BREIDBACH MIXED-USE & SERIVCE STATION DEVELOPMENT, KING WILLIAMS TOWN, EASTERN CAPE PROVINCE

Freshwater Aquatic Ecosystems Impact Assessment Report

Phase 1: Baseline Ecosystem Assessment & Design Recommendations

Version 1.0

Revision 0

Draft for EAP / Client Review

Date: 25 February 2021

Eco-Pulse Environmental Consulting Services

Report No: EP540-01A

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SPECIALIST ASSESSMENT REPORT DETAILS AND DECLARATION OF INDEPENDENCE

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (Act No. 107 OF 1998) ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014 as per Government Notice No. 38282 GOVERNMENT GAZETTE, 4 DECEMBER 2014 (as amended in 2017).
- The Department of Human Settlements, Water & Sanitation for Water Use Licensing and aquatic assessment as outlined in the '*Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals*' contained in the Government Gazette No. 40713 of 24 March 2017.

Assessment Title:	Freshwater Aquatic Ecosystem Impact Assessment – Phase 1: Baseline Ecosystem Assessment & Design Recommendations
Project:	Breidbach mixed-use and service station development
Location:	King Williams Town, Buffalo City Municipality, Eastern Cape
Report No.	540-01A
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Date:	25 February 2021
Author:	Shaun McNamara (*MSc.)*
Field of study/expertise:	Wetland & Aquatic Ecology
Externally reviewed by:	Leo Quayle (Pr.Sci.Nat)
Client:	CES Environmental & Social Advisory Services

I, **Shaun McNamara**, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the relevant environmental authorities.

Signed: _____ Date: 24 – 02 - 2021

Details of Specialist Team

The relevant experience of specialist team members involved in the compilation of this report are briefly summarized below. *Curriculum Vitae's* of the specialist team are available on request.

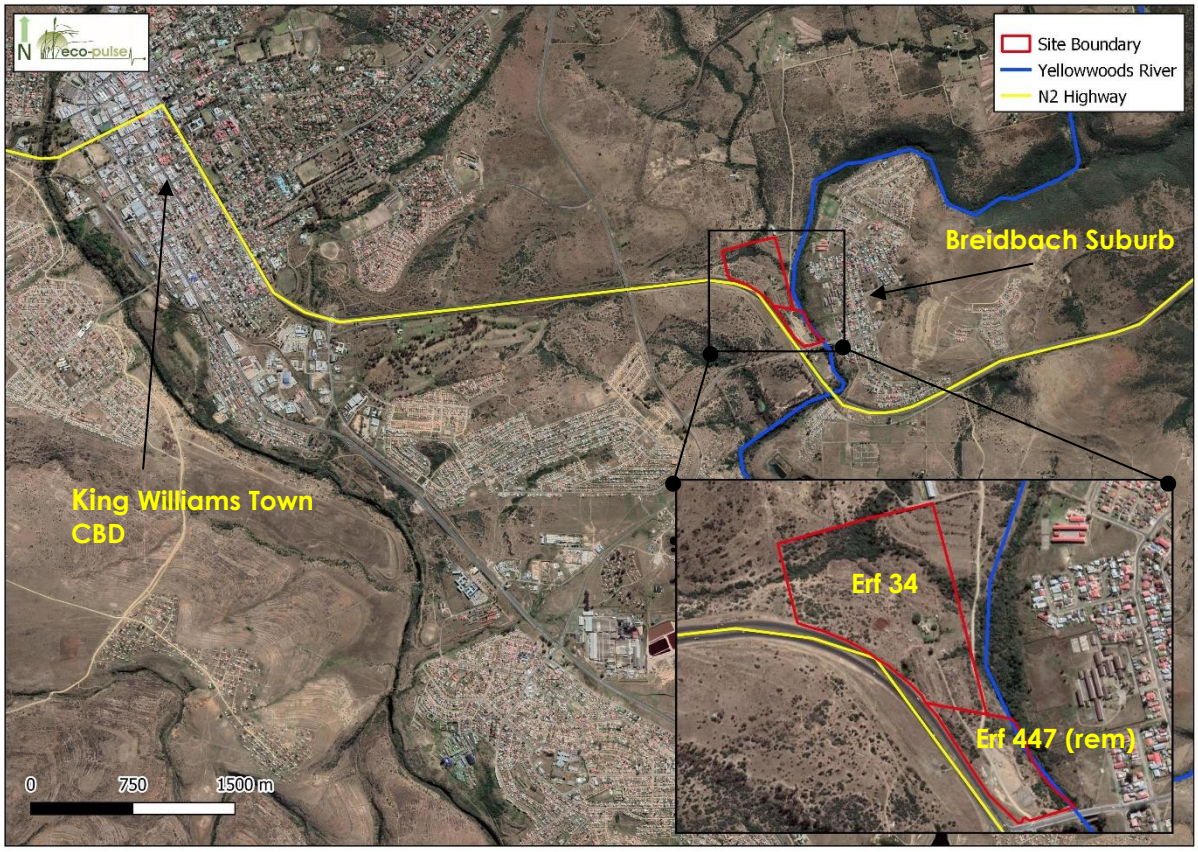
Specialist	Role	Details
Leo Quayle (*Pr.Sci.Nat.*) GIS Specialist & Aquatic Ecologist	Internal Review & Sign-off	Leo has a master's degree in environmental management and is an independent professional natural scientist working as an associate of Eco-Pulse. He is registered with the South African Council of Natural Scientific Professionals (SACNASP) in the fields of Water Resources and Ecology. He has 18 years of experience and a broad interest in various environmental and planning fields. He has worked locally and internationally as a project leader, GIS specialist/environmental planner and aquatic ecologist. He has worked on a variety of environmental management projects focusing on strategic environmental planning, water resources and catchment management and risk and vulnerability assessment with a focus on ecosystem services, land degradation and climate change. He has worked extensively in the aquatic ecological space focusing on water quality, river health and biomonitoring.
Shaun McNamara Wetland & Aquatic Ecologist Eco-Pulse	Fieldwork and author	Shaun is a Scientist at Eco-Pulse with an Honours degree in Environmental Water Management, with a strong focus on integrated catchment management and wetland ecology. He also holds an MSc in Geography with his dissertation focusing on fluvial geomorphology and processes of wetland formation and evolution. Shaun has experience in the collection and analysis of data relating to wetland and aquatic assessments. Shaun is an accredited SASS5 practitioner.

EXECUTIVE SUMMARY

This report sets out the findings of Phase 1 (Baseline Ecosystem Assessment & Design Recommendations) of the **Aquatic Ecosystem Impact Assessment** to inform the application for 1) environmental approval in terms of the NEMA: EIA Regulations (2014, *as amended in 2017*) and 2) a water use license application (WULA) in terms of the National Water Act, for the proposed Breidbach mixed-use development. An assessment of aquatic ecosystems was undertaken by Eco-Pulse Environmental Consulting Services in December 2020. The main findings of the baseline assessment have been summarized below.

Project Locality:

Breidbach Properties CC intend on establishing a mixed-use development and service station on Erf 34 (approximately 15.5ha) and Erf 447 (rem) (approximately 4.5ha) in the Breidbach suburb of King Williams Town, Eastern Cape. Erfs 34 and 447 are located approximately 5km east of the King Williams Town central business district (CBD) and immediately west of the Breidbach suburb (Figure 1). The properties are bordered by the Yellowwoods River (to the east) and N2 Highway (to the west).



Map showing the location of the proposed development (erfs 34 & 447) in relation to King Williams Town CBD, the N2 Highway and the Yellowwoods River.

Project Description:

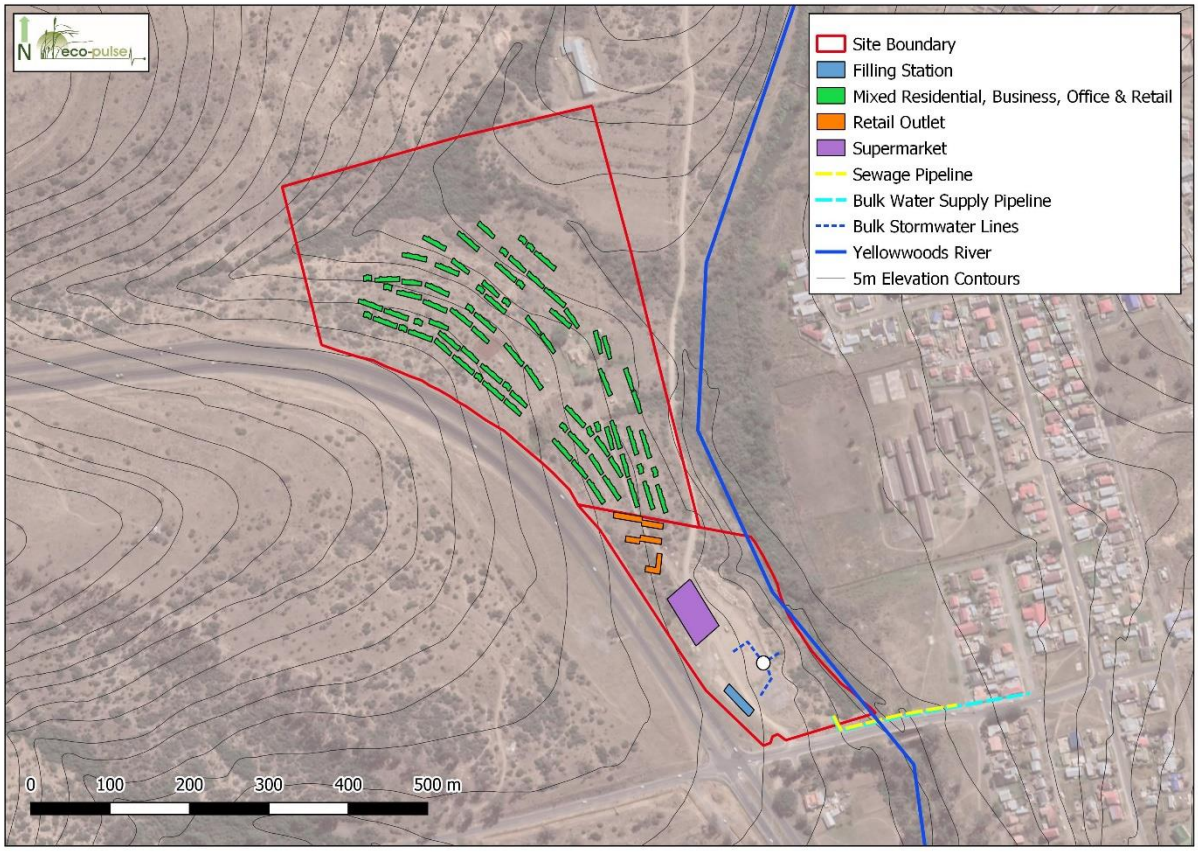
The proposed development is to be established in two (2) phases as follows:

Phase 1 (Erf 447):

- Establishment of the main access road linking the development to Welkom Street.
- Development of a fuel service station and associated convenience store.
- Development of a supermarket.
- Development of several small retail outlets.
- Development of an internal road network and outdoor parking facilities to service the above-mentioned infrastructure.

Phase 2 (Erf 34):

- Development of medium to high density residential apartments.
- Development of mixed business, office, and retail space facilities.
- Development of an internal road network and outdoor parking facilities to service the above-mentioned infrastructure.



Map showing the layout of the proposed mixed-use and fuel service station development.

Catchment Context:

The study area is located on the right bank~~s~~ of the lower Yellowwoods River, which is the main river system draining DHSWS quaternary catchment R20E. The Yellowwoods River flows into the Buffalo River approximately 8.5km downstream of the proposed development. The confluence point is immediately upstream of Laing Dam, a locally important irrigation and domestic water supply reservoir. A perennial unnamed tributary of the Yellowwoods River flows through Erf 34 in a general south easterly direction. The confluence of the unnamed tributary and the Yellowwoods River is immediately east of Erf 34.

Baseline River PES & EIS:

A total of three (3) river units were identified and delineated at the site. These watercourses were taken forward to the formal baseline assessment procedure. This includes a reach of the lower Yellowwoods River (River Unit 01), and seasonal tributary of the Yellowwoods River (River Unit 02) and a steep ephemeral mountain stream (River Unit 03). Each of the units was assessed as being in a C / Fair PES category. the dominant impacts to onsite watercourses were (i) altered catchment runoff processes which has led to unnatural bed and bank erosion and (ii) infestation of riparian zone by invasive alien woody and herbaceous vegetation species. The Yellowwoods River (Unit 01) was rated as being of 'High' EIS, River Unit 02 and 03 were assessed as being of 'Moderate' and 'Low' EIS, respectively.

Resource Management Objectives & Recommendations:

Based on the matrix in Table 16, the minimum recommended management objective (RMO) for River Unit R01 (Yellowwoods River) is to improve its PES. This would need to be achieved through the management of catchment activities to prevent both direct and indirect impacts to riparian and instream habitat associated with the system. An important part of achieving this is to incorporate environmentally sustainable design principles into all future developments within the unit's catchment. The RMO of both River Units R02 and R03 is to maintain their current PES.

Planning & Design Recommendations:

Aquatic Buffer Zone Recommendations:

- The aquatic ecosystem buffer model produced by Macfarlane & Bredin (2016) was applied to proposed development. This model produces a recommended buffer distance output based on potential risks associated with the proposed development type, with the output also taking into consideration the sensitivity of onsite aquatic resources.
- Without specific impact/risk mitigation a buffer of 27m was recommended for the onsite watercourses. With specific mitigation (focusing on construction phase sediment management and operation phase stormwater quality and quantity management) the model suggests that the buffers may be reduced to 15m.
- Under the current development layout scenario for both Phase1 and Phase 2, except for water supply and sewage reticulation pipelines, no development infrastructure is set to be located within the recommended 27m or 15m aquatic buffer zones area.

Stormwater Management Recommendations:

- When developing a stormwater management plan for the site, it will be critical that due consideration is given to the collection and basic filtering of stormwater prior to discharge into the natural environment. It is therefore recommended that the stormwater management plan be developed with appropriate ecological input and be developed based on Sustainable Drainage Systems (SUDS). Best practice stormwater management design measures have been outlined in Section 5.2. It is recommended that special attention be paid to the fuel station to ensure that contaminated runoff is not generated or discharged to the environment.

Underground (fuel) Storage Tanks:

- The following environmental design guidelines are recommended for Underground (fuel) Storage Tanks (USTs) and pipework required for the service station:
    - The USTs must be installed according to:
        - The selected petrol station Engineering Guidelines and specifications.
        - Relevant National Building Regulations.
        - Relevant SANS and SABS codes.
    - Additional UST design recommendations are provided in section 5.3.

The above-mentioned design recommendations should be discussed by the project team and incorporated into the project design as far as practically possible. Eco-Pulse will commence with the formal Impact Significance Assessment and DHSWS Risk Assessment once the mentioned design recommendations have been deliberated on, and we are given formal go-ahead.

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1. INTRODUCTION

1.1 Project Locality

Breidbach Properties CC intend on establishing a mixed-use development and service station on Erf 34 (approximately 15.5ha) and Erf 447 (rem) (approximately 4.5ha) in the Breidbach suburb of King Williams Town, Eastern Cape. Erfs 34 and 447 are located approximately 5km east of the King Williams Town central business district (CBD) and immediately west of the Breidbach suburb (Figure 1). The properties are bordered by the Yellowwoods River (to the east) and N2 Highway (to the west).

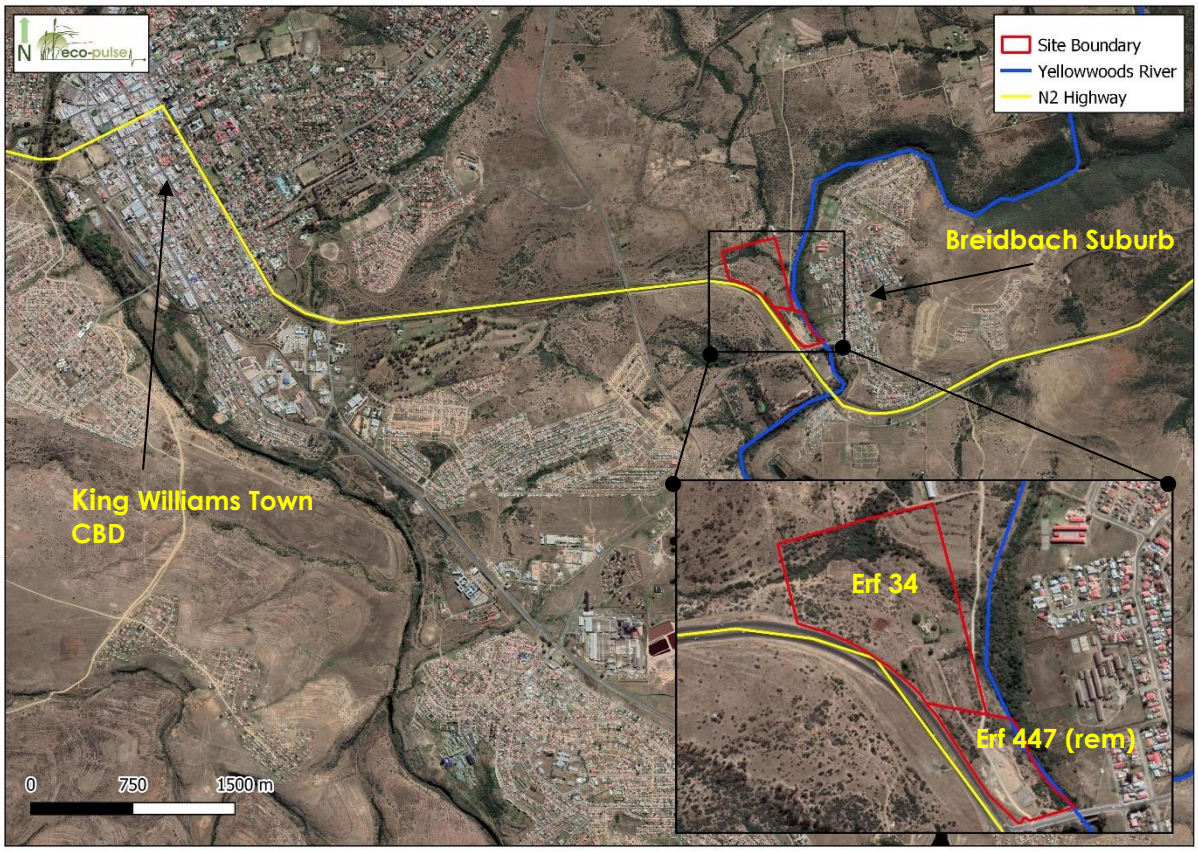

Figure 1. Map showing the location of the proposed development (erfs 34 & 447) in relation to King Williams Town CBD, the N2 Highway and the Yellowwoods River.

1.2 Project Description

The proposed development is to be established in two (2) phases as follows:

Phase 1 (Erf 447) (Figure 2):

- Establishment of the main access road linking the development to Welkom Street.
- Development of a fuel service station and associated convenience store.
- Development of a supermarket.
- Development of several small retail outlets.
- Development of an internal road network and outdoor parking facilities to service the above-mentioned infrastructure.

Phase 2 (Erf 34) (Figure 2):

- Development of medium to high density residential apartments.
- Development of mixed business, office, and retail space facilities.
- Development of an internal road network and outdoor parking facilities to service the above-mentioned infrastructure.

An engineering services report has been developed for Phase 1 of the project (JDS Planning & Design, 2019). Key points from this report are as follows:

- Bulk water supply:
  - Bulk water supply for Phase 1 of the proposed development will be via the Buffalo City Metropolitan Municipality (BCMM) reticulation system, which already exists in the area.
  - A 110mm uPVC pipe will connect the development to the BCMM water reticulation system. This pipe will cross the Yellowwoods River via the existing Welkom Road bridge.
- Sanitation:
  - A new 160mm sewer line will connect phase 1 of the development to an existing 300mm BCMM interceptor sewer line that currently services the Breidbach suburb. Wastewater associated with the development will then be treated at an offsite municipal treatment facility.
  - The new 160mm sewer line will cross the Yellowwoods River (via the existing Welkom Road bridge) to connect to the existing municipal pipeline.
- Stormwater management:
  - Stormwater runoff from the development will be intercepted by system of inlets linked to network underground stormwater pipes.
  - The underground stormwater pipe system will discharge into an off-channel detention pond (22m x 11m x 2.5m).
  - Stormwater will then be released from the detention pond into the downslope Yellowwoods River system via a 375mm diameter concrete outlet pipe.

No engineering services report was available to Eco-Pulse for Phase 2 of the development at the time that this report was compiled. The following assumptions relating to Phase 2 services infrastructure have therefore been made based on the information presented in the Phase 1 engineering services report for the project:

- Bulk water supply for Phase 2 of the proposed development will be via the Buffalo City Metropolitan Municipality (BCMM) reticulation system, which already exists in the area.
- Wastewater associated with Phase 2 of the development will be treated at an offsite municipal treatment facility.

Note: Should the above-mentioned assumptions prove to be inaccurate, aspects of this report may need to be updated.

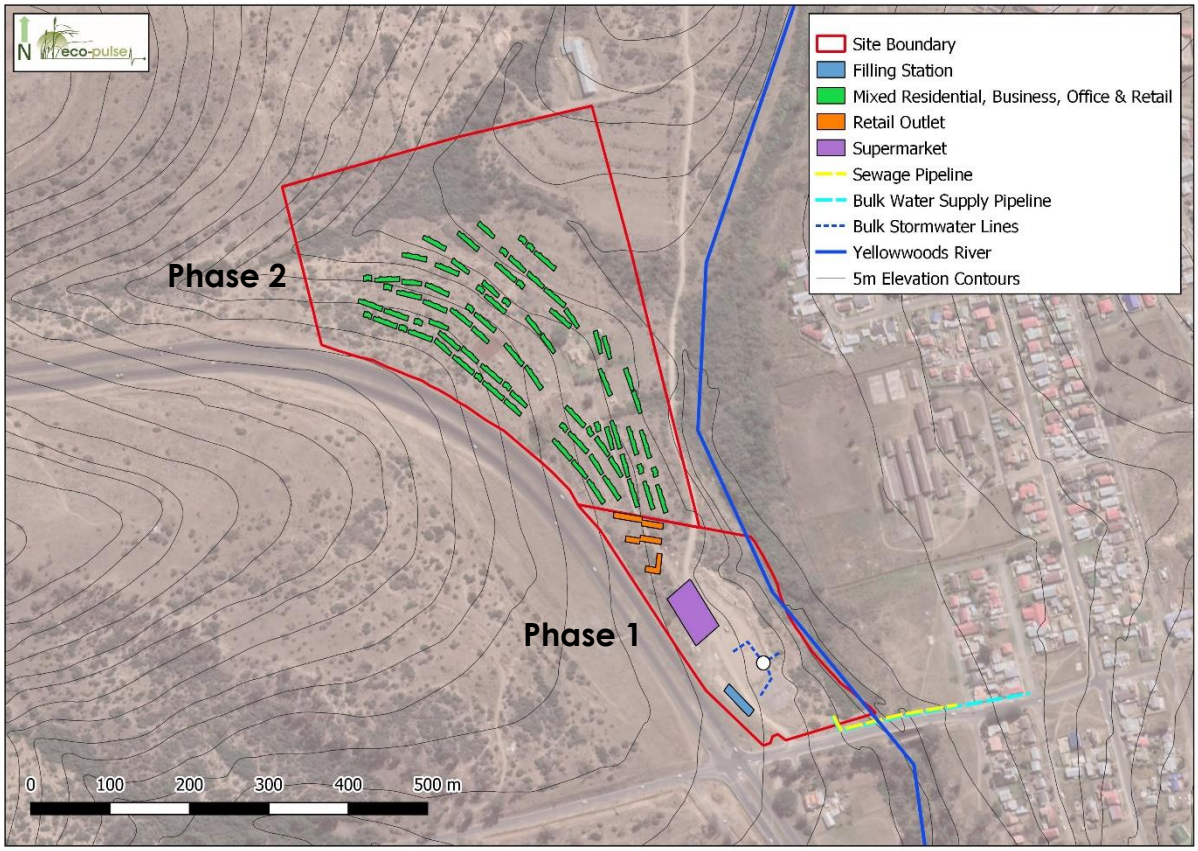

Figure 2. Map showing the layout of the proposed mixed-use and fuel service station development.

1.3 Purpose of Assessment

The proposed mixed-use and fuel service station development stands to potentially impact freshwater aquatic ecosystems (rivers / streams). A Freshwater Aquatic Ecosystems Impact Assessment Report is therefore required to inform the project Environmental Authorisation (EA) process according to the latest NEMA: EIA Regulations, and a Water Use License Application (WULA) in terms of the National Water Act.

1.4 Scope of Work

The Freshwater Aquatic Assessment is to be completed in two (2) phases, namely:

- Phase 1 – Baseline Aquatic Ecosystem Assessment & Design Recommendations.
- Phase 2 – Aquatic Ecosystem Impact Assessment.

This report constitutes the ***'Phase 1: Baseline Aquatic Ecosystem Assessment & Design Recommendations'*** component of the assessment. This was undertaken according to the following scope of work:

- Contextualization of the study area in terms of important biophysical characteristics and freshwater conservation planning through a review of available spatial datasets and relevant conservation plans.
- Desktop mapping and classification of all watercourses (e.g., wetlands, rivers, streams, dams) within 500m of the proposed development using aerial photography, contours, and water resource inventory databases.
- Identification of watercourses within 500m of the proposed development that are likely to be measurably negatively affected and the extent of the watercourses to be taken forward for detailed assessment (this constituted the study area).
- Delineation of all watercourses occurring within the study area according to the methods contained in the manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
- Subdivision of delineated watercourses into definable resource units and the classification of these units according to the national wetland and aquatic ecosystem classification system (Ollis *et al*., 2013).
- Assessment of the present ecological state (PES) of the delineated river units using the Qualitative Index of Habitat Integrity (Q-IHI) assessment tool (Kleynhans, 1996).
    - The river PES assessment of the Yellowwoods River was supplemented by water quality sampling and a SASS5 (Dickens & Graham, 2002) aquatic macroinvertebrate survey.
- Assessment of the Ecological Importance and Sensitivity (EIS) of the delineated river units using the EIS assessment method developed by Eco-Pulse adapted from the DWAF Resource Directed Measures EIS tools (Kleynhans, 1999 & Duthie, 1999).
- Provision of initial best-practice planning and design recommendations for discussion with the client.

1.5 Overview of Relevant Environmental Legislation

The link between ecological integrity of freshwater resources and their continued provision of valuable ecosystem goods and services to burgeoning populations is well-recognised, both globally and nationally (Rivers-Moore *et al.,* 2007). In response to the importance of freshwater aquatic resources, protection of wetlands and rivers has been campaigned at national and international levels. Relevant

environmental legislation pertaining to the protection and use of wetland and aquatic ecosystems in South Africa has been included in Table 1, below.

Table 1. Description of relevant environmental legislation pertaining to rivers and wetlands in South Africa.

South African Constitution 108 of 1996	This includes the right to have the environment protected through legislative or other means.
National Environmental Management Act 107 of 1998	This is a fundamentally important piece of legislation and effectively promotes sustainable development and entrenches principles such as the 'precautionary approach', 'polluter pays', and requires responsibility for impacts to be taken throughout the life cycle of a project.
Environmental Impact Assessment (EIA) Regulations	New regulations have been promulgated in terms of Chapter 5 of NEMA and were published on 4 December 2014 in Government Notice No. R. 32828. In addition, listing notices (GN 983-985) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	This Act imposes 'duty of care' on all landowners, to ensure that water resources are not polluted. The following Clause in terms of the National Water Act is applicable in this case: **19 (1**) "*An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring*" Chapter 4 of the National Water Act is of relevance to wetlands and addresses the use of water and stipulates the various types of Licenced and un-licenced entitlements to the use water. Water use is defined very broadly in the Act and effectively requires that any activities with a potential impact on wetlands (within 500m upstream or downstream of a wetland) be authorized.
General Authorisations (GAs)	These have been promulgated under the National Water Act and were published under GNR 398 of 26 March 2004. Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a Licence which should be obtained from the Department of Water and Sanitation (DWS).
National Environmental Management: Biodiversity Act No. 10 of 2004	The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed invasive alien plants.
Conservation of Agricultural Resources Act 43 of 1967	The intention of this Act is to control the over-utilization of South Africa's natural agricultural resources, and to promote the conservation of soil and water resources and natural vegetation. This includes wetland systems and requires authorizations to be obtained for a range of impacts associated with cultivation of wetland areas.

Other pieces of legislation that may also be of some relevance to wetlands/rivers include:

- The National Forests Act No. 84 of 1998; and
- Nature and Environmental Conservation Ordinance No. 19 of 1974.

2. BASELINE ASSESSMENT APPROACH AND METHODS

2.1 General Approach

The general approach to the wetland and aquatic ecosystem baseline assessment was based on the proposed framework for freshwater ecosystems assessment proposed in the Water Research Commission's (WRC) report titled: 'Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition' (Ollis *et al*., 2014). This is shown in Figure 3.

Note that the wetland and aquatic ecosystem impact assessment report will be developed in line with the requirements of the Department of Humans Settlements, Water & Sanitation (DHSWS) for Water Use Licensing, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017 and in accordance with the requirements in the latest NEMA Minimum Requirements and Protocol for Specialist Aquatic Biodiversity Impact Assessment as contained in the "*Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes of Section 45 (a) and (h) of the National Environmental Management Act, 1998, when applying for Environmental Authorization*", contained in Government Gazette No. 648 (10 May 2019).

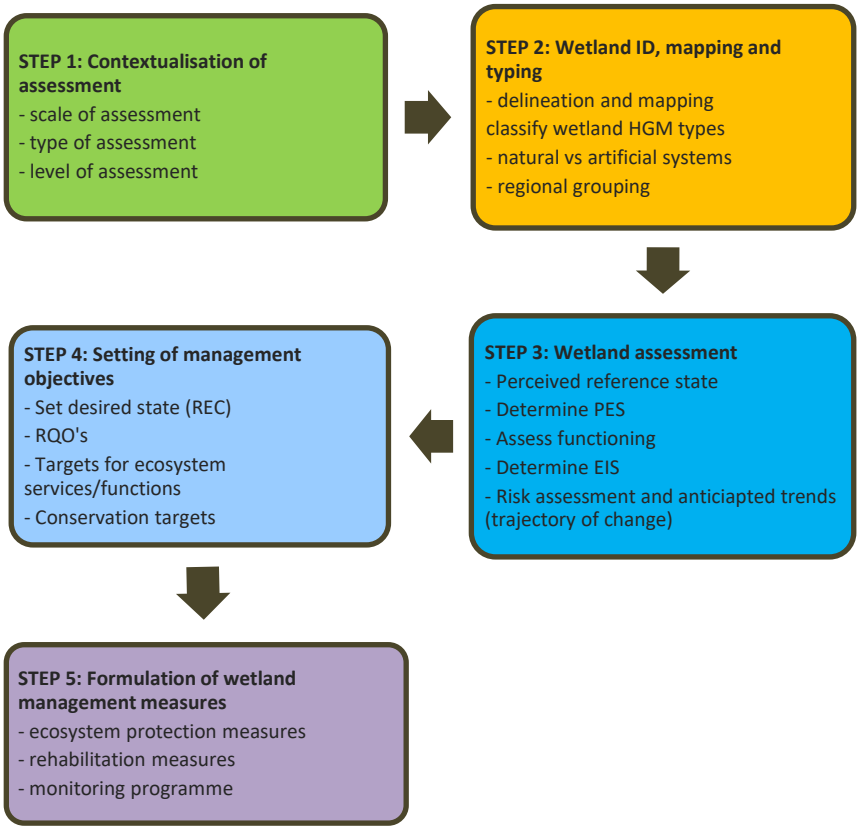

Figure 3. Proposed decision-support framework for wetland/aquatic assessment in SA (after Ollis *et al.*, 2014).

2.2 Desktop & Baseline Assessment Methods

2.2.1 Data Sources Consulted

The data sources and GIS spatial information listed in Table 2 (below) were consulted to inform the specialist assessment. The data type, relevance to the project and source of the information has been provided.

Table 2. Data sources and GIS information consulted to inform the assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Biophysical Context		
Colour aerial photography	*Desktop mapping of drainage network, wetlands, etc.*	NGI (online)
Latest Google Earth ™ imagery	*To supplement available aerial photography where needed*	Google Earth™ Online
DWA Eco-regions (GIS Coverage)	*Classification of local Ecoregions*	DWA (2005)
Geomorphological Provinces of South Africa	*Understand regional geomorphology controlling the physical environment*	Partridge *et al.* (2010)
South African Vegetation Map (GIS Coverage)	*Classify vegetation types and determination of reference primary vegetation*	Mucina & Rutherford (2012)
NFEPA: river and wetland inventories (GIS Coverage)	*Highlight potential onsite and local rivers and wetlands*	WRC (2011)
Conservation Context		
Inland Aquatic (Freshwater) Realm of the 2018 SANBI National Biodiversity Assessment (GIS Coverage)	*Provides insight into the national conservation planning status of watercourses in the study area*	Van Deventer et al. (2019)
NFEPA: River, wetland, and estuarine FEPAs (GIS Coverage)	*Shows location of national aquatic ecosystems conservation priorities*	WRC (2011)
Strategic Water Source Areas (GIS Coverage)	*Location and extent of strategic water source areas*	Le Maitra et al. (2018)
Eastern Cape Biodiversity – Aquatic Component (GIS Coverage)	*Provincial conservation planning importance.*	Desmet & Hawley (2019)

2.2.2 'Impact Potential' Screening Assessment

All watercourses within 500m of the proposed development were mapped at a desktop level as DHSWS identify the 500m buffer as their area of regulation when licensing new activities and developments . The topography of the site and the nature of onsite watercourses does however mean that not all watercourses in the 500m regulated area are likely to be impacted by the proposed development project. Therefore, following the desktop identification and mapping exercise, watercourses were assigned preliminary 'likelihood of impact' ratings based on the likelihood that activities associated with

the proposed development will result in measurable direct or indirect changes to the mapped watercourse units. The 'impact potential' ratings were refined following the completion of the field work. Each watercourse unit was ascribed a qualitative 'impact potential' rating according to the ratings and descriptions provided in Table 3, below.

Table 3. Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
High	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within the footprint** of the proposed development activity and will definitely be impacted by the project; and/or ➢ resources located **within 15m upstream and/or upslope** of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located **within 15m or downslope** of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: o **within 15m downstream** of a low risk development; o **within 50m downstream** of a moderate risk development; and/or o **within 100m downstream** of a high-risk development e.g. mining or large industrial land uses.
Moderate	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within 32m but greater than 15m upstream, upslope or downslope** of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation, and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: o **within 32m downstream** of a low risk development; o **within 100m downstream** of a moderate risk development; and/or o **within 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Low	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: o **greater than 32m downstream** of a low risk development; o **greater than 100m downstream** of a moderate risk development; and/or o **greater than 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);

Likelihood of Impact Rating	Description of Rating Guidelines
Very Low / None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment and which will not be impacted by the development in any way, shape or form.

2.2.3 Baseline Watercourse Assessment

The methods of data collection, analysis and assessment employed as part of the baseline assessment are briefly discussed in this section. The assessments undertaken as part of this study are listed in Table 4 (below) along with the relevant published guidelines and assessment tools / methods / protocols utilised.

Table 4. Summary of methods used in the baseline assessment.

	Reference for Methods/Tools Used
Riparian and wetland areas delineation	A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
Classification of riparian and wetland units	National Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis et al., 2013) Classification system for channelled watercourses (Eco-Pulse, 2013).
Present Ecological State (PES)	Index of Habitat Integrity (IHI) (after Kleynhans, 1996).
Aquatic Macroinvertebrate Assessment	South African Scoring System Version 5 (SASS5) (Dickens & Graham, 2002).
Riparian Ecological Importance & Sensitivity (EIS)	Freshwater/Aquatic EIS tool (Eco-Pulse, 2017).

2.3 Key Documents Consulted

- JDS Planning & Design. February 2019. Mixed Use Development: Phase 1. Rem of Erf 447, Breidbach. Engineering Services Report.
- N Veldtman (Pr. Arch.). February 2019. Site Development Plan. Phase 1. Plan No. BB. 06.
- CES. 2020. Proposed Breidbach Mixed Use Housing Development and Service Station, within the Buffalo City Metropolitan Municipality, Eastern Cape Province. Background Information Document (BID) & Invitation to Comment.

2.4 Assumptions, Limitations & Information Gaps

The following limitations and assumptions apply to the baseline freshwater aquatic ecosystem assessment:

2.4.1 General assumptions & limitations

- This report deals exclusively with a defined area and the extent and nature of aquatic ecosystems in that area.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the Province at the time of the assessment.
- All field assessments were limited to day-time assessments.

2.4.2 Sampling limitations & assumptions

- Although all watercourses occurring within 500m of the proposed activities were mapped at a desktop level, field investigations were confined to only those areas that stand to be measurably negatively affected (These areas constituted the study area of assessment). The watercourses making up the study area were determined using Eco-Pulse's qualitative 'likelihood of impact' rating system presented in Table 3, above.
- The mapping and classification of the watercourse units outside of the study area but occurring within a 500m radius of activities should be considered preliminary and coarse in resolution. These units were not verified in the field.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- Systematic sampling of was undertaken along transects spaced approximately 100m apart and focused on watercourses in the vicinity of proposed development infrastructure. The outer boundary of the watercourses identified can be considered accurate in the vicinity of these transects. Between transects the outer boundary had to be extrapolated using aerial photography and 5m contours and, as such, the accuracy of such extrapolated sections has limitations and is open to the interpretation of the delineator.
- The accuracy of the delineations is based solely on the recording of the riparian and aquatic indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points and therefore water resource boundaries, and an error of 1-5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin Montana™ Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Furthermore, only dominant, and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of freshwater ecosystems, it is important to note that the current extent and classification is reported on here.

2.4.3 'Seasonality' of the Assessment

- Eco-Pulse undertook the field visit in November 2020 (summer), during the study region's wet season. One infield visit does not fully cover the seasonal variation in conditions at the site.

2.4.4 Baseline Ecological Assessment

- The PES and EIS assessments make use of qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have tried to substantiate all claims where applicable and necessary.
- The EIS assessment did not specifically address in detail all the finer-scale ecological aspects of the water resources such as a list of aquatic fauna likely to occur (i.e., amphibians and fish) within the onsite riverine systems.

3. DESKTOP ASSESSMENT

3.1 Biophysical & Conservation Context

Understanding the biophysical and conservation context of the study area and surrounding landscape is important as it informs decision making regarding the significance of the area to be affected.

3.1.1 Biophysical Setting & Context

A summary of key biophysical details for study area and catchment area is presented in Table 5, below.

Table 5. Key details of the study area.

Freshwater Ecosystem Assessment Summary	
Project Name	Breidbach Mixed-Use Housing, Shopping Centre & Service Station Development - Freshwater Aquatic Ecosystem Impact Assessment
Site Area	~20ha
Location	King Williams Town, Buffalo City Metropolitan Municipality, Eastern Cape
Ecoregion (DWAF, 2007)	31.02 – Eastern Coastal Belt
National Water Act Water Management Area (WMA)	Mzimvubu to Keiskamma
Quaternary Catchment	R20E
Main Collecting River in the Catchment	Yellowwoods River
Study Area Watercourse Types	Rivers
NFEPA Planning Unit (WRC, 2011)	7775
NFEPA Planning Unit Status (WRC, 2011)	Fish Support Area (FSA) for threatened species (*Barbus anoplus, Barbus Trevelyan & Sandelia bainsii*)

3.1.2 Drainage Setting & Catchment Context

The study area is located on the right banks of the lower Yellowwoods River, which is the main river system draining DHSWS quaternary catchment R20E (Figure 4). The Yellowwoods River flows into the Buffalo River approximately 8.5km downstream of the proposed development. The confluence point is immediately upstream of Laing Dam, a locally important irrigation and domestic water supply reservoir. A perennial unnamed tributary of the Yellowwoods River flows through Erf 34 in a general south easterly direction. The confluence of the unnamed tributary and the Yellowwoods River is immediately east of Erf 34 (Figure 4).

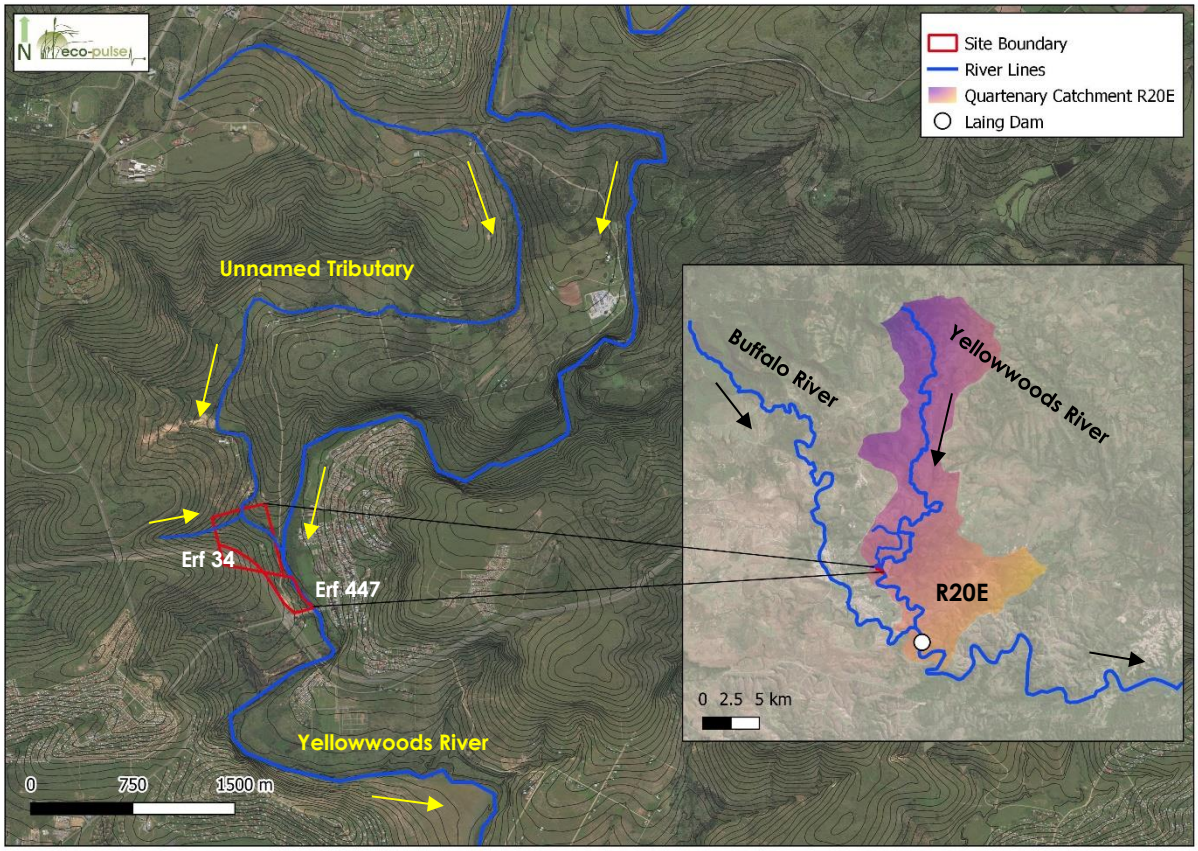

Figure 4. Map showing the quaternary catchment and local drainage network that characterises the project study area.

3.1.3 Freshwater Conservation Context

National and provincial conservation datasets were screened for the study area, the results of which are presented in Table 6. Important conservation importance points to note are as follows:

- According to the NFEPA project the sub-quaternary catchment planning unit associated with the study area (Unit 7775) is a Fish Support Area (FSA). This designation relates to the potential presence of three (3) threatened fish species within the Yellowwoods River, namely *Enteromius anoplus*[1], *Psuedobarbus trevelyani*, *and Sandelia bainsii*. Thus, the sub-quaternary catchment planning unit is not considered a Fish Sanctuary as the NFEPA project rated the Yellowwoods River as being below an A or B ecological category.
- The latest Eastern Cape Biodiversity Conservation Plan (Desmet & Hawley 2019) rated the Yellowwoods River as being a CBA1. This status appears to relate to the Yellowwoods River being a mainstem system that is largely free-flowing and its potential to host *Enteromius anoplus, Psuedobarbus trevelyani*, *and Sandelia bainsii*.

Table 6. Key freshwater conservation context details for the study area.

	NATIONAL LEVEL CONSERVATION PLANNING CONTEXT		
Conservation Planning Dataset	**Relevant Conservation Feature**	**Conservation Planning Status**	**Location in Relation to Project Site**
National Freshwater Ecosystem Priority Areas (NFEPA) (WRC, 2011)	Catchment Planning Unit 7775	Fish Support Area (FSA) for threatened species (*Barbus anoplus, Barbus Trevelyan & Sandelia bainsii*)	n/a
2018 National Biodiversity Assessment – Inland Aquatic / Freshwater Realm (GIS Coverage)	R01 (Figure5) - Yellowwoods River - Perennial Lower Foothill River in Ecoregion 31 (31_P_L)	Least Threatened	River runs adjacent to development property
	R02 (Figure 5) - Unnamed Tributary of Yellowwoods River Seasonal Transitional River in Ecoregion 31 (31_P_U)	Least Threatened	River runs through northern part of development property
	R03 (Figure 5) – Ephemeral mountain stream in Ecoregion 31 (31_N_M)	Least Threatened	River runs through northern part of development property
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT			
Conservation Planning Dataset	**Relevant Conservation Feature**	**Conservation Planning Status**	**Location in Relation to Project Site**
Eastern Cape Biodiversity Conservation Plan (Desmet & Hawley 2019)	R01 (Figure 5) - Yellowwoods River	CBA1 - Mainstem free-flowing River	River runs adjacent to development property
	R02 (Figure 5) - Unnamed Tributary of Yellowwoods River	ESA1 – Modelled Wetland habitat along unit	River runs through northern part of development property

[1] Fishbase.se was consulted to better understand the conservation of this fish species. This website indicated that this species is 'widely distributed' IUCN red list status of this fish being 'Least Concern' when assessed in 2017.

3.2 Watercourse Mapping & Likelihood of Impact Screening

Watercourses occurring within a 500m radius of the proposed development [i.e., within the DHSWS regulated area for Section 21 (c) and/or (i) wetland water use] were mapped at a desktop level and classified in accordance with the national wetland/river classification defined by Ollis *et al.* (2013). This was done using GIS (Geographical Information Systems) through the analysis of available aerial imagery and elevation contours. An initial desktop screening of 'impact potential' for identified watercourse units within the 500m radius of the development was then undertaken using GIS. The impact screening process was informed by the key risks identified below.

The main risks likely to be associated with the construction and operation of the proposed mixed-use development include:

1. **Increased sediment** deposition due to **construction phase earthworks**.
2. **Alteration of catchment surface water runoff processes / hydrological inputs** and associated watercourse **erosion and sedimentation.**
3. **Inadequate management of stormwater generated by the development leading to watercourse erosion and associated sedimentation.**
4. **Surface water runoff contamination** leading to watercourse **water quality deterioration.**

Based on the above-mentioned risks, three (3) watercourse units were rated as 'likely to be affected' by the development in terms of incurring potential construction and/or operation phase impacts (Figure 5). The watercourses are mentioned and labelled below, and are shown in Figure 5, below:

- River Unit R01 (Yellowwoods River) – Lower Foothills River
- River Unit R02 – Transitional River
- River Unit R03 – Mountain Stream

These three (3) watercourses units required further detailed assessment to inform the water use licence application (WULA) in terms of the requirements of Chapter 4 and Section 21 (c) and (i) water uses in terms of the National Water Act No. 36 of 1998, and the environmental authorisation in terms of National Environmental Management Act No. 107 of 1998. Eco-Pulse therefore conducted a site visit to delineate and assess watercourse units R01, R02 and R03. The outcomes of the infield delineation process are shown in Figure 5 with the detailed baseline assessment for each watercourse being presented in Chapter 4.

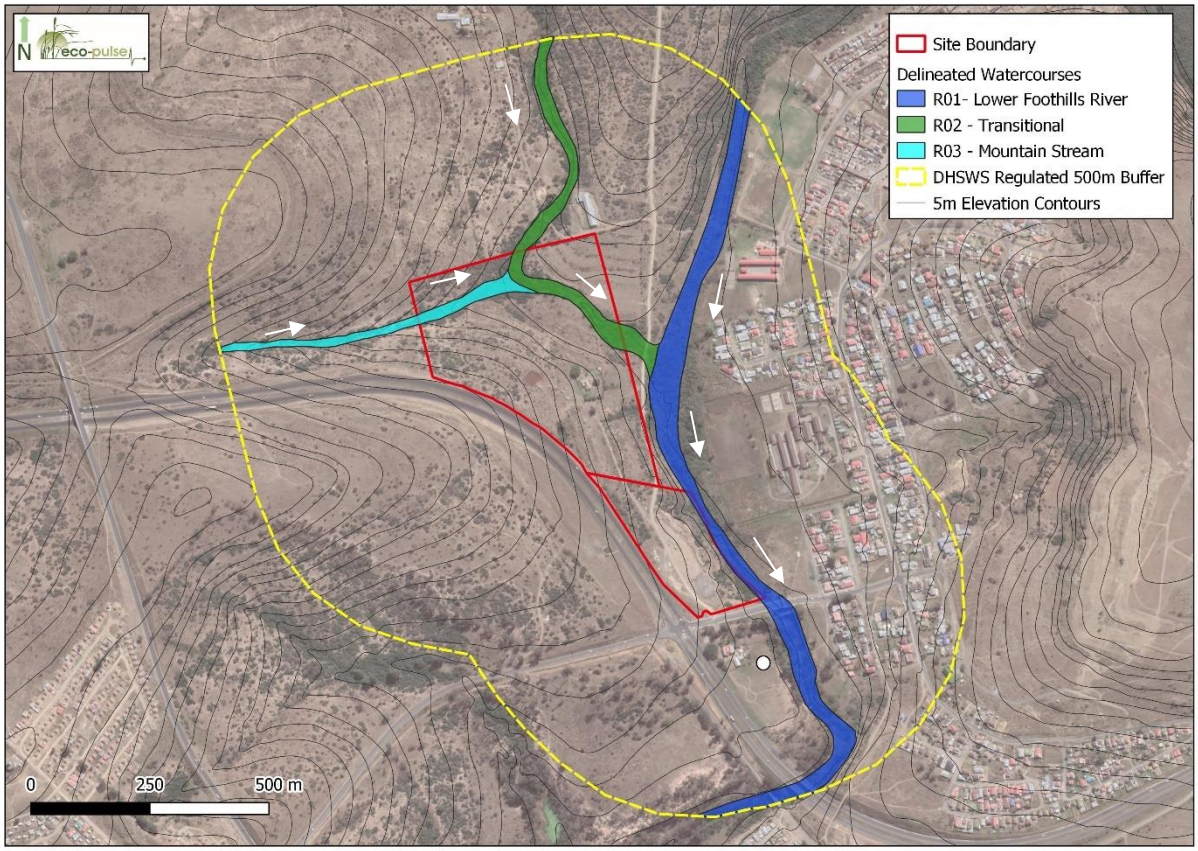

Figure 5. Desktop watercourse delineation and 'impact potential' screening outputs.

4. BASELINE HABITAT ASSESSMENT

The classification, habitat characteristics, present ecological state (PES) and ecological importance and sensitivity (EIS) of River Units R01, R02 and R03 is discussed in this section of the report.

4.1 Classification & Habitat Characteristics

4.1.1 River Unit R01 (Yellowwoods River)

River Unit R01 is a reach of the Yellowwoods River adjacent to the proposed development. The biophysical characteristics of the unit are summarised in Table 7, below.

Table 7. Summary of the key biophysical characteristics of River Unit R01 (Yellowwoods River).

River Unit R01 (Yellowwoods River)	
Longitudinal zone	Lower Foothills River
Perenniality	Perennial (year-round flow experienced)
Substrate type	Mixed bedrock and alluvial
Instream biotopes	• Riffles, rapids and runs (cobbles, boulders, and bedrock) • Pools (cobbles, boulders, bedrock, sand, and mud) • Marginal vegetation
Riparian topography features	• Active channel banks • Macro channel bank • Flood terrace
Vegetation characteristics	**Riparian zone & macro channel bank vegetation:** • Dominant species: *Acacia natalia, Acacia mearnsii* • Moderately abundant species: *Eucalyptus grandis., Melia azedarach., Syzigium cordatum* **Active channel bank community:** • Dominant and sub-dominant species: *Cyperus textalis, Cyperus latifolius* • Moderately abundant species: *Persicaria attenuata, Paspalum urvillei, Phragmites australis.*

Selected Photos of River Unit R01:

Photo 01: Upstream facing photo of R01 near its confluence with R02.

Photo 02: Downstream facing photo of R01 taken in the vicinity of the Welkom Street bridge.

4.1.2 River Unit R02

River Unit R02 is a right bank tributary of R01 (Yellowwoods River). The confluence of the two river units is immediately east of the proposed development property. An approximately 300m long reach of R02 runs through the northern portion of the proposed development (Erf 34). The biophysical characteristics of the unit are summarised in Table 8, below.

Table 8. Summary of the key biophysical characteristics of River Unit R02.

River Unit R01 (Yellowwoods River)	
Longitudinal zone	Transitional River
Perenniality	Seasonal
Substrate type	Alluvial
Instream biotopes	• Riffles and runs (cobbles and sand) • Pools (sand and mud) • Marginal vegetation
Riparian topography features	• Active channel banks • Macro channel bank • Flood terrace
Vegetation characteristics	**Riparian zone & macro channel bank vegetation:** • Dominant species: *Acacia natalia, Acacia mearnsii* • Moderately abundant species: *Eucalyptus grandis.* **Active channel bank community:** • Dominant and sub-dominant species: Stenotaphrum clandestine, Leersia hexandra • Moderately abundant species: Paspalum urvillei.

Selected Photos of River Unit R02:

Photo 03: Downstream facing view of the upper reach of W01.

Photo 04: Downstream facing view of the lower reach of W01.

4.1.3 River Unit R03

River Unit R03 is a right bank tributary of R02. The confluence of the two river units occurs in the northern portion of the proposed development boundary (Erf 34). An approximately 200m long reach of R03 runs through the northern portion of the proposed development. The biophysical characteristics of the unit are summarised in Table 9, below.

Table 9. Summary of the key biophysical characteristics of River Unit R03.

River Unit R01 (Yellowwoods River)	
Longitudinal zone	Mountain Stream
Perenniality	Ephemeral
Substrate type	Alluvial
Instream biotopes	• Dry sandy channel
Riparian topography features	• Active channel banks • Macro channel bank
Vegetation characteristics	**Riparian zone & macro channel bank vegetation:** • Dominant species: *Acacia natalia, Acacia mearnsii* • Moderately abundant species: *Dalbergia armata,* Allophylus dregeanus **Active channel bank community:** • Dominant and sub-dominant species: *Stenotaphrum clandestine*, • Moderately abundant species: *Commelina benghalesis, Setaria megaphylla.*

Selected Photos of River Unit R03:

Photo 05: Upstream facing photo of the middle reach of R03

Photo 06: Downstream facing view of the lower reach of R03.

4.2 Present Ecological State (PES) Assessment

This section of the specialist report documents the findings of the PES assessment and provides descriptions of key impacts and PES scores and ratings for each of the assessed rivers at risk of being impacted by the proposed development.

4.2.1 Water Quality Analysis – R01 (Yellowwoods River)

A once-off water quality sample was taken at a single location along River Unit R02 (Yellowwoods River). The sample location was immediately upstream of the Welkom Street bridge. The sample was collected at this location as it coincided with the reach of the Unit R01 that was sampled as part of the macroinvertebrate (SASS5) survey. The collected sample was analysed at a SANAS-accredited testing laboratory for several water quality determinants, including: Ammonia, *E. coli,* Electrical conductivity, Nitrate/Nitrite, Orthophosphate, pH and Suspended Solids.

The water quality analysis revealed slightly elevated Nitrate/Nitrite level within the river system (Table 10). Nitrite/Nitrate is a biologically available form of nitrogen essential for plant growth. River systems are however generally naturally nitrogen-poor, with the presence of excessive nitrogen in a water resource typically being an indicator of human impacts (Le et al., 2018). Orthophosphate levels were also elevated above typical natural levels, with the site being classified as hypertrophic according to the South African Target Water Quality Guidelines for Aquatic Ecosystems (DWAF, 1996). Unnaturally high concentrations of Nitrate/Nitrite and Orthophosphates can contribute to the eutrophication of aquatic ecosystems. Excessive algal growth noted along parts of R01 is likely linked to the elevated Nitrate/Nitrite concentration. The elevated nutrient levels along the assessed reach of the Yellowwoods River are likely a result of adjacent and upstream urban settlements, including Breidbach and Bisho (contributing raw and / or partially treated sewage and industrial effluent), as well as agricultural practices within the catchment of the assessed river reach. Except for Nitrate/Nitrite, all other determinands tested are within acceptable limits for aquatic ecosystems.

Table 10. Summary of the results of water quality sampling and analysis.

Variable / Determinant	Unit of measure	Result
Ammonia	mg N/l	<0.11
E. coli	colonies per 100ml	435.0
Electrical conductivity at 25°C	mS/m	64.0
Nitrate/Nitrite	mg N/l	4.05
Orthophosphate	mg P/l	0.41
pH	pH units	7.4
Suspended solids at 105°C	Mg/l	22

4.2.2 Macroinvertebrates (SASS5) Survey – R01 (Yellowwoods River)

SASS5 results can be used to place a river unit into an Ecological Category using the South Africa Scoring System (SASS) Data Interpretation Guidelines (Dallas, 2007). These guidelines use SASS5 Scores and the Average Scores per Taxon (ASPT) to place a sampled river reach into an Ecological Category. The Interpretation Guidelines (Dallas, 2007) use the DWAF (2005) level 1 eco-regions and simplified longitudinal zones as spatial groups for interpreting SASS5 survey outcomes. The SASS5 spatial group for the assessed reach of Yellowwoods River is 'Eastern Coastal Belt – Lower'.

SASS5 results are a function of both instream water conditions and the availability and quality of instream biotopes (biological habitat types). The SASS5 results were therefore interpreted considering both water quality and biotopes available for sampling during the site visit.

The SASS5 survey results place the assessed reach of the Yellowwoods River into the 'C' Ecological Category, which indicates that the instream component of the river unit is 'moderately modified' (Dallas, 2007) (Table 11). The overall biotope score for the assessed reach was 71%. This suggests that biotope diversity is unlikely to be the primary factor influencing invertebrate populations along the sampled river reach. The primary instream river health modification driver is therefore likely to be modified water quality at the time of the assessment. This hypothesis is supported by the water quality analysis results in Table 10, which indicate a significant degree of nutrient enrichment. It should however be noted that excessive algal growth within rivers can coat important biotope features such as rocks, preventing aquatic macro-invertebrate species from being able to dwell in certain locations.

Table 11. Summary of the SASS5 results for the Luzi River reach sampled (R01).

Biotope Rating (0-5)	Stones in Current (out of 5)	5
	Stones out of Current (out of 5)	5
	Bedrock (out of 5)	2
	Aquatic Vegetation (out of 5)	2
	Marginal Vegetation in Current (out of 5)	3
	Marginal Vegetation out Of Current (out of 5)	4
	Gravel (out of 5)	4
	Sand (out of 5)	3
	Mud (out of 5)	3
	Biotope Score (%)	**71%**
SASS Indices	**SASS Score**	**53**
	No Taxa	**13**
	ASPT	**4.08**
	Eastern Coastal Belt – Lower Zone	
	SASS5 Derived Ecological Category	**C: Moderately Modified (Fair)**

Table 12 contains a comprehensive list of taxa collected and identified during the SASS5 assessment, including their relative quality value (sensitivity) scores (see Table 13 for quality value score guidance). Most taxa identified during the assessment are considered 'Highly Tolerant' of water pollution and other perturbations, allowing these taxa to complete their life cycles within the modified conditions associated

with the sampled reach of the Yellowwoods River . Notably, the list of aquatic macroinvertebrate species identified at the site lacks typical stone dwelling taxa. This could be a result of the excessive algal growth along the assessed reach, which is coating stones and rocks and preventing stone dwelling macroinvertebrates from colonizing these features.

Table 12. Comprehensive list of taxa identified within the assessed reach of the Luzi River (R01) including their respective quality value (sensitivity) scores.

Taxon	Quality (Sensitivity) Value (Out of 15)
Oligochaeta (Earthworms)	1
Hirudinea (Leeches)	3
Potamonautidae* (Crabs)	3
Baetidae 1sp	4
Coenagrionidae (Sprites and blues)	4
Lestidae (Emerald Damselflies/Spread wings)	8
Gomphidae (Clubtails)	6
Libellulidae (Darters/Skimmers)	4
Corixidae* (Water boatmen)	3
Naucoridae* (Creeping water bugs)	7
Notonectidae* (Backswimmers)	3
Veliidae/M...veliidae* (Ripple bugs)	5
Chironomidae (Midges)	2

Table 13. Key for interpreting sensitivity scores based on Dickens and Graham (2002).

Quality Value Score	1 – 5	Highly tolerant to pollution (Low/Very Low Sensitivity taxa)
	6 -10	Moderately tolerate to pollution (Moderate Sensitivity taxa)
	11 – 15	Intolerant to pollution (High Sensitivity taxa)

4.2.3 Index of Habitat Integrity (IHI) Assessment – R01, R02 & R03

IHI (Index of Habitat Integrity) was applied to each assessed river unit. The water quality analysis results and SASS5 survey were used to inform the IHI assessment for R01 (Yellowwoods River). The results of the IHI (habitat) assessment suggest that each of the assessed river and stream units are in 'Fair' condition ('C' IHI PES Category) (see summary in Table 14). Prominent impacts to onsite watercourses are as follows:

(i) alteration of catchment runoff processes due to vegetation removal, overgrazing and the presence of various townships and settlements. This has led to an increase in runoff volumes reaching onsite watercourses. The altered runoff volumes and velocities has led to bed and bank erosion.

(ii) Infestation of riparian zone by woody and herbaceous invasive alien plants

Table 14. PES summary for the river units assessed.

Units	Instream IHI	Riparian IHI	Overall IHI	IHI PES Class	Key Impact(s)
R01: Yellowwoods River	3.29	3.85	3.51	**C: Fair**	• Altered catchment runoff processes associated with reduced catchment basal cover due to poor land management (overgrazing and vegetation clearing) and the presence of residential townships. Altered catchment processes has contributed to altered sediment and water inputs and has led to unnatural bed and bank erosion along the assessed reach. • Encroachment of development into the riparian zone. • Vegetation removal from riparian zone by local community. • Rubbish dumping into river. • Altered instream water quality (nutrient contamination). • Infestation of riparian zone by woody and herbaceous invasive alien plants.
R02	2.35	3.71	2.90	**C: Fair**	• Altered catchment runoff processes associated with reduced catchment basal cover due to poor land management (overgrazing and vegetation clearing) and the presence of residential townships. Altered catchment processes has contributed to altered sediment and water inputs and has led to unnatural bed and bank erosion along the assessed reach. • Altered flow characteristics due to several dams and weirs upstream of assessed reach. • Infestation of riparian zone by woody invasive alien plants.
R03	2.02	1.97	2.00	**C: Fair**	• Sediment, flow, and erosion (bed and bank) related impacts associated with reduced catchment basal cover due to poor land management, largely in the form over overgrazing, vegetation clearing and the discharge of stormwater from the N2 highway into the head of the unit. • Rubbish dumping into river. • Infestation of riparian zone by woody invasive alien plants.

4.3 Ecological Importance & Sensitivity (EIS) Assessment

The Ecological Importance of rivers is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a watercourse's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). For the purposes of this assessment, river EIS was based on rating the importance and sensitivity of riparian and in-stream biota (including fauna & flora) and habitat using both desktop and on-site indicators.

A summary of the results of the EIS assessment for each unit is contained in Table 15. A description of the main factors determining the EIS ratings for the assessed rivers is provided below:

- **River Unit 01 (Yellowwoods River) - <u>'High' EIS</u>**
    - The perennial flow that characterises this unit means that it likely plays host to a range of aquatic fauna that rely on the year-round presence of water for them to survive and breed. This watercourse also likely provides vital refugia to aquatic fauna, especially during times of environmental stress such as low-flow / drought periods. The species relying on this system are therefore likely to be sensitive to reductions in flow, making the Yellowwoods River system ecologically sensitive to flow related changes.
    - The diversity of instream habitat available to aquatic fauna makes the Yellowwoods River ecologically important.
    - According to the NFEPA project (CSIR, 2011) the sub-quaternary catchment planning unit associated with the study area (Unit 7775) is a Fish Support Area (FSA). This designation relates to the potential presence of three (3) threatened fish species within the Yellowwoods River, namely *Enteromius anoplus, Psuedobarbus trevelyani, and Sandelia bainsii*.
    - Due to it being a free-flowing mainstem river, the Yellowwoods River is highlighted as a CBA1 by the freshwater component of the Eastern Cape Biodiversity Conservation Plan (ECBCP) (Desmet & Hawley, 2019). This makes it an ecologically important system for meeting provincial conservation targets.

- **River Unit 02 - <u>'Moderate' EIS</u>**
    - Due to its prevailing seasonal flow regime, River Unit R02 is likely to be moderately sensitive to flow related changes and changes in water quality.
    - Riparian Habitat associated with River Unit R02 is well connected with River Unit R01. Together these systems form a vital ecological corridor for the movement of local game and birds in a landscape that is otherwise largely affected by urbanisation, urban sprawl, and agriculture.

- **River Unit 03 - <u>'Low' EIS</u>**
    - Due to its prevailing ephemeral flow regime, this watercourse has limited aquatic

species and habitat diversity, and provides limited habitat or refugia for aquatic biota. It is however likely to be moderately sensitive to changes in its flow regime, as even minor increases in flow could drastically change its natural hydrological and geomorphological processes.

Table 15. Summary of EIS scores and overall EIS rating for Stream Unit S01

	River Unit R01	River Unit R02	River Unit R03
Variables	**Scores (out of 4) and Rating**		
Rare & endangered species	2.0 (Moderate)	0.0 (None)	0.0 (None)
Unique species (endemic, isolated, etc.)	0.0 (None)	0.0 (None)	0.0 (None)
Intolerant species sensitive to flow/water quality modifications	3.0 (High)	2.0	0.0 (None)
Species/taxon richness	1.0 (Low)	1.0 (Low)	1.0 (Low)
Diversity of habitat types	3.0 (High)	2.0	1.0 (Low)
Refugia for biota	3.0 (High)	2.0	1.0 (Low)
Sensitivity to flow changes	2.0 (Moderate)	3.0 (High)	2.0 (Moderate)
Sensitivity to flow related water quality changes	3.0 (High)	3.0 (High)	1.0 (Low)
Migration route/corridor (instream & riparian)	3.0 (High)	2.0 (Moderate)	1.0 (Low)
Importance of conservation & natural areas	3.0 (High)	2.0 (Moderate)	1.0 (Low)
EIS Score	**2.5**	**2.0**	**1.0**
EIS Rating	**High**	**Moderate**	**Low**

4.4 Recommended Ecological Category (REC) & Management Objectives (RMOs)

The recommended ecological category (REC) is the target or desired state of resource units that is required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES, driven by context and setting.

The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the river (Kleynhans & Louw, 2007). However, the causes related to PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is

evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs and RMOs for water resources is shown in Table 16, below.

Table 16. Generic matrix for the determination of REC and RMO for water resources (based on Kleynhans and Louw, 2007).

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Improve	E/F Improve

Based on the matrix in Table 16, the minimum recommended management objective (RMO) for River Unit R01 (Yellowwoods River) is to improve its PES. This would need to be achieved through the management of catchment activities to prevent both direct and indirect impacts to riparian and instream habitat associated with the system. An important part of achieving this is to incorporate environmentally sustainable design principles into all future developments within the unit's catchment. The RMO of both River Units R02 and R03 is to maintain their current PES (Table 17).

Table 17. REC and RMO for the delineated watercourse units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
River Unit R01	C: Fair	High	B/C	Improve
River Unit R02	C: Fair	Moderate	C	Maintain
River Unit R03	C: Fair	Low	C	Maintain

5. PLANNING & DESIGN RECCOMENDATIONS

A strong legislative framework backs up South Africa's obligations to numerous international conservation agreements and creates the necessary enabling legal framework for the protection and management of freshwater resources in the country. Given the value of these ecosystems, it is against the law to deliberately damage wetlands and rivers. The law therefore places, directly and indirectly, the responsibility on landowners and other responsible parties, to manage and restore wetland and aquatic ecosystems where relevant.

According to the National Environmental Management Act No. 107 of 1998 (NEMA), sensitive, vulnerable, highly dynamic, or stressed ecosystems, such as wetlands or~~,~~ rivers require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. NEMA also requires "a risk-averse and cautious approach which takes into account the limits of current knowledge about the consequences of decisions and actions". The 'precautionary principle' therefore applies, and cost-effective measures must be implemented to pro-actively prevent degradation of the region's water resources. ***Ultimately, the risk of water resource degradation and biodiversity reduction / loss must drive sustainability in development design.***

Of importance is the requirement of 'duty of care' with regards to environmental remediation stipulated in Section 28 of NEMA (National Environmental Management Act No.107 of 1998):

> **Duty of care and remediation of environmental damage**: "(1) *Every person who causes has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing, or recurring, or, in so far as such harm to the environment is authorised by law or cannot be reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.*"

The protection of water resources begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimize or reduce such impacts. The mitigation of negative impacts on wetland and aquatic resources is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. This generally follows ~~some form of~~the 'mitigation hierarchy' (Figure 6), which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts.

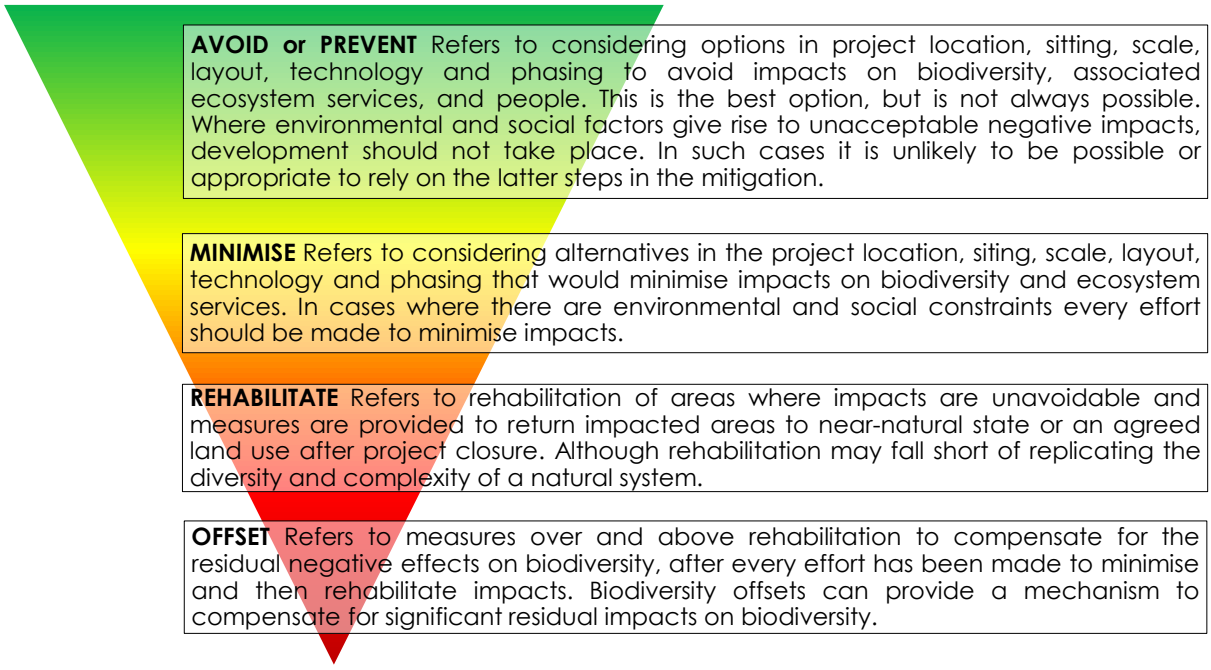

Figure 6. Diagram illustrating the 'mitigation hierarchy' (after DEA *et al*., 2013).

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology and phasing until the proposed development can be best accommodated without incurring significant negative impacts to the receiving environment. Therefore, based on the proposed project layout and the nature of the surrounding environment, Eco-Pulse have identified key project elements that they feel should be considered to avoid unnecessary impacts; namely (i) aquatic buffer zone considerations, (ii) underground fuel storage tank design, and (iii) stormwater management design considerations. These are discussed further in the sub-sections that follow.

5.1 Aquatic Buffer Zone Recommendations

'Buffer zones' (also termed "development set-backs") are strips of vegetated undeveloped land intended to act as a protective barrier between human activities and sensitive habitats such as rivers. Research shows that buffer zones are useful at performing a wide range of functions such as sediment trapping and nutrient retention, and in doing so, play an important role in protecting water resources from the adverse impacts that are typically associated with various land-uses and developments. Although there are no legislative requirements regarding the establishment of buffers around water resources in the South African legislation, the application of buffers is aligned with the principles of the National Water Act (1998), which is to provide for the sustaining of water quality and preserving natural aquatic habitats and ecosystem functions.

Based on the nature of the proposed development and the receiving aquatic environment's susceptibility to water quality and storm water run-off impacts, buffer zones are proposed as a means of

minimizing potential environmental impacts and reducing the risk of aquatic habitat degradation during the construction and operation of the proposed development.

The aquatic ecosystem buffer model produced by Macfarlane & Bredin (2016) was applied to proposed development. This model produces a recommended buffer output based on potential risks associated with the proposed development type, with the output also taking into consideration the sensitivity of onsite aquatic resources.

The buffer tool was applied for each river on the property. A summary of the buffer assessment, including key assumptions and considered criteria, is provided below:

- The "Petrol Station / Fuel Depot" development type was used when running the buffer tool for River Unit R01 (Yellowwoods River).
- The "Residential Medium Impact" development type was used when running the buffer tool for River Units R02 and R03.
- According to the buffer model the key construction phase risks linked with the proposed development are increased sediment inputs and turbidity associated with bulk earthworks at the site.
- According to the buffer model the key operation phase risks linked with the proposed development are increased flood peaks and alterations to flow volumes, and inputs of organic and heavy metal contaminants into onsite watercourses due to polluted stormwater runoff, mostly associated with the proposed fuel station.
- The proposed aquatic buffer zone widths do not specifically consider biodiversity concerns related to fauna/flora, etc.

Based on the threats posed by the proposed development, the buffer model calculated appropriate buffer widths under two scenarios:

1. Without specific Mitigation; and
2. With specific Impact / Risk Mitigation

W**ithout specific impact/risk mitigation a buffer of 27m was recommended** for the onsite watercourses. **With specific mitigation (focusing on construction phase sediment management and operation phase stormwater quality and quantity management) the model suggests that the buffers may be reduced to 15m** (Table 18). Eco-Pulse therefore recommend a buffer of 15m as being appropriate for the proposed development should site-specific mitigation measures be implemented during the construction and operational phases of this development. Note that the recommended buffer zones do not apply to bulk water and sewage reticulation pipelines which will have to cross River Unit R01.

Table 18 below summarises the buffer model outputs. The recommended buffers are shown spatially on the map in Figure 7.

Table 18. Summary of buffer recommendations for the proposed development project as produced by the Macfarlane and Bredin (2016) buffers model.

Project Phase	Recommended Aquatic Buffer Width	
	Without specific impact/risk mitigation	With specific impact/risk mitigation
Construction	27m	15m
Operation	15m	15m
Final Buffer Width	**27m**	**15m**

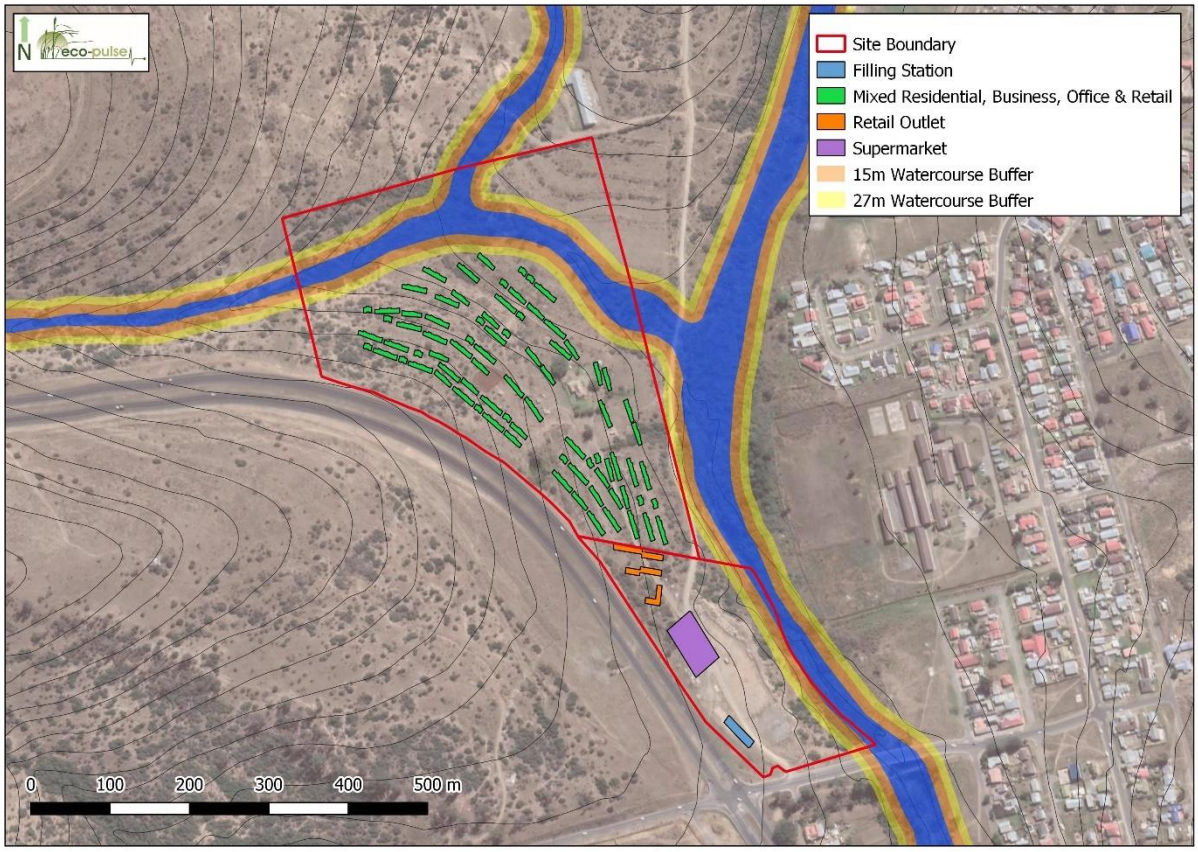

Figure 7. Map showing the recommended 15m aquatic buffer zone.

Note: under the current development layout scenario, except for water supply and sewage reticulation pipelines, no development infrastructure is set to be located within the recommended 27m or 15m aquatic buffer zones area (Figure 7).

5.2 Stormwater Management

Phase 1 (Erf 447):

According to the engineering services report for phase 1 of the development stormwater runoff from the development will be intercepted by system of inlets linked to a network of underground stormwater pipes. The underground stormwater pipe system will discharge into an off-channel detention pond (22m x 11m x 2.5m). Stormwater will then be released from the detention pond into the downslope Yellowwoods River system via a 375mm diameter concrete outlet pipe. The following design recommendations should be considered in relation to this system:

- Stormwater generation from the development should be minimized as far as possible. To this end the developer should consider incorporating the following measures into the project design:
    - Rainwater harvesting from rooftops and other impermeable surfaces.
    - Maximisation of permeable surfaces within the development property by creating grassed areas, using permeable options for parking areas etc.
- The stormwater management system associated with the fuel station forecourt should be separated from the main / 'clean' stormwater management system to avoid discharging diesel and gasoline into the environment (see below recommendations for fuel station stormwater management.
- The stormwater system, including the storage volume of the attenuation dam should ideally be designed to handle flows associated with the full range of expected storm events (1:1-year – 1:100-year flood / storms). However, it is understood that such a system might be financially unfeasible. Thus, as a minimum, rainfall events typical of 10 - 20-year flood events should be attenuated within the development footprint prior to discharge into the freshwater environment.
- The stormwater system would need to address pollution risks associated with contaminated runoff from the development, therefore:
    - Measures to capture solid waste and debris entrained in stormwater runoff must be incorporated into the design of the system and should include the use of either inlet drain grates and / or debris baskets/bags.
    - All stormwater generated from urban surfaces (parking areas, car washing areas etc.) must receive basic filtering and treatment prior to its discharge into the Yellowwoods River. Furthermore, all treatment should occur within the development footprint. Recommended filtering interventions include grit / oil separators and / or sand filter traps. These features will require regular maintenance by the site owners / operators. In this regard, a 'first-flush' system should also be investigated.
- The bulk outlet that will release attenuated water into the Yellowwoods River needs to consider the following best practice design recommendations:
    - Multiple smaller outlets are preferred to a single large outlet.
    - The outlet(s) must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. In this regard, suitably designed energy dissipation (e.g., stilling

basins) and erosion protection structures (Reno-mattresses) will need to be installed at appropriate locations. These interventions can be installed within the recommended aquatic buffer zone areas if required (Figure 7). Expected discharge velocities at each outlet should be calculated to inform the appropriate design of the energy dissipation and erosion protection measures. All erosion protection measures must be established to reflect the natural slope of the surface and should be located at the natural ground-level.

- To function adequately, it is critically important that the onsite stormwater system be regularly maintained over time. The organisation or person responsible for maintaining this infrastructure must be clearly and obviously assigned to prevent inactivity in this regard. Key maintenance will include litter and sediment clearing and the servicing and maintenance of key collection points like catch pits, filtering devices (e.g., grit / oil separators), detention tanks etc. Such maintenance should be the responsibility of either the local municipality or, where possible, the relevant owners/estate associations, and budgeted for.

Fuel Station Stormwater Management Recommendations:

- Due to the water quality unique risks posed by stormwater generated from the proposed fuel station facility, specific stormwater management recommendations for this area have been provided as follows:
    - The fuel station forecourt should be covered to ensure minimal runoff is generated.
    - The fuel station forecourt must be adequately bunded with appropriate sumps in place to ensure that (if generated) no runoff from the forecourt can enter the 'clean' stormwater management system.
    - All runoff from the forecourt should be contained and treated on site or disposed of appropriately as hazardous waste.

Phase 2 (Erf 34):

It is Eco-Pulse's understanding that no stormwater management system has been designed for Phase 2 at this time. The following best practice stormwater management design recommendations should therefore be considered by the project engineers during the design process for Phase 2 of the development project:

- The stormwater system should ideally be designed to handle flows associated with the full range of expected storm events (1:1-year – 1:100-year flood / storms). However, it is understood that such a system might be financially unfeasible. Thus, as a minimum, rainfall events typical of 10 - 20-year flood events should be attenuated within the development footprint prior to discharge into the freshwater environment.
- It is important to minimise runoff generation (through minimising the extent of hard standing, and using rainwater harvesting techniques with all buildings) and to maximise runoff infiltration within the footprint and within the recommended aquatic buffer zones (Figure 7). Recommended

infiltration structures include the use of permeable options for surfacing of parking areas, bioretention areas, unlined detention basins, infiltration basins, and grassed swales.

- Related to the previous point, it is important that runoff generated by the development is not discharged back into the environment via concentrated point source outlets. An engineer should therefore be consulted to determine the best approach to achieving diffuse stormwater flow through the aquatic buffer zone area.
- Where possible stormwater runoff should be directed into, and conveyed by, open, permeable swales. These features should be well vegetated with indigenous fast growing grass species and stabilised by means of gabion or concrete check walls to prevent erosion and vertical incision. This will provide for some filtration and removal of pollutants (e.g., oils and hydrocarbons), provide some attenuation by increasing the time runoff takes to reach low points, and will reduce the energy of storm water flows within the stormwater system through increased roughness when compared with pipes and concrete V-drains.
- Outlet design recommendations:
    - Many smaller stormwater outlets must be favoured over a few large outlets.
    - Outfalls should not release stormwater directly down steep slopes.
    - All outlets must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. In this regard, suitably designed energy dissipation (e.g., stilling basins) and erosion protection structures (Reno-mattresses) should be installed at appropriate locations.
- All stormwater generated by the proposed development must receive basic filtering and treatment onsite prior to discharge into the freshwater environment. Furthermore, all treatment should occur within the development footprint. Recommended filtering interventions include sand filter traps.
- To function adequately, it is critically important that the onsite stormwater system be regularly maintained over time. Key maintenance will include litter and sediment clearing and the servicing and maintenance of key collection points like catch pits, filtering devices, detention tanks etc.

5.3 Underground Fuel Storage Tanks (USTs)

The following environmental design guidelines are recommended for Underground (fuel) Storage Tanks (USTs) and pipework required for the service station:

- The USTs must be installed according to:
    - The selected petrol station Engineering Guidelines and specifications.
    - Relevant National Building Regulations.
    - Relevant SANS and SABS codes.
- USTs must be properly founded and be leak-proof.

- There must be a leak detection and monitoring programme to monitor ground water contamination risk and this should ideally be informed by a Geohydrological Assessment.
- Once in place, and before backfilling, all USTs must be inspected for damage / cracks. Any damage to be repaired, or the tanks to be replaced before any further action is taken.
- The tank farm must be lined with a HDPE liner or a suitable clay layer to prevent infiltration of product to the ground water should a spill\leak occur.
- The void around the UST must be back filled with a non-cohesive granular material to ensure that any product loss through the UST or ancillary pipe work will flow towards the low point, where a monitoring well should be located.
- The USTs are to be overlain with a reinforced concrete slab, its thickness and strength is to be determined by a qualified Engineer.
- The filler point and tank must be fitted with overfill protection. The critical level should be such that a space remains in the tank to accommodate the delivery hose volume.
- All pipeline connections are to be housed within impermeable containment chambers.
- All pipework to consist of internationally approved non-corrosive material and all pipes to be housed in secondary containment sleeving.
- Tanks should ideally be double walled / Jacketed (i.e., possessing secondary containment and must have an interstitial leak detection monitoring system between the two walls to monitor for product leakage)

6. CONCLUSION

Breidbach Properties CC intend on establishing a mixed-use development and service station on Erf 34 (approximately 15.5ha) and Erf 447 (rem) (approximately 4.5ha) in the Breidbach suburb of King Williams Town, Eastern Cape. As the proposed development may potentially impact freshwater aquatic ecosystems (rivers / streams), a Freshwater Aquatic Ecosystems Impact Assessment Report is required to inform the project Environmental Authorisation (EA) and a Water Use License Application (WULA). Eco-Pulse visited the proposed development site in December 2020 to assess onsite watercourses that may be impacted by the construction and operation of the development.

A total of three (3) river units were identified and delineated at the site. This includes a reach of the lower Yellowwoods River (River Unit 01), and seasonal tributary of the Yellowwoods River (River Unit 02) and a steep ephemeral mountain stream (River Unit 03). Each of the units was assessed as being in a C / Fair PES category. the dominant impacts to onsite watercourses were (i) altered catchment runoff processes which has led to unnatural bed and bank erosion, (ii) infestation of riparian zone by invasive alien woody and herbaceous vegetation species, and (iii) instream water quality impacts. The Yellowwoods River

(Unit 01) was rated as being of 'High' EIS, River Unit 02 and 03 were assessed as being of 'Moderate' and 'Low' EIS, respectively.

Based on the proposed project layout and the nature of the surrounding freshwater environment, Eco-Pulse have identified key project elements that they feel should be considered to avoid unnecessary impacts; namely (i) implementation of aquatic buffer zones during construction and operation, and (ii) stormwater management design considerations. Detail of the recommendations are outlined in Section 5. These should be discussed by the project team and incorporated into the project design as far as practically possible.

Eco-Pulse will commence with the formal Impact Significance and DHSWS Risk Assessments once the above-mentioned design recommendations have been deliberated on, and formal go-ahead has been provided To Eco-Pulse by CES.

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