled. Furthermore, controlling termites does not address the structural problems that are likely to have already taken place within the existing wall. The ecological implications of dam failure would be catastrophic and irreversible and so the intensity of this impact was rated as *Critical* (-6/7). Dam failure would result in high sediment loads in the watercourse and permanent scaring of the landscape, so duration was rated as *Beyond Project Life* (6/7). The spatial extent of dam failure could extend at least to the confluence with the Tlulandziteka (Sand) River and was therefore rated as *Local* (3/7). The probability of dam failure in the absence of mitigation was considered to be *Probable* (4/7). However, implementing the proposed mitigation measures should reduce the probability of this impact from *Probable* (4/7) to *Improbable* (2/7). The residual significance dam failure was rated, with moderate confidence, as **Negligible (-).**

Mitigation

6a Dam Safety Review. The proposed civil works must be reviewed by an independent Dam Safety Engineer(s). The review should pay particular attention to the proposed rehabilitation of the spillway donga, and the risks of the existing termite infestation on the structural stability of the existing wall.

6b Dam Safety Inspections. Periodic inspections must be undertaken by an independent Dam Safety Engineer(s), as required in terms of Dam Safety Regulations.

6c Dam Maintenance Programme. A long-term maintenance programme for the dam must be developed and implemented. Particular attention must be given to: 1) the control of erosion in the spillway channel; 2) the control of termites in the wall; and 3) the control of woody vegetation on the wall.

7.7 Cumulative Impacts on Aquatic Ecosystems

The cumulative impacts of the proposed rehabilitation on aquatic ecosystem were considered to be *Zero.*

8. RECOMMENDATIONS

8.1 Authorisation

Authorisation of the proposed rehabilitation in relation to potential impacts on aquatic ecosystems is recommended provided that the mitigation measures recommended in this report are followed. This recommendation is based on the following considerations:

- **Impacts**. The residual significance of the potential impacts on aquatic ecosystems was **Minor to Negligible**;
- **Reversibility.** The ecological functions of the affected wetland downstream of Casteel Dam can be easily restored by rehabilitating disturbed area and controlling the spread of alien invasive vegetation;
- **Loss of Irreplaceable Resources.** The proposed rehabilitation will not cause the loss of any irreplaceable resources;
- **Aquatic Habitats.** Casteel Dam has already incurred direct impacts on aquatic habitats, and the proposed rehabilitation will not have a significant further impact on aquatic habitats;
- **Present Ecological State.** The proposed rehabilitation is not expected to alter the Present Ecological State of the affected wetland;
- **Threatened Species.** One species of threatened fish was confirmed in the Study Area August 2022, namely *Oreochromis mossambicus.* This species is threated by hybridisation with the alien Nile tilapia, and is unlikely to be negatively impacted by the proposed rehabilitation;
- **Unique or Important Ecological Features**. The proposed rehabilitation is unlikely to impact measurably on any unique or important ecological features;
- **Ecological Connectivity**. The proposed rehabilitation will not impact migration corridors for aquatic biota;
- **Hydrological Functions.** The proposed rehabilitation could affect flow patterns in the wetland downstream of Casteel Dam, but these can be managed;
- **Sediment Transport.** The Project is certain to have increased sediment transport during the construction period, but this can be managed by implementing a Stormwater Management Plan;
- **Water Quality.** Water quality deterioration associated with the proposed rehabilitation is a potential issue of concern, but this can be managed by implementing the recommended mitigation measures;
- **Water Users and Uses**. The proposed rehabilitation could have direct negative impacts on the Dingley Dale Irrigation Scheme and other users downstream, but these impacts can be managed by ensuring that appropriate releases are made during the period of construction;
- **Key Ecosystem Services.** The proposed Project is not expected to impact negatively on ecosystem services.

8.2 Monitoring

8.2.1 Construction Phase

Regular inspections by the Environmental Compliance Officer (ECO) are recommended during construction. The aim of the inspections is to ensure that the control measures detailed in the RoD are adhered to. The recommended frequency of such inspections is weekly, but the frequency of inspections may be changed, pending the severity of impacts identified. Immediate corrective action must be taken if inspections identify any failures to comply.

8.2.2 Operational Phase

Routine Dam Safety Inspections are recommended during operation, as required in terms of the Dam Safety Regulations. Monitoring of aquatic ecosystems is not considered necessary because the proposed rehabilitation is not expected to have a measurable long-term negativeimpacts on aquatic ecosystems if the recommended mitigation measures are adhered to.

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10. APPENDICES

Appendix A: Certificate - SACNASP

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Robert William Palmer

Registration Number: 400108/95

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Biological Science (Professional Natural Scientist)

Effective 25 October 1995 Expires 31 March 2023

Chairperson

Chief Executive Officer

To verify this certificate scan this code

Appendix B: Certificate – SASS5

NATIONAL AQUATIC ECOSYSTEM HEALTH MONITORING PROGRAMME

Water and Sanitation

Water Research Commission

CERTIFICATE OF ACCREDITATION

This is to certify that

Dr Robert Palmer

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

COMPETENCY IN THE FOLLOWING AREAS HAVE BEEN DEMONSTRATED:

UNDERSTANDING OF THE SCOPE AND APPLICATION OF THE SASS5 METHOD.

DEMONSTRATION OF THE CORRECT SAMPLING PROTOCOLS

DEMONSTRATION OF THE CORRECT SAMPLE PREPARATION PROTOCOLS

IDENTIFICATION OF AQUATIC MACROINVERTEBRATES

COMPETENCY IS VALID FOR 3 YEARS FROM CERTIFICATE DATE

NATIONAL SASS5 AUDITOR

7 April 2022

DATE

Appendix C: Curriculum Vitae

Curriculm Vitae: One Page **Robert William Palmer**

Profession	:	**Aquatic Ecologist**
Date of Birth	:	15 Dec 1961
Name of Firm	:	Nepid Consultants CC
Position in Firm	:	Director
Years with Firm	:	16
Years' Experience	:	30
Nationality	:	South African
Place of birth	:	Grahamstown, South Africa
Marital Status	:	Married

Summary

Rob is an aquatic ecologist with a PhD in Zoology from Rhodes University, South Africa. He has over 30 years' experience as an independent consultant. He has specialist knowledge of the biodiversity of African rivers and wetlands, including aquatic flora, invertebrates and fish. He has participated in numerous ESIAs throughout Africa, many to environmental standards required by the IFC or World Bank. He has been a team leader for various mining and water resource development projects and environmental impact assessments involving coordination of multi-disciplinary teams. He is a member of the SA Council for Natural Scientific Professions and an accredited SASS5 biomonitoring practitioner.

Qualifications:

• PhD [Zoology]	Rhodes University, Grahamstown, RSA	1992
• BSc (Hons) [Mammalogy]	Pretoria University, RSA	1985
• BSc [Zoology]	University of Cape Town, RSA	1984

Professional Registrations:

- SA Council for Natural Scientific Professions (Biological Science): No 400108/95
- SASS5 Accreditation (Dept. Water Affairs & Sanitation)

Professional Societies

- International Association for Impact Assessment (South Africa)
- Southern African Society of Aquatic Scientists

Languages:

	Speaking	Reading	Writing
English (home):	Excellent	Excellent	Excellent
Afrikaans:	Good	Good	Poor
Xhosa:	Fair	Poor	Poor
Portuguese:	Poor	Fair	Poor

Countries of Work Experience (short-term consultancies):

Southern Africa:	Angola, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia
East Africa:	Eritrea, Ethiopia, Mozambique, Tanzania, Uganda
West Africa:	Burkina Faso, Guinea, Mali, Sierra Leone
Central Africa:	Cameroon, DRC
North Africa:	Morocco
Asia:	Afghanistan (virtual)

Key Qualifications: Freshwater Biodiversity - Rivers & Wetlands

Employment Record:

2005 – present	Nepid Consultants CC	Founder Director
2021 – present	World Bank	Short-Term Consultant (S Asia)
1997 – 2004	AfriDev Consultants Pty Ltd	Associate from 1997; Director from 2000
1991 – 1997	Onderstepoort Veterinary Institute	Research Fellow
1986 – 1991	Rhodes University	PhD Student

Contact Details: email: rob@nepid.co.za; Tel: +27(0)82 574 4486; PO Box 4349, White River, 1240, RSA
website: https://nepid.co.za/ ; Linkedin: www.linkedin.com/in/palmer-rob

Dated: 3rd January 2022

Page 1

Appendix D: Declaration of Independence

The Specialist Appointed in terms of the Regulations

I, **Robert William Palmer**, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

✓	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation **18** of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist

Nepid Consultants CC

Name of company

2022-01-03

Date

Signature of the Commissioner of Oaths for project/application:

2022/01/03

Date:

Designation:

Official stamp (below):

2022 -01- 03

SOUTH AFRICAN POLICE SERVICE

Appendix E: Baseline Data - Macroinvertebrates

Date	22-Aug-2022
Site Code	X32A - C2
River	Trib of Tlulandziteka
Elev (m)	578
Grid	S24.69337 E31.03466
Accuracy	
Gradient	
Zonation	
Quat	X32A
Ecoregion	3: Lowveld

Project	Casteel Dam Rehabilitation
Collector	Rob Palmer
Flow	Low
Clarity (NTU)	3
Turbidity	V Low
Colour	Clear
Benthic Algae (%)	0
Temp (°C)	-
pH	8.2
Cond (mS/m)	14
DO (mg/ℓ)	-
Disturbance	-

Biotopes	(0-5)
Stones In Current	1
Stones Out Current	0
Bedrock	3
Aquatic Veg	0
Marg Veg In Current	0
Marg Veg Out Of Current	4
Gravel	0
Sand	4
Mud	1
Visual observation	y

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8		B		B
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	1			1
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6				
Baetidae > 2 sp	12	B	A		B
Caenidae (Squaregills/Cainfles)	6	A		1	A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A		A
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5		A		A
Chironomidae (Midges)	2	A	B	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5	1			1
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3		A		A
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		A		A
Thiaridae* (=Melanidae)	3			A	A
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score					[97]
No. of Taxa					20
ASPT					[4.8]
Present Ecological State (A-F)					-

Other biota:

Cherax quadricarinatus *

Comments/Observations:

Appendix F: Baseline Data - Fish

Field Data Sheet: RSA

Site:	C1
River:	Casteel Dam @ Spillway Apron
Grid:	S24.69337; E31.03466
Date:	2022/08/22

Cover (0-4)

Marginal	2
Macrophytes	0
Undercut Banks &	0
Woody Debris	0
Bed Substrate	4
	30%

Depth-Flow Classes (0-4)

Shallow-Slow	4
Deep-Slow	0
Shallow-Fast	0
Deep-Fast	0
	25%

Family	Species	Sensitivity	Regional Status	IUCN Status	Expected	Total (No)	Weight (g)	0 - 3 (0.05 g)	3 - 5 (0.52 g)	5 - 7 (1.9 g)	7 - 10 (4.0 g)	10 - 15 (16 g)	15 - 20 (52 g)	20 - 25 (113 g)	25 - 30 (210 g)	30 - 35 (352 g)	35 - 40 (547 g)	40 - 45 (800 g)	45 - 50 (1130 g)
Order Characiformes																			
Alestidae	*Micralestes acutidens*	3.1	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Order Cypriniformes																			
Cyprinidae	*Engraulicypris brevianalis*	2.8	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius afrohamiltoni*	2.5	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius annectens*	3.0	LC	LC	y	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius eutaenia*	4.9	DD	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius paludinosus*	1.8	LC	LC	y	3	4	2	0	0	1	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius radiatus*	1.4	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius toppini*	3.0	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius trimaculatus*	1.8	LC	LC	y	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius unitaeniatus*	2.2	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Enteromius viviparus*	3.0	LC	LC	y	15	5	13	1	0	1	0	0	0	0	0	0	0	0
Cyprinidae	*Labeo cylindricus*	3.1	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Labeo molybdinus*	3.2	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Labeobarbus marequensis*	2.1	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	*Opsaridium peringueyi*	4.4	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Order Osteoglossiformes																			
Mormyridae	*Marcusenius pongolensis*	3.4	LC	LC	y	2	104	0	0	0	0	0	2	0	0	0	0	0	0
Mormyridae	*Petrocephalus wesselsi*	3.0	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Order Perciformes																			
Cichlidae	*Coptodon rendalli*	2.1	LC	LC	y	5	52	4	0	0	0	0	1	0	0	0	0	0	0
Cichlidae	*Oreochromis mossambicus*	1.3	VU	VU	y	15	123	5	7	1	1	0	0	1	0	0	0	0	0
Cichlidae	*Pseudocrenilabrus philander*	1.4	LC	LC	y	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Cichlidae	*Serranochromis meridianus*	2.1	EN	EN		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Gobiidae	*Glossogobius callidus*	2.3	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Gobiidae	*Glossogobius giuris*	2.5	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Order Siluriformes																			
Clariidae	*Clarias gariepinus*	1.0	LC	LC		3	242	0	0	0	0	1	0	2	0	0	0	0	0
Mochokidae	*Chiloglanis anoterus*	4.7	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Mochokidae	*Chiloglanis paratus*	3.1	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Mochokidae	*Chiloglanis swierstrai*	3.3	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0
Schilbeidae	*Schilbe intermedius*	1.8	LC	LC		0	-	0	0	0	0	0	0	0	0	0	0	0	0

Effort (min)		12		
Total Catch		43	530	
Catch per Unit Effort (/Hour)		215	2 651	
Total Number of Species	8	6		
FAII (%)		**71%**		
Present Ecological State (A-F)		**C**		

Site:	**C2**
River:	Casteel Dam D/S
Grid:	S24.692801; 31.02568912
Date:	2022/08/22

Cover (0-4)

Marginal	3
Macrophytes	0
Undercut Banks &	0
Woody Debris	0
Bed Substrate	3
	30%

Depth-Flow Classes (0-4)

Shallow-Slow	4
Deep-Slow	0
Shallow-Fast	0
Deep-Fast	0
	25%

Family	Species	Sensitivity	Regional Status	IUCN Status	Expected	Total (No)	Weight (g)
Order Characiformes							
Alestidae	*Micralestes acutidens*	3.1	LC	LC		2	2
Order Cypriniformes							
Cyprinidae	*Engraulicypris brevianalis*	2.8	LC	LC		0	-
Cyprinidae	*Enteromius afrohamiltoni*	2.5	LC	LC		0	-
Cyprinidae	*Enteromius annectens*	3.0	LC	LC	y	2	2
Cyprinidae	*Enteromius eutaenia*	4.9	DD	LC	y	2	2
Cyprinidae	*Enteromius paludinosus*	1.8	LC	LC	y	0	-
Cyprinidae	*Enteromius radiatus*	1.4	LC	LC		0	-
Cyprinidae	*Enteromius toppini*	3.0	LC	LC		0	-
Cyprinidae	*Enteromius trimaculatus*	1.8	LC	LC	y	2	2
Cyprinidae	*Enteromius unitaeniatus*	2.2	LC	LC		0	-
Cyprinidae	*Enteromius viviparus*	3.0	LC	LC	y	0	-
Cyprinidae	*Labeo cylindricus*	3.1	LC	LC		0	-
Cyprinidae	*Labeo molybdinus*	3.2	LC	LC		0	-
Cyprinidae	*Labeobarbus marequensis*	2.1	LC	LC		2	2
Cyprinidae	*Opsaridium peringueyi*	4.4	LC	LC		0	-
Order Osteoglossiformes							
Mormyridae	*Marcusenius pongolensis*	3.4	LC	LC	y	0	-
Mormyridae	*Petrocephalus wesselsi*	3.0	LC	LC		0	-
Order Perciformes							
Cichlidae	*Coptodon rendalli*	2.1	LC	LC	y	2	2
Cichlidae	*Oreochromis mossambicus*	1.3	VU	VU	y	2	2
Cichlidae	*Pseudocrenilabrus philander*	1.4	LC	LC	y	0	-
Cichlidae	*Serranochromis meridianus*	2.1	EN	EN		0	-
Gobiidae	*Glossogobius callidus*	2.3	LC	LC		0	-
Gobiidae	*Glossogobius giuris*	2.5	LC	LC		0	-
Order Siluriformes							
Clariidae	*Clarias gariepinus*	1.0	LC	LC		0	-
Mochokidae	*Chiloglanis anoterus*	4.7	LC	LC		0	-
Mochokidae	*Chiloglanis paratus*	3.1	LC	LC		0	-
Mochokidae	*Chiloglanis swierstrai*	3.3	LC	LC		0	-
Schilbeidae	*Schilbe intermedius*	1.8	LC	LC		0	-

Effort (min)		9	
Total Catch			
Catch per Unit Effort (/Hour)			
Total Number of Species	9	7	
FAII (%)		**81%**	
Present Ecological State (A-F)		**B**	