SENQU RURAL WATER SUPPLY SCHEME WORK PACKAGE 7 – SEQNU LOCAL MUNICIPLAITY, EASTERN CAPE

Wetland & Aquatic Assessment Report




Version 1.0

Revision 0

Draft for EAP / Client Review

Date: 15 November 2021

Eco-Pulse Environmental Consulting Services

Report No: EP590-10

Prepared for:

CES Environmental & Social Advisory Services

Address: 6 Stewart Drive, Baysville, East London, 5241

Contact Person: Robyn Thomson

Tel: 043 726 7809

Email: r.thomson@cesnet.co.za

Prepared by:

Eco-Pulse Environmental Consulting Services

Contact: Shaun McNamara

No. 3 Second Avenue, Hilton, 3245, South Africa

E-mail: smcnamara@eco-pulse.co.za

Cell: 084 596 6078

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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:	Wetland & Aquatic Assessment
Project:	Senqu Rural Water Supply Scheme – Work Package 7
Location:	Senqu Local Municipality, Eastern Cape
Report No.	590-01
Version No.	1.0
Revision:	Rev 0
Date:	15 November 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: 15 November 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* of the specialist team are available on request.

Specialist	Role	Details
Leo Quayle (*Pr.Sci.Nat.*) Aquatic Ecologist	External 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 the Wetland & 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 uses license application (WULA) in terms of the National Water Act, for the proposed Work Package 7 of the Senqu Rural Water Supply Scheme. An assessment of wetland and aquatic ecosystems was undertaken by Eco-Pulse Environmental Consulting Services in November 2021. The main findings of the assessment have been summarized below.

Project Locality:

The Senqu Rural Supply Scheme provides potable water to a total of fifteen villages within the Senqu Local Municipality. These villages are all located in the northern Eastern Cape, near the provinces' border with Lesotho.

Project Description:

Senqu Rural Supply Scheme – Work Package 7 involves the following:

- The refurbishment of the Jozana Water Treatment Works package plant by replacing the duty and standby pumps. Duty of pumps quantity will be 9.5 l/s and height will be 150m.
- The construction of new rising mains from water treatment works; distance of the main is 1900m with a 160mm diameter.
- Addition of rising main from booster pump to ward 12 (Jozana Nek and Magadla), 5400m main with 50mm diameter.
- The refurbishment of booster pump station which supplies the Jozana Nek and Magadla village (ward 12), quantity of pump is 2.3 l/s and height is 180m. It is recommended that an Eskom power supply be applied for the booster pump.
- Upgrade of existing reticulation in Jozana Nek and Magadla (ward 12)- the aim is to upgrade to yard connections.
- Upgrade Magwiji stand-alone scheme by increasing storage capacity to 80 kl/day.
- Increase storage capacity by upsizing the gravity main supplying Madakane and Bambospruit reservoir to meet annual average daily demand.
- Design a system which includes equipping Borehole EC-D12-036 with a yield of 3.3 l/s (Approximately 285 kl/day) in ward 7 (Makojong, Roosisand, & Maralaneng).
    - Note: This wetland and aquatic assessment deals exclusively with surface water resources and has not attempted to assess the impact of the project on groundwater associated with the planned borehole connection.
- Design complete water system (bulk supply and reticulation network) for Enteni (ward 7) and Makheteng (ward 10) based on 80 l/c/d consumption.

Note: It proved difficult for CES and Eco-Pulse to decipher which pipelines and other infrastructure in the GIS layout provided were existing and to be upgraded, and which were planned new pipeline

alignments. CES therefore requested that the entire GIS layout provided to Eco-Pulse be incorporated into the baseline and impact assessment.

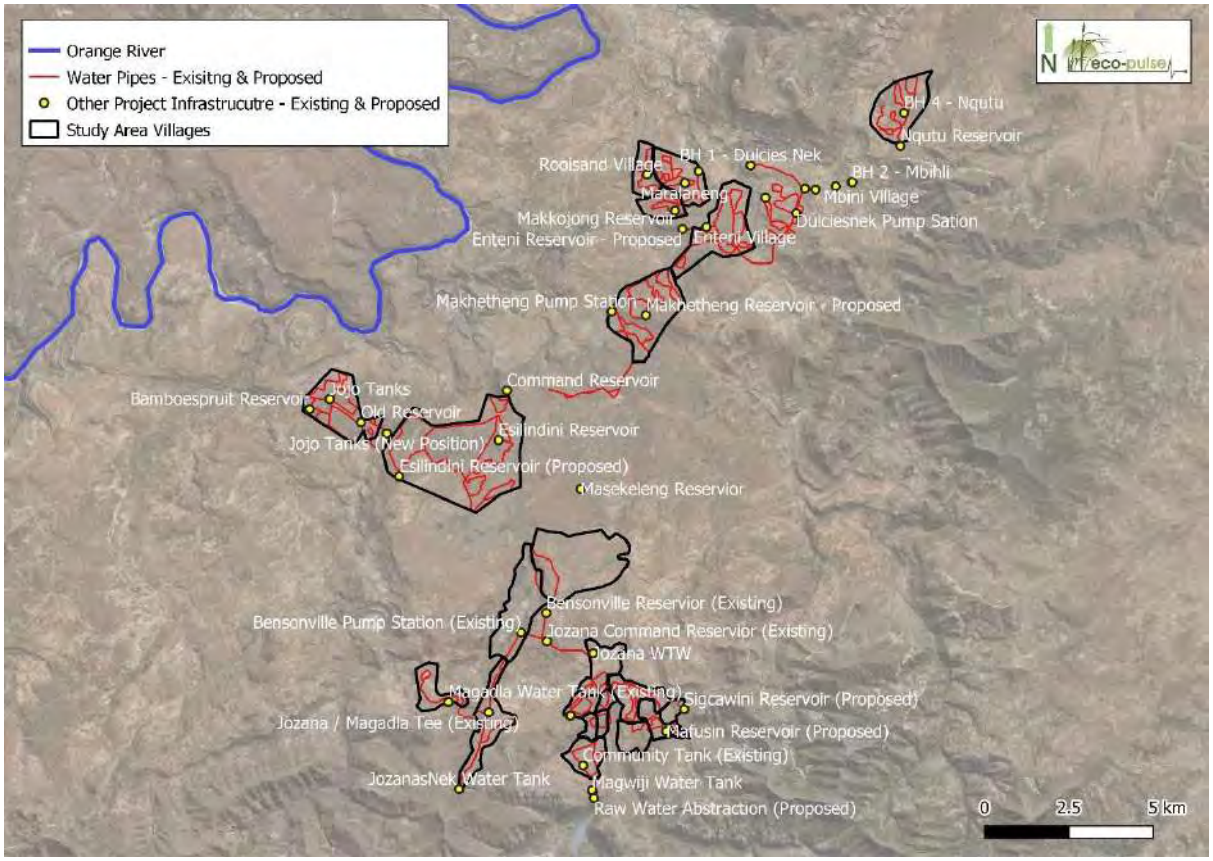

Figure A. Senqu Rural Water Supply Scheme infrastructure (existing and proposed).

Catchment / Drainage Context:

The study area is located on the left bank of the Orange River system, looking downstream and covers portions of DWS Quaternary Catchments D12A, D12B, D12C and D18L. These Quaternary Catchments existing within the Orange River Water Management Area. The main river draining D12A and D18L is the upper Orange. The main rivers draining D12B and D12C are the Sterkspruit / Kromspruit and Bamboesspruit Rivers, respectively. The Sterkspruit and Bamboesspruit Rivers are right bank tributaries of the Orange River. The Joezana's Hoek Dam is located within DWS Quaternary Catchment D12B along the lower Mhlangeni River. This river and dam are however upstream of the study general area.

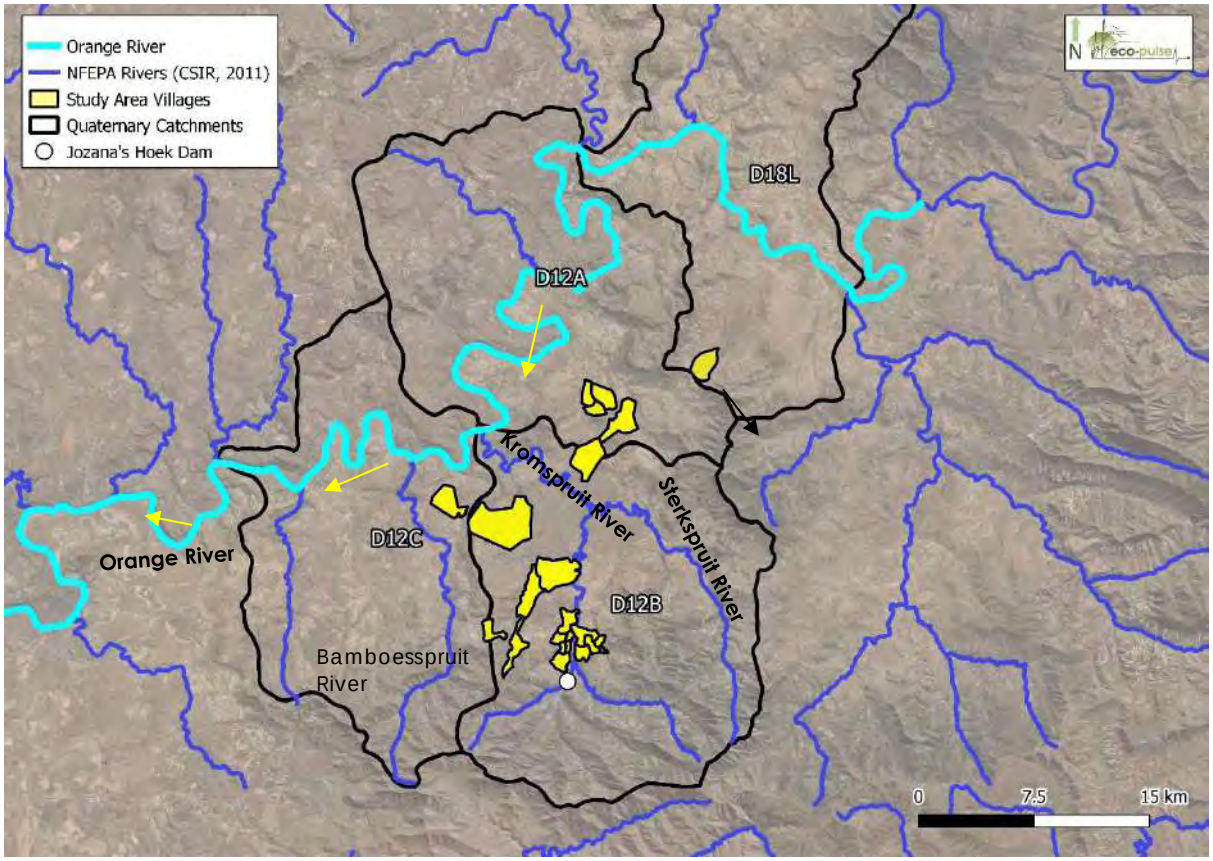

Figure B. Map showing the quaternary catchment and local drainage network that characterises the project study area.

Baseline River PES & EIS:

A total of eighty-nine (89) watercourses were carried forward for the baseline assessment (chapter 4). Wetland PES was assessed using the WET-Health (Macfarlane et al., 2008) assessment method and tool at a rapid level 1 assessment level. The outcomes of the assessment indicate that wetlands within the study area range from moderately to critically modified (C – F PES Category). No natural or partially natural wetlands were noted at the site. Rivers / streams PES was assessed using the Index of Habitat Integrity or IHI (Kleyhans, 1996). Rivers and streams within the study area range from moderately to seriously modified (C – E PES Category). No natural or partially natural river / stream units were noted at the site.

Wetlands belonging to Process Unit Group 02 are of Moderate Ecological Importance because of the role these wetlands play in trapping sediment. These wetlands were also assessed as being of Moderate Ecological Sensitivity. This largely relates to the erosion risk associated with rapidly aggrading wetland reaches. The overall EIS rating for wetlands belonging to Process Unit Group 02 is therefore Moderate. Wetlands belonging to Process Unit Group 03 are of Moderate Ecological Importance. This is because these wetlands represent moderately intact examples of unchanneled valley bottom wetlands within the mesic highveld grassland bioregion. These wetland ecosystems are considered Critically Endangered by the latest National Biodiversity Assessment (SANBI, 2018). These wetlands were also assessed as being of

Moderate Ecological Sensitivity due to their erosion risk. The overall EIS rating for wetlands belonging to Process Unit Group 03 is therefore Moderate. Wetlands belonging to Process Unit Groups 01, 04, 05, 06, and 07 are all considered to be of Low overall EIS. All watercourse units associated with River Process Unit Group 01, 02, and 03 were rated as being of 'Low' EIS. Rivers 01 to 06 were rated as being of 'Moderate' EIS.

Impact Significance & DWS Risk Assessment:

The most notable potential impacts associated with both the construction phase of the project relate to (i) direct habitat modification, (ii) altered sediment delivery processes and volumes to onsite watercourses, and (ii) altered water quality of onsite watercourses, largely due to turbidity issues. However, with the implementation of construction phase impact mitigation measures provided in section 6.3 of this report, all potential construction phase impacts can be reduced to a low overall significance. The overall significance of operation phase impacts associated with the upgraded supply scheme is 'Low'. This is due to the low likelihood and intensity of impacts. The outcomes of the impact significance assessment for the project are summarised in Table 35. A summary of the DWS Risk Assessment ratings for the proposed development activities is provided in Table 36 below, the results of the assessment indicate that with effective mitigation (as outlined in section 6) all impacts can be managed down a low overall risk.

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1. INTRODUCTION

1.1 Project Locality

Royal Mndawe Holdings (Pty) Ltd (ROMH) on behalf of the Joe Gqabi Economic Development Agency (JoGEDA), propose to construct and upgrade infrastructure for the Senqu Rural Water Supply – Work Package 7. The Senqu Rural Supply Scheme provides potable water to a total of fifteen villages within the Senqu Local Municipality. These villages, all located in the northern Eastern Cape, near the provinces' border with Lesotho, are as follows (Figure 1):

- Dulcies Nek
- Mbini
- Bamboespruit
- Majokong
- Rooisand
- Enteni
- Esilindini
- Bensonvale
- Magwiji
- Magadla
- Jozanas Nek
- Madakane
- Nqutu
- Maralaneng
- Makheteng

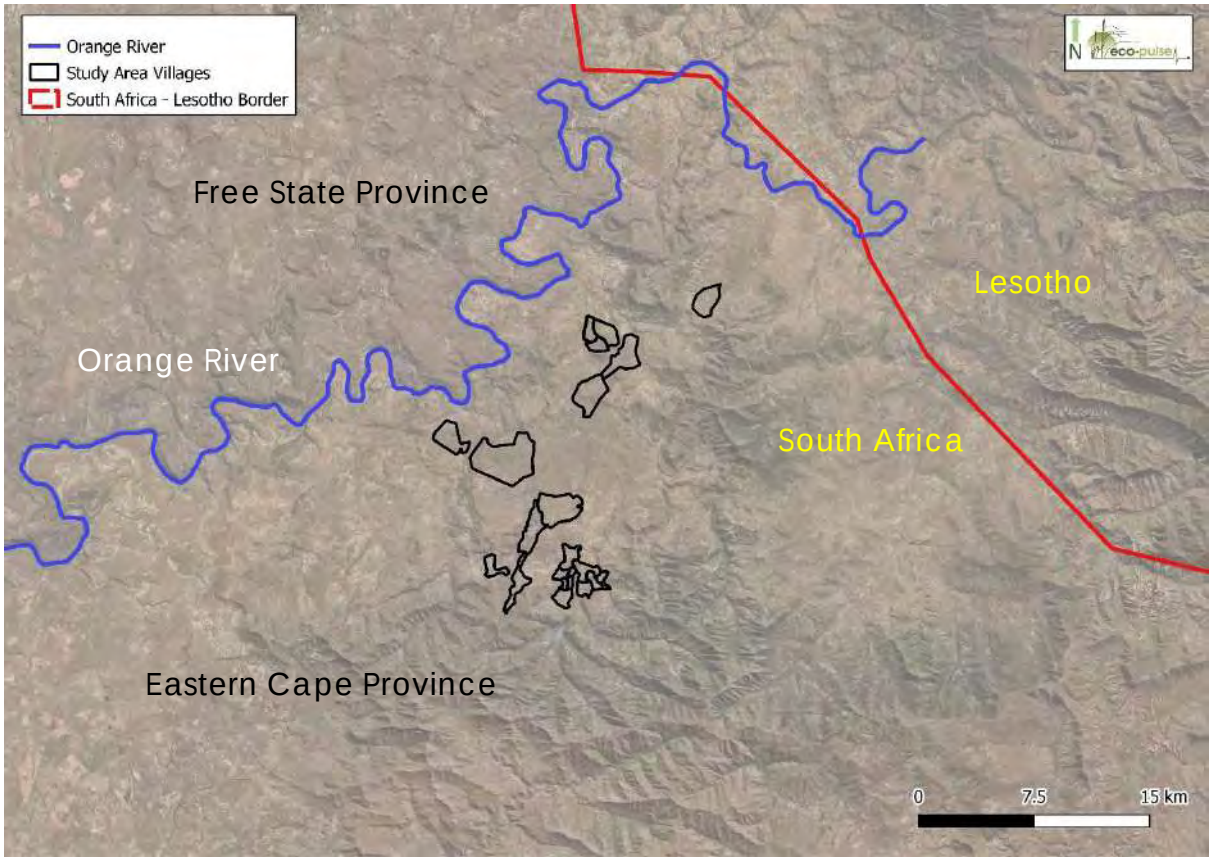


Figure 1. Location of the villages served by the Senqu Rural water supply Scheme in relation to the Orange River and the South Africa – Lesotho Border.

1.2 Project Description

Senqu Rural Supply Scheme – Work Package 7 involves the following:

- The refurbishment of the Jozana Water Treatment Works package plant by replacing the duty and standby pumps. Duty of pumps quantity will be 9.5 l/s and height will be 150m.
- The construction of new rising mains from water treatment works; distance of the main is 1900m with a 160mm diameter.
- Addition of rising main from booster pump to ward 12 (Jozana Nek and Magadla), 5400m main with 50mm diameter.
- The refurbishment of booster pump station which supplies the Jozana Nek and Magadla village (ward 12), quantity of pump is 2.3 l/s and height is 180m. It is recommended that an Eskom power supply be applied for the booster pump.
- Upgrade of existing reticulation in Jozana Nek and Magadla (ward 12)- the aim is to upgrade to yard connections.
- Upgrade Magwiji stand-alone scheme by increasing storage capacity to 80 kl/day.
- Increase storage capacity by upsizing the gravity main supplying Madakane and Bambospruit reservoir to meet annual average daily demand.
- Design a system which includes equipping Borehole EC-D12-036 with a yield of 3.3 l/s (Approximately 285 kl/day) in ward 7 (Makojong, Roosisand, & Maralaneng).
    - Note: This wetland and aquatic assessment deals exclusively with surface water resources and has not attempted to assess the impact of the project on groundwater associated with the planned borehole connection.
- Design complete water system (bulk supply and reticulation network) for Enteni (ward 7) and Makheteng (ward 10) based on 80 l/c/d consumption.

Note: It proved difficult for CES and Eco-Pulse to decipher which pipelines and other infrastructure in the GIS layout provided were existing and to be upgraded, and which were planned new pipeline alignments. CES therefore requested that the entire GIS layout provided to Eco-Pulse be incorporated into the baseline and impact assessment.

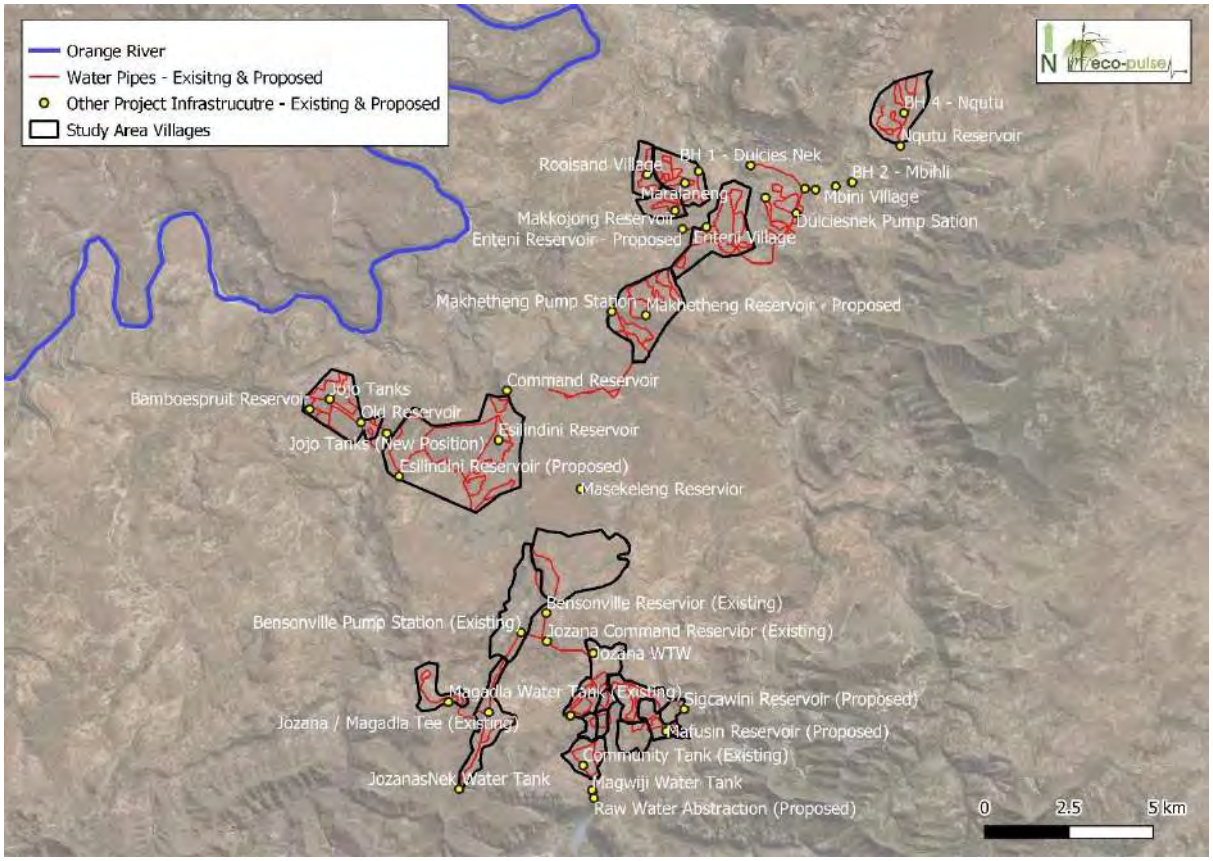


Figure 2. Senqu Rural Water Supply Scheme infrastructure (existing and proposed).

1.3 Purpose of Assessment

Work Package 7 of the Senqu Rural Water Supply Scheme project stands to potentially impact onsite watercourses. A Wetland and Aquatic Ecosystems 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

This freshwater ecosystem impact assessment was undertaken and the relevant specialist report compiled 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). Additionally, since the proposed development is likely to require a Water Use Licensing in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998, the assessment was aligned with the requirements of the Department of Water & Sanitation (DWS) 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.

The following scope of work was completed for the Wetland and Aquatic Assessment:

1. 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
2. Desktop GIS mapping of all wetlands and aquatic units within 500m of any proposed or existing infrastructure associated with the Senqu Rural Water Supply Scheme (i.e., the DWS Regulated Area for Section 21 c/i wetland water use). This was done using available digital imagery and elevation contour data.
3. Identification all watercourses within 500m of all proposed infrastructure that are likely to be measurably negatively affected (these watercourses constituted the study area).
4. Classification of wetlands and rivers/streams in the study area using the National Wetland Classification Guidelines (Ollis *et al.*, 2013), and grouping of wetlands and rivers/streams into 'process units' for assessment purposes (i.e., watercourses with similar biophysical attributes such as HGM type, slope, level of disturbance/impact, etc.).
5. Ground-truthing of focal wetland and riverine/stream process units, including the refinement of the desktop wetland and riparian zone delineations according to the methods outlined in the national wetland and riparian area delineation guidelines (DWAF, 2005) and rapid vegetation surveys.
6. Refinement of all desktop wetland and riparian boundaries by extrapolating field sampling data across the broader project area.
7. Present Ecological State (PES) assessment of focal wetlands and river stream process units:
    - For wetlands this was done using the level 1 WET-Health (Macfarlane *et al.,* 2008) assessment tool.
        - An older version of the WET-Health assessment tool was used for this assessment as it can easily be applied to wetland process units. The New version of the tool, released in 2020, requires the wetland and catchment landcover of each wetland unit to be mapped. This was not feasible for this project ~~t~~ given the budget constraints and large study area.
    - For rivers/streams this was done using the Index of Habitat Integrity or IHI (Kleyhans, 1996):
8. Assessment of wetland ecosystem services for wetland process units using WET-Ecoservices (Kotze *et al.,* 2019).
9. Assessment of wetland and river EIS (Ecological Importance & Sensitivity) using the EIS assessment method developed by Eco-Pulse adapted from the DWAF Resource Directed Measures EIS tools (Kleynhans, 1999 & Duthie, 1999).
10. Application of the "DWS Risk Assessment Matrix" at a project level, as detailed in the General Authorization in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (c) or Section 21 (i), as contained in Government Gazette No. 40229, 26 August 2016 and contained within the DHSWS document titled 'Section 21(c) and (i) Risk-based assessment and authorization, October 2014, Edition 2' to inform water licensing requirements for the project (i.e. full WULA vs GA).

11. Description and assessment of the significance of wetland/aquatic impacts for all project phases (construction and operation).
12. Provision of planning and project design recommendations.
13. Provision of impact and risk mitigation measures and management recommendations for the various project phases.
14. Identification of assumptions, limitations, and information gaps.
15. Scientific Reporting: Compilation of a single combined Wetland and Aquatic Assessment Report including all relevant maps and supporting information.

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, Vörösmarty *et al.*, 2010). 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.

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 Water & Sanitation (DWS) 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. The report will also be developed 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).

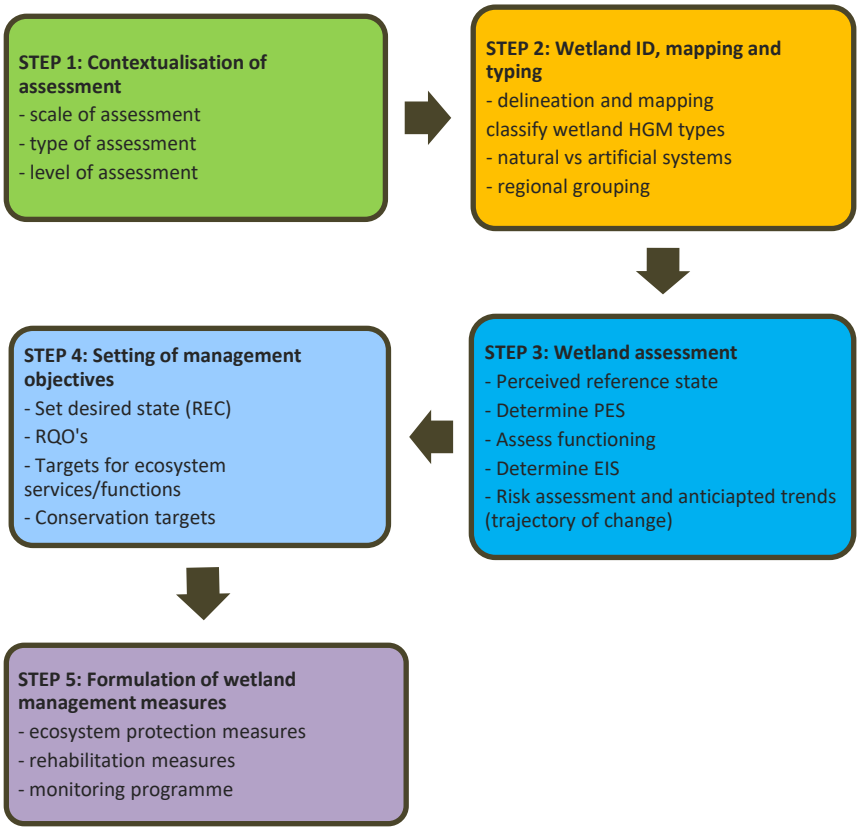


Figure 3. Proposed decision-support framework for wetland/aquatic assessment in SA (after Ollis *et al.*, 2014).

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 (2018)
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*	Lotter & Le Maitre (2021)
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 project were mapped at a desktop level. 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);
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 Watercourse Mapping Refinements & Classification

Data collected during the rapid field visit was used to refine the desktop mapped watercourses. All watercourses (rivers / riparian zones and wetlands) within 500m of the proposed and existing

infrastructure that were considered likely to be impacted by the project were then classified terms of their Hydro Geomorphic (HGM) type in accordance with the national wetland/river classification defined by Ollis et al. (2013).

2.2.4 Watercourse Process Unit Grouping

Given the numerous watercourses associated with the study area and the time and budget constraints imposed by the project, it was not feasible to conduct detailed baseline assessments on each individual watercourse unit given. Instead, a '**Process Units' based approach** was adopted for this project.

'Process Units' in this context refer to wetlands or rivers of the same general type in terms of their classification, with similar existing impacts to ecosystem health, similar processes, and ecological functions. Using a 'Process Unit' type approach can be particularly useful when required to assess numerous wetlands at a rapid and efficient level and where conditions allow for similar wetlands/rivers to be grouped to make the baseline assessment of PES/EIS more efficient.

This approach involved assigning each of the mapped watercourses to a 'Process Unit' group (a collection of watercourses with similar biophysical attributes and processes) according to the following criteria:

- Wetland HGM type
- River longitudinal zonation
- Watercourse and catchment biophysical characteristics
- Level of watercourse and catchment disturbance/impact

2.2.5 Baseline Watercourse Assessment

Watercourse Process Unit groups associated with systems rated as 'high' or 'moderate' in terms of their likelihood of impact rating (according to Table 3) were taken forward to for PES and EIS assessments. 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.

Method/Technique		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)
Rivers/Streams	Present Ecological State (PES)	Index of Habitat Integrity (IHI) (after Kleynhans, 1996).

	Method/Technique	Reference for Methods/Tools Used
	Riparian Ecological Importance & Sensitivity (EIS)	Freshwater/Aquatic EIS tool (Eco-Pulse, 2017)
Wetlands	Present Ecological State (PES)	WET-Health assessment (Macfarlane *et al.*, 2008).
	Functional Importance (Eco-services assessment)	WET-EcoServices assessment (Kotze *et al.*, 2019).
	Wetland Ecological Importance & Sensitivity (EIS)	Wetland EIS assessment tool developed by Eco-Pulse based on Rountree and Kotze (2013) and Duthie (1999).

2.3 Impact Assessment Framework & Methodology

For the purposes of this study, the assessment of potential freshwater impacts was undertaken using an "*Impact Assessment Methodology for EIAs*" adopted by Eco-Pulse (2020). This assessment was informed by baseline information contained in this report relating to the sensitivity of freshwater habitats and potential occurrence of protected species, as well as on information relating to the proposed project. Note that the Impact Assessment has been aligned as far as possible with the minimum criteria and requirements for Aquatic Biodiversity Impact Assessment 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).

The impact assessment process begins with a general description of the proposed development (construction and operation phases), with the various environmental stressors and risks associated with development activities then being defined (Table 19). Impacts are then described under four (4) distinct 'groups' with impact significance assessed for each group based on a range of assessment criteria. The general framework for the freshwater impact assessment is shown below in Table 5.

Table 5. Freshwater ecosystem impact assessment framework for development projects.

WETLAND & AQUATIC ECOSYSTEM IMPACT ASSESSMENT FRAMEWORK	
DEVELOPMENT ACTIVITIES	
Construction Phase Description:	Operation Phase Description:
Construction and installation works required to upgrade existing water supply scheme infrastructure.	Operation of the upgraded water supply scheme.
WETLAND & AQUATIC ECOSYSTEM IMPACT & RISK ASSESSMENT GROUPS	
1 Direct physical loss or modification of freshwater habitat.	
2 Alteration of hydrological and geomorphological processes (*flow, erosion & sediment regime changes*).	

3	Impacts to water quality.
4	Impacts to ecological connectivity and / or ecological disturbance impacts.

The significance of potential impacts associated with the proposed development on freshwater ecosystems was assessed for the following scenarios:

- **Realistic "poor mitigation" scenario** – this is a realistic worst-case scenario involving the poor implementation of construction mitigation, bare minimum incorporation of recommended design mitigation, poor operational maintenance, and poor onsite rehabilitation.
- **Realistic "good** mitigation**" scenario** – this is a realistic best-case scenario involving the effective implementation of construction mitigation, incorporation of most of the design mitigation, good operational maintenance, and successful rehabilitation.

The approach to the impact significance assessment is to identify the main ultimate ecological consequences associated with each impact group. The four ultimate ecological consequences are:

1. Water resource management: The inter-connected nature of water resources is emphasised here by recognising that an impact at a site will ultimately affect downstream users and the ability to meet user requirements and resource quality objectives. An understanding of the catchment context, with emphasis on the existing use of and reliance on water resources by downstream communities is therefore required. Key concerns therefore relate to any impacts on water quantity and quality together with habitat-related impacts that could exacerbate downstream impacts by undermining the ability of wetlands and riparian areas to attenuate floods, trap sediments and assimilate pollutants (regulating & supporting services).
2. Ecosystem conservation: The focus here is specifically on understanding the significance of impacts in relation to the ability to meet habitat conservation targets. This is informed by an understanding of conservation significance that is influenced by factors such as the ecosystem threat status, regional conservation context, condition of habitat, and connectivity to other intact habitats.
3. Species conservation: The focus here is specifically on species of special or notable conservation importance or concern, including Red Data Book or Red List taxa in threatened or conservation concern categories, Threatened or Protected Species listed under the National Environmental Management: Biodiversity Act, endemic taxa, locally threatened taxa and/ or any particular taxa of special management concern. Includes both fauna and flora.
4. Direct use values: The emphasis here is specifically on understanding and assessing the social impacts of the development based on an understanding of the impacts on provisioning (water supply, harvestable natural resources, cultivated foods or food for livestock) and cultural services available to local communities. This assessment is therefore based on an understanding of the current importance of water resources for local users and supporting local livelihoods, including religious ceremonies, tourism & recreation, or educational activities.

Once the ultimate ecological consequence has been selected for each impact group, and the impact intensity rated (according to Eco-Pulses rating scheme), the likelihood of the impact occurring, as well as the anticipated extent and duration of the impact are rated and combined in a structured way to determine the impact significance. This is done in accordance with the following formula:

Impact significance = (impact intensity + impact extent + impact duration) x impact likelihood

This formula is based on the basic risk formula: Risk = consequence x probability

Table 6. Impact significance categories and definitions.

Impact Significance	Definition
High	Totally unacceptable and fatally flawed from an environmental perspective. The proposed activity should only be approved under very special circumstances (i.e., national priorities with large societal benefit). If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderately High	Generally unacceptable and should ideally be avoided. The potential impact will affect a decision regarding the proposed activity and require that the need and desirability for the project be clearly substantiated to justify the associated ecological risks. If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderate	Potentially unacceptable and should ideally be reduced to lower significance levels. The potential impact should influence the decision regarding the proposed activity and requires a clear and substantiated need and desirability for the project to justify the risks. If authorised, offsets should be considered to compensate for residual impacts.
Moderately Low	Acceptable with low to moderate risks. The potential impact may not have any meaningful influence on the decision regarding the proposed activity.
Low	Acceptable. The potential impact is very small or insignificant and should not have any meaningful influence on the decision regarding the proposed activity.

A confidence rating was also given to the rated impacts rated in accordance with the table below:

Table 7. Confidence ratings used when assigning impact significance ratings.

Level of confidence	Contributing factors affecting confidence
Low	A low confidence level is attributed to a low-moderate level of available project information and somewhat limited data and/or understanding of the receiving environment.
Medium	The confidence level is medium, being based on specialist understanding and previous experience of the likelihood of impacts in the context of the development project with a relatively large amount of available project information and data related to the receiving environment.
High	The confidence level is high, being based on quantifiable information gathered in the field.

2.4 Risk Assessment Method

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorization of Section 21(c[1]) and 21(i[2]) water uses, key among which is that

[1] 21(c): Impeding or diverting the flow of water in a watercourse
[2] 21(i): Altering the bed, banks, course, or characteristics of a watercourse

only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
- Use of water within the 'regulated area'[3] of a watercourse where the Risk Class is Medium or High.
- Where any other water uses as defined in Section 21 of the NWA must be applied for.
- Where storage of water results from Section 21 (c) and/or (i) water use.
- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 c and I water use Risk Assessment Protocol') was applied to the proposed project. The tool uses the following approach to calculating risk:

RISK = CONSEQUENCE X LIKELIHOOD

whereby:

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The key risks associated with the proposed development project are presented in Table 5, and are again outlined below:

1. Direct physical loss or modification of freshwater habitat.
2. Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes).
3. Impacts to water quality (pollution).
4. Impacts to ecological connectivity and/or ecological disturbance impacts.

For each of the above stressors, risk was assessed qualitatively using the DWS risk matrix tool.

It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i)

[3] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

i. The outer edge of the 1:100 yr flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.
ii. In the absence of a determined 1:100 yr flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).
iii. A 500m radius from the delineated boundary of any wetland or pan.

the initial risk score is within twenty-five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses and was used to inform WUL requirements for the proposed development.

2.5 Key Documents / Files Consulted

- CES Request Letter for EIA Pre-Application Meeting with the Department of Economic Development, Environmental Affairs & Tourism. 17th September 2021. Provided to Eco-Pulse by Robyn Thomson.
- Senqu Water Supply KML Layout provided to Eco-Pulse by Robyn Thomson on 29th September 2021.

2.6 Assumptions, Limitations & Information Gaps

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

2.6.1 General assumptions & limitations

- This report deals exclusively with a defined area and the extent and nature of wetland and 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.

2.6.2 Sampling limitations & assumptions

- Although all watercourses occurring within 500m of the proposed activities were mapped at a desktop level, field investigations were confined to 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 of the watercourse units in areas not visited during the field assessment 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.
- The accuracy of infield delineations is based solely on the recording of wetland 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.

2.6.3 'Seasonality' of the Assessment

- Eco-Pulse undertook the field visit in October 2021 (summer). One infield visit does not fully cover the seasonal variation in conditions at the site.

2.6.4 Baseline Ecological Assessment

- The mapping, description, and assessment of wetland/river PES & EIS was undertaken at desktop level with limited field verification of key focal areas selected. This data was then extrapolated for the broader project area. Areas assessed only at a desktop level therefore have a relatively low level of confidence.
- The PES and EIS assessments make use of qualitative assessment tools and thus the results are open to professional opinion and interpretation. Eco-Pulse has 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. invertebrates, amphibians and fish) within and make use of these systems.
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked.
- The vegetation information provided is based on observation not formal vegetation plots. As such species documented in this report should be considered as a list of dominant and/or indicator wetland/riparian species and only provide a very general indication of the composition of the wetland/riverine vegetation communities.
- 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.

2.6.5 Impact Assessment

- It must be mentioned that it proved difficult for CES and Eco-Pulse to decipher which rising mains, gravity mains and reticulation pipelines in the GIS layout provided were existing and to be upgraded, and which were planned new pipeline alignments. CES therefore requested that the entire GIS layout provided to Eco-Pulse be impact assessment. It has therefore been assumed as part of this impact assessment procedure that all pipeline alignments that appear on the provided GIS layout are either existing alignments that are having their conveyance capacity upgraded or are new pipeline alignments to extend the reach of the supply scheme.

- An activity included in Work Package 7 of the water supply scheme upgrade is the refurbishment of the existing Jozana Water Treatment Plant by replacing the current duty and standby pumps with larger capacity pumps. This aspect of the proposed works has not been included in the impact assessment as replacing the pumps at the existing water treatment will not affect any onsite watercourses as the nearest watercourse to the plant is >80m away.
- This wetland and aquatic assessment deals exclusively with surface water resources and has not attempted to assess the impact of the project on groundwater associated with the planned borehole connection in Ward 7.
- The impact assessment was undertaken considering two mitigation scenarios referred to as the 'realistic poor mitigation' and 'realistic good mitigation' scenarios.
- The evaluation of impact significance under the 'realistic good mitigation' scenario assumes all project design and impact mitigation measures presented in Chapter 6 will be implemented during planning, construction, and operation of the project.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar development projects.
- The impact descriptions and assessment are based on the author's understanding of the proposed development based on information provided.

2.6.6 Risk Assessment

- All risk ratings generated by the DWS risk matrix are conditional on the effective implementation of the mitigation measures provided in the specialist freshwater habitat assessment report for the project.
- For the purposes of this study, the term 'stressor[4]' was favoured instead of the term 'aspect' referred to in the DWS risk matrix.
- For the purposes of this study, the criterion 'frequency of stressor occurrence' was favoured instead of the criterion 'frequency of activity' referred to in the DWS risk matrix.
- For the severity ratings, impacts were assessed on their merits rather than automatically scoring impacts as 'disastrous' as guided in the DHSWS risk matrix.
- The severity assessment for changes in flow regime and physico-chemical impacts were interpreted in terms of the changes to the local freshwater ecosystem represented by the potentially affected reaches.

[4] Any physical, chemical, or biological entity that can induce an adverse response to the structure and function of an ecosystem (Reference: USEPA (1998). Guidelines for Ecological Risk Assessment; Notice Fed. Reg. 6326846-26924. Environmental Monitoring Systems Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati, Ohio.

3. DESKTOP ASSESSMENT

3.1 Catchment & 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 Drainage Setting & Catchment Context

The study area is located on the left bank of the Orange River system, looking downstream and covers portions of DWS Quaternary Catchments D12A, D12B, D12C and D18L. These Quaternary Catchments existing within the Orange River Water Management Area. The main river draining D12A and D18L is the upper Orange. The main rivers draining D12B and D12C are the Sterkspruit / Kromspruit and Bamboesspruit Rivers, respectively. The Sterkspruit and Bamboesspruit Rivers are right bank tributaries of the Orange River. The Joezana's Hoek Dam is located within DWS Quaternary Catchment D12B along the lower Mhlangeni River. This river and dam are however upstream of the study general area.

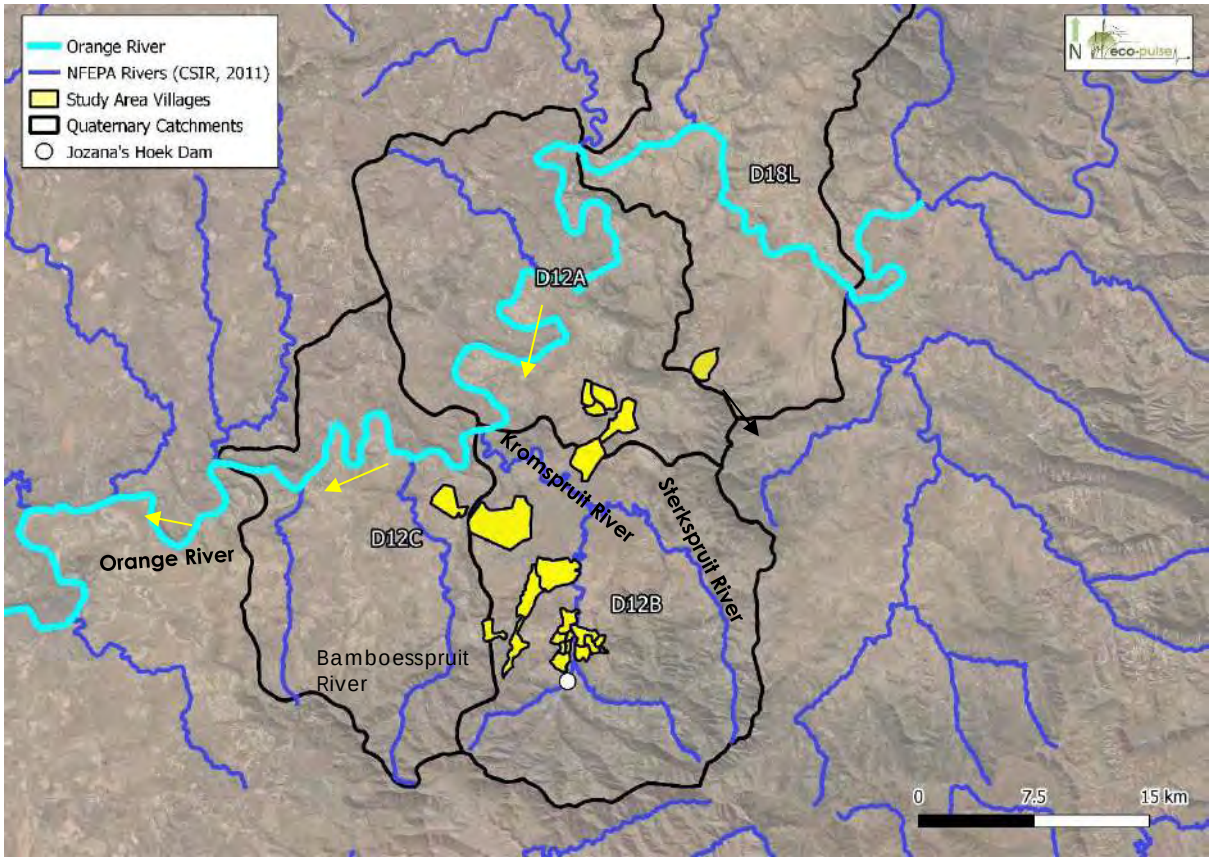


Figure 4. Map showing the quaternary catchment and local drainage network that characterises the project study area.

3.1.2 Freshwater Conservation Context

National and provincial conservation datasets were screened for the study area, the results of which are presented in Table 8. Important conservation importance points to note are as follows:

- Most NFEPA Catchment Planning Units are Upstream Management Areas. These are sub-quaternary catchment areas in which human activities must be managed to prevent the degradation of a downstream FEPA, in this case the Orange River. Planning Unit 5144, associated with the Orange River is a Freshwater Ecosystem Priority Area (FEPA).
- According to the inland aquatic realm of the 2018 National Biodiversity Assessment (SANBI, 2019) the following ecosystem types associated with the study area are considered Critically Endangered:
  - Non-Perennial Lower Foothill Rivers.
  - Mesic Highveld Grassland Channel Valley Bottom Wetlands.
  - Mesic Highveld Grassland Floodplain Wetlands.
  - Mesic Highveld Grassland Seep Wetlands.
  - Mesic Highveld Grassland Unchanneled Valley Bottom Wetlands.

Table 8. Key freshwater conservation context details for the study area.

	NATIONAL LEVEL CONSERVATION PLANNING CONTEXT	
Conservation Planning Dataset	Relevant Conservation Feature	Conservation Planning Status
National Freshwater Ecosystem Priority Areas (NFEPA) (WRC, 2011)	Catchment Planning Units: • 5017 • 5144 • 5222 • 5232 • 5262 • 5297 • 5414	Upstream Management Area (5222, 5232, 5262, 5263, 5297, 5414) FEPA Catchment (5144)
2018 National Biodiversity Assessment – Rivers	Non-Perennial Upper Foothill Rivers Non-Perennial Lower Foothill Rivers Perennial Lowland Rivers	Endangered Critically Endangered Endangered
	**All other river ecosystem types within the study area are Least Concern*	
2018 National Biodiversity Assessment – Wetlands	Channel Valley Bottom Depression Floodplain Seep Unchanneled Valley Bottom	Critically Endangered Least Concern Critically Endangered Critically Endangered Critically Endangered
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT		
Conservation Planning Dataset	Relevant Conservation Feature	Conservation Planning Status
Eastern Cape Biodiversity Conservation Plan (Desmet & Hawley 2019)	Watercourses within study area	ESA 1

3.2 Watercourse Mapping & Likelihood of Impact Screening

Watercourses occurring within a 500m radius of the existing and proposed water supply scheme infrastructure [i.e., within the DWS regulated area for Section 21 (c) and/or (i) wetland water use] were mapped at a desktop level. 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 project 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 upgrade of water supply infrastructure and establishment of new infrastructure are as follows:

1. Direct physical modification of habitat due to pipe trenching within watercourses.
2. Increased sediment deposition due to construction phase earthworks within and near watercourses.
3. Alteration of catchment surface water runoff processes and associated watercourse erosion and sedimentation.
4. Alteration of natural flow / wetness regimes due to leaking / malfunctioning water supply infrastructure during the operation phase of the upgraded supply scheme.

A total of two-hundred and forty-six (246) watercourse units were mapped during the desktop delineation process. The location of the watercourses is shown in Figure 5 and 6, including the impact likelihood rating for each watercourse unit. the results of the impact likelihood rating process are as follows:

- 'High' likelihood of being impacted – Eighty-Three (83) watercourses
- 'Moderate' likelihood of being impacted – six (6) watercourses
- '**No / None**' likelihood of being impacted – One-Hundred and Fifty-Six (156) watercourses

A total of eighty-nine (89) watercourses were therefore carried forward for the baseline assessment (chapter 4).

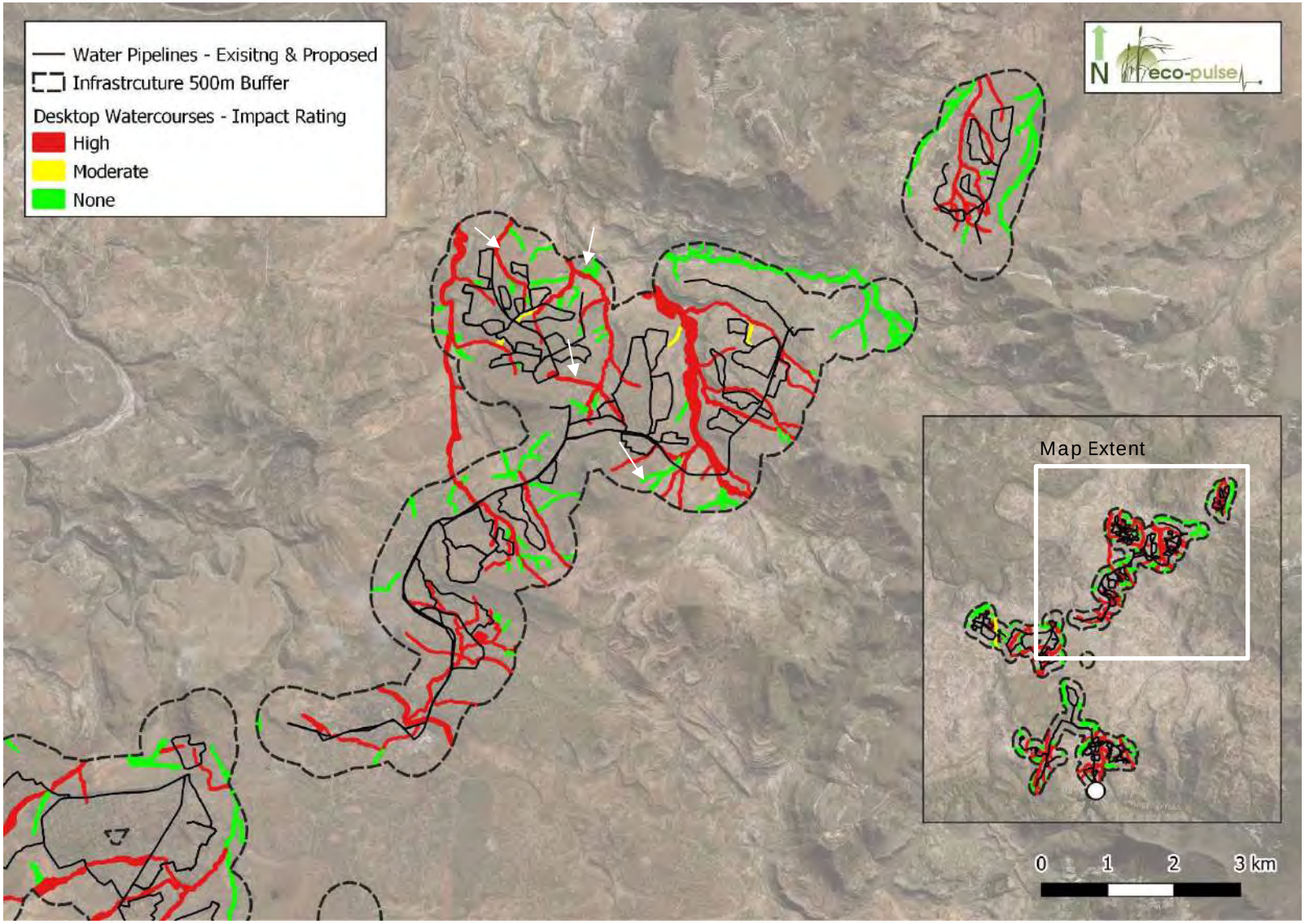
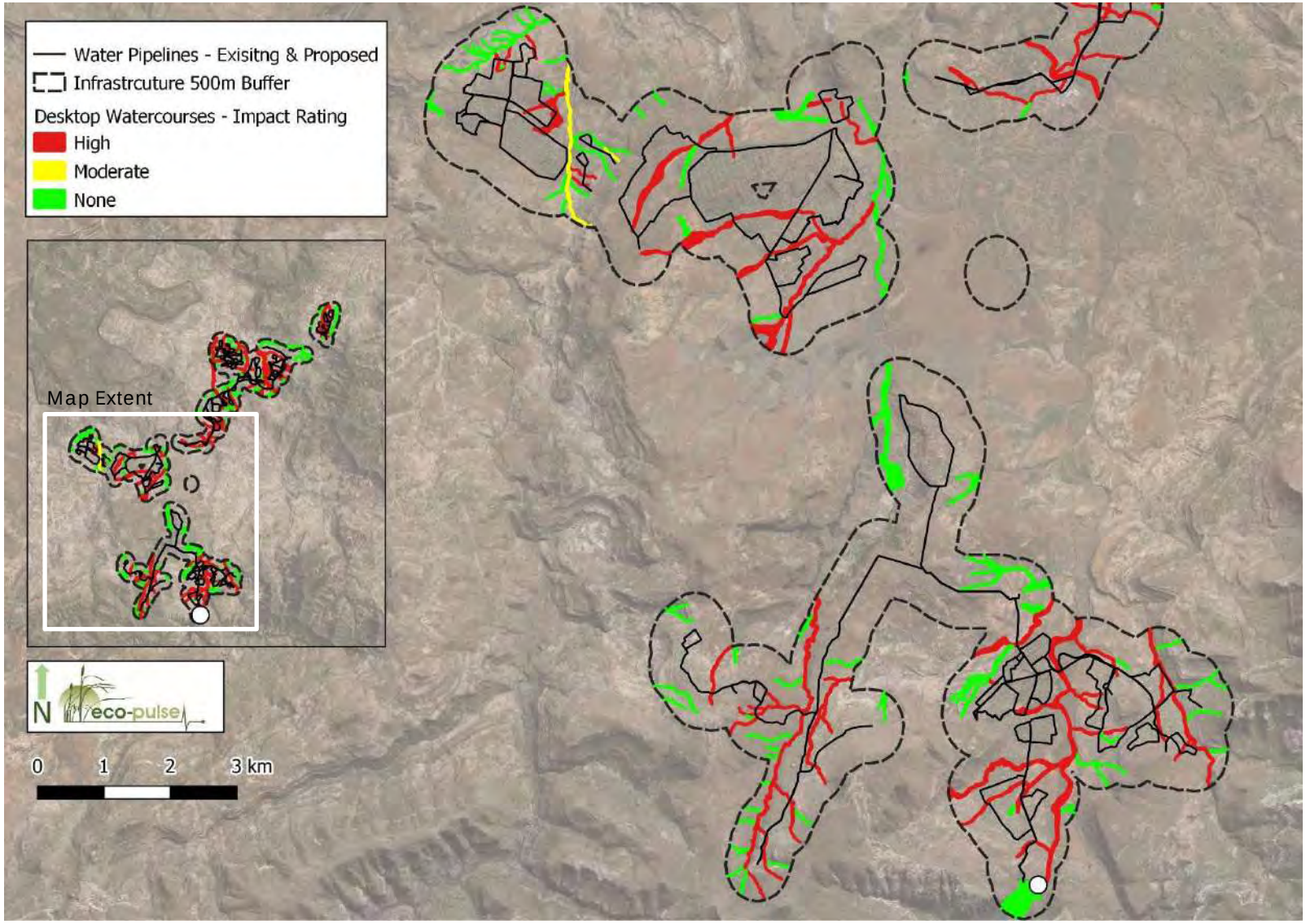


Figure 5. Desktop watercourse delineation and 'impact potential' screening outputs for the northern section of the study area.



Desktop watercourse delineation and 'impact potential' screening outputs for the southern section of the study area.

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 Watercourse Classification & Process Unit Grouping

All watercourses with a high and moderate likelihood of being impacted according to the rating method in Table 3 were classified in terms of their Hydro Geomorphic (HGM) type in accordance with the national wetland/river classification defined by Ollis et al. (2013). These units were then further divided into a total of ten (10) different 'process unit groups' to assist with the efficient assessment of watercourses in the study area (see Box 1 below for further information on the 'process units' approach). Large perennial river systems were not assigned to a process unit group and were instead assessed individually. The outcomes of the classification and process unit grouping process are outlined below and are shown in Figures 7 and 8:

- Wetland Process Unit 01 – Eleven (11) Unchanneled Valley-Bottom Wetlands
- Wetland Process Unit 02 – Thirty (35) Unchanneled Valley-Bottom Wetlands
- Wetland Process Unit 03 – Ten (10) Unchanneled Valley-Bottom Wetlands
- Wetland Process Unit 04 – Five (5) Seep Wetlands
- Wetland Process Unit 05 – Four (4) Seep Wetlands
- Wetland Process Unit 06 – Four (4) Seep Wetlands
- Wetland Process Unit Group 07 – One (1) Depression Wetland
- River Process Unit Group 01 – Sixteen (16) Mountain Streams
- River Process Unit Group 02 – Two (2) Mountain Streams
- River Process Unit Group 03 – Thirteen (13) Transitional Rivers
- River 01 – Upper Foothills River (Unnamed)
- River 02 – Upper Foothills River (Unnamed)
- River 03 – Lower Foothills River (Kromspruit)
- River 04 – Transitional River (Bensonvale Spruit)
- River 05 – Lower Foothills Rivers (Sterkspruit)
- River 06 – Transitional River (Unnamed)

Box 1. 'Process Units' assessment approach

'Process Units' refer to wetlands or rivers of the same general type in terms of their classification, with similar existing impacts to ecosystem health, drivers and response, similar processes, ecological functions and). Using a 'Process Unit' type approach can be particularly useful when required to assess numerous wetlands at a rapid and efficient level and where conditions allow for similar wetlands/rivers to be grouped to make the baseline assessment of PES/EIS more efficient.

Process units were defined and differentiated based on the following criteria: wetland/river type, soil type/texture, longitudinal slope, vegetation characteristics and existing catchment land sue and onsite impacts to the fundamental drivers of aquatic ecosystems.

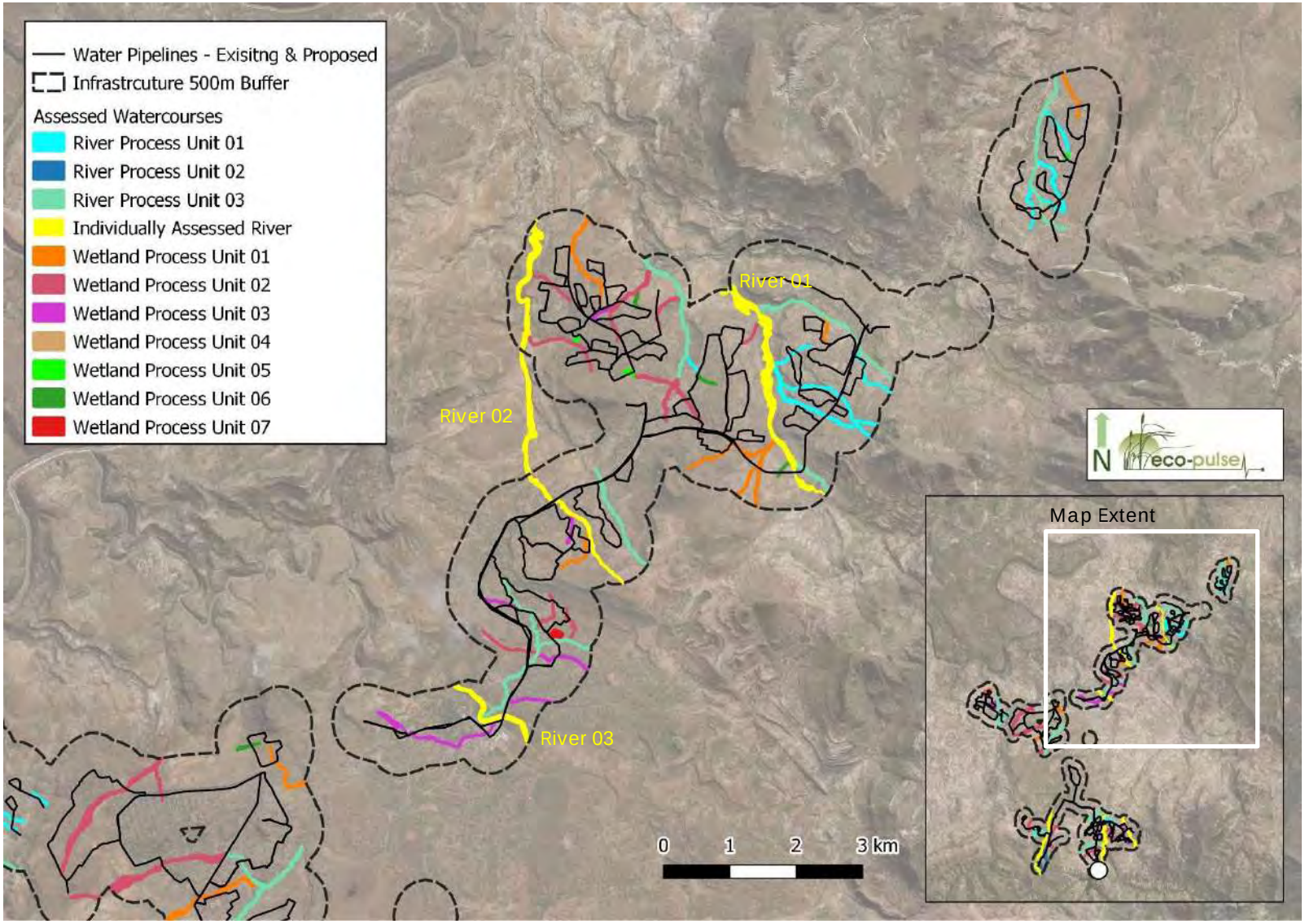


Figure 6. Delineated and classified watercourses (rivers & wetlands) in the north section of the study area, separated into different 'process units.

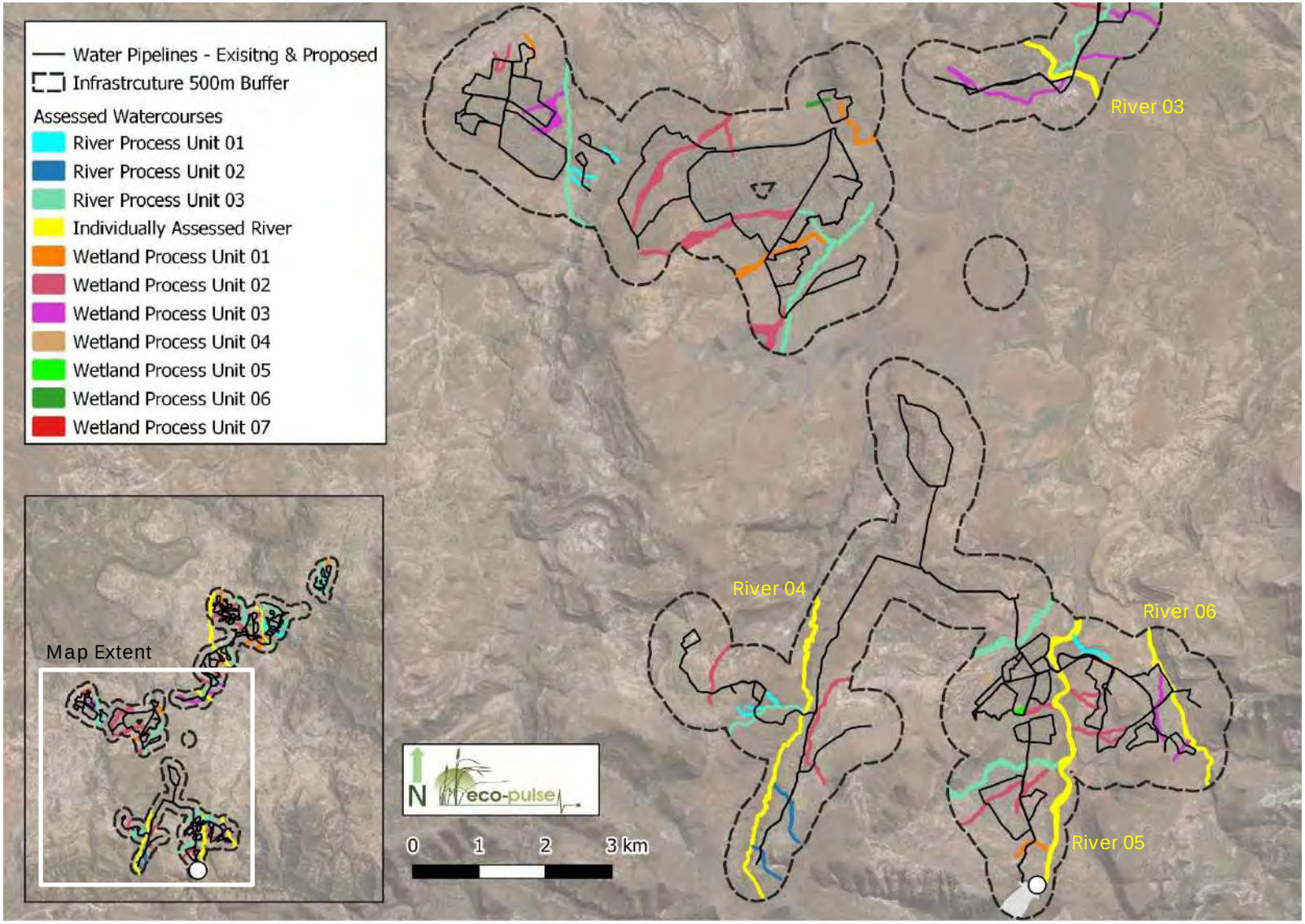


Figure 7. Delineated and classified watercourses (rivers & wetlands) in the south section of the study area, separated into different 'process units.

4.2 Habitat Characteristics

All ten (10) process unit groups associated with the study area described in this section of the report. Rivers R01 – R06 are described as individual units rather than as part of a Process Unit group. The location and extent of the delineated watercourses is shown on the maps in Figures 6 and 7. A summary of the key biophysical characteristics of each process unit, as well as River units R01 – R06 are presented in the tables that follow.

4.2.1 Wetlands

A total of seven (7) wetland Process Unit groups were identified. Each of these is described in Tables 9 – 15, which follow.

Table 9. Summary of key features of wetland 'Process Unit' group 01, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 01	
Applicable Units *Units sampled in 'Red'*	W1, W7, W8, W9, W10, W16, W21, W28, W29, W34, W43
Reference HGM Classification	Unchanneled Valley Bottom Wetland (with notable lateral water inputs)
General Unit Description	Historically narrow unchanneled valley bottom wetland systems with notable water inputs from its upstream and adjacent catchment area. In the present state these wetlands are dominated by extensive active gully erosion. Isolated reaches exist along wetlands where eroded material is accumulating and where wetland habitat is present.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Seasonal
Dominant water input	Surface flow from upstream catchment
Dominant Low flow pattern	Surface flow along eroded gully bed
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	Dominated by bare eroded areas. Where vegetation was present this was largely in the form of heavily degraded secondary hygrophilous grassland communities. The exact composition of the grassland community depended on land use and the level of grazing.

Selected Photos of Wetlands associated with Process Unit 01 are included below:

Photo 01: Downstream view of wetland W9.

Photo 02: Downslope view of wetland W08.

Table 10. Summary of key features of wetland 'Process Unit' group 02, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 02	
Applicable Units *Units sampled in 'Red'*	W2, W3, W4, W6, W13, W15, W17, W19, W22, W24, W25, W30, W31, W35, W36, W39, W40, W44, W45, W54, W55, W56, W57, W58, W59, W60
Reference HGM Classification	Unchanneled Valley Bottom Wetland (with notable lateral water inputs)
General Unit Description	Historically narrow unchanneled valley bottom wetland systems with notable water inputs from its upstream and adjacent catchment area. In their present state these wetlands contain extensive heavily eroded areas, but also contain reaches of notable sediment accumulation associated with wetland habitat and processes.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Seasonal
Dominant water input	Surface flow from upstream catchment
Dominant Low flow pattern	Surface flow along eroded gully beds.
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	Zones of sediment accumulation were typically dominated by a mix of obligate wetland plants (Schoenoplectus sp., Typha capensis, Cyperus sexangularis) and overgrazed hygrophilous grassland communities. Actively eroding zones were largely void of vegetation.

Selected Photos of Wetlands associated with Process Unit 02 are included below:

Photo 03: Downstream view of wetland W55.

Photo 04: Upslope view of W59

Table 11. Summary of key features of wetland 'Process Unit' group 03, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 03	
Applicable Units *Units sampled in 'Red'*	W11, W20, W26, W27, W32, W33, W37, W38, W51, W61
Reference HGM Classification	Unchanneled Valley Bottom Wetland (with notable lateral water inputs)
General Unit Description	Grassy unchanneled valley bottom wetland systems that have not undergone extensive erosion.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Seasonal
Dominant water input	Surface flow from upstream catchment
Dominant Low flow pattern	Diffuse subsurface flow
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	overgrazed hygrophilous grassland communities

Selected Photos of Wetlands associated with Process Unit 03 are included below:

Photo 05: Downstream view of wetland W20.

Photo 06: Downstream view of W51

Table 12. Summary of key features of wetland 'Process Unit' group 04, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 04	
Applicable Units *Units sampled in 'Red'*	W5, W41, W46, W47, W49
Reference HGM Classification	Seep
General Unit Description	Headwater seep systems characterised by extensive active erosion
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Temporary
Dominant water input	Diffuse surface from bare and eroded catchment areas.
Dominant Low flow pattern	Surface flow along erosion gullies,
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	Largely void of vegetation due to erosion.

Selected Photos of Wetlands associated with Process Unit 04 are included below:

Photo 07: Downstream view of wetland W47

Photo 08: Downstream view of W49

Table 13. Summary of key features of wetland 'Process Unit' group 05, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 05	
Applicable Units *Units sampled in 'Red'*	W14, W18, W42, W52
Reference HGM Classification	Seep
General Unit Description	Headwater seep systems that have been extensively overgrazed and which contain small stock watering dams.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Temporary
Dominant water input	Diffuse surface from bare and eroded catchment areas.
Dominant Low flow pattern	Diffuse subsurface flow
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	Overgrazed hygrophilous grassland vegetation.

Selected Photos of Wetlands associated with Process Unit 05 are included below:

Photo 09: Downstream view of wetland W14

Photo 10: Downstream view of W52

Table 14. Summary of key features of wetland 'Process Unit' group 06, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 06	
Applicable Units *Units sampled in 'Red'*	W12, W48, W50, W53
Reference HGM Classification	Seep
General Unit Description	Uneroded but overgrazed or historically cultivated seeps
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Temporary
Dominant water input	Diffuse surface from bare and eroded catchment areas.
Dominant Low flow pattern	Diffuse subsurface flow
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	Overgrazed hygrophilous grassland vegetation.

Selected Photos of Wetlands associated with Process Unit 06 are included below:

Photo 11: Upslope view of wetland W12

Photo 12: Downstream view of W50

Table 15. Summary of key features of wetland 'Process Unit' group 07, including general biophysical characteristics of wetlands associated with this process unit group.

Wetland Process Unit 07	
Applicable Units *Units sampled in 'Red'*	W23
Reference HGM Classification	Depression
General Unit Description	Depression wetland with extensive open water
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Biophysical Characteristics	
Dominant wetness zone	Permanent
Dominant water input	Diffuse surface and subsurface flow from surrounding catchment area.
Dominant Low flow pattern	NA
General soil characteristics	Temporary Soils: 0-10cm: Grey-brown clay loam (7.5YR 4/2). No soil mottles. 40-50cm: Grey-brown clay loam (7.5YR 4/2). Low abundance of orange soil mottles.
General vegetation characteristics	Open water with fringing obligate sedge community

Selected Photos of Wetlands associated with Process Unit 07 are included below:

Photo 13: Upslope view of wetland W23.

4.2.2 Rivers / Streams

A total of three (3) river / stream Process Unit groups were identified. River units R01 - R06 were assessed individually. Each of these units is described in Tables 16 to 24, which follow.

Table 16. Summary of key features of river 'Process Unit' group 01, including general biophysical characteristics of streams associated with this process unit group.

River Process Unit 01	
Applicable Units *Units sampled in 'Red'*	R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22
Longitudinal zone	Mountain Stream
General Unit Description	Heavily eroded streams with relatively small catchments areas. These units current exist as erosion gullies.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Ephemeral
Expected dominant substrate type	Bedrock
Expected Instream biotopes	• Riffles • Runs • Pools
Expected Riparian features	• Active channel banks • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by a hygrophilous grassland community with a moderate abundance of woody species associated with surround thicket. Active Channel: • Limited instream vegetation expected due to eroded nature of the channel bed.

Selected Photos of rivers associated with River Process Unit 01 are included below:

Photo 14: Downstream facing photo of the upper reaches of R13.

Photo 15: Downstream facing photo of the upper reaches of R14.

Table 17. Summary of key features of river 'Process Unit' group 02, including general biophysical characteristics of streams associated with this process unit group.

River Process Unit 02	
Applicable Units *Units sampled in 'Red'*	R23, R24
Longitudinal zone	Mountain Stream
General Unit Description	Mountain streams with eroded reaches but which also contain reaches were stream functional processes remain partly intact.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Ephemeral
Expected dominant substrate type	Bedrock
Expected Instream biotopes	• Riffles • Runs • Pools
Expected Riparian features	• Active channel banks • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by a hygrophilous grassland community with a moderate abundance of woody species associated with surround thicket. Active Channel: • Limited instream vegetation.

Selected Photos of rivers associated with River Process Unit 02 are included below:

Photo 14: Downstream facing photo of the upper reaches of R24

Table 18. Summary of key features of river 'Process Unit' group 03, including general biophysical characteristics of streams associated with this process unit group.

River Process Unit 03	
Applicable Units *Units sampled in 'Red'*	R25, R26, R27, R28, R29, R30, R31, R32, R33, R34 , R35, R36, R37
Longitudinal zone	Transitional River
General Unit Description	Heavily eroded river systems with extensive reaches existing as active erosion gullies.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Seasonal
Expected dominant substrate type	Bedrock
Expected Instream biotopes	• Riffles • Runs • Pools
Expected Riparian features	• Active channel banks • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by a hygrophilous grassland community with a moderate abundance of woody species associated with surround thicket. Active Channel: • Limited instream vegetation expected due to eroded nature of the channel bed.

Selected Photos of rivers associated with River Process Unit 03 are included below:

Photo 15: Downstream facing photo of the lower reaches of R17.

Photo 16: Downstream facing photo of the lower reaches of R25.

Table 19. Summary of key features of River 01 (Unnamed), including general biophysical characteristics of streams associated with this process unit group.

River 01 (Unnamed)	
Longitudinal zone	Upper Foothills River
General Unit Description	Heavily degraded river system with a braided active channel within a greater erosion channel
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Perennial
Expected dominant substrate type	Mixed bedrock and course alluvium
Expected Instream biotopes	• Riffles • Runs • Pools
Expected Riparian features	• Active channel banks • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by a hygrophilous grassland community with a moderate abundance of woody species associated with surround thicket. Active Channel: • Limited instream vegetation expected due to eroded nature of the channel bed.

Selected Photos of rivers associated with River 01 are included below:

Photo 17: Downstream facing photo of the upper reaches of River 01.

Photo 18: Upstream facing photo of the upper reaches of River 01.

Table 20. Summary of key features of River 02 (Unnamed), including general biophysical characteristics of streams associated with this process unit group.

River 02 (Unnamed)	
Longitudinal zone	Upper Foothills River
General Unit Description	Heavily degraded river system with a narrow active channel within a greater erosion channel
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Perennial
Expected dominant substrate type	Mixed bedrock and course sandy alluvium
Expected Instream biotopes	• Riffles • Runs • Pools
Expected Riparian features	• Active channel banks • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by a secondary grassland community with a low abundance of woody species. Active Channel: • Limited instream vegetation expected due to eroded nature of the channel bed.

Selected Photos of rivers associated with River 02 are included below:

Photo 19: Downstream facing photo of the upper reaches of River 03.

Table 21. Summary of key features of River 03 (Kromspruit), including general biophysical characteristics of streams associated with this process unit group.

River 03 (Kromspruit)	
Longitudinal zone	Lower Foothills River
General Unit Description	Large slow flowing perennial river with extensive pools.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Perennial
Expected dominant substrate type	Mixed bedrock and course sandy alluvium
Expected Instream biotopes	• Riffles • Rapids • Runs • Pools
Expected Riparian features	• Active channel banks • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by *Arundo donax, Senna didymobotrya, Solanum mauritianum and Lantana camara* (Visited reach was within the toen of Sterkspruit and was characterised by a largely modified riparian vegetation community.

Selected Photos of rivers associated with River 03 are included below:

Photo 20: Upstream facing photo of the lower reaches of River 03.

Table 22. Summary of key features of River 04 (Bensonvale Spruit), including general biophysical characteristics of streams associated with this process unit group.

River 04 (Bensonvale Spruit)	
Longitudinal zone	Transitional River
General Unit Description	Narrow and perennially flowing rocky river.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Perennial
Expected dominant substrate type	Mixed bedrock and course alluvium
Expected Instream biotopes	• Riffles • Runs • Pools
Expected Riparian features	• Active channel banks • Flood bench • Macro channel bank
Expected Vegetation characteristics	Marco Bank • Dominated by *Populus alba, Acacia mearnsii, Leucosidea sericea, and Eragrostis plana* Marco Bank • Dominated by *Leucosidea sericea and Eragrostis plana*

Selected Photos of rivers associated with River 04 are included below:

Photo 20: Upstream facing photo of the lower reaches of River 04.

Table 23. Summary of key features of River 05 (Sterkspruit), including general biophysical characteristics of streams associated with this process unit group.

River 05 (Sterkspruit)	
Longitudinal zone	Lower Foothills River
General Unit Description	Largely perennial system dominated by bedrock boulders.
General Catchment Description	A mix of current and abandoned agricultural lands and scattered rural homesteads
Expected Biophysical Characteristics	
Expected Perenniality	Perennial
Expected dominant substrate type	Mixed bedrock boulder and sandy alluvium
Expected Instream biotopes	• Riffles • Rapids • Runs • Pools
Expected Riparian features	• Active channel banks • Flood bench • Macro channel bank
Expected Vegetation characteristics	Marco Bank & Flood bench • Dominated by a overgrazed secondary grassland community

Selected Photos of rivers associated with River 05 are included below:

Photo 20: Upstream facing photo of the lower reaches of River 03.

4.3 Present Ecological State (PES) Assessment

This section of the specialist report documents the findings of the wetland and river 'Present Ecological State' (PES) assessments and provides descriptions of key impacts and PES scores and ratings.

4.3.1 Wetland PES

Wetland PES was assessed using the WET-Health (Macfarlane *et al.*, 2008) assessment method and tool at a rapid level 1 assessment level. Given the large number of wetlands requiring assessment (61 individual wetlands) and time/budget constraints, a process unit approach was used to group and assess similar wetlands (*this approach is discussed in more detail in Section 3.2 and under the methods section in 2.2.3*).

The outcomes of the assessment indicate that:

- Wetlands within the study area range from moderately to critically modified (C – F PES Category). No natural or partially natural wetlands were noted at the site.
- One of the most notable impacts to onsite wetlands is a general increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. In most instances this has resulted in considerable wetland erosion.
- Wetlands in the study area were often heavily overgrazed and exhibited a poor-quality secondary grassland community.

Table 24. PES Summary for the assessed wetland process unit groups.

Wetland Process Unit	Hydrology	Geomorphology	Vegetation	Overall PES	Key Impact(s)
Process Unit 01	E	E	F	F Critical Modification	• Critical increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Altered geomorphic structure and processes due to extensive loss of wetland soils because of widespread erosion. • Altered water distribution and retention patterns due concentrated flow paths caused by gulley erosion. • Critically modified wetland vegetation with extensive bare areas caused by erosion impacts.
Process Unit 02	D	D	D	D Large Modification	• Increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Altered geomorphic structure and processes due to extensive loss of wetland soils because of widespread erosion. Although reaches exist where sediment is accumulating and unchanneled wetland processes are partially reinstated. • Altered water distribution and retention patterns due concentrated flow paths caused by gulley erosion. • modified wetland vegetation with extensive bare areas caused by erosion impacts. Grass and sedgeland species are re-colonising stable gully bed reaches.
Process Unit 03	C	D	C	C Moderate Modification	• Increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Minor concentration of flowing where rills and minor erosion gullies are present. • Heavily overgrazed wetland vegetation resulting in a change in species composition.
Process Unit 04	F	F	F	F Critical Modification	• Critical increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Altered geomorphic structure and processes due to extensive loss of wetland soils because of widespread erosion. • Altered water distribution and retention patterns due concentrated flow paths caused by gulley erosion. • Complete modification of wetland vegetation with extensive bare areas caused by erosion impacts.
Process Unit 05	C	C	D	C Moderate Modification	• Increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Minor concentration of flowing where rills and minor erosion gullies are present. • Impeding of flow along the wetland due the presence of a dam. • Heavily overgrazed wetland vegetation resulting in a change in species composition.

Wetland Process Unit	Hydrology	Geomorphology	Vegetation	Overall PES	Key Impact(s)
Process Unit 06	C	C	C	C Moderate Modification	• Increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Minor concentration of flowing where rills and minor erosion gullies are present. • Heavily overgrazed wetland vegetation resulting in a change in species composition.
Process Unit 07	C	C	C	C Moderate Modification	• Heavily overgrazed wetland vegetation surrounding the open water area, resulting in a change in species composition. • Increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands.

4.3.2 River & Stream PES

Rivers / streams PES was assessed using the Index of Habitat Integrity or IHI (Kleyhans, 1996). Key outcomes are as follows:

- Rivers and streams within the study area range from moderately to seriously modified (C – E PES Category). No natural or partially natural river / stream units were noted at the site. The most severally modified units were the heavily eroded mountain stream systems (Process Unit 01).
- All rivers and streams were noted as having experienced a degree of bed and bank erosion associated with altered catchment water and sediment runoff processes.
- Natural riparian vegetation was largely lacking from rivers / streams within the study area. In many instances natural woody riparian vegetation had been removed by local communities. Old and present cultivated lands often extended to the edge of river and stream boundaries, critically changing the system vegetation composition, and affecting bank stability.

Table 25. PES summary for the river units assessed based on instream and riparian habitat integrity.

River Process Units	Instream	Riparian	PES	Key Impact(s)
River Process Unit 01	E	E	E Serious Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Bed and bank modification associated with extensive erosion. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.
River Process Unit 02	C	D	C Moderate Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.

River Process Units	Instream	Riparian	PES	Key Impact(s)
River Process Unit 03	D	E	D Large Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Bed and bank modification associated with extensive erosion. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.
River 01 (Unnamed)	D	E	D Large Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Bed and bank modification associated with extensive erosion. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.
River 02 (Unnamed)	D	E	D Large Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Bed and bank modification associated with extensive erosion. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.
River 03 (Kromspruit)	C	D	C Moderate Modification	• Notable solid waste disposal and rubbish dumping. • Altered physiochemical water quality associated with contaminated runoff from the Sterkspruit settlement • Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover and urban catchment setting. • Bed and bank modification associated with extensive erosion. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.
River 04 (Bensonvale Spruit)	B	C	C Moderate Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover and urban catchment setting. • Minor bed and bank modifications associated with localised erosion processes. • Infestation of riparian vegetation by woody invasive alien plant species.
River 05 (Sterkspruit)	D	D	D Large Modification	• Altered flow and inundation regimes due to upstream Joezana's Hoek Dam. • Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. • Bed and bank modification associated with extensive erosion. • Altered instream and riparian vegetation communities due to erosion, vegetation removal and agricultural practices.
River 06 (Unnamed)	C	C	C Moderate Modification	• Increase in water and sediment inputs into river system due to a reduction in catchment vegetation basal cover and urban catchment setting. • Minor bed and bank modifications associated with localised erosion processes. • Infestation of riparian vegetation by woody invasive alien plant species.

4.4 Wetland Ecosystem Services Assessment

An assessment of wetland ecosystem services importance (i.e. wetland functionality) was assessed using the WET-Ecoservices method (Kotze *et al.*, 2019). Given the large number of wetlands recorded (>70 individual wetlands) and time/budgetary constraints, a process unit approach was used to group and assess similar wetlands (*this approach is discussed in more detail in Section 3.2 and under the methods section in 2.2.3*).

4.4.1 Regulating Ecosystem Services (Functional) Assessment

A summary of the regulating services importance scores and ratings for the wetlands assessed is provided in Table 26 below:

- Wetlands belonging to Process Unit Group 02 were assessed as being of moderate importance for sediment trapping. This relates to the notable accumulation of sediment in aggradational wetland reaches with the sediment being mobilised by upstream erosional processes. the accumulation of sediment within these wetlands prevents the export of large quantities of sediment to downstream watercourses.
- Wetland 07 was assessed as being moderate importance for its carbon storage services. This wetland unit is dominated by permanent and seasonal wetland conditions and is characterised by relatively robust vegetation. This means the wetland is reasonably well suited as a long-term carbon sink.
- Wetland Process Unit Groups 01, 03, 04, 05, and 06 were all assessed as being of Very Low or Low overall regulating services importance.

Table 26. Summary of regulating services importance scores and overall importance rating for each wetland process unit.

Wetland Process Units	Regulating Services Scores (0-4)								Overall Rating
	Flood attenuation	Streamflow regulation	Sediment trapping	Erosion control	Phosphate removal	Nitrate removal	Toxicant removal	Carbon storage	
01	0.0	0.5	0.4	0.0	0.0	0.0	0.0	0.1	Very Low
02	0.0	0.5	1.9	0.0	1.2	0.0	0.8	0.4	Moderate
03	0.0	0.5	1.1	1.1	1.0	0.6	0.8	1.2	Low
04	0.0	0.2	0.0	1.0	0.0	0.0	0.0	0.0	Low
05	0.0	0.2	0.0	1.2	0.0	0.0	0.0	0.0	Low
06	0.0	0.2	0.0	0.3	0.0	0.0	0.0	0.0	Very Low

Wetland Process Units	Regulating Services Scores (0-4)								Overall Rating
	Flood attenuation	Streamflow regulation	Sediment trapping	Erosion control	Phosphate removal	Nitrate removal	Toxicant removal	Carbon storage	
07	0.0	0.0	0.0	0.8	0.0	0.0	0.0	2.1	Moderate

4.4.2 Provisioning and Cultural Services Assessment

A summary of the provisioning and cultural services importance scores and ratings is provided in Table 27 below:

- Wetlands belonging to Process Unit Groups 05 and 07 were assessed as being of Moderately Low provisioning importance. This relates to the seasonal availability of open water within these units which is used for livestock watering.
- Wetland Process Unit Groups 01, 02, 03, 04, and 06 were all assessed as being of Very Low or Low overall provisioning and cultural services importance.

Table 27. Summary of provisioning & cultural services importance scores and overall importance rating for each wetland unit.

Wetland Process Units	Provisioning & Cultural Services Scores (0-4)							Overall Rating
	Water supply	Harvestable natural resources	Food for livestock	Cultivated foods	Cultural significance	Tourism and recreation	Education and research	
01	0.3	0.0	0.0	0.8	0.5	0.0	0.0	Very Low
02	0.3	0.0	1.2	0.8	0.5	0.0	0.0	Low
03	0.3	0.0	1.2	0.8	0.5	0.0	0.0	Low
04	0.0	0.0	0.2	1.3	0.5	0.0	0.0	Low
05	1.7	0.0	.0.2	1.3	0.5	0.0	0.0	Moderately Low
06	0.0	0.0	0.2	1.3	0.5	0.0	0.0	Low
07	1.7	0.0	0.2	0.3	0.5	0.0	0.0	Moderately Low

4.5 Ecological Importance & Sensitivity (EIS) Assessment

The Ecological Importance of wetlands and 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 system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007).

4.5.1 Wetland EIS Assessment

The wetland EIS assessment involved rating four (4) major components, namely:

- Ecological Importance in terms of biodiversity maintenance
- Ecological Importance in terms of ecological functions
- Ecological Importance in terms of regulating functions
- Ecological sensitivity

A summary of the EIS assessment is provided in Table 28. Key factors driving EIS wetland are as follows:

- Wetlands belonging to Process Unit Group 02 are of Moderate Ecological Importance because of the role these wetlands play in trapping sediment. These wetlands were also assessed as being of Moderate Ecological Sensitivity. This largely relates to the erosion risk associated with rapidly aggrading wetland reaches. The overall EIS rating for wetlands belonging to Process Unit Group 02 is therefore Moderate.
- Wetlands belonging to Process Unit Group 03 are of Moderate Ecological Importance. This is because these wetlands represent moderately intact examples of unchanneled valley bottom wetlands within the mesic highveld grassland bioregion. These wetland ecosystems are considered Critically Endangered by the latest National Biodiversity Assessment (SANBI, 2018). These wetlands were also assessed as being of Moderate Ecological Sensitivity due to their erosion risk. The overall EIS rating for wetlands belonging to Process Unit Group 03 is therefore Moderate.
- Wetlands belonging to Process Unit Groups 01, 04, 05, 06, and 07 are all considered to be of Low overall EIS.

Table 28. Summary of the EIS rating for the assessed wetland Process Unit Groups.

	Process Unit 01	Process Unit 02	Process Unit 03	Process Unit 04	Process Unit 05	Process Unit 06	Process Unit 07
Ecological Importance	Low	Mod	Mod	Low	Mod	Low	Mod
Ecological Sensitivity	Low	Mod	Mod	Low	Low	Low	Low
Overall EIS Rating	Low	Mod	Mod	Low	Low	Low	Low

4.5.2 River & Stream EIS Assessment

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 29. Key outcomes are as follows:

- All watercourse units associated with River Process Unit Group 01, 02, and 03 were rated as being

of 'Low' EIS. Important considerations for the EIS assessment for onsite streams include the following:

- Mountain streams and transitional rivers in the study area are 'Least Threatened' in terms of conservation threat status (SANBI, 2018).
- These watercourse units do not host important or sensitive taxa and provide only limited refugia for biota due to their ephemeral / seasonal flow.
- The stream units are likely to be moderately sensitive to flow related changes and changes in water quality due to their prevailing ephemeral / seasonal flow conditions.

- Rivers 01 to 06 were rated as being of 'Moderate' EIS. Important considerations for the EIS assessment for onsite streams include the following:
  - Rivers in the study area are 'Least Threatened' in terms of conservation threat status (SANBI, 2018).
  - The perennial flow that characterises these river units means that they are likely to play host to a range of aquatic fauna that rely on the year-round presence of water for them to survive and breed.
  - These rivers likely provide 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.
  - The diversity of instream habitat available to aquatic fauna makes these rivers ecologically important.

Table 29. Summary of EIS scores and overall EIS rating for the assessed South Block River and stream

Watercourse(s)	Hosts Rare & endangered	Unique species (endemic, isolated, etc.)	Intolerant species sensitive to flow/water quality modifications	Species/taxon richness	Diversity of habitat types	Refugia for biota	Sensitivity to flow changes	Sensitivity to flow related water quality changes	Migration route/corridor (instream & riparian)	Importance of conservation & natural areas	EIS Class
Scores (out of 4) and Rating											
River Process Unit 01	None	None	None	Low	Low	Low	Mod	Mod	Low	Mod	Low
River Process Unit 02	None	None	None	Low	Low	Low	Mod	Mod	Low	Mod	Low
River Process Unit 03	None	None	None	Low	Low	Low	Mod	Mod	Low	Mod	Low
River 01 (Unnamed)	None	None	Mod	Low	Mod	Mod	Mod	Mod	Low	Mod	Moderate
River 02 (Unnamed)	None	None	Mod	Low	Mod	Mod	Mod	Mod	Low	Mod	Moderate
River 03 (Kromspruit)	None	None	Mod	Low	Mod	Mod	Mod	Mod	Low	Mod	Moderate

Watercourse(s)	Hosts Rare & endangered	Unique species (endemic, isolated, etc.)	Intolerant species sensitive to flow/water quality modifications	Species/taxon richness	Diversity of habitat types	Refugia for biota	Sensitivity to flow changes	Sensitivity to flow related water quality changes	Migration route/corridor (instream & riparian)	Importance of conservation & natural areas	EIS Class
River 04 (Bensonvale Spruit)	None	None	Mod	Low	Mod	Mod	Mod	Mod	Low	Mod	Moderate
River 05 (Sterkspruit)	None	None	Mod	Low	Mod	Mod	Mod	Mod	Low	Mod	Moderate
River 06 (Unnamed)	None	None	Mod	Low	Mod	Mod	Mod	Mod	Low	Mod	Moderate

4.6 Recommended Ecological Categories (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 30, below.

Table 30. 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 30, the minimum recommended management objective (RMO) for wetland in Process Unit Group 01, rivers in Process Group 01, River 03 (Kromspruit), River 04 (Bensonvale Spruit), River 05 (Sterkspruit), and River 06 (Unnamed) is to improve their PES class. The RMO for all other watercourses is to maintain their current PES condition.

Table 31. REC and RMO for the delineated watercourse units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
Wetlands				
Wetland Process Unit Group 01	F	Low	E/F	Improve
Wetland Process Unit Group 02	D	Mod	D	Maintain
Wetland Process Unit Group 03	C	Mod	C	Maintain
Wetland Process Unit Group 04	F	Low	E/F	Improve
Wetland Process Unit Group 05	C	Low	C	Maintain
Wetland Process Unit Group 06	C	Low	C	Maintain
Wetland Process Unit Group 07	C	Low	C	Maintain
Wetlands				
River Process Unit Group 01	E	Low	E/F	Improve
River Process Unit Group 02	C	Low	C	Maintain
River Process Unit Group 03	D	Low	D	Maintain
River 01 (Unnamed)	D	Moderate	D	Maintain
River 02 (Unnamed)	D	Moderate	D	Maintain
River 03 (Kromspruit)	C	Moderate	B/C	Improve
River 04 (Bensonvale Spruit)	C	Moderate	B/C	Improve
River 05 (Sterkspruit)	D	Moderate	D	Maintain
River 06 (Unnamed)	C	Moderate	B/C	Improve

5. IMPACT AND RISK ASSESSMENTS

This section deals with the assessment of the potential construction and operation phase risks and impacts associated with the proposed mixed-use and fuel service station development. Potential impact consequences are discussed and assessed separately for the construction and operational phases under 'realistic poor' and 'realistic good' or 'best practice' mitigation scenarios as defined in the 'methods' section of this report (*refer to Section 2.3*).

5.1 Impact Significance Assessment

5.1.1 Identification of Impact-Causing Activities

Potential impact-causing activities identified for the construction and operational phases of the water supply scheme upgrade project are presented in Table 32, below.

It must be mentioned that it proved difficult for CES and Eco-Pulse to decipher which rising mains, gravity mains and reticulation pipelines in the GIS layout provided were existing and to be upgraded, and which were planned new pipeline alignments. CES therefore requested that the entire GIS layout provided to Eco-Pulse be subjected to impact assessment. It has therefore been assumed as part of this impact assessment procedure that all pipeline alignments that appear on the provided GIS layout are either existing alignments that are having their conveyance capacity upgraded or are new pipeline alignments to extend the reach of the supply scheme. An activity included in Work Package 7 of the water supply scheme upgrade is the refurbishment of the existing Jozana Water Treatment Plant by replacing the current duty and standby pumps with larger capacity pumps. This aspect of the proposed works has not been included in the impact assessment as replacing the pumps at the existing water treatment will not affect any onsite watercourses.

Table 32. Potential impact-causing activities identified for the construction and operational phases of the proposed development project.

Construction Phase Activities	Operational Phase Activities
Construction and installation works required to upgrade existing water supply scheme infrastructure. This includes: • Earthworks and concrete works (outside of any watercourses) associated with the construction and upgrade of the rising main pumpstation infrastructure as part of the water supply to the Jozana Nek and Magdala villages. • Excavations and trenching within and outside of watercourses to lay new water bulk supply and reticulation pipes, and to upgrade existing bulk supply and reticulation pipes (this includes rising mains).	Operation of the upgraded water supply scheme. This includes: • Bulk supply of potable water from the treatment plant to the various reservoirs servicing the target villages via upgraded rising mains. • Reticulation of water from various storage reservoirs to individual yard connections via the new and upgraded pipeline infrastructure.

5.1.2 Impact Significance Assessment

Summaries of the impact significance assessment for the construction and operational phases of the proposed development are contained in Tables 20 and 21, respectively.

Construction Phase:

Table 33. Summary results of the impact significance assessment for construction phase impacts associated with the proposed development.

Construction Phase Impact Assessment	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
Direct physical loss or modification of freshwater habitat	Moderately Low	Low
The most notable direct physical loss of freshwater ecosystem habitat will occur where trenching through wetlands to lay and upgrade pipelines is required. A desktop scan of the pipeline alignment layout provided to Eco-Pulse revealed a total of 106 watercourse crossing locations. The desktop scan did however also reveal that 95 of the 106 planned crossings take place within the alignment of existing watercourse road crossings. Limited new freshwater ecosystem habitat loss or modification is anticipated at these crossing locations, especially in a best practice pipeline crossing design and construction phase impact mitigation scenario. Some habitat modifications will occur at the 9 crossing locations not associated with roads. These modifications are however expected to be limited in extent and temporary in nature. Therefore, the impact significance for construction phase direct habitat loss was rated as 'Moderately-Low' under a 'poor' or standard mitigation scenario. This can be reduced to a 'Low' level where best practical mitigation is implemented (as listed below and explained in detail in Chapter 6 of this report.		
Alteration of hydrological and geomorphological processes (erosion and sediment)	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
	Moderately Low	Low
Potential sediment related risks associated with the construction phase of this project relate to an increase in sediment supply to watercourses associated with trenching taking place within and near watercourse units. Extensive watercourse and dryland erosion within the study area increases the risk of construction phase sediment mobilisation due to trenching or excavation activities, especially where pipelines are not associated with existing road crossings. Sediment related risks are however temporary in nature and are easily manageable during pipeline upgrades and installations. Trenching within wetlands to lay or upgrade pipes will also temporarily alter natural water distribution patterns. This is not expected to affect many watercourses as most pipe crossings are associated with roads, where the pipelines will be buried in the road fill, rather than in the wetland bed material. All pipeline crossings of large perennial river systems are at the location of existing bridges with the water reticulation pipelines expected to be attached to bridges. These are therefore no expected diversions of watercourses to create dry working areas. The impact significance for construction phase alteration to hydrological and geomorphological processes was therefore rated as 'Moderately-Low' under a 'poor' or standard mitigation scenario. This can be reduced to a 'Low' level where best practical mitigation is implemented (as listed below and explained in detail in Chapter 6 of this report.		
Impacts to water quality	Impact Significance	
	'poor' mitigation scenario	'poor' mitigation scenario
	Moderately Low	Low
Water quality impacts during construction will be limited to potential increased water turbidity associated with potential increased sediment supply to watercourses, and pollution related to potential spillages of fuels and chemicals during construction of the pipeline alignments. If poorly managed, this impact could be of a moderately low significance, where large sediment plumes are regularly deposited into onsite watercourses during construction, and where onsite spill related pollution risks are not mitigated properly. Where best practical		

mitigation is implemented (as listed below and explained in detail in Chapter 6 of this report), this can be potentially reduced to a 'Low' level.		
Impacts to ecological connectivity and/or ecological disturbance impacts	Impact Significance	
	'poor' mitigation scenario	'poor' mitigation scenario
	Low	Low
During construction, the presence of workers and machinery in the general vicinity of onsite watercourses is likely to create noise, vibrations and dust which have the potential to temporarily disturb and displace fauna that make use of watercourse corridors for movement and refuge. Use of watercourses for refugia by fauna in the context of the study area is however likely to be limited due to the urban and per-urban nature of the area, and the generally degraded state of onsite watercourses. Additionally, construction phase disturbances will be temporary. The overall construction phase ecological connectivity / disturbance impact significance is therefore 'Low'.		

Operation Phase (O1):

Table 34. Summary results of the impact significance assessment for operational phase impacts associated with the residential, business and retail infrastructure aspects of the development (including associated services infrastructure).

Operation Phase Impact Assessment	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
O1 - Direct physical loss or modification of freshwater habitat	Low	Low
During the operational phase of the upgraded water supply scheme project direct impacts to freshwater habitat may occur during maintenance of pipeline infrastructure within the vicinity of watercourses. This is likely to occur very infrequently and where sensitive areas are avoided during repairs or maintenance, impact significance will be 'Low'.		
O1 - Alteration of hydrological and geomorphological processes (erosion and sediment)	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
	Low	Low
The main impact causing risk to hydrological and geomorphological processes during the operation phase of the upgraded water supply scheme is pipeline infrastructure within the vicinity of a watercourse bursting or leaking. This would temporarily alter the flow regime of river / stream units and would alter the natural wetness regime of wetland units. Should a rising main burst in the vicinity of a watercourse, the velocity of flow along the receiving watercourse could initiate or exacerbate erosional processes. Pipe bursts or leakages are however considered unlikely to occur. The intensity of such an impact is also considered to be relatively low as the scheme is transporting clean water. Should a burst or leakage occur the issue will be easy to detect and repair, limiting the impact duration. Therefore, operation phase impact significance to hydrological and geomorphological processes is considered 'Low' overall.		
O1 - Impacts to water quality	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
	Low	Low
Water quality impacts during the operation of the upgraded supply scheme are mostly unlikely to take place. Where these could occur is during pipeline crossing repairs or maintenance, where any potential pollutants used (fuels etc.) are poorly managed and there is a risk of spillage. Where best practical mitigation is implemented, this can be potentially reduced to a Low overall level.		
O1 - Impacts to ecological connectivity and/or ecological disturbance impacts	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario

	Low	Low
During operation phase maintenance and repairs the presence of workers and machinery in the general vicinity of onsite watercourses is likely to create noise, vibrations and dust which have the potential to temporarily disturb and displace fauna that make use of watercourse corridors for movement and refuge. This is likely to occur very infrequently with the overall operation phase ecological connectivity / disturbance impact significance being 'Low'.		

5.1.3 Impact Significance Assessment Summary Table

The most notable potential impacts associated with both the construction phase of the project relate to (i) direct habitat modification, (ii) altered sediment delivery processes and volumes to onsite watercourses, and (ii) altered water quality of onsite watercourses, largely due to turbidity issues. However, with the implementation of construction phase impact mitigation measures provided in section 6.3 of this report, all potential construction phase impacts can be reduced to a low overall significance. The overall significance of operation phase impacts associated with the upgraded supply scheme is 'Low'. This is due to the low likelihood and intensity of impacts. The outcomes of the impact significance assessment for the project are summarised in Table 35.

Table 35. Impact significance assessment summary table for the proposed quarry project.

Impact Type	Impact Significance	
	'poor' mitigation scenario	**'good' mitigation** scenario
Construction Phase		
Direct physical loss or modification of freshwater habitat	Moderately Low	Low
Alteration of hydrological and geomorphological processes	Moderately Low	Low
Impacts to water quality	Moderately Low	Low
Impacts to ecological connectivity and/or ecological disturbance impacts	Low	Low
Operation Phase		
Direct physical loss or modification of freshwater habitat	Low	Low
Alteration of hydrological and geomorphological processes	Low	Low
Impacts to water quality	Low	Low
Impacts to ecological connectivity and/or ecological disturbance impacts	Low	Low

5.2 Risk Assessment to inform S21 c & i Water Use Licensing

It is our understanding that the purpose of the risk matrix tool developed by the DWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) on local and regional water resources. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services.

Possible activities, aspects (or stressors) and potential ecological risks associated with the planned project that could potentially manifest into impacts to watercourse condition / functioning have been identified in Section 5.1.1 (Table 32) of this report.

A summary of the potential risk and impacts ratings for the proposed development activities is provided in Table 36 below, the results of which are discussed as follows:

- With effective mitigation (as outlined in section 6.2) all construction phase impacts can be managed down a low overall risk.
- With effective mitigation (as outlined in section 6.3) all operation phase impacts associated with the planned residential, retail and business infrastructure can be managed down a low overall risk.

Table 36. Summary of the risk matrix assessment scores and ratings for each activity and risk group.

Activity	Aspects	Impact	Risk Rating
CONSTRUCTION PHASE	Accidental direct physical modification to freshwater habitat during construction.	C1-1: Direct physical loss or modification of freshwater habitat	Low
	increase in sediment supply to watercourses associated with trenching taking place within and near watercourse units. Temporarily alteration natural water distribution patterns.	C1-2: Alteration of hydrological and geomorphological processes	Low
	Potential elevated sediment delivery (and associated turbidity) to watercourses and potential pollution related to accidental spillages / leakages of fuels and chemicals during construction.	C1-3: Impacts to water quality	Low
	Presence of workers and heavy machinery in the general vicinity of onsite watercourses creating noise, vibrations, and dust.	C1-4: Impacts to ecological connectivity and/or ecological disturbance impacts	Low
OPERATIONAL PHASE	Accidental direct physical modification to river or stream habitat during operation phase maintenance and repair.	O1-1: Direct physical loss or modification of freshwater habitat	Low
	Operation phase storm water management.	O1-2: Alteration of hydrological and geomorphological processes	Low
	Operation phase storm water management (contaminated runoff).	O1-3: Impacts to water quality	Low
	The presence of workers and machinery during infrastructure repairs and maintenance, and the use of the developed area by cars and people creating ecological noise and vibration disturbances.	O1-4: Impacts to ecological connectivity and/or ecological disturbance impacts	Low

For further details on risk assessment scores and ratings refer to Annexure B of this report.

6. IMPACT MITIGATION

A strong legislative framework which backs up South Africa's obligations to numerous international conservation agreements creates the necessary enabling legal framework for the protection and management of freshwater resources in the country. According to the National Environmental Management Act No. 107 of 1998 (NEMA), sensitive, vulnerable, highly dynamic, or stressed ecosystems, such as wetlands, rivers and similar systems 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 and the social systems that depend on it. *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.*"

6.1 The 'Mitigation Hierarchy' Best Practice Environmental Planning Framework

The protection of water resources (wetlands & rivers/streams) 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 minimizes or reduces such impacts. Driver *et al.* (2011) recommend that the management of freshwater ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging (e.g., because of sedimentation and pollution). 'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts because of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on 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 'mitigation hierarchy' (see Figure 12, below) 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.

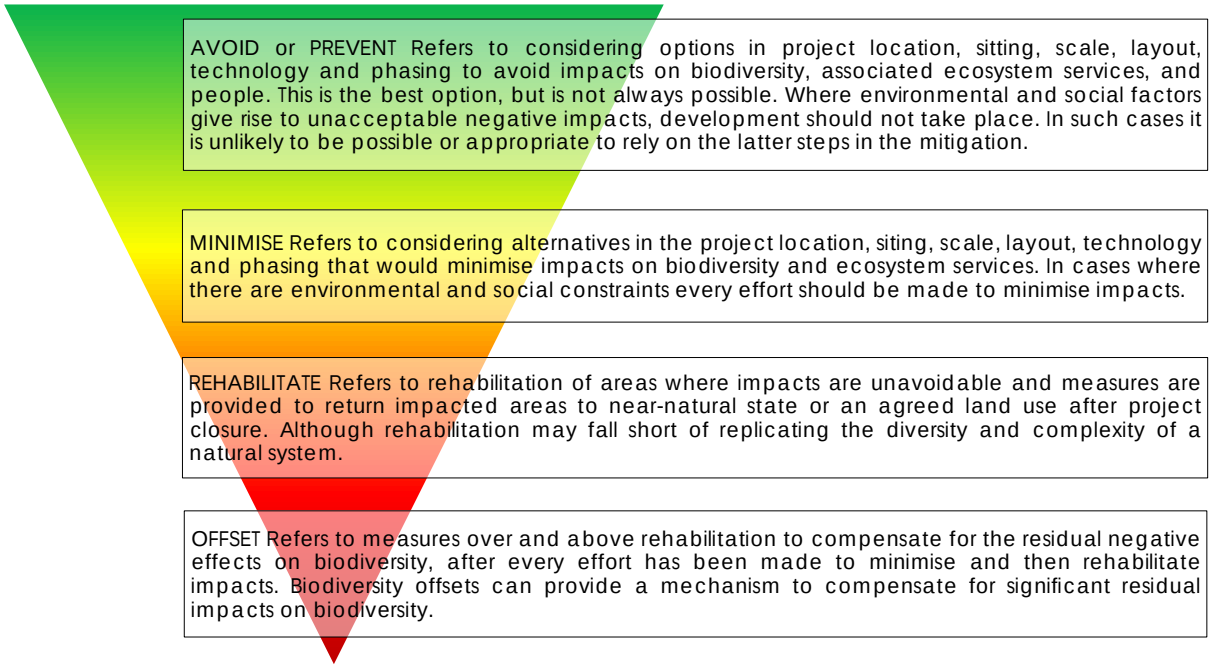


Table 37. Diagram illustrating the 'mitigation hierarchy' (after DEA et al., 2013).

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 best be accommodated without incurring significant negative impacts to the receiving environment. In cases where the receiving environment cannot support the development or where the project will destroy the natural resources on which local communities are wholly dependent for their livelihoods or eradicate unique biodiversity; the development may not be feasible and the developer knows of these risks, and can plan to avoid them, the better. In the case of particularly sensitive ecosystems, where ecological impacts can be severe, the guiding principle should generally be "*anticipate and prevent*" rather than "*assess and repair*". This principle is also in line with the recommended management objective for the project and receiving aquatic environment, that being to '*maintain the current status quo of aquatic ecosystems without any further loss of integrity (PES) or functioning*'.

It is thus recommended that a stepped approach be followed in trying to minimize impacts, which includes:

i. Firstly, attempt to avoid/prevent impacts through appropriate project design and location. This is typically achieved by implementing best practice measures during the project planning and design.

ii. Secondly, employ mitigation measures aimed at minimizing the likelihood and intensity of potential risks/impacts: This includes the provision of pre-construction, construction and operational phase management and mitigation measures to avoid any unnecessary direct or indirect impacts to watercourses.

iii. Thirdly, address residual impacts of the project that remain after the application of the mitigation for Step 2 above. This is typically achieved by implementing an appropriate onsite rehabilitation and management plan focussed on mitigating projects impacts and sometimes legacy impacts as well.

iv. Lastly, compensate for any remaining/residual impacts associated with permanent habitat transformation: If the residual impact is significant (i.e., of moderate significance or higher), then an offset may be required to compensate for this impact. (Not applicable to this project).

6.2 Planning & Design Measures

6.2.1 Design Recommendations for Pipeline Crossings

Every effort should be made to minimize the area of watercourses affected by pipelines crossings. In this regard, please consider the following:

- Crossings points should be aligned along areas or corridors of existing disturbance, e.g., along existing roads, and should ideally be buried within the road fill if possible.
- If it is not possible to bury the pipe within the road fill and if the crossed watercourse is a stream or river with a defined channel the pipeline crossings should be via pipe bridge rather than trenched.
    - Pipe bridges must be designed such that pipes are suspended sufficiently high above the channel bed and above the high-water mark so as not to interfere with natural flow regimes and such that pipes do not act as traps for debris and sediment transported through the channel.
    - Pipe bridge piers should be placed on either side of the watercourse for smaller rivers/streams and not to be placed within the channel bed. Piers should be placed with enough distance up the bank (preferably on the top of the upper bank) and not below the water mark/bank full level.
- If it is not possible to bury the pipe within the road fill and if the crossed watercourse is a wetland or drainage line without a defined channel pipeline crossings should be established underground.
    - Buried pipelines should cross watercourses at a reasonable depth, such that they do not interfere with surface water movement or create obstructions where flows can cause erosion to initiate.
    - Buried pipelines within watercourses will need to be protected to minimise the risk of damage or leakage. This means typically encasing the pipe in concrete or other suitable resistant material.
- All pipeline joins within watercourses must be appropriately sealed to avoid leaks.
- Crossings must be aligned at right angles to flow.

6.3 Construction Phase Mitigation and Management Measures

The following mitigation measures must be implemented in conjunction with any generic measures provided in the Environmental Management Programme (EMPr).

6.3.1 **Demarcation of 'No-Go' areas and construction corridors**

- Prior to the commencement of any construction activities, the following features must be staked out by a surveyor and demarcated using brightly coloured shade cloth:
    - The construction servitude at all watercourses crossings extending 15m either side of the crossing.
    - The delineated watercourses upstream and downstream of the construction servitude for 15m.
- Demarcations are to remain until construction is complete.
- All areas outside of this demarcated working servitude must be considered no-go areas for the entire construction phase. Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project.
- No equipment laydown or storage areas must be located within delineated wetland or riparian habitats, even the areas that are to be inundated by the proposed dam.
- Access to and from the project site should be either via existing roads or within the construction servitude.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO. All disturbed areas must be prepared and then re-vegetated to the satisfaction of the ECO as per the relevant rehabilitation plan.

6.3.2 Runoff, erosion, and sediment control

- The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- If re-vegetation of exposed surfaces cannot be established, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.

<u>Measures specific to working within watercourses:</u>

- The duration of construction work within the watercourses must be minimised as far as practically possible through proper planning and phasing.
- Construction work within the watercourses should be limited to the dry winter season wherever possible.
- When working within watercourses, downstream silt traps / curtains should be installed to capture sediment eroded from the working area prior to construction activities commencing within the watercourses. These silt traps must be regularly monitored and maintained and replaced / repaired immediately as and when required. The ECO must sign-off on these measures prior to construction activities within the watercourses commencing.

6.3.3 Soil management

- At pipeline crossing locations, soil stockpiles should be located at least 15m away from delineated watercourses.
- Erosion/sediment control measures such as silt fences, low soil berms or wooden shutter boards must be placed around the stockpiles to limit sediment runoff from stockpiles.
- Subsoil and topsoil are to be stockpiled separately. Stockpiled soil must be replaced in the reverse order as to which it was removed (subsoil first followed by topsoil).

6.3.4 Establishment and Management of Construction Camp, Storage and Laydown Areas

- Attempts must be made to situate camps on flat ground that is at least 30m away from the edge of the nearest delineated watercourse.
- The location of the camp site should be approved by the appointed ECO.
- An adequate number of self-contained chemical toilets must be established on site – at least one toilet for every 15 workers.
- Site camp chemical toilets must be situated at least 30m away from the edge of the nearest watercourse.
- Waste from chemical toilets must be disposed of regularly by a registered waste contractor.
- Contractors must ensure that no spillage occurs when chemical toilets are cleaned and that the contents are properly stored and removed off-site.

6.3.5 Hazardous Substances / Materials Management

- The proper storage and handling of hazardous substances (e.g., fuel, oil, cement, etc.) needs to be administered.
- Mixing and / or decanting of all chemicals and hazardous substances must take place on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all fuel dispensing areas.
- No refuelling, servicing or chemical storage should occur within 50m of any watercourse.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period. Bund walls should be high enough to contain at least 110% of any stored

volume. The surface of the bunded area should be graded to the centre so that spillage may be collected and satisfactorily disposed of.

- An emergency spill response procedure must be formulated for the site, and staff are to be trained in spill response.
- All necessary equipment for dealing with spills of fuels / chemicals must be available at the site.
- Spills must be cleaned up immediately and contaminated soil / material disposed of appropriately at a registered site.
- Drums must be kept on site to collect contaminated soil. These should be disposed of at a registered waste site.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at an appropriate registered site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.

6.3.6 Solid Waste Management

- Litter generated by the construction crew must be collected in rubbish bins and disposed of at registered landfill sites
- Adequate rubbish bins and waste disposal facilities must be available on site and at the construction camp.
- Regular clearing / maintenance of bins is required.
- The contractor must clear and completely remove all general waste, construction plant, equipment, surplus rock, and other foreign materials from the site once construction has been completed.
- The contractor must retain paperwork proving the correct disposal of waste at a registered landfill site.

6.3.7 Water Abstraction and Use

- No water is to be abstracted from onsite watercourses for use in construction activities without prior approval from the appropriate authorities. Should the contractor want to utilise water from onsite streams, this needs to be registered as a water use under section 21 (a) of the National Water Act for taking water from a water resource.

6.3.8 Invasive Alien Plant Control

- All alien invasive vegetation that colonises construction sites must be regularly cleared. The contactor should consult the ECO regarding the method of removal.

6.3.9 Noise & Dust Pollution Minimisation

- Temporary noise pollution due to construction works should be minimized where possible.
- Water trucks will be required to suppress dust. This will likely be required daily.

6.3.10 Wildlife Management

Appropriate environmental awareness talks must be given to workers. This must include training on the need to protect wildlife and conserve biodiversity. Key messages should include:

- No firewood or medicinal plants may be harvested from natural areas.
- No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way, or removed from the site. This includes animals perceived to be vermin.
- No fishing is to take place.
- Access to sensitive habitat types (e.g., riparian and instream areas) outside of the construction zone is not permitted.
- Any fauna that are found within the construction corridor should be moved to the closest point of natural or semi-natural vegetation outside the construction servitude.

6.3.11 Construction Phase Monitoring Measures

- The ECO must undertake regular compliance monitoring audits. Freshwater ecosystem aspects that must be monitored include:
    - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures or sediment deposits within watercourses.
    - Evidence of elevated river / stream turbidity levels.
    - Evidence of new gully or bed/bank erosion.
    - Evidence of construction work having taken place outside of the demarcated areas / in no-go areas
    - The condition of waste bins and the presence of litter within the working area.
    - Evidence of solid waste within the no-go areas.
    - Evidence of hazardous materials spills and soil contamination.
    - Presence of alien invasive and weedy vegetation within the working area.
    - Rehabilitation and re-vegetation successes and failures.
- Once the construction and rehabilitation has been completed, the ECO should conduct a close out site audit.

6.4 Operational Phase Mitigation and Management Measures

6.4.1 Alien Plant Monitoring and Control

In line with the requirements of Section 2(2) and Section 3 (2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on his property, all IAPs within the study area must be controlled on an on-going basis. It is the responsibility of the operation phase project management body to eradicate and control alien invasive plants that may invade areas disturbed by the construction and operation of the water supply scheme. In terms of section 75 of NEMBA, the following applies to the control & eradication of invasive species:

- The control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.
- It is recommended that bi-annual alien plant clearing be undertaken by the quarry operator for the first-year. Thereafter, alien plant clearing should be undertaken annually.

7. OPPINION ON LEGISLATIVE IMPLICATIONS

7.1 National Water Act (No. 36 of 1998) ('NWA')

Chapter 4 and Section 21 of the National Water Act (No. 36 of 1998) lists certain activities for which water uses must be licensed unless its use is excluded. There are several reasons why water users are required to register and license their water use with the Department of Water & Sanitation (DWS), the most important being: (i) to manage and control water resources for planning and development; (ii) to protect water resources against over-use, damage and impacts and (iii) to ensure fair allocation of water among users. The water uses described in Table 38 have been identified as being associated with the proposed upgrade of the Senqu Water Supply Project.

Table 38. Section 21 'water uses' associated the proposed upgrade of the Senqu Water Supply Project.

NWA Section 21 Water Use	Development activity
Section 21(c): Impeding or diverting the flow of water in a water course	Upgrading of existing and installing of new water pipelines involving trenching / excavations within watercourses across the study area.
Section 21(i): Altering the bed, banks, course, or characteristics of a water course	

Given that the above water uses have been identified and apply to the development project, the project will need to be licenced according to Chapter 4 and Section 21 of the National Water Act (No. 36 of 1998). It is important to note that government notices and legislation allow for Section 21 (c), (i)) water uses to be generally authorised (referred to as a General Authorisation or GA) provided risks and be reduced to acceptable level. In the case of this development, the DWS risk assessment matrix run by Eco-Pulse (section 5.2 and Annexure B) suggests that the risks associated with the upgrade and operation of the water supply project are generally low. The project is therefore likely to be subject to a GA rather than a full water use licence application. This will however need to be confirmed by DWS as part of the license process.

7.2 National Environmental Management Act (No. 107 of 1998) **('NEMA')**

The establishment and operation of the proposed development constitutes the following listed activities relating to watercourses in terms the NEMA: EIA Regulations (2014, as amended in 2017):

Table 39. Listed activities relating to watercourses in terms the NEMA: EIA Regulations (2014, as amended in 2017)

Activity No:	Listing Notice 1 of the EIA Regulations, 2014 as amended.	Development activity
12	The development of— (i) infrastructure or structures with a physical footprint of 100 square metres or more. where such development occurs— (a) within a watercourse. (b) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse:	The proposed new water reticulation pipelines cross several watercourses.
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles, or rock of more than 10 cubic metres from a watercourse;	
48	The expansion of— (i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more. (a) within a watercourse. (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse:	

Any additional listed activities associated with the project will need to be confirmed by the project environmental assessment practitioner (EAP) as well the competent regulatory environmental authority.

8. CONCLUSION

Royal Mndawe Holdings (Pty) Ltd (ROMH) on behalf of the Joe Gqabi Economic Development Agency (JoGEDA), propose to construct and upgrade infrastructure for the Senqu Rural Water Supply – Work Package 7. The Senqu Rural Supply Scheme provides potable water to a total of fifteen villages within the Senqu Local Municipality. Work Package 7 of the Senqu Rural Water Supply Scheme project stands to potentially impact onsite watercourses. A Wetland and Aquatic Ecosystems 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.

A total of two-hundred and forty-six (246) watercourse units were mapped during the desktop delineation process. The location of the watercourses is shown in Figure 5 and 6, including the impact likelihood rating for each watercourse unit. the results of the impact likelihood rating process are as follows:

- 'High' likelihood of being impacted – Eighty-Three (83) watercourses
- 'Moderate' likelihood of being impacted – six (6) watercourses
- 'No / None' likelihood of being impacted – One-Hundred and Fifty-Six (156) watercourses

A total of eighty-nine (89) watercourses were therefore carried forward for the baseline assessment (chapter 4). Wetland PES was assessed using the WET-Health (Macfarlane et al., 2008) assessment method and tool at a rapid level 1 assessment level. The outcomes of the assessment indicate that wetlands within the study area range from moderately to critically modified (C – F PES Category). No natural or partially natural wetlands were noted at the site. One of the most notable impacts to onsite wetlands is a general increase in water and sediment inputs into wetlands due to a reduction in catchment vegetation basal cover associated with overgrazing, poor veld management practices, and agricultural lands. In most instances this has resulted in considerable wetland erosion. Wetlands in the study area were often heavily overgrazed and exhibited a poor-quality secondary grassland community. Rivers / streams PES was assessed using the Index of Habitat Integrity or IHI (Kleyhans, 1996). Rivers and streams within the study area range from moderately to seriously modified (C – E PES Category). No natural or partially natural river / stream units were noted at the site. The most severally modified units were the heavily eroded mountain stream systems (Process Unit 01). All rivers and streams were noted as having experienced a degree of bed and bank erosion associated with altered catchment water and sediment runoff processes. Natural riparian vegetation was largely lacking from rivers / streams within the study area. In many instances natural woody riparian vegetation had been removed by local communities. Old and present cultivated lands often extended to the edge of river and stream boundaries, critically changing the system vegetation composition, and affecting bank stability.

The most notable potential impacts associated with both the construction phase of the project relate to (i) direct habitat modification, (ii) altered sediment delivery processes and volumes to onsite watercourses, and (ii) altered water quality of onsite watercourses, largely due to turbidity issues. However, with the implementation of construction phase impact mitigation measures provided in section 6.3 of this report, all potential construction phase impacts can be reduced to a low overall significance.

The overall significance of operation phase impacts associated with the upgraded supply scheme is 'Low'. This is due to the low likelihood and intensity of impacts. The outcomes of the impact significance assessment for the project are summarised in Table 35. A summary of the DWS Risk Assessment ratings for the proposed development activities is provided in Table 36 below, the results of the assessment indicate that with effective mitigation (as outlined in section 6) all impacts can be managed down a low overall risk.

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10. ANNEXURES

Annexure A: Impact Significance Assessment Tables.

Construction Phase Impact Significance Assessment

Construction Phase Impact Significance Assessment

Realistic 'Poor' (standard) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
C1	Direct physical loss or modification of freshwater habitat	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Local	Permanent	Definite	Moderately-Low	Medium
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Local	Short-term	Highly Probable	Moderately-Low	Medium
C3	Impacts to water quality	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Local	Short-term	Highly Probable	Moderately-Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Immediate	Probable	Low	Medium

Realistic 'Good' (best-practical) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
C1	Direct physical loss or modification of freshwater habitat	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Site	Permanent	Definite	Low	Medium
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Short-term	Possible	Low	Medium
C3	Impacts to water quality	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Short-term	Possible	Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Site	Immediate	Possible	Low	Medium

Operation Phase Impact Significance Assessment

Operational Phase Impact Significance Assessment

Realistic 'Poor' (standard) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
O1	Direct physical loss or modification of freshwater habitat	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Site	Short-term	Highly Probable	Low	Medium
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Short-term	Possible	Low	Medium
O3	Impacts to water quality	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Short-term	Possible	Low	Medium
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Immediate	Possible	Low	Medium

Realistic 'Good' (best-practical) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
O1	Direct physical loss or modification of freshwater habitat	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Site	Short-term	Unlikely	Low	Medium
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Short-term	Unlikely	Low	Medium
O3	Impacts to water quality	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Short-term	Unlikely	Low	Medium
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Direct	Secondary / Indirect	Irrelevant	Irrelevant	Moderately-Low	Site	Immediate	Unlikely	Low	Medium

Annexure B: DWS Risk Matrix Assessment Table.

Phase(s)	Activity	Aspect	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
Construction	Construction and installation works required to upgrade existing water supply scheme infrastructure.	Direct physical loss or modification of freshwater habitat	1	1	3	1	**1.5**	1	4	**6.5**	1	1	5	1	**8**	**52**	**Low**
		Alteration of hydrological and geomorphological processes	2	2	2	1	**1.75**	1	4	**6.75**	1	1	5	1	**8**	**54**	**Low**
		Impacts to water quality	1	2	1	2	**1.5**	2	1	**4.5**	1	1	5	1	**8**	**36**	**Low**
		Impacts to ecological connectivity and/or ecological disturbance impacts	1	1	1	2	**1.25**	1	1	**3.25**	1	2	5	1	**9**	**29.25**	**Low**
Operation	Operation of the upgraded water supply scheme.	Direct physical loss or modification of freshwater habitat	1	1	4	1	**1.75**	1	4	**6.75**	1	1	5	1	**8**	**54**	**Low**
		Alteration of hydrological and geomorphological processes	2	2	2	1	**1.75**	1	1	**3.75**	1	1	5	1	**8**	**30**	**Low**
		Impacts to water quality	1	2	1	1	**1.25**	2	1	**4.25**	1	1	5	2	**9**	**38.25**	**Low**
		Impacts to ecological connectivity and/or ecological disturbance impacts	1	1	1	2	**1.25**	1	1	**3.25**	1	1	5	1	**8**	**26**	**Low**

ECOLOGICAL IMPACT ASSESSMENT REPORT

PROPOSED SENQU RURAL WATER SUPPLY SCHEME, JOE GQABI DISTRICT MUNICIPALITY, EASTERN CAPE PROVINCE

CES

ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES

PROPOSED SENQU RURAL WATER SUPPLY SCHEME, JOE GQABI DISTRICT MUNICIPALITY, EASTERN CAPE PROVINCE

ECOLOGICAL IMPACT ASSESSMENT

PREPARED FOR:

ROYAL MNDAWE HOLDINGS (PTY) LTD (ROMH)

ON BEHALF OF

THE JOE GQABI ECONOMIC DEVELOPMENT AGENCY (JOGEDA)

PREPARED BY:

COASTAL AND ENVIRONMENTAL SERVICES (PTY) LTD (TRADING AS "CES")

67 African Street, Grahamstown, 6140

Tel.: +27 (0)46 622 2364 | Website: www.cesnet.co.za

MARCH 2022

REVISIONS TRACKING TABLE

CES Report Revision and Tracking Schedule

Document Title:	Ecological Impact Assessment for the Proposed Senqu Rural Water Supply Scheme, Joe Gqabi District Municipality, Eastern Cape Province		
Client Name & Address:	Royal Mndawe Holdings (Pty) Ltd (ROMH) Address: 51 Balfour Road, Vincent, East London		
Status:	Draft		
Issue Date:	February 2022		
Authors:	Ms Nicole Wienand Ms Elena Reljic	n.wienand@cesnet.co.za e.reljic@cesnet.co.za	
Reviewer:	Dr Chantel Bezuidenhout	c.bezuidenhout@cesnet.co.za	
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	All I&APs	0	Available on the CES website for download
Report Version	***Date***		
	March 2022		

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SPECIALIST TEAM

Ms Nicole Wienand, Botanical Specialist and Report Author *(SACNASP Reg No. 130289)*

Ms Nicole Wienand (SACNASP Reg No. 130289) is an Environmental Consultant with 3 years' experience based in the Port Elizabeth branch. Nicole obtained her BSc Honours in Botany (Environmental Management) from Nelson Mandela University (NMU) in December 2018. She also holds a BSc Degree in Environmental Management (Cum Laude) from NMU. Nicole's honours project focused on the composition of subtidal marine benthic communities on warm temperate reefs off the coast of Port Elizabeth and for her undergraduate project she investigated dune movement in Sardinia Bay. Since her employment with CES in January 2019, Nicole has specialised in the field of ecology and botanical specialist assessments, ensuring that these specialist assessments are undertaken and prepared in accordance with the Protocols for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (GN R. 320), Plant Species and Animal Species (GN R. 1150). Nicole has undertaken numerous Ecological Impact Assessments for a range of developments including Wind Energy Facilities (WEFs), Overhead Lines (OHL) and infrastructure, working closely with developers to ensure a development which is environmentally sustainable as well as financially and technically feasible.

Ms Elena Reljic, Faunal Specialist and Co-Author

Elena is an ecologist specialising in restoration ecology and has extensive experience in conservation and long-term research projects across southern Africa. Elena enjoys the challenge of remote field work and has conducted field surveys for a range of species (e.g., birds, snakes, small mammals, seals) and environments (e.g., Succulent Karoo, Kalahari Desert, Indian Ocean Coastal Belt Forests). She was also part of a 14-month research expedition to the sub-Antarctic, Marion Island, where she focused on seabird research. This is complimented by her expertise in the design and management of databases, GIS, and the use of remote monitoring techniques, as well as the programming language R.

Dr Chantel Bezuidenhout, Principle Environmental Consultant and Estuarine Ecologist *(SACNASP (Pri.Sci.Nat) Reg No. 124731)*

Dr Chantel Bezuidenhout holds MSc and PhD degrees in Botany (estuarine ecology) and a BSc degree in Botany and Geography from NMMU. Chantel has been an Environmental Consultant for over 13 years and as such has been focused on environmental management and impact assessment. Chantel is well versed in environmental legislation and has managed a number of environmental impact assessments and management plans for heavy mineral mining in South African and Madagascar, as well as a number of EIAs for open case mines (copper, nickel, graphite) in Zambia and Mozambique. These projects have been completed to international standards (IFC and World Bank),and have been granted authorisation by their host countries. Chantel is also well versed in stakeholder engagement and stakeholder processes, all EIAs that has been managed by Chantel has included community consultations and as such Chantel has been used for various forms of community engagement in rural African settings. Chantel has also been extensively involved in the data collection and report writing for land and natural resource use assessments in both Madagascar and Mozambique.

The data gathering component involves extensive community meetings in order to establish land use (including agriculture) and natural resource use within the communities and wider regions. Chantel has recently completed an extensive land survey as part of a Resettlement process for a heavy minerals mine in Mozambique as well as in-kind compensation surveys in Tanzania. She is currently a principal consultant and Branch Manager of the Port Elizabeth Office of CES.

Contact Details: Botanical Specialist and Lead Author

Name	**Ms Nicole Wienand**
Designation	Botanical Specialist, CES
E-mail	n.wienand@cesnet.co.za

Contact Details: Faunal Specialist and Co-Author

Name	**Ms Elena Reljic**
Designation	Faunal Specialist, CES
E-mail	e.reljic@cesnet.co.za

Contact Details: Reviewer

Name	**Dr Chantel Bezuidenhout**
Designation	Principal Environmental Consultant
E-mail	c.bezuidenhout@cesnet.co.za

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ACRONYM LIST

ADU	Animal Demography Unit
BA	Basic Assessment
BI	Biodiversity Importance
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CES	Coastal and Environmental Services
CI	Conservation Importance
CR	Critically Endangered
DAFF	Department of Agriculture, Forestry and Fisheries
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
EA	Environmental Authorisation
ECBCP	Eastern Cape Biodiversity Conservation Plan
EIA	Environmental Impact Assessment
EN	Endangered
EMPr	Environmental Management Programme
ESA	Ecological Support Area
EOO	Extent of Occupancy
FI	Functional Integrity
GIS	Geographical Information System
GN	Government Notice
IBA	Important Birding Areas
IUCN	International Union for Conservation of Nature
JOGEDA	Joe Gqabi Economic Development Agency
LC	Least Concern
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy

NT	Near Threatened
PA	Protected Area
PNCO	Provincial Nature Conservation Ordinance
POSA	Plants of Southern Africa
PPP	Public Participation Process
ROMH	Royal Mndawe Holdings
RR	Receptor Resilience
SCC	Species of Conservation Concern
SOTER	Soil and Terrain
QDS	Quarter Degree Square
VU	Vulnerable
SANBI	South African National Biodiversity Institute
SAPAD	South Africa Protected Areas Database
SEI	Site Ecological Importance
TOPS	Threatened and Protected Species

DEFINITIONS

***Alien Invasive Plant Species* (AIPS)** refers to an exotic species that can spread rapidly and displace native species causing damage to the environment

Biodiversity is the term that is used to describe the variety of life on Earth and is defined as "*the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems*" (Secretariat of the Convention on Biological Diversity, 2005).

Habitat Fragmentation occurs when large expanses of habitat are transformed into smaller patches of discontinuous habitat units isolated from each other by transformed habitats such as farmland.

Natural Habitat refers to habitats composed of viable assemblages of plant and/or animal species of largely native origin and/or where human activity has not essentially modified an area's primary ecological function and species composition.

Protected Area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values**.** *(IUCN Definition 2008).*

Species of Conservation Concern all species that are assessed according to the IUCN Red List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Data Deficient (DD) or Near Threatened (NT), as well as range-restricted species which are not declining and are nationally listed as Rare or Extremely Rare [also referred to in some Red Lists as Critically Rare].

SPECIALIST CHECK LIST

The contents of this specialist report complies with the legislated requirements as described in the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Plant and Animal Species (GN R.1150).

SPECIALIST REPORT REQUIREMENTS ACCORDING TO GN R. 320			SECTION OF REPORT
3.1	The Terrestrial Biodiversity Specialist Assessment Report must contain, as a minimum, the following information:		
	3.1.1	Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Page iv – v, Appendix 5
	3.1.2	A signed statement of independence by the specialist;	Appendix 6
	3.1.3	A statement of the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 2.1
	3.1.4	A description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	Chapter 2
	3.1.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.4
	3.1.6	A location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Chapter 4 and Chapter 6
	3.1.7	Additional environmental impacts expected from the proposed development;	Chapter 5
	3.1.8	Any direct, indirect and cumulative impacts of the proposed development;	Chapter 5
	3.1.9	The degree to which the impacts and risks can be mitigated;	Chapter 5
	3.1.10	The degree to which the impacts and risks can be reversed;	
	3.1.11	The degree to which the impacts and risks can cause loss of irreplaceable resources;	
	3.1.12	Proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Chapter 5 and Section 6.2
	3.1.13	A motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a “low” terrestrial biodiversity sensitivity and that were not considered appropriate;	N/A
	3.1.14	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	Chapter 6
	3.1.15	Any conditions to which this statement is subjected.	Section 6.2
3.2	The findings of the Terrestrial Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which must be incorporated into the EMPr where relevant.		✓
3.3	A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.		✓

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1 INTRODUCTION AND PROJECT DESCRIPTION

1.1 PROJECT DESCRIPTION AND LOCALITY

The proposed Senqu Rural Water Supply Scheme (Work Package 7) project includes the following:

- The refurbishment of the Jozana Water Treatment Works package plant by replacing the duty and standby pumps. Duty of pumps quantity will be 9.5 l/s and height will be 150m.
- The construction of new rising mains from water treatment works; distance of the main is 1900m with a 160mm diameter.
- Addition of rising main from booster pump to ward 12 (Jozana Nek and Magadla), 5400m main with 50mm diameter.
- The refurbishment of booster pump station which supplies the Jozana Nek and Magadla Village (ward 12), quantity of pump is 2.3 l/s and height is 180m. It is recommended that an Eskom power supply be applied for the booster pump.
- Upgrade of existing reticulation in Jozana Nek and Magadla (ward 12) - the aim is to upgrade to yard connections.
- Upgrade Magwiji stand-alone scheme by increasing storage capacity to 80 kl/day.
- Increase storage capacity by upsizing the gravity main supplying Madakane and Bambospruit reservoir to meet annual average daily demand.
- Design a system which includes equipping Borehole EC-D12-036 with a yield of 3.3 l/s (Approximately 285 kl/day) in ward 7 (Makojong, Roosisand, & Maralaneng).
- Design complete water system (bulk supply and reticulation network) for Enteni (ward 7) and Makheteng (ward 10) based on 80 l/c/d consumption.

The overall development footprint of the proposed Senqu Rural Water Supply Scheme is approximately 18.5 ha. However, the majority of the proposed development is located within previously cleared areas / existing servitudes. Therefore, based on the known remaining extent of the two vegetation types occurring on site (Red List of Ecosystems (RLE) for terrestrial realm for South Africa, 2021), the development of the Senqu Rural Water Supply Scheme will result in the loss of approximately 393.21 m^2 (0.04 ha) of Senqu Montane Shrubland and 8425.51 m^2 (0.84 ha) of Zastron Moist Grassland. The project extent spans over wards 2, 6, 7, 10, 12 and 17 within the Senqu Local Municipality in the Eastern Cape Province. The villages are in the former administrative area of Sterkspruit and they can be accessed via Sterkspruit through R58 East from Aliwal North and then R392 towards Sterkspruit Town. It should be noted however, that the majority of the development footprint is located within existing gravel roads, servitudes, and the boundaries of the rural villages.

CES has been appointed by Royal Mndawe Holdings (Pty) Ltd (ROMH) on behalf of the Joe Gqabi Economic Development Agency (JOGEDA) to apply for Environmental Authorisation (EA) by means of conducting a Basic Assessment (BA) Process, inclusive of the relevant specialist studies. This Ecological Impact Assessment report forms part of the BA Process for the proposed Senqu Rural Water Supply Scheme.

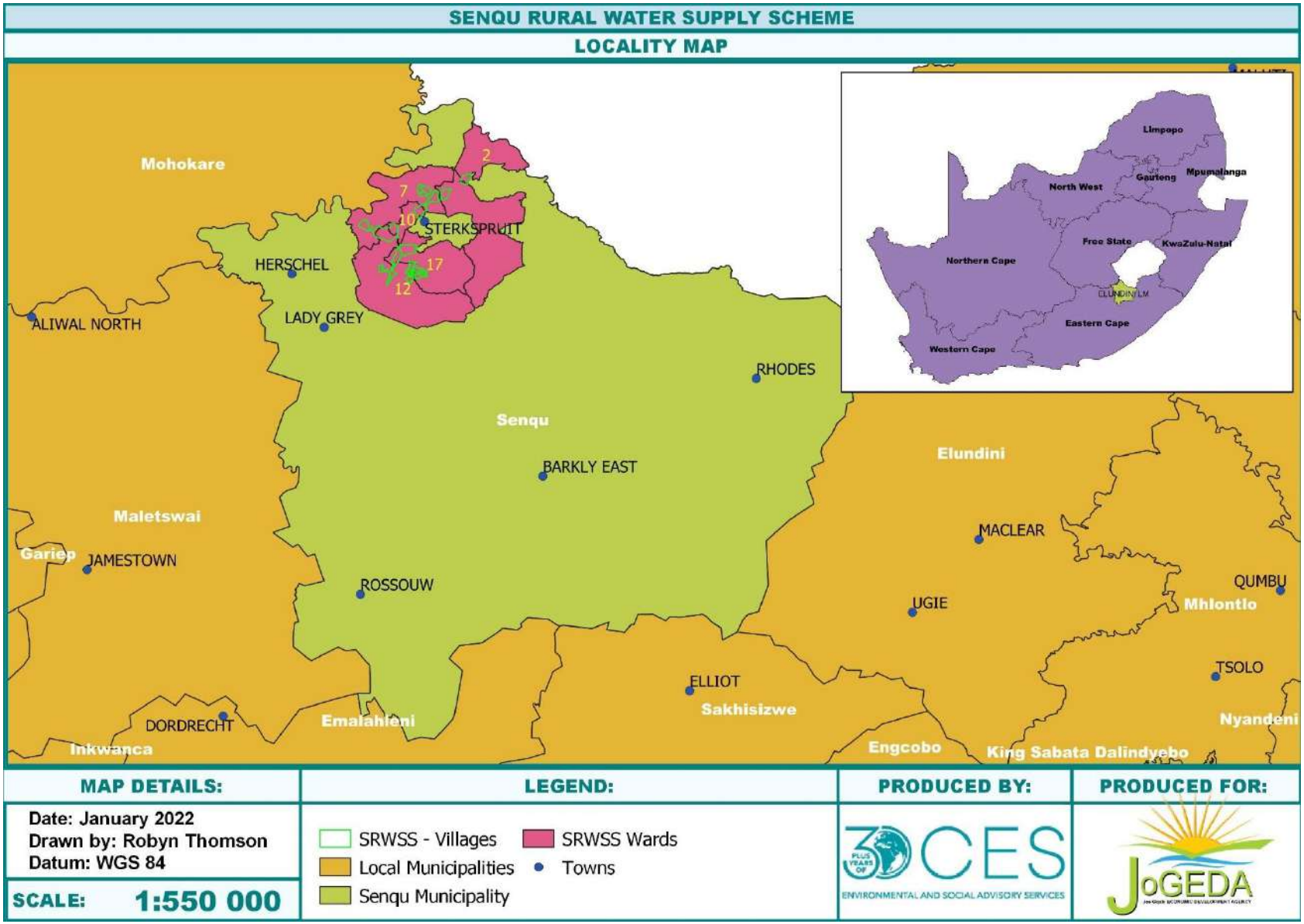

Figure 1.1: Locality Map of the proposed Senqu Rural Water Supply Scheme, Joe Gqabi District Municipality, Eastern Cape Province.

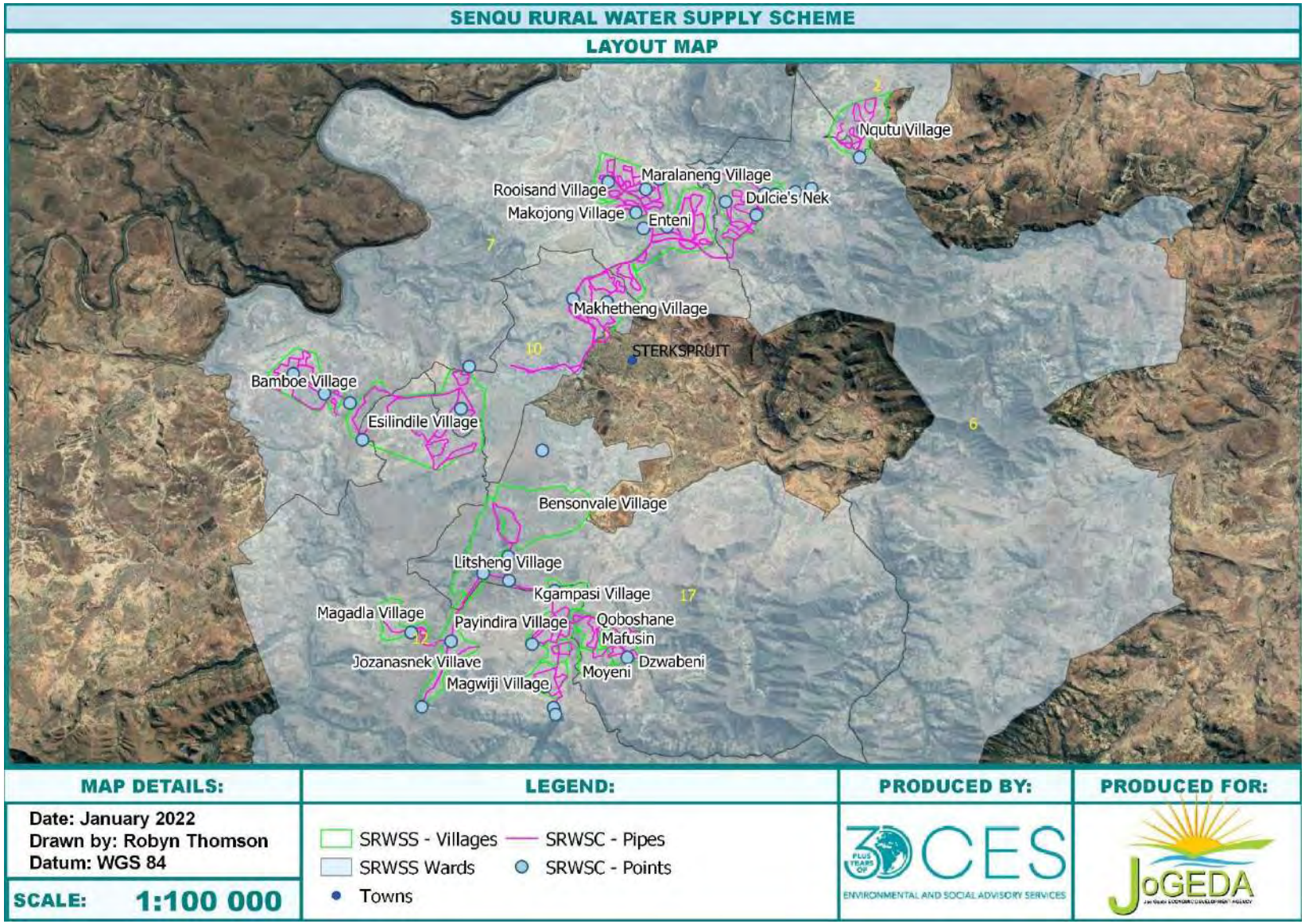

Figure 1.2: Layout Map of the proposed Senqu Rural Water Supply Scheme.

1.2 Site Sensitivity Verification and Minimum Report Content Requirements

In terms of the Protocol for the Specialist Assessment and Minimum Reporting Content Requirements for Environmental Impacts on Terrestrial Biodiversity (GN R. 320 of 2020) and Terrestrial Animal and Plant Species (GN R. 1150), prior to the commencement of a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool, must be confirmed by undertaking a site sensitivity verification. The results of the screening tool, together with the site sensitivity verification, ultimately determines the minimum report content requirements.

According to the results of the Screening Report generated for the proposed Senqu Rural Water Supply Scheme, the relative terrestrial biodiversity theme sensitivity is classified as **VERY HIGH** due to the development occurring within a Critical Biodiversity Area (CBA) 1 and 2; an Ecological Support Area (ESA) 1 and 2; a Freshwater Ecosystem Priority Area (FEPA) Subcatchment; and a Strategic Water Source Area. The Animal Species Theme is classified as **HIGH** due to the likely presence of four (4) threatened faunal species while the Plant Species Theme is classified as **MEDIUM** Sensitivity due to the likely occurrence of four (4) threatened plant species. According to Section 3 (1) of GN R. 320, '*an applicant intending to undertake an activity identified in the scope of this protocol, on a site identified on the screening tool as being of "very high sensitivity" for terrestrial biodiversity, must submit a Terrestrial Biodiversity* [Ecological] *Specialist Assessment'*.

Due to the very high sensitivity rating of the site, a full **Ecological Specialist Assessment** (this report) has been undertaken as part of the BA Process for the proposed Senqu Rural Water Supply Scheme.

1.3 Objectives and Terms of Reference

The objectives for the ecological assessment are as follows:

- Describe and map the vegetation types in the study area.
- Describe the biodiversity and ecological state of each vegetation unit.
- Establish and map sensitive vegetation areas showing the suitability for development and no-go areas.
- Identify plant and animal species of conservation concern (Red Data List, PNCO and TOPS lists). In the case of the fauna, this was done at a desktop level.
- Identify alien plant species, assess the invasive potential, and recommend management procedures.
- Identify and assess the impacts of development on the site's natural vegetation and faunal species in terms of habitat loss, fragmentation and degradation of key ecosystems and, where feasible, provide mitigation measures to reduce these impacts.

1.4 LIMITATIONS AND ASSUMPTIONS

This report is based on current available information and, as a result, the following limitations and assumptions are implicit:

- The report is based on a project description received from the client.
- A detailed faunal survey was not conducted. The faunal survey was mainly a desktop study, using information from previous ecological surveys conducted in the area, supplemented by recording animal species that were observed during the site survey.
- Species of Conservation Concern (SCC) are difficult to find and difficult to identify, thus species described in this report do not comprise an exhaustive list. However, the list of SCC likely to occur and compiled for the project area is based on various sources of information available at the time. It is possible that additional SCCs will be found during construction and operation of the development.
- Sampling could only be carried out at one stage in the annual or seasonal cycle, in this case the survey was conducted in Summer (December) as this falls within the optimal survey period for the grassland biome in which the study areas occurs (SANBI, 2020). Although some late flowering species may have gone undetected, the time available in the field and information gathered during the survey was sufficient to provide enough information to determine the status of the affected area.
- The site visit was carried out over one (1) day due to time constraints associated with this project. As such, sampling targeted undeveloped areas of the project site in order to obtain an accurate list of the indigenous species and/or Species of Conservation Concern (SCC) which will be impacted by proposed development.

1.5 PUBLIC CONSULTATION

The Public Participation Process (PPP) followed to date has been described in detail in the BAR. The Draft BAR, together with the Ecological Impact Assessment Report, will be made available for a 30-day mandatory commenting and public review period. Any comments received relating to the Ecological Impact Assessment Report will be addressed by the Ecological Specialists and included in the Comments and Response Report in the Final BAR.

2 METHODOLOGY

2.1 THE ASSESSMENT

A site visit was undertaken on the 7th of December 2021 to assess the site-specific ecological state, current land-use, identify potential sensitive ecosystems and identify plant species associated with the proposed project activities. The site visit also served to identify potential impacts of the proposed development, and its impact on the surrounding ecological environment.

In addition to the site visit, key resources that were consulted include the following:

- South African Vegetation Map (SA VEGMAP) (Mucina *et al*., 2018);
- Council for Geoscience (2013);
- Soil and Terrain (SOTER) Database of South Africa (2008);
- Eastern Cape Biodiversity Conservation Plan (ECBCP, 2019);
- The National Freshwater Ecosystem Priority Areas (NFEPA, 2011/14);
- National Biodiversity Management: Biodiversity Act (NEM:BA) List of Threatened or Protected Species (2005);
- The National Protected Areas Expansion Strategy (NPAES, 2010);
- Review of the SANBI Red Data List;
- The National Biodiversity Assessment (NBA) (SANBI, 2018);
- Red List of Ecosystems (RLE) for terrestrial realm for South Africa (2021);
- The Animal Demography Unit (ADU);
- International Union for Conservation of Nature (IUCN);
- Provincial Nature Conservation Ordinance (PNCO);
- Plants of Southern Africa (POSA) database;
- iNaturalist;
- National Biodiversity Management: Biodiversity Act (NEM:BA) Alien and Invasive Species Lists (2014);
- Conservation of Agricultural Resources Act (Act No. 43 of 1983) Invasive Plant List; and
- Department of Agriculture, Forestry and Fisheries (DAFF) List of Protected Trees (2014).

2.2 SPECIES OF CONSERVATION CONCERN

Data on the known distribution and conservation status for each potential Species of Conservation Concern (SCC) has to be obtained to develop a list of 'Species of Conservation Concern'. According to the Species Environmental Assessment Guideline (SANBI, 2020), the term 'SCC' refers to all species that are assessed according to the IUCN Red List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Data Deficient (DD) or Near Threatened (NT), as well as range-restricted species which are not declining and are nationally listed as Rare or Extremely Rare [also referred to in some Red Lists as Critically Rare]. These species may be impacted significantly by the proposed activity. Species that are afforded special protection, notably those that are protected by NEM:BA (Act No. 10 of 2004), PNCO

(1975), the List of Protected Tree Species under the National Forest Act (Act No. 84 of 1998) or which occur on the South African Red Data List as SCC fall within this category.

2.3 Sampling Protocol

The aim of the site visit was to characterise and describe each vegetation community within the study site as well as identify areas of high sensitivity and SCC. However, analysis of Google Earth imagery in preparation for the site visit indicated that a large portion of the project area has been degraded or transformed most likely due to livestock grazing, cultivation, and the expansion of rural villages. As much of the development footprint is located within these transformed areas and within existing roads and/or servitudes, and due to the time constraints associated with this project, sampling targeted undeveloped, natural, and near-natural areas of the proposed development footprint. This would ensure that a comprehensive list of indigenous species which occur within the project area was obtained.

Prior to the site visit, nine (9) sampling locations were identified within the proposed development footprint of the Senqu Rural Water Supply Scheme (Figure 2.1). At each sampling location, transects were visually surveyed and the species identified and recorded to evaluate vegetation composition and to provide detailed information on the plant communities present. Transects were surveyed until no new species were recorded. Vegetation communities were then described according to the dominant set of species recorded from each vegetation type. These were mapped and assigned a sensitivity score using the methodology outlined in the Species Environmental Assessment Guideline Document. After the site visit, all plant species recorded were uploaded to iNaturalist (https://www.inaturalist.org/).

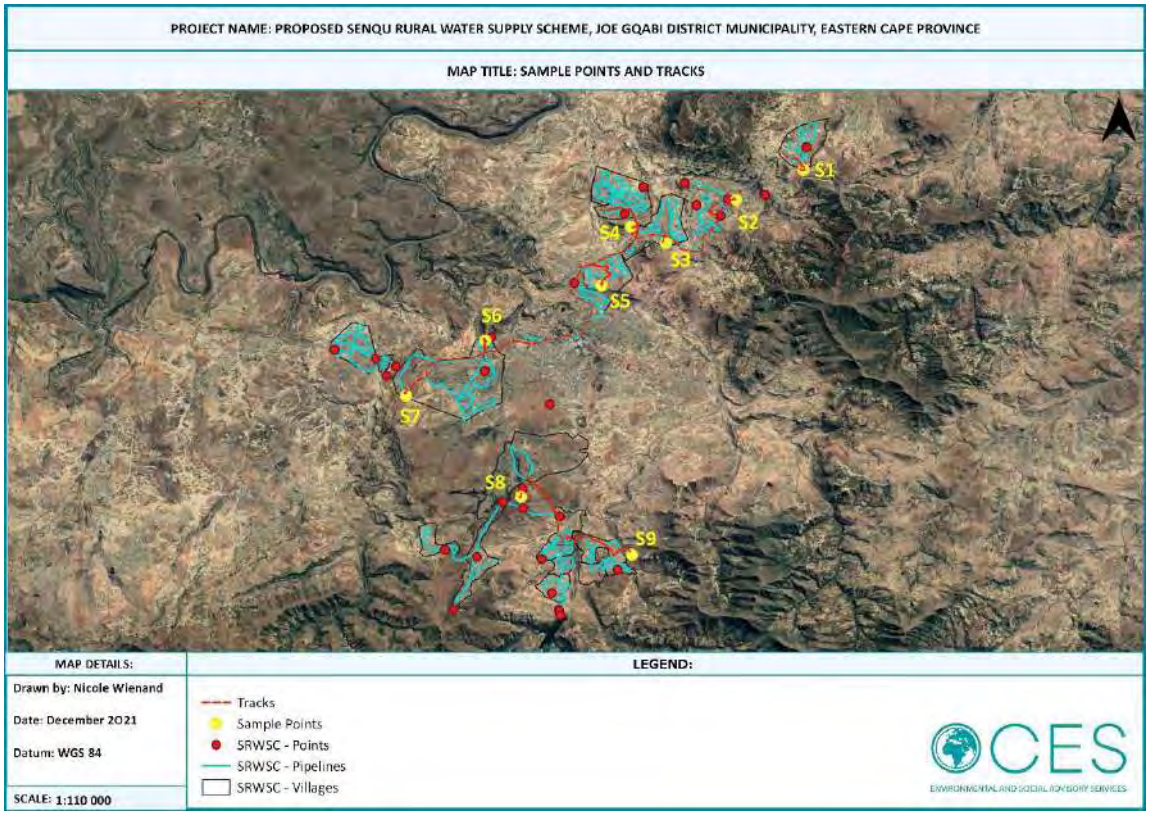

Figure 2.1: Sampling locations and survey tracks.

2.4 VEGETATION MAPPING

The revised SA VEGMAP (2018) was established in order to "*provide floristically based vegetation units of South Africa, Lesotho and Swaziland at a greater level of detail than had been available before*." The map was developed using a wealth of data provided by a network of ecologists, biologists and conservation planners that make periodic contributions to the project. These contributions have allowed for the best national vegetation map to date, the last being that of Acocks developed over 50 years ago. The SANBI Vegetation map informs finer scale bioregional plans and includes an additional 47 new vegetation units since its refinement in 2012.

The SA VEGMAP project has two main aims:

1. To determine the variation in and units of Southern African vegetation based on the analysis and synthesis of data from vegetation studies throughout the region, and
2. To compile a vegetation map. The aim of the map was to accurately reflect the distribution and variation in the vegetation and indicate the relationship of the vegetation with the environment. For this reason, the collective expertise of vegetation scientists from various universities and state departments were harnessed to make this project as comprehensive as possible.

The map and accompanying book describes each vegetation type in detail, along with the most important species, including endemic species and those that are biogeographically important.

The SA VEGMAP is compared to actual conditions of vegetation observed onsite during the site assessment through mapping from aerial photographs, satellite images, literature descriptions (e.g., SANBI and ECBCP) and related data gathered on the ground.

2.5 SENSITIVITY ASSESSMENT

The Species Environmental Assessment guideline (SANBI, 2020) was applied to assess the Site Ecological Importance (SEI) of the project area. The habitats and the species of conservation concern in the project area were assessed based on their conservation importance, functional integrity and receptor resilience (Table 2.1). The combination of these resulted in a rating of SEI and interpretation of mitigation requirements based on the ratings.

The sensitivity map was developed using available spatial planning tools as well as by applying the SEI sensitivity based on the field survey.

Table 2.1: Criteria for establishing Site Ecological importance and description of criteria.

Criteria	Description
Conservation Importance (CI)	*The importance of a site for supporting biodiversity features of conservation concern present e.g. populations of IUCN Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, range-restricted species, globally significant populations of congregatory*

	species, and areas of threatened ecosystem types, through predominantly natural processes.
Functional Integrity (FI)	*A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.*
Biodiversity Importance (BI) is a function of Conservation Importance (CI) and the Functional Integrity (FI) of a receptor.	
Receptor Resilience (RR)	*The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.*
Site Ecological Importance (SEI) is a function of Biodiversity Importance (BI) and Receptor Resilience (RR)	

2.6 ECOLOGICAL IMPACT ASSESSMENT

2.6.1 Impact rating methodology

To ensure a balanced and objective approach to assessing the significance of potential impacts, a standardized rating scale was adopted which allows for the direct comparison of specialist studies. This rating scale has been developed in accordance with the requirements outlined in Appendix 1 of the NEMA EIA Regulations (2014 and subsequent 2017 & 2021 amendments).

The details of this rating scale are included in Appendix 4.

3 DESCRIPTION OF THE ENVIRONMENT

3.1 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

3.1.1 Climate

The information provided herewith is based on the climate data for Sterkspruit – the nearest urban area in proximity to the project area. The hottest temperatures are recorded in January when the mean daily maximum temperature reaches 29°C. The coldest temperatures are recorded in July when the mean daily minimum temperature falls to 1°C. Rainfall occurs throughout the year, however the greatest rainfall occurs within the summer months with an average of 52 mm recorded for December (Figure 3.1) (www.meteoblue.com).

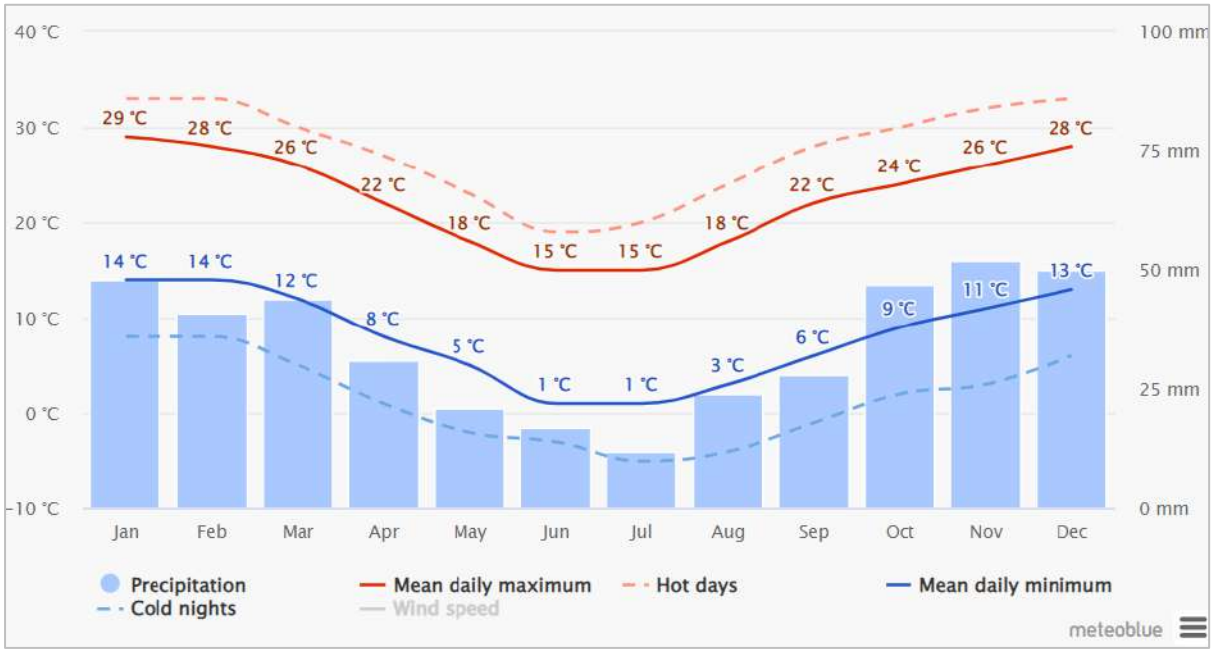

Figure 3.1: Climate data for Sterkspruit (Source: www.meteoblue.com).

3.1.2 Topography, Soils and Geology

Vegetation types are influenced by a range of biotic and/or abiotic factors at different spatial and temporal scales, which together influence the distribution, composition, structure and diversity of plant communities (Rodrigues *et al.*, 2018). Among the abiotic factors influencing vegetation types, topography (landform), geology, and soils are considered three of the major factors determining habitat heterogeneity and species diversity.

Topography

The project area falls within the Witteberg Mountains near to the southernmost extent of the Drakensberg Mountain range. Although the surrounding areas are mountainous, the topography of the project area is characterised by low to moderately undulating hills cut by rivers and tributaries. The altitude ranges from 1489 m to 2000 m above sea level (a.s.l) (Figure 3.2 & Figure 3.3).

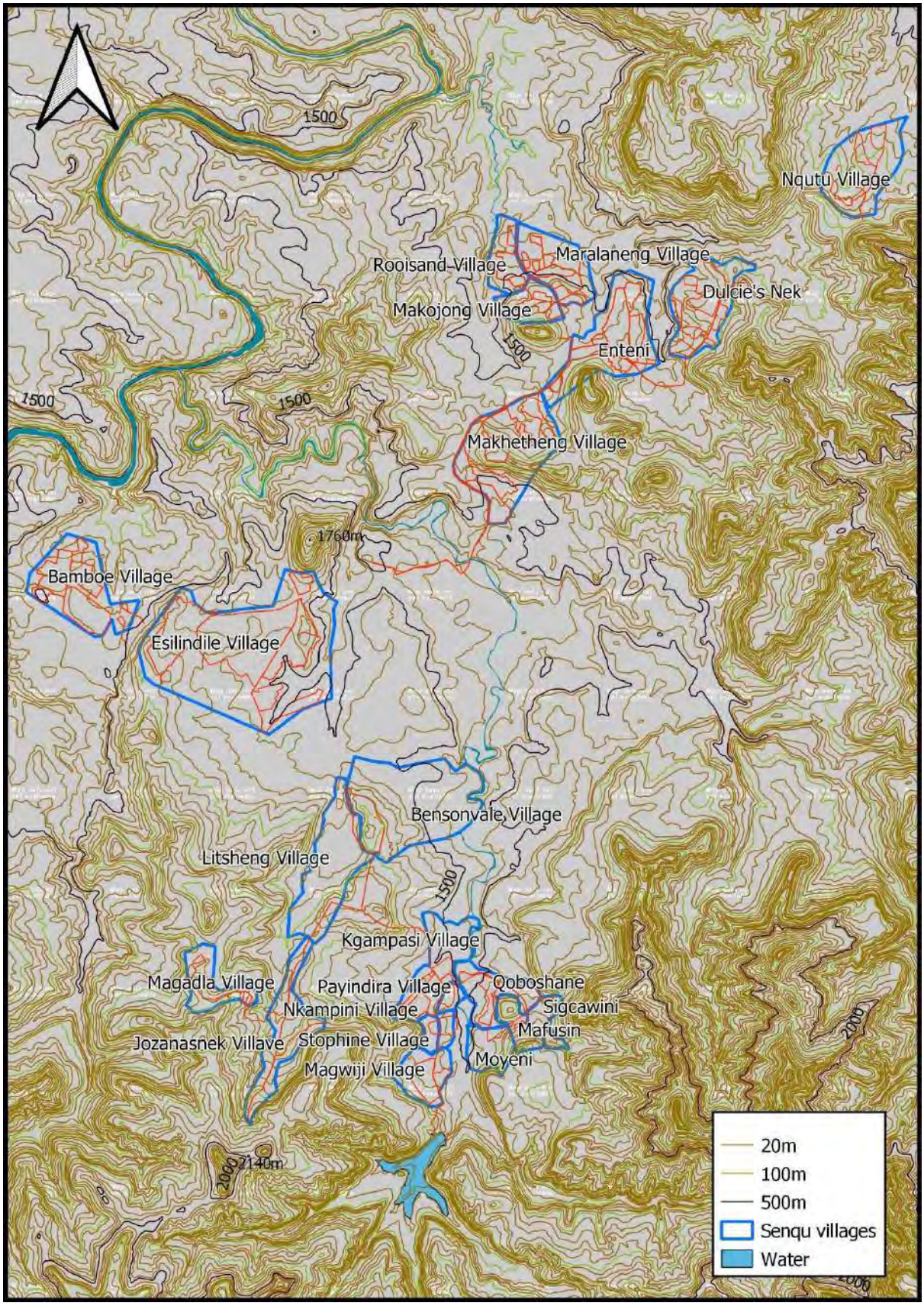

Figure 3.2:Contour Map of the study area.

Figure 3.3: Elevation profile of the study site from northeast to southwest.

3.1.3 Geology and Soils

Geology

The footprint of the proposed Senqu Rural Water Supply Scheme is underlain by sedimentary rocks of the Karoo Supergroup. In order of deposition (from youngest to oldest), the sequence of units includes the Clarens Formation (siltstone and arenite), the Elliot Formation (arenite and mudstone), and the Molteno Formation (arenite, mudstone and shale) (Rubidge and Hancox, 2002). These sedimentary rocks have also been intruded by Karoo Dolerite which forms a layer throughout a large portion of the project area (Leyland *et al.,* 2016).

Soils

According to SOTER (1995), there are four (4) types of soil underlying the project area including lithic leptosols, haplic solonetz, ferric luvisols and haplic luvisols (Figure 3.5).

Leptosols are very shallow soils which overlie continuous rock. These soils are usually extremely gravelly and/or stony and the parent material consists of various types of continuous rock or of unconsolidated materials with less than 20% fine earth. Leptosols generally occur in areas of high or medium altitude, with strongly dissected topographies (Nachtergaele, 2010).

According to the International Soil Reference and Information Centre (ISRIC), solonetz are characterised by a dense, strongly structured, clayey subsurface horizon that has a high proportion of absorbed sodium and/or magnesium ions.

Luvisols are characterised by a noticeable difference in texture within the soil profile. The surface horizon is depleted of clay while the subsurface 'argic' horizon has a marked accumulation of clay. ISRIC defines luvisols as, "*Soils having an argic horizon with a cation exchange capacity (in 1M NH4OAc at pH 7.0) equal to or greater than 24 cmol (+)kg^{-1} clay, either starting with 100 cm from the soil surface, or within 200 cm from the soil surface if the argic horizon is overlain by loamy sand or coarser textures throughout".*

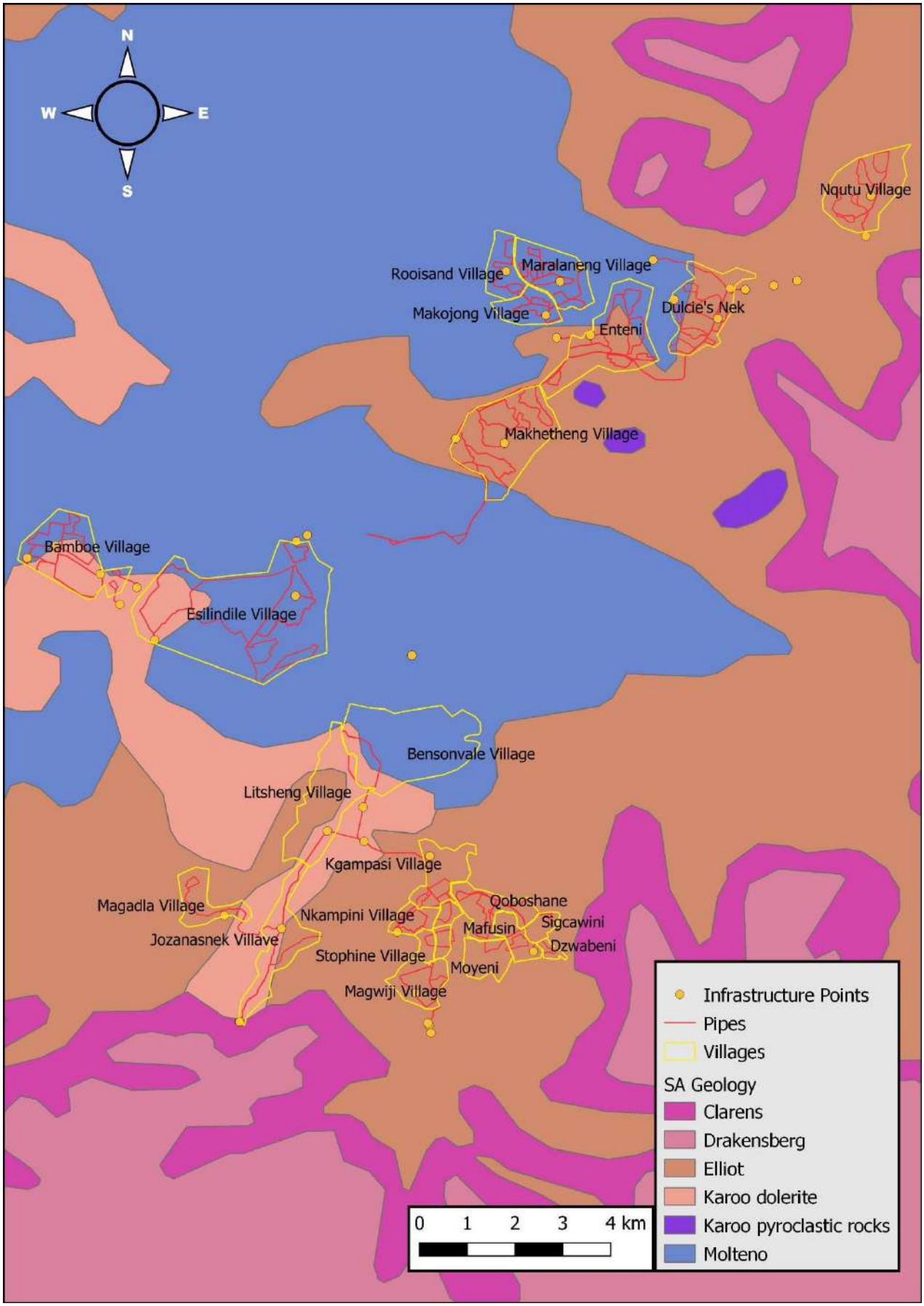

Figure 3.4: Geology Map of the study site.

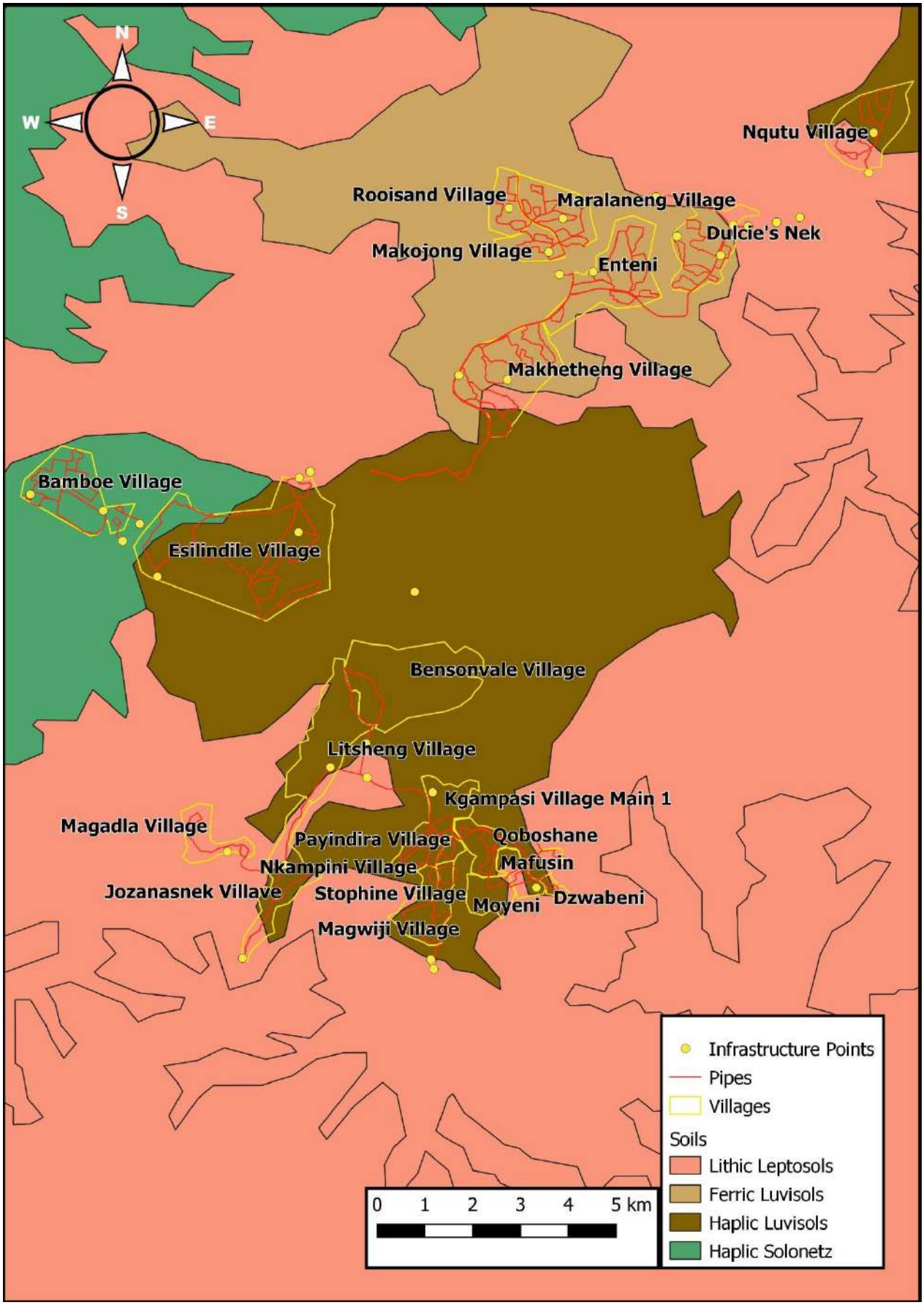

Figure 3.5: SOTER SAF Soil Map of the project area.

3.1.4 Surface water Features

The aquatic sensitivity of the proposed site is classified as VERY HIGH in the Screening Report as the site falls within a Freshwater Ecosystem Priority Area Quinary Catchment, a Strategic Water Source Area, and traverses' numerous wetlands and drainage lines. The proposed development falls within three quaternary catchments, D12A, D12B and D12C of the Orange Water Management Area (WMA 6) (Figure 3.6 & Figure 3.7).

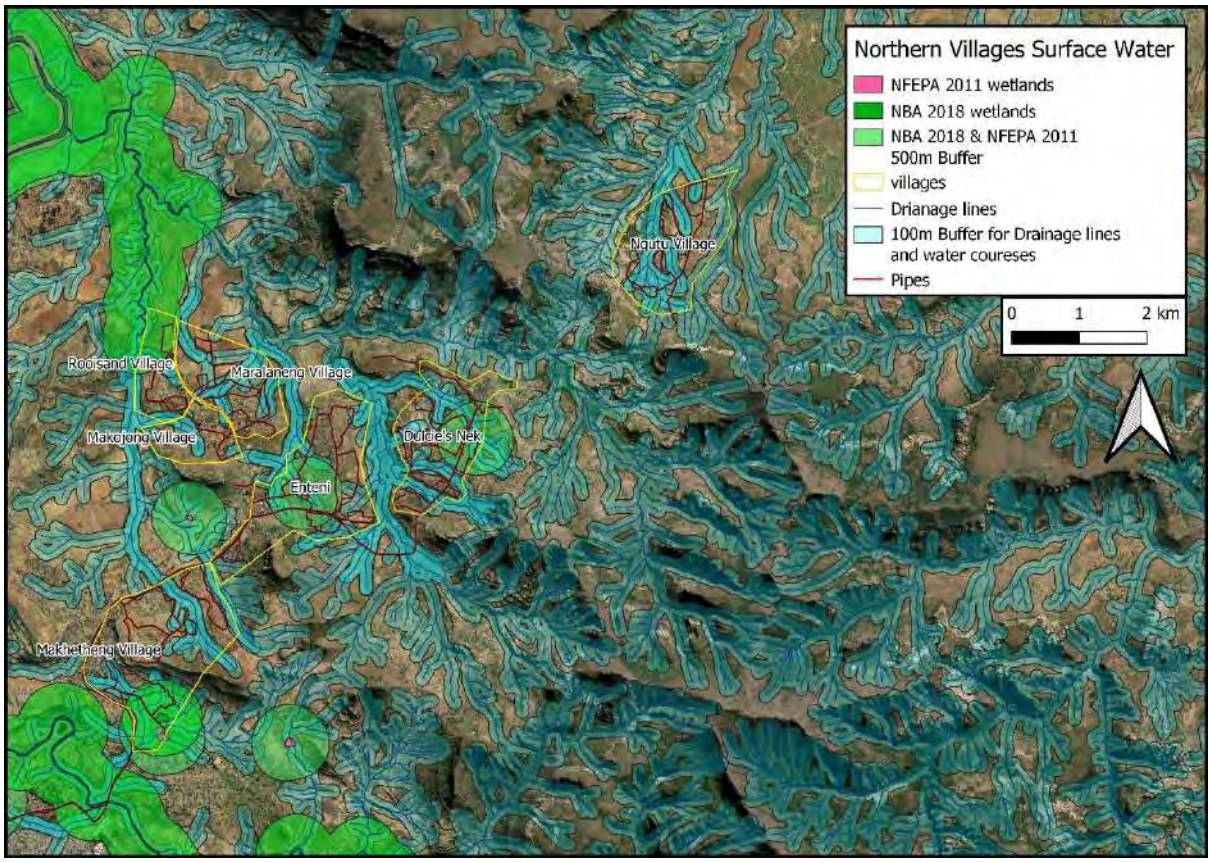

Figure 3.6: Surface water features affected by the northern portion of the proposed development.

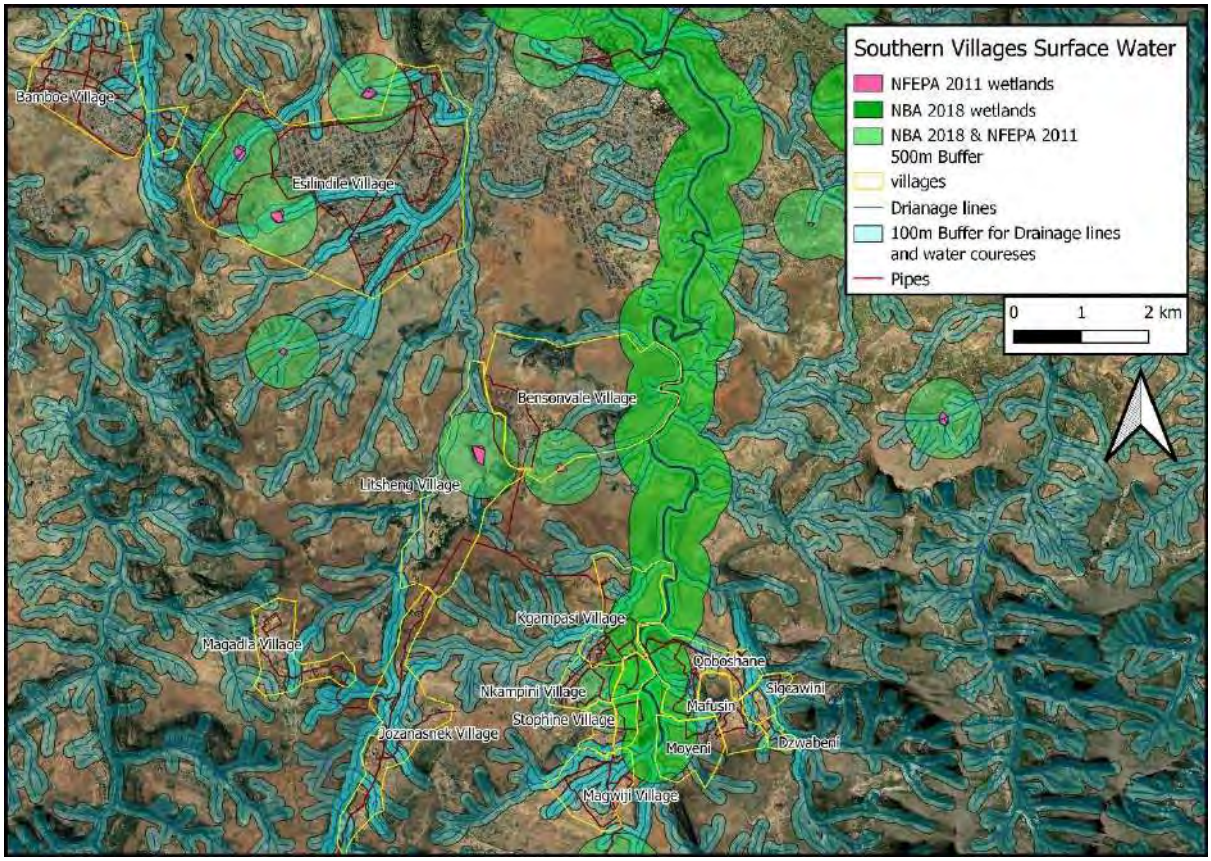

Figure 3.7: Surface water features affected by the southern portion of the proposed development.

3.2 LAND COVER

3.2.1 South African National Land-Cover Map (2018)

According to the South African National Land-Cover (2018) spatial dataset, the majority of the infrastructure associated with the prosed development is located within *Residential Formal* (low veg / grass / bare / tree), *Village Scattered* and *Subsidence Annual Crops*. The major land cover classes surrounding the outskirts of the villages and traversed by the proposed development include *Natural Grassland, Herbaceous Wetlands, Natural Rock Surfaces,* and *Other Bare*, with small patches of *Dense Forest & Woodland* (shrubland). A number of *Herbaceous Wetlands* also occur within the project area (Figure 3.8Figure 3.9 - Figure 3.10).

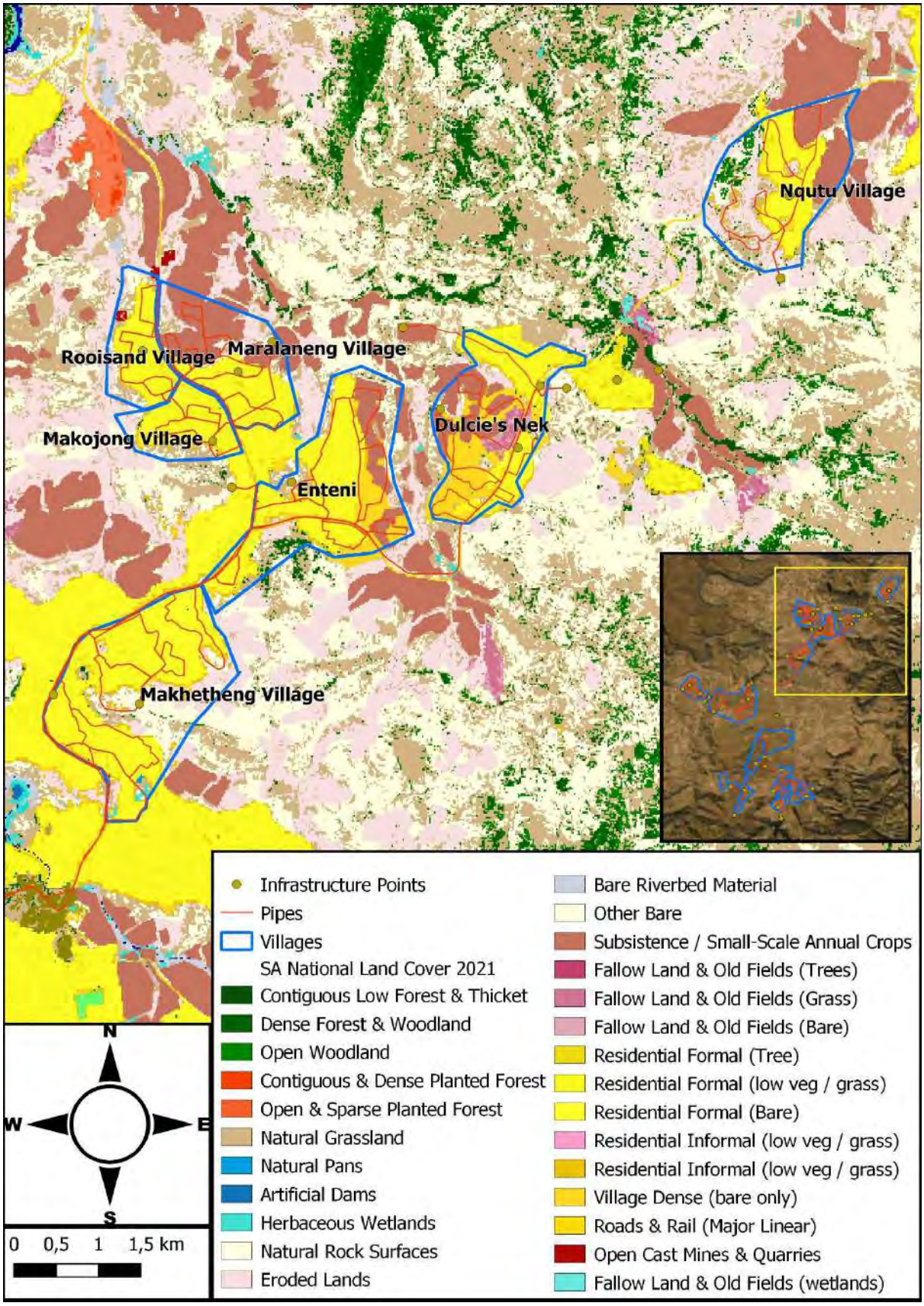

Figure 3.8: South African National Land-Cover (SANLC, 2018) Map of the northern portion of the project area.

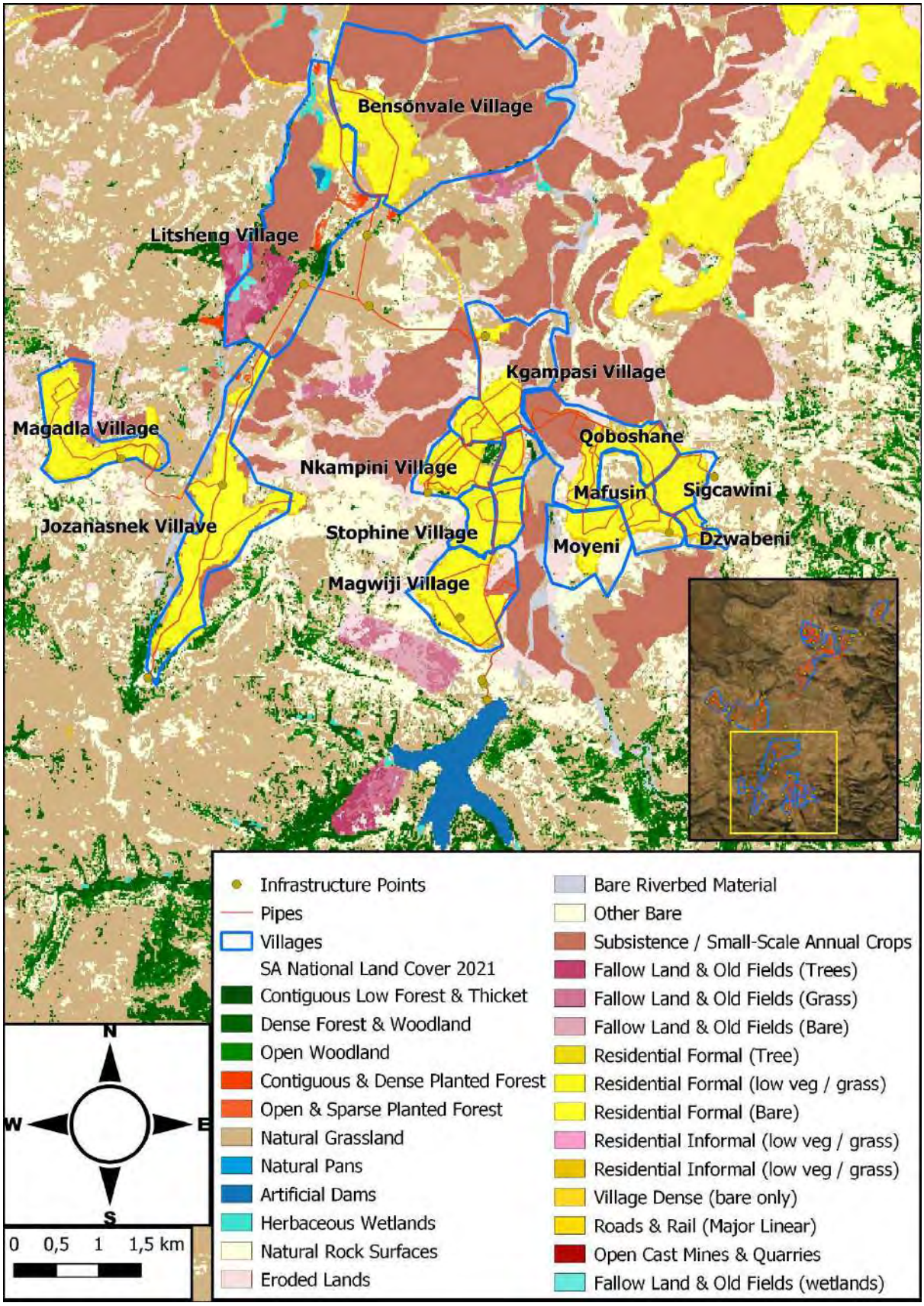

Figure 3.9: South African National Land-Cover (SANLC, 2018) Map of the southern portion of the project area.

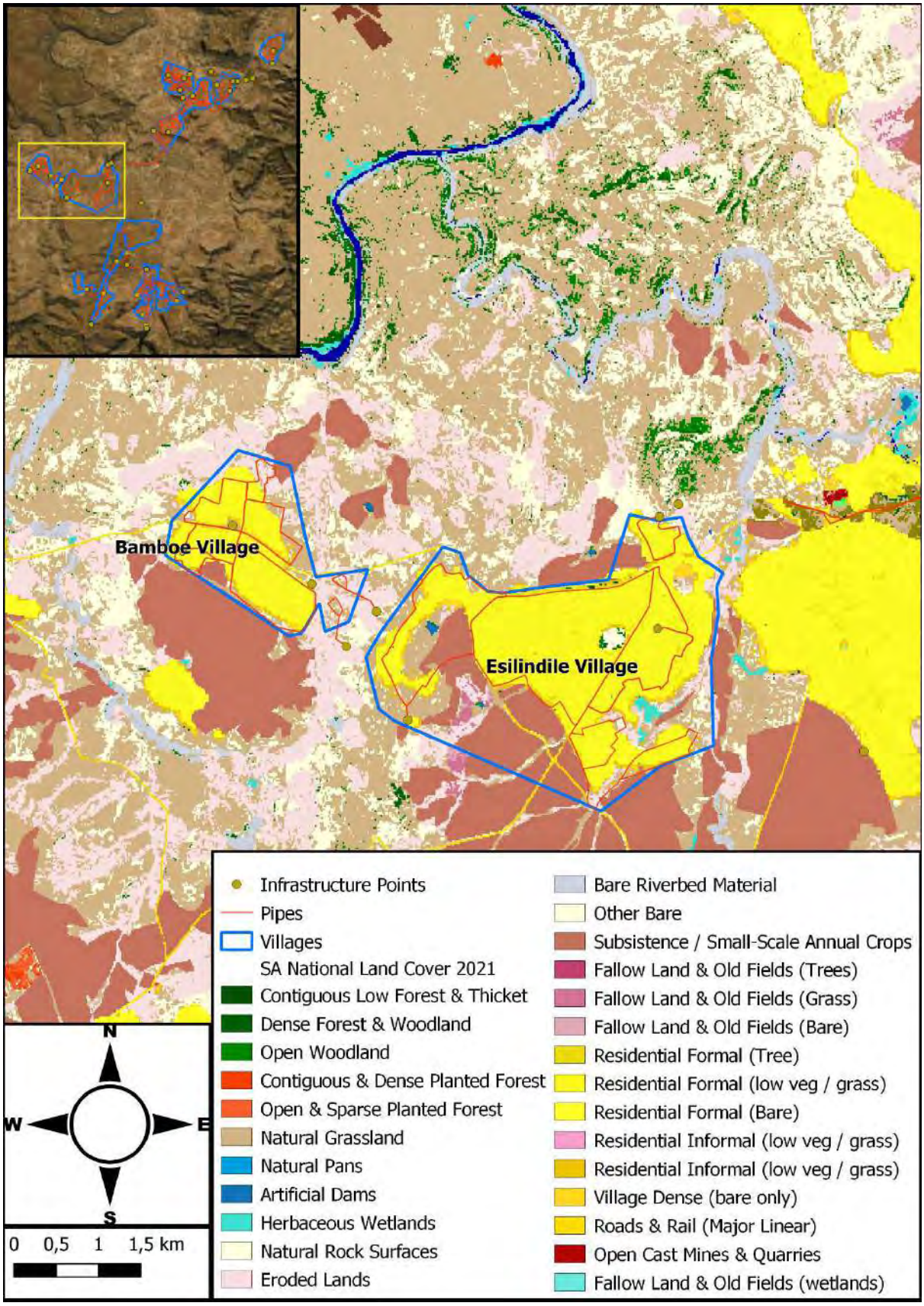

Figure 3.10: South African National Land-Cover (SANLC, 2018) Map of the western portion of the project area.

3.3 THE CURRENT LAND USE

In line with the South African National Land-Cover (2018) data obtained for the project area (see Section 3.2.1 above), the majority of the development is located in previously transformed areas (roads, previously cultivated areas, and grazing land) within the boundaries of various villages. Parts of the development footprint, particularly the proposed reservoirs, are located on the outskirts of the villages, on slopes which are more indicative of the natural vegetation composition. However, even in these areas, grazing by livestock (cattle, sheep, and goats) was observed.

Plate 3.1: Cattle grazing near to the existing Bensonville Reservoir.

3.4 DESCRIPTION OF THE VEGETATION AND FLORISTICS

The proposed Senqu Rural Water Supply Scheme falls within the Grassland Biome (VEGMAP, 2018). Grasslands in South Africa boast remarkable biodiversity and cover approximately one third of South Africa's total land surface area, stretching over the majority of the Eastern Cape and KwaZulu-Natal Provinces. These ecosystems provide important habitat for a range of the country's rare, endangered and endemic animal and plant species, with plant diversity of the grassland biome only second to that of the fynbos biome. The incredible diversity and provision of ecosystem services has contributed to the classification of this ecosystem as an important biodiversity asset of global significance. Grasslands are considered important water production landscapes and provide various ecosystem services particularly for rural communities in South Africa (SANBI, 2013).

Approximately 40% of the grassland biome in South Africa has been transformed, while almost 60% of the remaining grassland areas are classified as threatened due to the loss of vital aspects of their composition, structure, and functioning. Only 3% of this valuable ecosystem is formally conserved. The fragmentation and degradation of the grassland ecosystem severely affects the ecosystems' ability to provide valuable ecosystem services such as soil formation, water and climate regulation, and erosion prevention. As such, development within the remaining natural grassland areas should be well informed and err on the side of caution (SANBI, 2013).

The two (2) key ecological drivers of grassland ecosystems include climate and fire which influences their character, community structure, composition, and primary productivity. In addition to climate and fire, other ecological drivers influencing these factors include grazing, soil types, and nutrient status. Due to their high biodiversity and their suitability for human habitation, these ecosystems are often negatively impacted by various anthropogenic activities including grazing by livestock, over harvesting of natural resources, misappropriation of fire, mining, agriculture, urban and industrial expansion, amongst others (SANBI, 2013).

3.4.1 National Vegetation Map (SA VEGMAP2018): Expected Vegetation Types

The South African Vegetation Map (SA VEGMAP) of 2018 is an important resource for biodiversity monitoring and conservation management in South Africa. Under the custodianship of the South African National Biodiversity Institute (SANBI) the SA VEGMAP, (2018) was updated in order to '*provide floristically based vegetation units of South Africa, Lesotho and Swaziland at a greater level of detail than had been available before*'. The map provides a detailed description of each of South Africa's unique vegetation types along with a comprehensive list of the important species associated with each, including endemic and biologically important species.

According to SANBI's National Vegetation Map (2018), the proposed development falls within two (2) vegetation types, namely Zastron Moist Grassland and Senqu Montane Shrubland (Figure 3.11Figure 3.11).

<u>Zastron Moist Grassland</u>

Zastron Moist Grassland occurs on relatively deep sandy soil overlying sandstone layers of the Tarkastad Subgroup of the Beaufort Group (Karoo Supergroup) on undulating plains in the Eastern Cape and Free State Provinces. This vegetation type falls within the summer rainfall region (MAP of 615 mm) and is characterised by a mosaic of moist open sourveld grassland interspersed with Besemkaree Kopppies Shrubland on dolerite outcrops or Basotho Montane Shrubland on sandstone outcrops. Areas that have suffered heavy grazing tend to have a greater occurrence of Karroid Shrubland (Mucina *et al.,* 2006).

Zastron Moist Grassland is classified as **Least Concern**, with low rates of natural habitat loss and biotic disruption, placing this ecosystem at low risk of collapse. Approximately 64% of its historical extent (±3571.14 km^2) remains. This vegetation type is not protected as determined by the 2018 NBA. Primary threats to Zastron Moist Grassland includes agriculture, urban development, and erosion (SANBI, 2021).

Senqu Montane Shrubland

Senqu Montane Shrubland is restricted to steep, boulder-strewn slopes of valleys and deep gullies, supporting open-canopy montane shrubland in Lesotho and the Eastern Cape and Free State Provinces. Shrub species diversity decreases towards low-lying, south western areas. Senqu Moist Grassland is dominated by evergreen shrubs such as *Sersia erosa, Olea europaea* and *Diospyros lycioides* but tends to transform into thicket in sheltered inaccessible areas, dominated by *Kiggelaria africana, Leucosidea sericea* and *Rhamnus prinoides* (Mucina *et al.,* 2006).

.

Senqu Montane Shrubland is classified as **Least Concern** and at low risk of ecosystem collapse due to low rates of natural habitat loss and biotic disruptions. Approximately 75% of its historical extent (±720.24 km^2) remains. This vegetation type is not protected as determined by the 2018 NBA and its primary threatening processes are currently undocumented (SANBI, 2021).

Figure 3.11: National Vegetation Map for the project site.

3.4.2 Vegetation types recorded on site

While National level vegetation maps have described broad vegetation types, local conditions, and micro-habitats (rainfall, soil structure, rocky outcrops, etc.) can result in variations in plant composition. As such, site surveys are critical for the verification of desktop findings and establishing the baseline ecological conditions of a site.

The site visit conducted on the 7th of December 2021 confirmed that two (2) vegetation types occur within the project area, namely Zastron Moist Grassland and Senqu Montane Shrubland. Zastron Moist Grassland occurs within the lower lying areas whilst Senqu Montane Shrubland was recorded within higher lying areas, on slopes and koppies. The distinct difference between the two (2) vegetation types is the evergreen shrub component characteristic of Senqu Montane Shrubland. The dominant shrubs included *Sersia erosa, S. burchellii,* and *Diospyros lycioides.* Other shrub species recorded on site include *Leucosidea sericea, Olea europaea, Colpoon compressum, Gomphocarpus fruticosus, Myrsine africana, Clutia pulchella* and *Lycium sp.* Various herbs such as *Jamesbrittenia breviflora, Jamesbrittenia aurantiaca, Jamesbrittenia sp., Papaver aculeatum, Hermannia coccocarpa, Stachys aethiopica, Salvia stenophylla, Aristea sp., Dianthus thunbergii* and *Hypoxis sp*. *Helichrysum* spp. amongst others, were recorded in and amongst the grass species (*Aristida congesta, Digitaria argyrograpta, Setaria sphacelate, Themeda triandra, Eragrostis capensis, Harpochloa falx, Bromus catharticus,* amongst others) observed on site (Plate 3.2 and Plate 3.3). Although more intact in comparison to Zastron Moist Grassland, grazing by livestock (sheeps, goats and cattle) within this vegetation type was observed and apparent in the structure of the vegetation community.

Plate 3.2: Senqu Montane Shrubland near to the proposed Nqutu Reservoir.

Plate 3.3: Senqu Montane Shrubland near to the proposed Nqutu Reservoir.

Plate 3.4: Degraded Senqu Montane Shrubland near to the existing Dulciesnek Reservoir.

The Zastron Moist Grassland was recorded within the lower lying, flat areas of the project area. Large portions of this vegetation type has been transformed or degraded due to human settlement and agricultural activities (i.e., cultivation and grazing by livestock) as these areas are more suitable for development. Due to overgrazing within these areas, the identification of grass species was difficult in some cases. Higher densities of alien plant species such as *Agave americana, Hypochaeris radicata, Xanthium spinosum, Opuntia ficus-indica,* and *Argemone Mexicana,* amongst others, were also recorded within these areas, especially within and around the villages. It should be noted that the majority of the development falls within this vegetation type and the boundaries of existing villages and previously disturbed areas (gravel roads and existing servitudes).

Erosion is a major issue in the project area where the indigenous vegetation has been disturbed/lost due to overgrazing as a result of poor rangeland management (Plate 3.6). Erosion leads to the loss of soil quality, and although a natural process by wind and water, grasslands with higher stocking rates (expressed as Livestock Units per hectare land surface) experience more frequent soil erosion (Hendricks *et al.,* 2005; Zhao *et al*., 2007 in Torresani *et al*., 2019). This should be an important consideration during construction and rehabilitation of disturbed areas during the proposed development.

Plate 3.5: Human settlement within lower lying areas which coincides with the distribution of Zastron Moist Grassland.

During the site visit, eighty-five (85) indigenous plant species were recorded during the site survey. All of those identified to species level are classified as Least Concern in terms of the Red List of South African Plants. It should be noted that it is almost certain that more species occur within the project area. Thirteen (13) alien plant species were recorded (refer to Section 3.4.4).

Plate 3.6: Erosion gully near to the proposed Nqutu Reservoir.

Plate 3.7: Degraded Zastron Moist Grassland near to the existing Masekeleng Reservoir.

3.4.3 Species of Conservation Concern (SCC)

The below list of SCC has been compiled using records obtained from the Plants of Southern Africa (POSA) website, the National Screening Report generated for the site, as well as the List of Important Taxa recorded for Zastron Moist Grassland and Senqu Montane Shrubland (Mucina *et al*., 2006). The likelihood of each species occurring within the project area is assessed in Table 3.1 below.

Two (2) threatened Species of Conservation Concern (SCC) were identified for the site, including Sensitive species 441 (EN) and Sensitive species 1248 (VU), neither of which was recorded during the site survey. An additional two (2) rare species, including *Calpurnia reflexa* and *Pterygodium alticola* were identified for the site. Although not recorded during the site survey, based on the habitat requirements and known distribution of these species it is possible that these species occur within the project area although the likelihood of occurrence is considered low (Table 3.1: List of plant SCC likely to occur within the project area.Table 3.1).

A full list of species recorded on site during the field survey is included in Appendix 1.

Table 3.1: List of plant SCC likely to occur within the project area.

Family	Species	SA Red List	PNCO	Protected Tree	NEMBA	Habitat, distribution and population trend (SANBI Red List)	Probability of occurrence on site based on habitat requirements
-	*Sensitive species 441*[1]	EN	Schedule 4	-	-	A formerly widespread and frequently recorded species, this species has now become extremely rare as a result of the destruction and disturbance of wetlands. There are currently three known remaining subpopulations, but it is estimated that there could be up to six. Survey data indicates that subpopulations are small, consisting of fewer than 250 mature individuals. Its habitat includes wetlands, seepages, or stream edges in high altitude grasslands (1 500 – 2000 m) (von Staden et al., 2022).	This species was not recorded during the site survey. Although historically recorded within the nearby surrounds of the project area, it is unlikely that this species occurs within the project area as most of the watercourses observed on site have been impacted by anthropogenic disturbance – a major factor resulting in the loss of this species.
-	*Sensitive species 1248*	VU	-	-	-	This species occurs from the Eastern Cape to Limpopo Province and is relatively widespread elsewhere in South Africa. It typically occurs at low and medium altitudes, usually along mountain ranges and in thickly vegetated river valleys, often under bush clumps and in boulder screes, sometimes found scrambling at the margins of karroid, succulent bush in the Eastern Cape. Its major habitats include Zastron Moist Grassland (one of the vegetation types occurring within the project area). The major threats to this species incudes harvesting for medicinal plant trade and provincial authorities estimate at least a 30% population decline in the past 30 years.	This species was not recorded during the site survey. However, the site does support one of its known habitats, namely Zastron Moist Grassland. It is possible that this species could occur within the more densely vegetated, undisturbed portions of the project area such drainage lines, under bush clumps, and boulder screes.
Fabaceae	*Calpurnia reflexa*	Rare	-	-	-	This species is not endemic to South Africa. Its major habitat includes ravines above 1800 m in grasslands along the mountains of the Eastern Cape and Free State Provinces. It is not threatened, and its population trend is classified as stable, however this is a rare species known from less than 10 sites (Kamundi and Raimondo, 2013).	Based on the known distribution and habitat requirements, it is possible that this species occurs within the project area, particularly along the Bensonvale Spruit River however, the likelihood of occurrence based on rarity is considered low.
Orchidaceae	*Pterygodium alticola*	Rare	Schedule 4	-	-	Although widespread, this species is sparsely distributed in damp grasslands at altitudes of approximately 1 950 – 2400 m. Although its population trend is classified as stable, this is a rare montane species that occurs in small, localised subpopulations of less than 20 individuals (Helme *et al*., 2015).	This species was not recorded during the site survey. However, based on the known habitat requirements and distribution, it is possible that this species occurs within the project area although the likelihood of occurrence based on rarity is considered low.

[1] Some SCC are sensitive to illegal harvesting. As such, their names are obscured and listed as "Sensitive species #". As per the best practice guideline that accompanies the protocol and screening tool, the name of the sensitive species may not appear in any BAR or EIA report, nor any specialist reports released into the public domain.

3.4.4 Alien Invasive Species Present on site

An "invasive species" is any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health. Invasive alien plant species are globally considered as one of the greatest threats to the environment, biodiversity, ecosystem integrity and the economy.

According to the Conservation of Agricultural Resources Act (No. 43 of 1983 - Regulation 15, 30 March 2001) (CARA), for agricultural land, and the National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA), for natural areas, invasive alien plant species should be controlled and eradicated with an emphasis on urgent action in biodiversity priority areas. NEM:BA published a list of Alien and Invasive Species (No 599) in 2014/1 which regulates the management of alien and invasive plants in natural environments.

During the site visit, the following alien invasive species were recorded:

Table 3.2: Alien Invasive species recorded within the project area.

FAMILY	SPECIES	COMMON NAME	RED LIST	CARA (Act No. 43 of 1983)	NEMBA NATIONAL LIST OF INVASIVE SPECIES IN TERMS SECTIONS 70(1), 71(3) and 71A
Amaranthaceae	*Guilleminea densa*	Small Matweed	Naturalized exotics not assessed for National Red List.	-	-
Asteraceae	*Hypochaeris radicata*	Common Cat's-Ear		-	-
	Xanthium spinosum	Spiny Cocklebur		Category 1	-
	Tagetes sp.	-		-	-
Cactaceae	*Opuntia ficus-indica*	Prickly Pear		Category 1	Category 1b
Fabaceae	*Robinia pseudoacacia*	Black Locust		Category 2	-
Onagraceae	*Oenothera rosea*	Rose Evening Primrose		-	-
Papaveraceae	*Argemone ochroleuca*	Mexican poppy		Category 1	Category 1b
Rosaceae	*Rosa rubiginosa*	Sweet-Brier		Category 1	-
Salicaceae	*Populus x canescens*		Hybrids not assessed for National Red List.	Category 2	-
Solanaceae	*Nierembergia sp.*	-	Naturalized exotics not assessed for National Red List.	-	-

NEM:BA Category 1b: Invasive Species

Opuntia ficus-indica and *Argemone ochroleuca* are listed under Category 1b of the NEMBA: National List of Invasive Species in Terms Sections 70(1), 71(3) and 71A. Plants classified as Category 1b alien invasive species are prohibited from:

- Being imported into the Republic;
- Growing or in any other way propagating any specimen;
- Conveying, moving, or otherwise translocating any specimen;
- Spreading or allowing the spread of any specimen; and
- Releasing any specimen.

CARA Category 1: Declared weeds

Plants classified as Category 1 in CARA are Declared Weeds. These are prohibited plants, which must be controlled or eradicated where possible (except in biocontrol reserves, which are areas designated for the breeding of biocontrol agents). *Xanthium spinosum, Opuntia ficus-indica, Argemone ochroleuca* and *Rosa rubiginosa* are classified as Category 1 in terms of the CARA.

CARA Category 2: Invader Plants

Plants classified as Category 2 are declared Invader Plants and may only be grown under controlled conditions if a permit is acquired. No trade in these plants is permitted. *Robinia pseudoacacia* and *Populus x canescens* are classified as Category 2 in terms of the NEM:BA.

* All alien and invasive plant species must be controlled during all phases of development according to the recommendations outlined in the Environmental Management Programme (EMPr).

3.5 Description of Fauna

This section provides a brief description of the herpetofauna (amphibians and reptiles), mammals, and avifauna (birds) likely to occur within the proposed project area. According to the Screening Report generated for the project area, the relative Animal Species Theme Sensitivity is classified as HIGH due to the likely occurrence of four (4) species, including *Aquila verreauxii* (Verreaux's eagle – LC), *Gypaetus barbatus* (Bearded Vulture – NT), *Gyps coprotheres* (Cape Vulture – VU), and *Hydrictis maculicollis* (Spotted-necked otter – VU). These species are assessed in the relevant sections below (Section 3.5.1: *Mammals* and Section 3.5.3: *Avifauna*).

A comprehensive desktop review was undertaken to assess the current threat status and probability of occurrence of the faunal SCC identified for the study area. This was done using the *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland* (Minter *et al*. 2004), *Red-Listing The Amphibians of South Africa* (Measey 2010) and *Ensuring A Future For South Africa's Frogs: A Strategy For Conservation Research* (Measey 2014) as well as iNaturalist (https://www.inaturalist.org/places/south-africa#taxon=20978) and ADU's FrogMAP (http://vmus.adu.org.za) to obtain a list of amphibians likely to occur within the project area. The *Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland* (Minter *et al*. 2014) as well as iNaturalist (https://www.inaturalist.org/places/south-africa#taxon=26036) and ADU's ReptileMAP (https://vmus.adu.org.za) was consulted in order to compile a list of reptiles likely to occur within the project area. The Red Data Book of Southern African Mammals: a Conservation Assessment (EWT 2016, updated in 2020) as well as iNaturalist (https://www.inaturalist.org/places/south-africa#taxon=40151) and ADU's MammalMAP (https://vmus.adu.org.za), was consulted in order to obtain a list of mammal species likely to occur within the project area.

3.5.1 Mammals

The iNaturalist (2021) database suggests that seventeen (17) native mammal species occur within the Joe Gqabi District of the Eastern Cape. In addition, the DFFE Screening report indicates that an additional mammal species (*Hydrictis maculicollis*) distribution intersects with the Senqu Rural Water Supply Scheme, bringing the total number of mammal species likely to occur within the project area to eighteen (18) (see Appendix 2). Of the mammal species likely to occur within the project area, four (4) threatened SCC were identified, including the Mountain Reedbuck (*Redunca fulvorufula fulvorufula* - EN), Spotted-necked Otter (*Hydrictis maculicollis* - VU), Grey Rhebok (*Pelea capreolus* - NT), and the Southern African Hedgehog (*Atelerix frontalis* - NT) (Table 3.3).

In addition to the threatened SCC described above, seven (7) mammal species are protected in terms of the Eastern Cape Provincial Nature Conservation Ordinance (Act No. 19 OF 1974), including the Aardwolf (*Proteles cristata*), Cape Fox (*Vulpes chama*), Grey Rhebok, Mountain Reedbuck, Springbok (*Antidorcas marsupialis*), Greater Kudu (*Tragelaphus strepsiceros*), Blesbok (*Damaliscus pygargus phillipsi*) and Southern African Hedgehog (Appendix 2).

Although not recognised as SCC, three (3) of the mammal species listed are endemic including Sloggett's Vlei Rat (*Otomys sloggetti*), Hewitt's Red Rock Hare (*Pronolagus saundersiae*) and Grey Rhebok (*Pelea capreolus*), while one (1) species is near endemic (Mountain Reedbuck) (Appendix 2).

Table 3.3: Threatened mammal SCC likely to occur within the project area.

NAME	CONSERVATION STATUS (EWT 2016)	THREAT STATUS	HABITAT (SANBI & EWT 2016)	PROBABILITY OF OCCURRENCE (High, Medium, Low, Confirmed)
Spotted-necked Otter	*Hydrictis maculicollis*	Vulnerable	Likely to inhabit clean, non-silted, freshwater habitats with plenty of fish, however they can occur in relatively polluted rivers. There are a number of watercourses that surround the project area. As such, the probability of occurrence of this species on site is medium.	Medium

Mountain Reedbuck	*Redunca fulvorufula fulvorufula*	Endangered	Live on grass-covered ridges and hillsides in broken rocky country and high-altitude grasslands often with some tree or bush cover. They are predominantly grazers and eat the greenest, softest parts of grasses such as Red Grass (*Themeda triandra*) and Thatch Grass (*Hyparrhenia spp*.). They tend to avoid very open areas with no cover and the availability of drinking water is crucial to their presence. As such, they are often associated with the lower slopes, making use of relatively moist, cool more southerly aspects. The study area intersects mostly with rural villages. Due to the relatively densely populated nature of the project area and level of human activity and traffic, it is unlikely that this species would occur within the project area.	Low
Grey Rhebok	*Pelea capreolus*	Near Threatened	In the eastern extent of their distribution, this species is associated with rocky hills, grassy mountain slopes, and plateau grasslands. They require good grass cover within their home ranges for shelter and to hide from predators, but often use steep open areas with little cover when feeding. The study area intersects mostly with rural villages. Due to the relatively densely populated nature of the project area and level of human activity and traffic, it is unlikely that this species would occur within the project area.	Low
Southern African Hedgehog	*Atelerix frontalis*	Near Threatened	Prefer grass and Bushveld areas that are not too damp and covered with leaves and other debris. They require ample ground cover, for cover, nesting and insect food sources. On a local scale, the species appears to prefer dense vegetation habitats and rocky outcrops that may provide food, cover and nesting materials. There may be vegetated areas on the rocky slopes on the outskirts of the villages that provides habitat which could potentially support this species.	Moderate

3.5.2 Herpetofauna

The Eastern Cape Province is home to approximately one-hundred-and-seventy-seven (177) herpetofauna species, which includes fifty-seven (57) amphibian species and one-hundred-and-twenty (120) reptile species (iNaturalist, 2021). Of these, approximately thirty-two (32) species potentially occur within project area.

The iNaturalist (2021) database indicates that eight (8) amphibian species and twenty-four (24) reptile species have been observed within the Joe Gqabi District in the Eastern Cape Province. None of these species are threatened in terms of the Regional Red Data List for frogs (2004, 2010 & 2014) and reptiles (2014). While none of these species are listed as threatened in terms of the Regional Red List, all tortoises and lizards, as well as five (5) snake species, listed in this report are protected in terms of Schedule II of the PNCO and are therefore regarded as SCC (Appendix 3). Permits must be acquired prior to the removal and/or translocation of SCC.

3.5.3 Avifauna

About 250 bird species potentially occur within the assessment area. Out of these, twenty-four (24) species were identified as SCC in the avifauna assessment for the proposed development (Table 3.4). While the African Black Duck (*Anas sarsa*) is listed as Least Concern, as a river specialist, it is facing continuous decline in South Africa because of river degradation (Taylor et al. 2015), which may render this species vulnerable to the type of development being proposed in the assessment area. The Screening Report generated for the project area identifies three (3) avifaunal species which contribute to the relative Animal Species Theme Sensitivity, including *Gyps coprotheres* (VU), *G. barbatus* (NT), *Aquila verreauxii* (LC).

Table 3.4: Avifaunal SCC likely to occur within the project area.

Scientific Name	Common Name	Regional Red List Status (BLSA, 2019)	PNCO EC	NEM:BA	Habitat (Taylor *et al*. 2015))
Anas sparsa	African Black Duck	LC	Schedule II	-	Utilises mainly perennial rivers and streams fringed by thick vegetation, rendering it vulnerable to changes in water quality and flow, and clearance of riverine vegetation. Additional threats to this species include siltation, pollution, construction of dams and introduction of alien organisms.
Tyto capensis	African Grass Owl	VU	Schedule II	-	Typically roosts and breeds in tall, rank grass or sedges associated with damp substrates such as permanent and non-perennial wetlands and streams. This species does not exclusively breed in wetland areas, but it

					requires tall grass to nest/roost in.
Circus ranivorus	African Marsh Harrier	EN	Schedule II	-	Breeds roosts and feeds exclusively in permanent coastal/inland wetlands, but can forage outside of wetland areas, e.g., drier floodplains, grasslands and croplands.
Gypaetus barbatus	Bearded Vulture	CR	-	Schedule I	Restricted to rugged mountains above 1 500 m. In lowland areas, the main threat to this species is electrification networks.
Circus maurus	Black Harrier	EN	Schedule II	-	Breeds preferably in Fynbos habitat, but forages in a wide range of habitat, including high-altitude grasslands, alpine meadows, Karoo scrubland, semi-desert, marshy floodplains and croplands.
Grus paradisea	Blue Crane	NT	Schedule II	-	Found in dry grassland but make extensive use of agricultural landscapes for foraging habitat. This species normally roosts in wetlands or dams.
Balearica regulorum	Grey Crowned Crane	EN	Schedule II	-	Require mixed wetland-grassland habitats, where they typically nest within or on the edges of wetlands. This species forages in wetlands, nearby grasslands, and croplands.
Gyps coprotheres	Cape Vulture	EN	Schedule II	-	In the study region, this species would typically nest on tall cliff faces and forage in open grassland. Poisoning is a major threat to this species.
Eupodotis caerulescens	Blue Korhaan	LC (NT globally)	Schedule II	-	Occurs in the interior grasslands and grassy Karoo of the central part of South Africa as well as lowlands of west Lesotho. Birds of up to 5 individuals may inhabit mainly flat or slightly undulating, short or burnt grassland within 1 km of water.
Neotis denhami	Denham's Bustard	VU	Schedule II	-	In the Eastern Cape, this species distribution is close to the coastal and sub-coastal belt, extending to the Karoo Midlands, and may occur seasonally on the upland grassland of East Griqualand. This species breeds in grassland and fynbos habitats. In the grassland biome, this species inhabits high-lying open, sour

					grassland, often in rocky areas and on a plateau, as well as coastal lowland grassland. This species occasionally uses cultivated fields such as irrigated lucerne, particularly in winter and droughts.
Neotis ludwigii	Ludwig's Bustard	EN	Schedule II	-	Occurs in the flat, open, semi-arid shrublands of the Succulent Karoo, Nama Karoo and Namib. This species may also be found in the arid western edge of the grassland biome in the Eastern Cape and occasionally in the Fynbos biome. In the Grassland and Fynbos biomes this species is frequently found in pastures and cultivated fields.
Mycteria ibis	Yellow-billed Stork	EN	Schedule II	-	This species uses a mixture of permanent and seasonal wetland habitats, with open shallow water that is generally free of vegetation, for foraging. Food includes frogs, small fish and other small aquatic prey. The dam on site is largely surrounded by dense vegetation. As this species prefers foraging in areas free of vegetation, it is unlikely to occur on site.
Polemaetus bellicosus	Martial Eagle	EN	Schedule II	-	Prefers open woodland in flat areas, including arid and mesic savannah and forest edges. Also occurs in open farmland, provided there are adequate tall trees or pylons for nesting and perching, and open shrubland with drainage line woodland. In addition, densities of this species are relatively high in areas stocked with indigenous game.
Circus macrourus	Pallid Harrier	NT	Schedule II		Prefers dry to damp grasslands associated with open pans or floodplains, or open areas in woodland, where it hunts mainly for rodents by flying low above the ground.
Sagittarius serpentarius	Secretarybird	VU	Schedule II	-	Prefers open grassland and scrub, with the ground cover shorter than 50 cm and with sufficient scattered trees to use as roost/nest sites. Absent from dense woodland.

Oxyura maccoa	Maccoa Duck	NT	Schedule II	-	Prefers permanent wetlands in open grassland and semi-arid Karoo, breeding usually in stands of young, emergent vegetation.
Falco biarmicus	Lanner Falcon	VU	Schedule II	-	Frequently found in open grassland or open woodland, and agricultural areas, breeding in cliffs or man-made structures such as pylons in the absence of cliffs.
Anthus editus	Mountain Pipit	NT	Schedule II	-	Found on high-altitude plateaus above 2 000 m.
Anthus crenatus	African Rock Pipit	NT	Schedule II	-	Associated with rocky or boulder-strewn slopes and rocky scree.
Aquila verreauxii	Verreaux's Eagle	Not Assessed	Schedule II	-	Restricted to areas with mountains, gorges and inselbergs, nesting in rocky outcrops or cliffs, and rarely making use of man-made structures such as pylons.
Ciconia nigra	Black Stork	VU	Schedule II	-	Absent from seasonal pans lacking fish but readily found at dams, shallow pans and floodplains. This species is a cliff-nester.
Campethera notata	Ground Woodpecker	NT	Schedule II	-	Inhabits treeless, rocky slopes along mountainous spine of South Africa, Lesotho and western Swaziland. THe formation of gullies as a result of soil erosion and construction activities that lead to the formation of excavations, quarries and road cuttings may provide this species with additional nesting opportunities.
Monticola explorator	Sentinel Rock Thrush	LC (NT globally)	Schedule II	-	Inhabits grassland areas where it is confined to rocky slopes or higher Altitudes. This species may benefit from reduced vegetation cover by agricultural activities.

3.6 Ecosystem Threat Status

The National Environmental Management: Biodiversity Act, (Act No. 10 OF 2004) (NEM:BA) provides a National List of Ecosystems that are threatened and in need of protection – GN 1002 of 2011. According to the NEM:BA List of threatened ecosystems, the study site does not occur within or near to a threatened ecosystem. These findings are supported by the NBA (2018) *Terrestrial ecosystem threat status assessment* (Skowno *et al*., 2019) and South Africa's Terrestrial Red List of Ecosystems (RLE) (SANBI, 2021), which confirmed that both ecosystems within the study area, including Zastron Moist Grassland and Senqu Montane Shrubland, are classified as Least Concern (LC).

4 SITE SENSITIVITY

4.1 CRITICAL BIODIVERSITY AREAS

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

1) Identify the minimum spatial requirements needed to maintain a living landscape that continues to support all aspects of biodiversity and retain/maintain essential ecological infrastructure. This is achieved through the selection of areas, based on achieving targets, which represent important biodiversity patterns AND ecological processes;
2) Serve as the primary source of biodiversity information for land use planning and decision-making; and
3) Inform conservation and restoration action in important biodiversity areas.

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

In terms of the ECBCP (2019), the majority of the proposed development footprint falls within an area with no CBA/ESA classification. Small portions of the proposed development fall within a terrestrial ESA 1 and ESA 2. Only approximately 420 m of the existing Jozana Rising Main which connects to the JozanasNek Water Tank falls within an area classified as a terrestrial CBA 2 (Figure 4.1). The existing servitude in which the Jozana Rising Main occurs is apparent on Google Earth Imagery (Figure 4.3). In terms of the ECBCP (2019) Freshwater CBA spatial data set, the majority of the proposed development falls within an area with no CBA/ESA classification however, sections of the development footprint traverse areas classified as aquatic ESA 1 (Figure 4.3).

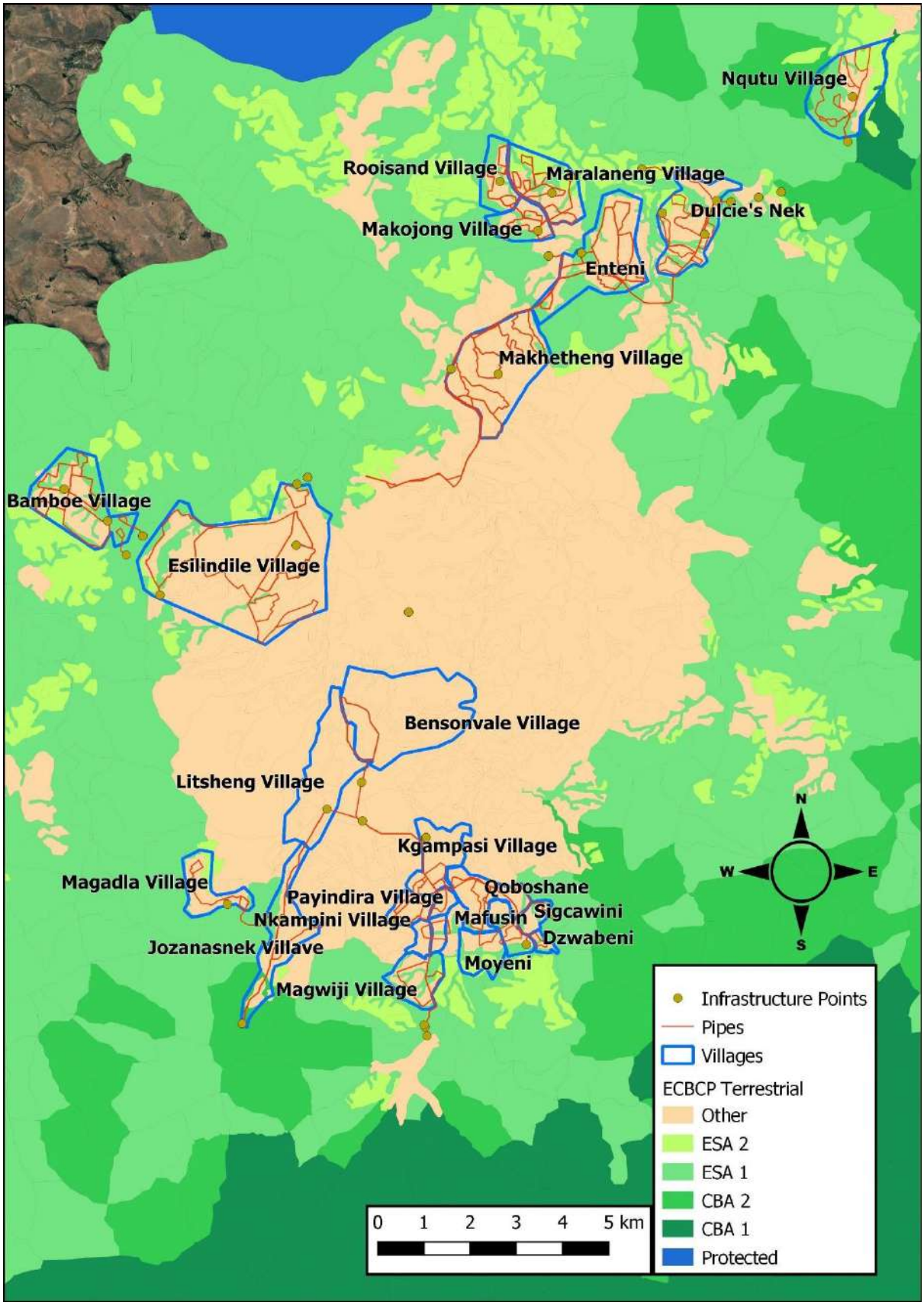

Figure 4.1: ECBCP (2019) terrestrial CBAs within the project area.

Figure 4.2: The existing Jozana Rising Main servitude evident on Google Earth Imagery.

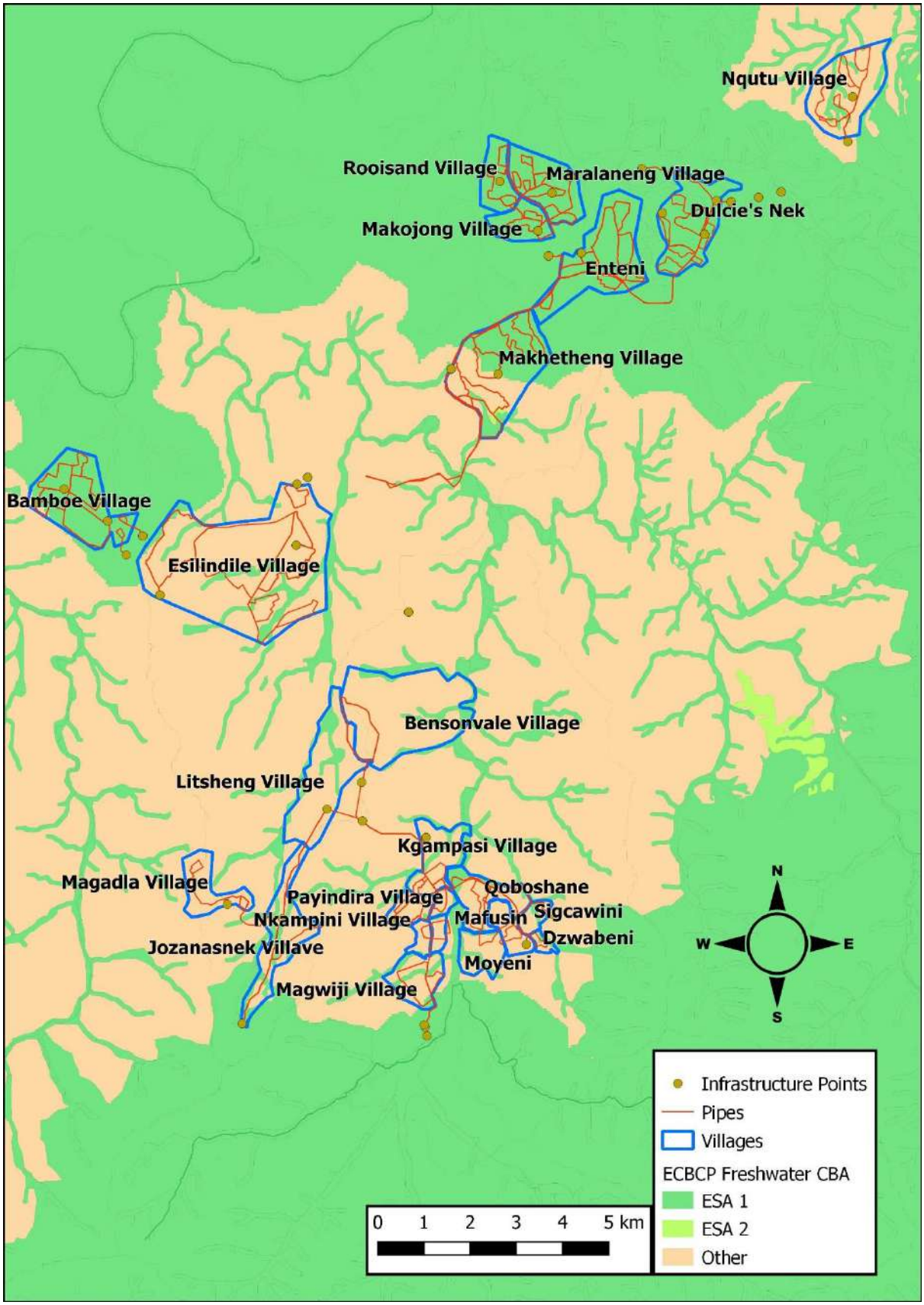

Figure 4.3: ECBCP (2019) Aquatic CBAs within the Project Area.

Table 4.1: Biodiversity priority areas affected by the proposed Senqu Rural Water Supply Scheme.

Category	Sensitivity Features	Desired Management Objective	Recommendation
ECBCP (2019) Terrestrial CBAs/ESAs			
CBA 2	CBAs are selected to meet biodiversity targets for species, ecosystems, and ecological processes. These include: ➢ Critically Endangered and Endangered Ecosystems; ➢ Critical linkage points (bottle-necks or pinch-points) in the corridor network; and ➢ All areas required to meet biodiversity targets and to ensure future persistence of species, ecosystems, and special habitats. CBAs are areas of high biodiversity value and should therefore be maintained in a natural state, with no further loss of habitat. Ecological Support Areas (ESAs)	Maintain in natural (or near-natural state if this is the current condition of the site) that secures the retention of biodiversity pattern and ecological processes: For areas classified as CBA2, the following objectives must apply: ➢ Ecosystem and species must remain intact and undisturbed; ➢ There is some flexibility in the landscape to achieve biodiversity targets in these areas. It must be noted that the loss of a CBA2 area may elevate other CBA 2 areas to a CBA 1 category. ➢ These biodiversity features are at risk of reaching their limits of acceptable change. If land use activities are unavoidable in these areas, and depending on the condition of the site, set-aside areas must be designed in the layout and implemented. If site specific data confirms that biodiversity is significant, unique and/or highly threatened or that a Critically Endangered or Endangered species is present, Biodiversity Offsets must be implemented.	Maintenance/upgrades on the existing Jozana Rising Main and Jozanasnek Water Tank which fall within an area classified as a CBA 2 must be undertaken within the footprint of the existing servitude. The existing servitude should not be made wider and existing access roads must be utilised in order to avoid the further loss of vegetation within an area classified as a terrestrial CBA 2.
ESA 1	ESAs are not essential for meeting biodiversity targets, but are essential in terms of: <u>Terrestrial landscape:</u> Ensuring connectivity between CBAs, strengthening climate change resilience and proper function of	Maintain ecological function within the localised and broader landscape. A functional state in this context means that the area must be maintained in a semi-natural state such that ecological function and ecosystem services are maintained.	The development footprint for the proposed Senqu Rural Water Supply Scheme must be limited to that which is strictly necessary. Mitigation measures as specified in this report must be implemented and adhered to in areas classified as an ESA 1.

	ecosystem infrastructure for delivery of ecosystem services. From a terrestrial perspective, ESAs may include riparian areas, coastal corridors, ridges, etc.	For areas classified as ESA1, the following objectives apply: • These areas are not required to meet biodiversity targets, but they still perform essential roles in terms of connectivity, ecosystem service delivery and climate change resilience. • These systems may vary in condition and maintaining function is the main objective, therefore: o Ecosystems still in natural, near natural state should be maintained. Ecosystems that are moderately disturbed/degraded should be restored.	
ESA 2		Maintain current land use with no intensification For areas classified as ESA2, the following objectives apply: ➢ These areas have already been subjected to severe and/or irreversible modification. ➢ These areas are not required to meet biodiversity targets, but they may still perform some function with respect to connectivity, ecosystem service delivery and climate change resilience ➢ Objective is to maintain remaining function, therefore: • Areas should not undergo any further deterioration in ecological function.	As above.

		• Opportunities to change land use practices to improve ecological function (i.e. cultivation agriculture to livestock grazing agriculture) are desirable in ESA2 areas.	
ECBCP (2019) Aquatic CBAs/ESAs			
ESA 1	ESAs are not essential for meeting biodiversity targets, but are essential in terms of: • Aquatic landscape: ESAs extend into catchments that are essential for the maintenance of CBA rivers and wetlands.	Same as for Terrestrial ESA 1.	Same as for Terrestrial ESA 1.

4.2 PROTECTED AREAS

The National Protected Areas Expansion Strategy (NPAES, 2008) was developed to "*achieve cost-effective protected area expansion for ecological sustainability and increased resilience to climate change*." The NPAES originated as Government recognised the importance of protected areas in maintaining biodiversity and critical ecological processes. The NPAES sets targets for expanding South Africa's protected area network, placing emphasis on those ecosystems that are least protected.

Although not located directly within an NPAES Focus Area, the proposed development is located within 200 m of the Southern Berg Griqualand NPAES Focus Area. The site is not located within 12 km of a National Park or a protected area, however it is located within 3 km of the Mayaputi Private Nature Reserve and 7.2 km of the Lammergeier Highlands Nature Reserve (SAPAD, 2021). The site is not located within or near to a conservation area recognised by SACAD (2021) or an Important Bird Area (IBA) recognised by Birdlife (2015) (**Error! Reference source not found.**).

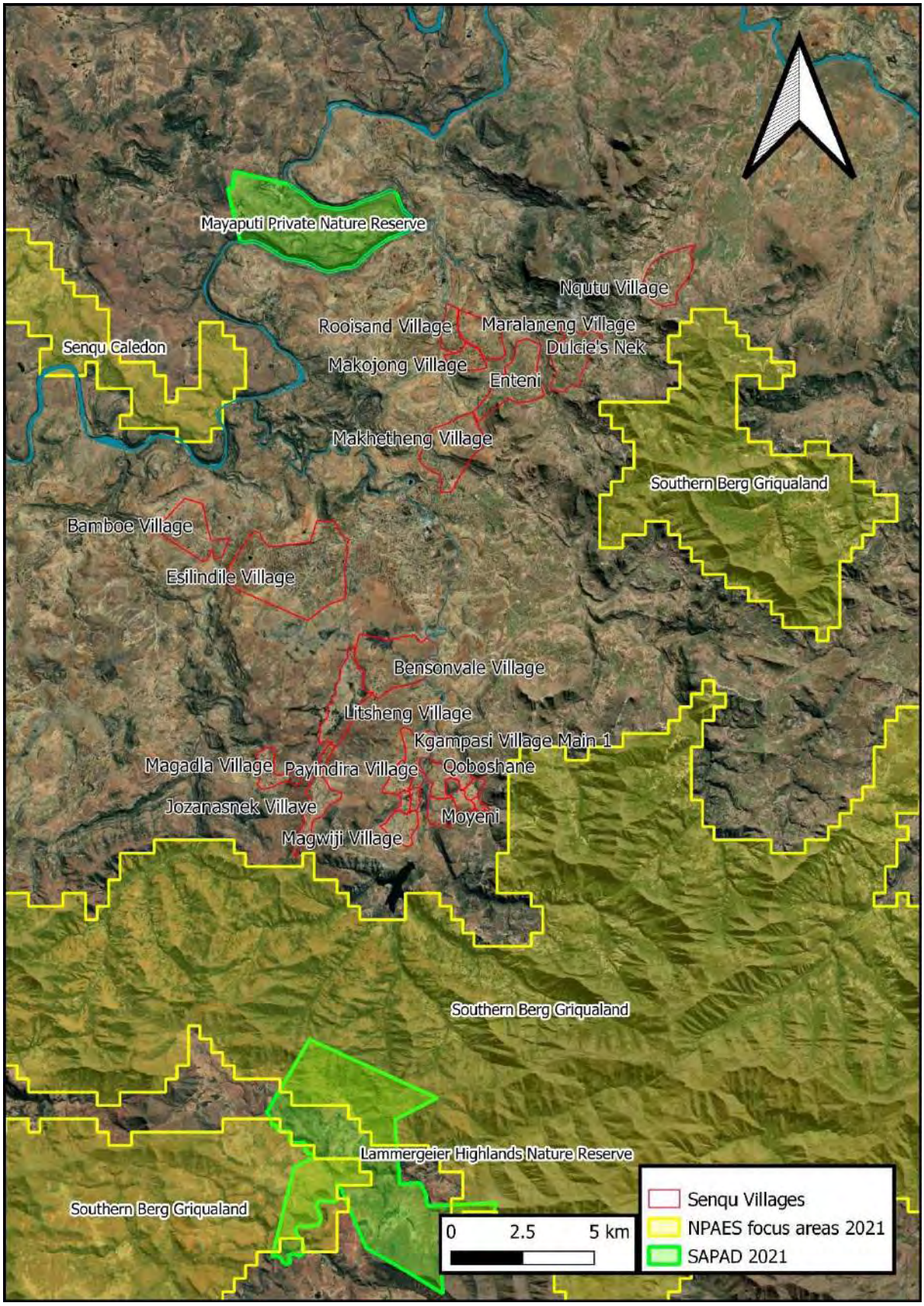

Figure 4.4: NPAES Focus Areas and Protected Areas.

4.3 SITE SENSITIVITY

The Species Environmental Assessment Guideline (SANBI, 2020) was applied to assess the Site Ecological Importance (SEI) of the project area. The habitats and the species of conservation concern in the project area were assessed based on their conservation importance, functional integrity and receptor resilience (Table 4.2). The combination of these resulted in a rating of SEI and interpretation of mitigation requirements based on the ratings.

The sensitivity map was developed using available spatial planning tools as well as by applying the SEI sensitivity based on the field survey.

Table 4.2: Criteria for establishing Site Ecological importance and description of criteria.

Criteria	Description
Conservation Importance (CI)	*The importance of a site for supporting biodiversity features of conservation concern present e.g. populations of IUCN Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.*
Functional Integrity (FI)	*A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.*
Biodiversity Importance (BI) is a function of Conservation Importance (CI) and the Functional Integrity (FI) of a receptor.	
Receptor Resilience (RR)	*The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.*
Site Ecological Importance (SEI) is a function of Biodiversity Importance (BI) and Receptor Resilience (RR)	

Table 4.3 provides a summary of how the ecosystem type was assessed.

Each ecosystem type (inclusive of both faunal and floral components) was assessed separately to determine the overall SEI. The overall SEI of Senqu Montane Shrubland is classified as LOW, whilst the overall SEI of Zastron Moist Grassland is VERY LOW (Table 4.3). According to the Guidelines for Interpreting SEI in the Context of the Proposed Development Activities (SANBI, 2020) in ecosystems with an SEI of very low, development activities of medium to high impact are acceptable and restoration activities may not be required. In ecosystems with an SEI of low, development activities of medium to high impact are acceptable followed by the appropriate restoration activities (Table 4.4).

Table 4.3: Evaluation of Site Ecological Importance (SEI) of habitat and SCC.

Habitat / Species	Conservation Importance (CI)	Functional Integrity (FI)	BI	Receptor Resilience	SEI
	Medium	**Medium**		**High**	
Senqu Montane Shrubland	Although not confirmed, likely occurrence of the near-threatened Southern African Hedgehog (listed under Criterion A). No confirmed or highly likely populations of range-restricted species. >50% of receptor, **which includes the development footprint,** contains natural habitat with potential to support SCC.	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts (i.e. grazing by livestock, erosion, invasion by AIPS). Moderate rehabilitation potential.	**MEDIUM**	According to Cadman et al. (2013, p. 38), "*changes in species composition and structure resulting from poor rangeland management are generally reversible in the short to mid-term (5-20 years), especially if the primary grassland species (forbs and grasses) are still scattered across the grassland, even in low numbers. Dry Highveld ecosystems [such as the Senqu Montane Shrubland] will generally recover more quickly than mesic ones as they are dominated by plants that recruit more often from seeds stored in the seed bank, depending on rainfall*." The Senqu Montane Shrubland is mainly dominated by grasses, with scattered trees, and is therefore likely to recover relatively quickly and retain a high degree of the original species composition and functionality.	**LOW**

Habitat / Species	Conservation Importance (CI)	Functional Integrity (FI)	BI	Receptor Resilience	SEI
	.				
Zastron Moist Grassland	**Low** No confirmed or highly likely populations of plant and/or faunal SCC. No confirmed or highly likely populations of range restricted species. <50% of receptor, **which includes the development footprint,** contains natural habitat with limited potential to support SCC.	Low Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts (i.e. transformation for rural villages and agricultural activities, grazing by livestock, erosion, invasion by AIPS).	**LOW**	**High** According to Cadman et al. (2013, p. 38), "*changes in species composition and structure resulting from poor rangeland management are generally reversible in the short to mid-term (5-20 years), especially if the primary grassland species (forbs and grasses) are still scattered across the grassland, even in low numbers. Dry Highveld ecosystems [such as the Zastron Moist Grassland] will generally recover more quickly than mesic ones as they are dominated by plants that recruit more often from seeds stored in the seed bank, depending on rainfall*." It should be noted that much of this ecosystem type which includes the development footprint has been transformed due to rural village expansion, cultivation, erosion, and grazing by livestock.	**VERY LOW**

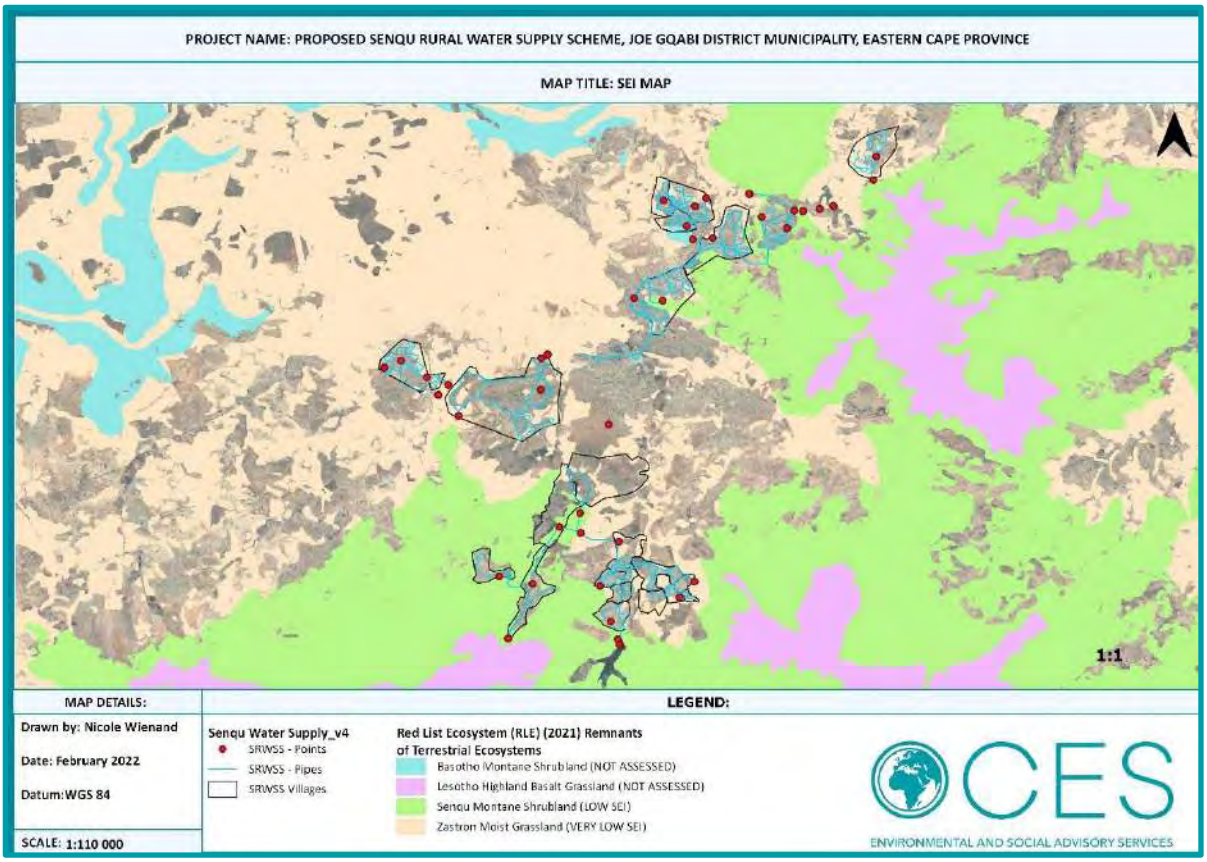

Figure 4.5: Sensitivity map indicating the SEI of the study site as per the classification in terms of the Species Environmental Assessment Guideline (SANBI, 2020).

Table 4.4: Guidelines for interpreting SEI in the context of the proposed development activities.

SEI	Interpretation in relation to proposed development activities.
LOW	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
VERY LOW	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

5 IMPACT IDENTIFICATION AND ASSESSMENT

The study that has been undertaken provides the necessary information in order to assess the impacts of the proposed Senqu Rural Water Supply Scheme on the ecology of the area at the appropriate spatial and temporal scales. The impacts identified and described in Section 5.1 below have been assessed in terms of the criteria described in Appendix 4 of this report.

5.1 IMPACT ASSESSMENT

Table 5.1: Assessment of impacts associated with the proposed Senqu Rural Water Supply Scheme.

CONSTRUCTION PHASE

IMPACT 1: IMPACTS OF EROSION ON THE FEPA SUBCATCHMENT AND STRATEGIC WATER SOURCE AREA

Cause and Comment

Direct Impact

The proposed Senqu Rural Water Supply Scheme falls within a Freshwater Ecosystem Priority Area Quinary Catchment, a Strategic Water Source Area, and traverses' numerous wetlands and drainage lines (NBA, 2018). During the construction phase, the clearance of vegetation for the proposed development could result in possible erosion and the loss of topsoil which would directly impact the FEPA Subcatchment and Strategic Water Source Area within which the proposed development is located. This in turn could impact on the water quality entering the nearby rivers. It should be noted that the majority of the development footprint is located within existing servitudes and the overall development footprint of the proposed Seqnu Rural Water Supply Scheme is relatively small (18.5 ha). As such, if mitigation measures are implemented this impact will be of low significance.

Cumulative Impact

Severe erosion has already taken place within the project area, particularly along slopes, drainage lines, and water courses. In addition, portions of the FEPA Subcatchment and Strategic Water Source Area have already been impacted by the expansion of rural villages, agricultural activities, roads, and the erosion that has taken place. However, the footprint of the proposed Senqu Rural Water Supply Scheme is relatively small (18.5 ha) compared to the existing infrastructure such as roads, powerlines, etc, and settlements. Therefore, the additional impact of the Senqu Rural Water Supply Scheme on erosion and the FEPA Subcatchment and Strategic Water Source Area will therefore have a Moderate cumulative impact.

No-Go Alternative

The current impacts associated with agricultural activities (i.e., runoff and erosion), grazing by livestock, the existing road network, expansion of the rural villages, etc, will persist, regardless of whether the proposed development is authorised or rejected. As such, the no-go alternative is classified as moderate negative.

Mitigation Measures:

- → An Erosion Method Statement should be compiled and implemented during the Construction Phase.
- → Activities within 500m of a wetland and/or 100 m of a watercourse must obtain the necessary Water Use Authorisation (WUA) prior to the commencement of such activities.
- → Vegetation clearance must be kept to a minimum and retained where possible to avoid soil erosion.
- → Disturbed areas must be rehabilitated as soon as possible after construction.
- → The site should be monitored regularly for signs of erosion.
- → Remedial action must be taken at the first signs of erosion.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Short-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	Reversible	Resource will not be lost	Achievable	**LOW (-)**
Cumulative	Cumulative	Short-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Long-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	**N/A**			

IMPACT 2: LOSS OF INDIGENOUS VEGETATION (SENQU MONTANE SHRUBLAND AND ZASTRON MOIST GRASSLAND)

Cause and Comment

Direct Impact

The clearing of land for the construction of the proposed Seqnu Rural Water Supply Scheme will result in the loss of 393.21 m^2 (0.04 ha) of Senqu Montane Shrubland and 8425.51 m^2 (0.84 ha) of Zastron Moist Grassland. However, the layout of the proposed Senqu Rural Water Supply Scheme will largely follow the existing gravel roads and servitudes within the boundaries of the existing villages and the pipeline will be located underground. Once construction has been completed, the natural vegetation is likely to re-establish in the majority of the development footprint within the short- to medium-term . As such, the clearance of vegetation required for the proposed development is unlikely to impact on the extent and long-term conservation of these vegetation types, which are listed as Least Threatened.

The overall significance of the project activities at this site, provided the recommended mitigation measures are implemented, would be low negative.

Cumulative Impact

Approximately 25% of Senqu Montane Shrubland and 36% of Zastron moist Grassland has been transformed, most likely as a result of agricultural activities. Within the project area, portions of these vegetation types have already been lost due to agricultural activities (crop production, livestock farming and grazing), the existing road network, rural village expansion, etc. The footprint of the proposed Senqu Rural Water Supply Scheme is relatively small and largely confined to existing gravel roads and servitudes within the boundaries of the existing villages. As such, the cumulative impact associated with the clearance of Senqu Montane Shrubland and Zastron Moist Grassland for the proposed development is classified as a low cumulative impact.

No-Go Alternative

Should the proposed development not be authorised, there will be no further loss of Senqu Montane Shrubland and Zastron Moist Grassland. However, the existing impacts associated with agricultural activities (crop production, livestock farming and grazing), the existing road network, rural village expansion, etc, will persist. As such, the no-go alternative is classified as moderate negative.

Mitigation Measures:

- Vegetation clearance must be strictly limited to that which is necessary for the construction of the Senqu Rural Water Supply Scheme.
- Disturbed areas must be rehabilitated as soon as possible after construction.
- Only indigenous species must be used for rehabilitation.
- Lay down areas must be located within previously disturbed areas.
- Construction workers must be prohibited from making open fires during the construction phase.
- The Alien Invasive Method Statement must be compiled and implemented.
- Where possible, SCC known to survive translocation, must be transplanted, used for rehabilitation purposes, or planted for aesthetic purposes around the tented camp and/or farm manor.
- Permits must be obtained for the removal/translocation of SCC protected in terms of the PNCO.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Short to Medium-term	Study-Area	Moderate	Definite	**MODERATE (-)**	Reversible	Resource will be partly lost	Achievable	**Low (-)**
Cumulative	Cumulative	Permanent	Regional	Slight	Definite	**LOW (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Permanent	Regional	Moderate	Definite	**MODERATE (-)**	**N/A**			

IMPACT 3: LOSS OF PLANT SPECIES OF CONSERVATION CONCERN

Cause and Comment

Direct Impact

The permanent loss of plant species of conservation concern (SCC) may occur (see Section 3.4.3 and Appendix 1). However, it should be noted that the SCC recorded on site are all classified as Least Concern. Provided that the SCC known to survive translocation are transplanted and/or used for rehabilitation purposes, this impact can be mitigated to low negative.

Cumulative Impact

SCC have likely already been lost as a result of the existing developments in the area (rural village expansion, powerlines, road network, agriculture, etc). As such, the loss of SCC associated with the proposed Senqu Rural Water Supply Scheme will likely contribute to the cumulative loss of SCC within the region. However, it should be noted that the SCC recorded on site are all classified as Least Concern.

No-Go Alternative

Should the proposed development not be authorised, there will be no further loss of SCC as a result of the proposed development. However, the loss of vegetation and SCC associated with existing developments in the area (rural village expansion, powerlines, road network, agriculture, etc) and grazing by livestock will persist. As such, the no-go alternative is classified as low negative.

Mitigation Measures:

- → Where possible, SCC known to survive translocation, must be transplanted and used for rehabilitation purposes.
- → Where possible, the proposed pipeline network should be routed along existing gravel roads and servitudes within the boundaries of rural villages as far as possible or within areas with sparse vegetation cover.
- → Permits must be obtained for the removal/translocation of SCC protected in terms of the PNCO.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Short-term	Localized	Moderate	Definite	**MODERATE (-)**	Reversible	Resource will be partly lost	Achievable	**Low (-)**
Cumulative	Cumulative	Permanent	Regional	Moderate	Definite	**MODERATE (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their			**N/A**

							development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.	
No-Go	Direct	Permanent	Regional	Moderate	Definite	**MODERATE (-)**	**N/A**	Direct

IMPACT 4: IMPACT ON FAUNAL SPECIES AND FAUNAL SCC
Cause and Comment ***Direct Impact*** During the construction phase, the clearance of vegetation and the use of heavy plant/machinery could result in the disturbance to nearby faunal populations (including birds) and/or habitats or the mortality of faunal SCC likely to occur within the project area (see Section 3.5 above) due to vehicle collisions. However, it should be noted that the majority of the proposed development is located within the boundaries of rural villages and adjacent to an existing busy road (R392) which has likely already impacted the feeding and breeding behaviour of faunal SCC within the project area. ***Cumulative Impact*** Faunal species and habitats within the project area have already been impacted by existing developments and anthropogenic activities (such as the expansion of rural villages, road networks, agricultural activities, hunting by domestic animals such as dogs and cats, etc). The cumulative impact on faunal species associated within the construction of the Senqu Rural Water Supply Scheme is therefore classified as moderate negative. ***No-Go Alternative*** Under the no-go alternative there will be no construction of the proposed Senqu Rural water Supply Scheme and no clearance of habitat within the project area and therefore no additional impact on faunal species associated with the proposed development. However, the existing impacts associated with existing developments and anthropogenic activities will persist. As such, the no-go alternative is therefore classified as Moderate Negative.
Mitigation Measures: → Where possible, the proposed infrastructure should be routed along the existing gravel road and servitudes within the boundaries of the villages as far as possible or within areas that have been disturbed as a result of current agricultural practices. → A member of staff should be appointed to walk the development footprint, directly prior to construction/vegetation clearance at the start of each day to ensure no faunal species are in harms way. In the event that faunal species are encountered, these should be allowed to move away from the area safely. Slow moving species e.g. tortoises and cryptic species should be moved out of harms way and into suitable neighbouring habitat. → Any faunal species that may die as a result of construction must be recorded (photographed, GPS coordinates) and if somewhat intact, preserved and donated to SANBI. → Any faunal species observed onsite must be recorded (photographed, GPS coordinates) and loaded onto iNaturalist.

- It should be noted that most of the animals listed in this report, including all amphibians, lizards and tortoises, are legally protected in terms of the PNCO (Act No. 19 OF 1974) and therefore may not be harmed or killed. Additionally, no species protected in terms of the PNCO may be removed from site without obtaining the relevant permit.
- Where possible, existing service/access roads must be used.
- Construction activities, including the transporting of equipment, staff and goods, should be restricted to day-light hours unless in case of emergencies.
- Speed restrictions (40 km per hour) should be implemented and adhered to in order to reduce the likelihood of faunal fatalities and the production of dust.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Short-Term	Study-Area	Moderate	May occur	**MODERATE (-)**	Reversible	Resource will not be lost	Achievable	**Low (-)**
Cumulative	Cumulative	Short-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Long-Term	Study-Area	Moderate	Definite	**MODERATE (-)**	**N/A**			

IMPACT 5: ESTABLISHMENT OF ALIEN PLANT SPECIES

Cause and Comment

Direct Impact

The removal of existing natural vegetation creates 'open' habitats which favours the establishment of undesirable vegetation in areas that are typically very difficult to eradicate and could pose a threat to surrounding ecosystems. Alien Invasive Plant (AIP) species such as *Opuntia ficus-indica, Argemone ochroleuca and Xanthium spinosum* observed on site can become quickly established. AIP species often outcompete indigenous vegetation. Therefore, their establishment and spread could result in the replacement of indigenous plant species.

Cumulative Impact

Scattered alien invasive species have already established in the surrounding area. Therefore, should the construction of the proposed Senqu Rural Water Supply Scheme result in the further establishment of alien invasive species in the project area, the invasion by alien species could be exacerbated. However, considering the overall footprint of the proposed development and the transformed nature of a large portion of the project area the cumulative impact associated therewith has been classified as moderate.

No-Go Alternative

There is already evidence of a number of AIPS within the site (refer to Section 3.4.4). Under the no-go alternative these species are likely to continue multiplying if left unchecked. The current no-go alternative is thus rated as moderate negative.

Mitigation Measures:

→ The site must be checked regularly for the presence of alien invasive species. Any alien seedlings which establish within the construction area must be removed and disposed of as per the Working for Water Guidelines relating to the management of invasive alien plants.

→ An Alien Invasive Method Statement should be compiled and implemented for the proposed development.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Long-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	Reversible	Resource will be partly lost	Achievable	**Low (-)**
Cumulative	Cumulative	Long-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Long-Term	Study-Area	Moderate	Probable	**MODERATE (-)**	**N/A**			

OPERATIONAL PHASE

IMPACT 6: INFESTATION OF ALIEN PLANT SPECIES

Cause and Comment

Direct Impact

Disturbed areas can become places for alien invasive species to become established and if left unmitigated these species can spread and establish themselves in intact vegetation resulting in the displacement of indigenous species and possible local extinctions of SCC. AIP species often outcompete indigenous vegetation. Therefore, their establishment and spread could result in the loss of indigenous plant species.

Cumulative Impact

Scattered alien invasive species have already established in the surrounding area. Therefore, if the establishment of Alien Plant Species is not mitigated during the construction phase, these species are likely to spread during the operational phase of the proposed development. However, considering the small footprint of the proposed development and the location of the development within previously disturbed areas (gravel roads, existing servitudes, etc) the cumulative impact associated therewith has been classified as low.

No-Go Alternative

There is already evidence of AIPS establishment within the site. Under the no-go alternative these species are likely to continue multiplying if left unchecked. The current no-go alternative is thus classified as moderate.

Mitigation Measures:

- → The site must be monitored for the presence of alien invasive species. Any alien seedlings which establish within the project area must be removed and disposed of as per the Working for Water Guidelines relating to the management of invasive alien plants.
- → An Alien Invasive Method Statement must be compiled and implemented during the operational phase of the proposed development.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Long-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	Reversible	Resource will be partly lost	Achievable	**Low (-)**
Cumulative	Cumulative	Long-Term	Study-Area	Slight	May Occur	**LOW (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above.			**N/A**

No-Go	Direct	Long-Term	Study-Area	Moderate	Probable	**MODERATE (-)**	**N/A**

DECOMMISSIONING PHASE

It is highly unlikely that the proposed Senqu Rural Water Supply Scheme will be decommissioned in the near future. It is more likely that the network will be expanded as the rural villages expand and the demand on infrastructure increases. However, should the infrastructure be decommissioned in the long-term, the impacts associated with the decommissioning phase are likely to be similar to those identified for the construction phase. The mitigation measures and recommendations specified below must be implemented during the decommissioning of the proposed Senqu Rural Water Supply Scheme should this occur.

IMPACT 7: IMPACTS ON THE FEPA SUBCATCHMENT AND STRATEGIC WATER SOURCE AREA

Cause and Comment

Direct Impact

The proposed Senqu Rural Water Supply Scheme falls within a Freshwater Ecosystem Priority Area Quinary Catchment, a Strategic Water Source Area, and traverses' numerous wetlands and drainage lines (NBA, 2018). During the decommissioning phase, the disruption of vegetation surrounding the infrastructure could result in possible erosion and the loss of topsoil which would directly impact the FEPA Sub catchment and Strategic Water Source Area within which the proposed development is located. This in turn could impact on the water quality entering the nearby rivers. However, the majority of the development footprint is located within existing servitudes and the overall development footprint of the proposed Seqnu Rural Water Supply Scheme is relatively small (18.5 ha). As such, if mitigation measures are implemented this impact will be of low significance.

Cumulative Impact

Portions of the FEPA Subcatchment have already been impacted by other developments in the area, namely roads and the clearance of natural vegetation for agricultural lands. However, the footprint of the proposed Senqu Rural Water Supply Scheme is relatively small compared to the existing infrastructure such as roads, powerlines, etc, and it is mainly located within previously disturbed areas such as gravel roads, exiting servitudes, etc. The additional impact of the decommissioning of the Senqu Rural Water Supply Scheme on the FEPA Subcatchment will therefore have a low cumulative impact.

No-Go Alternative

The current impacts associated with agricultural activities (i.e., runoff and erosion), the existing road network and expansion of the rural villages, amongst others, will persist, regardless of whether the proposed development is authorised or rejected. However, these impacts are relatively minor within the project area and as such, the no-go alternative is classified as low negative.

Mitigation Measures:

→ An Erosion Method Statement should be compiled and implemented during the decommissioning phase.
→ Vegetation clearance associated with the decommissioning of the Senqu Rural Water Supply Scheme should be avoided where possible.
→ Disturbed areas must be rehabilitated as soon as possible after decommissioning.
→ Remedial action must be taken at the first signs of erosion.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Short-Term	Study-Area	Slight	May Occur	**Low (-)**	Reversible	Resource will not be lost	Achievable	**Low (-)**
Cumulative	Cumulative	Short-Term	Study-Area	Slight	May Occur	**Low (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Long-Term	Study-Area	Slight	May Occur	**Low (-)**	**N/A**			

IMPACT 8: LOSS OF INDIGENOUS VEGETATION (SENQU MONTANE SHRUBLAND AND ZASTRON MOIST GRASSLAND) AND SCC

Cause and Comment

Direct Impact

The decommissioning of the Senqu Rural Water Supply Scheme could result in the loss of indigenous vegetation/ species which have re-established post-construction. However, the layout of the proposed development will largely follow the existing gravel roads, servitudes, etc. Therefore, the impact associated with the potential loss of indigenous vegetation during the decommissioning phase is low negative.

Cumulative Impact

Within the project area, portions of indigenous vegetation have been lost due to agricultural activities (crop production, livestock farming and grazing), development of roads, rural village expansion, etc. The footprint of the proposed Senqu Rural Water Supply Scheme is relatively small and largely confined to existing gravel roads and servitudes. As such, the cumulative impact associated with the potential loss of indigenous vegetation during the decommissioning phase is anticipated to be low negative.

No-Go Alternative

Should the proposed development not be authorised, there will be no potential further loss of indigenious vegetation. However, the existing impacts associated with agricultural activities (crop production, livestock farming and grazing), development of roads, rural village expansion, etc, within the broader project area will persist. As such, the no-go alternative is classified as low negative.

Mitigation Measures:

- An Erosion Method Statement should be compiled and implemented during the decommissioning phase.
- Vegetation clearance associated with the decommissioning of the Senqu Rural Water Supply Scheme should be avoided where possible.
- Disturbed areas must be rehabilitated as soon as possible after decommissioning.
- Remedial action must be taken at the first signs of erosion.
- Only indigenous species must be used for rehabilitation.
- Lay down areas must be located within previously disturbed areas (e.g. the parking lot at the tented camp or within the footprint of existing gravel roads).
- The Alien Invasive Method Statement must be compiled and implemented.
- Where possible, SCC which have established post-construction must be removed prior to the decommissioning of the Senqu Rural Water Supply Scheme, and re-planted in order to facilitate the rehabilitation of the project area.
- Permits must be obtained for the removal/translocation of SCC protected in terms of the PNCO.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Permanent	Study-Area	Slight	May Occur	**Low (-)**	Reversible	Resource will be partly lost	Achievable	**Low (-)**
Cumulative	Cumulative	Permanent	Regional	Slight	May Occur	**Low (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Permanent	Regional	Slight	Definite	**Low (-)**	**N/A**			

IMPACT 9: IMPACT ON FAUNAL SPECIES

Cause and Comment

Direct Impact
Decommissioning of the Senqu Rural Water Supply Scheme could result in the disturbance to nearby faunal populations and/or habitats or the mortality of faunal SCC likely to occur within the project area (see Section 3.5 above) due to vehicle collisions. However, it should be noted that the majority of the proposed development is located within the boundaries of rural villages and adjacent to an existing busy road (R392). Due to the high levels of activity within the project area, it is unlikely that many faunal SCC utilise the area as breeding and/or feeding grounds.

Cumulative Impact
Faunal species and habitats within the project area have already been impacted by existing developments and anthropogenic activities (such as the expansion of rural villages, road networks, agricultural activities, hunting by domestic animals such as dogs and cats, etc). The cumulative impact on faunal species associated within the decommissioning of the Senqu Rural Water Supply Scheme is therefore classified as low negative.

No-Go Alternative
Under the no-go alternative there will be no decommissioning of the proposed Senqu Rural Water Supply Scheme and disturbance of habitat within the project area and therefore no additional impact on faunal species. However, the existing developments and anthropogenic activities (such as the expansion of rural villages, road networks, agricultural activities, hunting by domestic animals such as dogs and cats, etc) will persist. Therefore, the no-go alternative is classified as low negative.

Mitigation Measures:

- A member of staff should be appointed to walk the development footprint, directly prior to decommissioning, at the start of each day to ensure no faunal species are in harm's way. In the event that faunal species are encountered, these should be allowed to move away from the area safely. Slow moving species e.g., tortoises and cryptic species should be moved out of harm's way and into suitable neighbouring habitat.
- Any faunal species that may die as a result of decommissioning must be recorded (photographed, GPS coordinates) and if somewhat intact, preserved and donated to SANBI.
- Any faunal species observed onsite must be recorded (photographed, GPS coordinates) and loaded onto iNaturalist.
- It should be noted that most of the animals listed in this report, including all amphibians, lizards and tortoises, are legally protected in terms of the PNCO (Act No. 19 OF 1974) and therefore may not be harmed or killed. Additionally, no species protected in terms of the PNCO may be removed from site without obtaining the relevant permit.
- Where possible, existing service/access roads must be used.
- Decommissioning activities, including the transporting of equipment, staff and goods, should be restricted to day-light hours unless in case of emergencies.
- Speed restrictions (40 km per hour) should be implemented and adhered to in order to reduce the likelihood of faunal fatalities and the production of dust.

Significance Assessment:

Impact	Nature	Duration	Extent	Severity	Likelihood	Significance Before Mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Significance After Mitigation
Preferred Alternative	Direct	Short-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	Reversible	Resource will not be lost	Achievable	**Low (-)**

Cumulative	Cumulative	Short-Term	Study-Area	Slight	May Occur	**Low (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.	**N/A**
No-Go	Direct	Long-Term	Study Area	Slight	Definite	**Low (-)**	**N/A**	

IMPACT 10: ESTABLISHMENT OF ALIEN PLANT SPECIES

Cause and Comment

Direct Impact

The decommissioning activities are likely to result in the disturbance of natural vegetation within the project area which could create 'open' habitats in which AIP species establish. AIP species such as *Opuntia ficus-indica, Argemone ochroleuca and Xanthium spinosum*, amongst others, were observed on site can become quickly established. AIP species often outcompete indigenous vegetation. Therefore, their establishment and spread could result in the loss of indigenous plant species.

Cumulative Impact

Scattered alien invasive species have already established in the surrounding area. Therefore, should the decommissioning of the proposed development result in the further establishment of alien invasive species in the project area, the invasion by alien species could be exacerbated. However, considering the small footprint of the proposed Senqu Rural Water Supply Scheme and its location within previously disturbed areas such as gravel roads and existing servitudes, the cumulative impact associated therewith has been classified as low.

No-Go Alternative

There is already evidence of *Opuntia ficus-indica, Argemone ochroleuca and Xanthium spinosum*, amongst others, within the project area. Under the no-go alternative these species are likely to continue multiplying if left unchecked. The current no-go alternative is thus rated as moderate negative.

Mitigation Measures:

- → The site must be checked regularly for the presence of alien invasive species. Any alien seedlings which establish within the project area must be removed and disposed of as per the Working for Water Guidelines relating to the management of invasive alien plants.
- → An Alien Invasive Method Statement should be compiled and implemented for the proposed Senqu Rural Water Supply Scheme.

Significance Assessment:										
Impact	**Nature**	**Duration**	**Extent**	**Severity**	**Likelihood**	**Significance Before Mitigation**	**Reversibility**	**Irreplaceable Loss**	**Mitigation Potential**	**Significance After Mitigation**
Preferred Alternative	Direct	Long-Term	Study-Area	Moderate	May Occur	**MODERATE (-)**	Reversible	Resource will be partly lost	Achievable	**Low (-)**
Cumulative	Cumulative	Long-Term	Study-Area	Slight	May Occur	**LOW (-)**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above for the direct impacts.			**N/A**
No-Go	Direct	Long-Term	Study-Area	Moderate	Probable	**MODERATE (-)**	**N/A**			

6 IMPACT STATEMENT, CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The overall development footprint of the proposed Senqu Rural Water Supply Scheme is approximately 18.5 ha. However, the majority of the proposed development is located within previously cleared areas / existing servitudes. Therefore, based on the known remaining extent of the two vegetation types occurring on site (Red List of Ecosystems (RLE) for terrestrial realm for South Africa, 2021), the development of the Senqu Rural Water Supply Scheme will result in the loss of approximately 393.21 m^2 (0.04 ha) of Senqu Montane Shrubland and 8425.51 m^2 (0.84 ha) of Zastron Moist Grassland. Ten (10) impacts were identified for the proposed development, eight (8) of which were classified as moderate and two (2) were classified as low prior to mitigation. If the mitigation measures specified in this report are implemented and adhered to, all these impacts will be reduced to low (Figure 6.1).

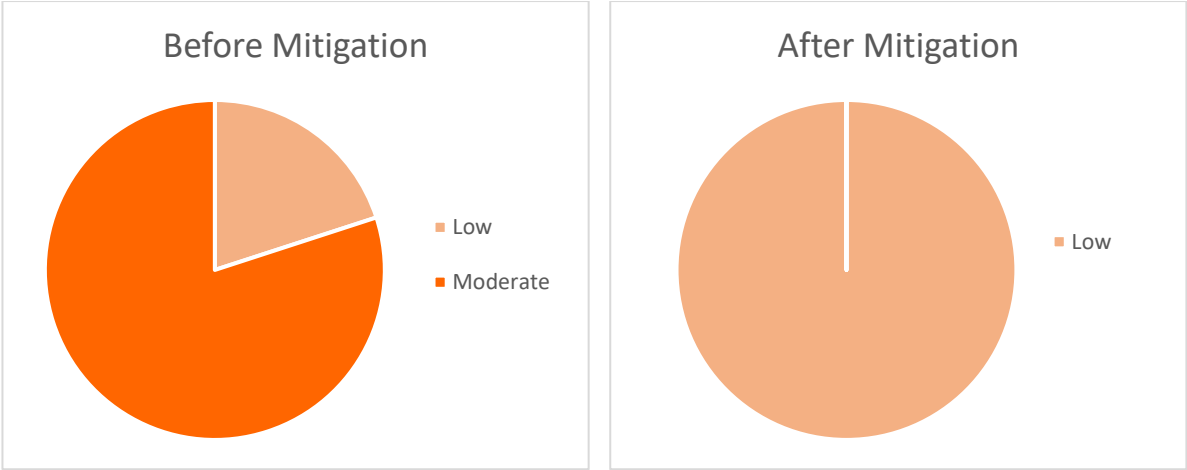

Figure 6.1: Pie charts summarising the number of high, moderate and low impacts before and after mitigation.

6.2 CONDITIONS OF EMPR, EA AND MONITORING

All management / mitigation measures identified for the impacts associated with the proposed Senqu Rural Water Supply Scheme must be incorporated into the EMPr and implemented during the relevant phases of the proposed development (please refer to Section 5.1 above for the recommended mitigation measures associated with each impact identified). Specific mitigation measures and recommendations that should be incorporated into the EA (if granted) include:

- All necessary permitting and authorisations must be obtained prior to the commencement of any construction activities.

- Botanical SCC which are known to survive translocation must be relocated to nearest appropriate habitat.
- An Erosion Method Statement must be developed prior to the commencement of construction activities in order to mitigate the unnecessary loss of topsoil and runoff.
- An Alien Invasive Method Statement should be compiled and implemented during all phases of the proposed development.
- Activities within 500 m of a wetland and 100 m of a watercourse must obtain the necessary Water Use Authorisation prior to the commencement of such activities.
- Lay down areas must be located within previously disturbed areas.
- A member of staff should be appointed to walk the development footprint directly prior to construction/vegetation clearance at the start of each day to ensure no faunal species are in harm's way. In the event that faunal species are encountered, these should be allowed to move away from the area safely. Slow moving species e.g. tortoises and cryptic species should be moved out of harm's way and into suitable neighbouring habitat.

6.3 Ecological Statement and Opinion of the Specialist

Based on the evaluation of SEI in terms of the Species Environmental Assessment Guideline (SANBI, 2020), the SEI of Senqu Montane Shrubland is classified as low while the SEI of Zastron Moist Grassland is classified as very low. Interpretation of this classification in relation to proposed development activities, specifies "*Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities*" for areas with a LOW SEI (Senqu Montane Shrubland), and "*Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required*" for areas with a VERY LOW SEI (Zastron Moist Grassland).

It should be emphasized that erosion is a major issue in the project area where the indigenous vegetation has been disturbed/lost due to overgrazing as a result of poor rangeland management. Erosion leads to the loss of soil quality, and although a natural process by wind and water, grasslands with higher stocking rates (expressed as Livestock Units per hectare land surface) experience more frequent soil erosion (Hendricks et al., 2005; Zhao et al., 2007 in Torresani et al., 2019). This should be an important consideration during construction and rehabilitation of disturbed areas during the proposed development.

Based on an analysis of the Remaining Extent of Terrestrial Ecosystem (SANBI, 2021) and Google Earth Imagery, it is evident that a large portion of the proposed development is located within previously disturbed areas, such as gravel roads, existing servitudes, and within the boundaries of rural villages. Furthermore, the overall development footprint within intact areas of natural vegetation is relatively small and the residual impacts associated with the proposed Senqu Rural Water Supply Scheme are classified as low negative. As such, the proposed development of the Senqu Rural Water Supply Scheme will not negatively impact on the conservation targets set for the vegetation types of the project area nor will it contribute to the increase in the conservation status thereof. Additionally, due to the existing anthropogenic impacts within the project area, impacts on faunal species are anticipated to be low. It is the

opinion of the specialist that there are no fatal flaws associated with the proposed development of the Senqu Rural Water Supply Scheme.

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APPENDIX 1: LIST OF PLANT SPECIES OCCURRING WITHIN THE PROJECT AREA.

Table A.1 Plant species occurring within the project area.

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
INDIGENOUS PLANT SPECIES							
	Achariaceae	cf *Kiggelaria africana*	LC	-	-	-	5

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Agavaceae	*Chlorophytum sp.*	LC	-	-	-	4
	Aizoaceae	*Delosperma aliwalense*	LC	Schedule 4	-	-	4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Aizoaceae	*Stomatium sp.*	LC	Schedule 4	-	-	2
	Anacardiaceae	*Searsia erosa*	LC	-	-	-	1; 2; 4; 5; 6; 7

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Anacardiaceae	*Searsia burchellii*	LC	-	-	-	1; 4
	Anemiaceae	*Anemia sp.*	LC	-	-	-	4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Apocynaceae	*Gomphocarpus fruticosus*	LC	Schedule 4	-	-	4; 5; 9
	Asphodelaceae	*Aloe ferox*	LC	-	-	-	4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asphodelaceae	*Aloiampelos striatula*	LC	Schedule 4	-	-	1; 2; 9
	Asparagaceae	*Asparagus suaveolens*	LC	-	-	-	1

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Unidentified*	Unknown	-	-	-	6
	Asteraceae	*Gerbera piloselloides*	LC	-	-	-	2; 4; 6

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Helichrysum aureum*	LC	-	-	-	8
	Asteraceae	*Haplocarpha scaposa*	LC	-	-	-	2; 6; 8

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Arctotheca prostrata*	LC	-	-	-	3
	Asteraceae	*Chrysocoma ciliata*	LC	-	-	-	1; 2; 4; 5; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Senecio sp.*	LC	-	-	-	3; 9
	Asteraceae	*Felicia muricata*	LC	-	-	-	1; 2; 3; 4; 5; 8; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Berkheya onopordifolia*	LC	-	-	-	1; 6
	Asteraceae	*Gazania krebsiana*	LC	-	-	-	1; 2; 3; 4; 5; 6; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Dimorphotheca cuneata*	LC	-	-	-	2
	Asteraceae	*Helichrysum rugulosum*	LC	-	-	-	2; 3; 4; 7; 8

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Helichrysum chionosphaerum*	LC	-	-	-	2
	Asteraceae	*Nolletia ciliaris*	LC	-	-	-	1; 2
	Asteraceae	*Lactuca inermis*	LC	-	-	-	1; 2

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Unidentified*	Unknown	-	-	-	3
	Campanulaceae	*Wahlenbergia nodosa*	LC	-	-	-	4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Convolvulaceae	*Ipomoea crassipes*	LC	-	-	-	1;3; 4; 9
	Caryophyllaceae	*Dianthus thunbergii*	LC	-	-	-	2

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Crassulaceae	*Cotyledon orbiculata*	LC	-	-	-	1; 4
	Crassulaceae	*Cotyledon orbiculata var. oblonga*	LC	-	-	-	1; 4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Cyperaceae	*Cyperus denudatus*	LC	-	-	-	9
	Dipsacaceae	*Scabiosa columbaria*	LC	-	-	-	Near sample site 6;

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Ebenaceae	*Diospyros lycioides*	LC	-	-	-	1; 2; 3; 4; 5; 6; 9
	Euphorbiaceae	*Clutia pulchella*	LC	-	-	-	9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Fabaceae	*Argyrolobium sp.*	LC (Based on the Red List of South African Plants, no known threatened species of the Genus *Argyrolobium* occur within the project area)	-	-	-	6
	Fabaceae	*Lotononis sp.*	Unknown	-	-	-	5

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Fabaceae	*Unidentified*	Unknown	-	-	-	1
	Fabaceae	*Indigofera nigromontana*	LC	-	-	-	5

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Fabaceae	*Melolobium sp.*	LC (Based on the Red List of South African Plants, no known threatened species of the Genus *Melolobium* occur within the project area)	-	-	-	1
	Hypoxidaceae	*Hypoxis sp.*	LC	-	-	-	2; 3; 4; 6; 7

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Iridaceae	*Aristea abyssinica*	LC	Schedule 4	-	-	2
	Iridaceae	*Watsonia gladioloides*	LC	Schedule 4	-	-	2

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Lamiaceae	*Salvia stenophylla*	Unknown	-	-	-	3; 4; 9
	Lamiaceae	*Stachys aethiopica*	LC	-	-	-	1; 2; 3; 4; 6

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Lamiaceae	*Stachys sp.*	LC	-	-	-	1; 2
	Malvaceae	*Hermannia depressa*	LC	-	-	-	1; 3; 4; 5; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Malvaceae	*Hermannia coccocarpa*	LC	-	-	-	1; 3; 5; 6
	Malvaceae	*Hibiscus pusillus*	LC	-	-	-	3

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Myrsinaceae	*Myrsine africana*	LC	-	-	-	6
	Oleaceae	*Olea europaea*	LC	-	-	-	1

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Papaveraceae	*Papaver aculeatum*	LC	-	-	-	3
	Plantaginaceae	*Plantago lanceolata*	LC	-	-	-	All sample sites

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	*Aristida congesta*	LC	-	-	-	All sample sites except sample site 7
	Poaceae	*Tragus sp.*	LC	-	-	-	1; 2; 5; 7; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	cf *Digitaria argyrograpta*	LC	-	-	-	All sample sites
	Poaceae	*cf Setaria sphacelata*	LC	-	-	-	3

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	*Themeda triandra*	LC	-	-	-	All sample sites except sample site 7
	Poaceae	*Eragrostis capensis*	LC	-	-	-	All sample sites except sample site 7

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	*Harpochloa falx*	LC	-	-	-	3
	Poaceae	*Melinis repens*	LC	-	-	-	1; 4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	*Andropogon appendiculatus*	LC	-	-	-	1; 4; 5
	Poaceae	*Unidentified*	Unknown (likely LC)	-	-	-	All sample sites

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	*Unidentified*	Unknown (likely LC)	-	-	-	1; 5; 7
	Poaceae	*Eragrostis sp.*	LC	-	-	-	All sample sites

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Poaceae	*Elionurus muticus*	LC	-	-	-	All sample sites
	Poaceae	*Andropogon appendiculatus*	LC	-	-	-	All sample sites

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Polygalaceae	*Polygala sp.*	LC	-	-	-	1; 3; 4; 6
	Pteridaceae	*Cheilanthes eckloniana*	LC	-	-	-	2; 5; 7; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Pteridaceae	*Cheilanthes hirta*	LC	-	-	-	1
	Pteridaceae	*Pellaea calomelanos*	LC	-	-	-	4

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Rosaceae	*Rubus ludwigii*	LC	-	-	-	4
	Santalaceae	*Osyris lanceolata*	LC	-	-	-	1

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Scrophulariaceae	*Jamesbrittenia breviflora*	LC	-	-	-	5
	Scrophulariaceae	*Jamesbrittenia aurantiaca*	LC	-	-	-	7

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Scrophulariaceae	*Jamesbrittenia filicaulis*	LC	-	-	-	1; 2; 3; 4; 5; 6; 9
	Scrophulariaceae	*Selago sp.*	LC	-	-	-	1; 2; 3; 4; 7 9
	Solanaceae	*Solanum tomentosum*	LC	-	-	-	1; 5; 6

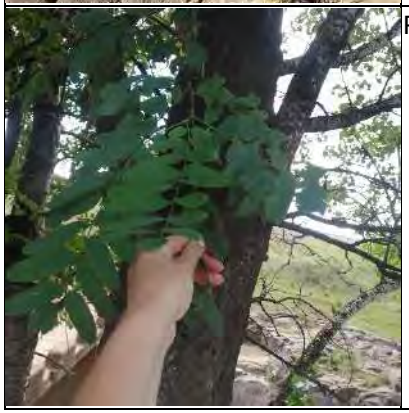
PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Solanaceae	*Lycium sp.*	LC	-	-	-	1; 3
		*Unidentified species*					1

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
		*Unidentified species*					2
		*Unidentified species*					9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
		*Unidentified species*					1
		*Unidentified species*					6
ALIEN PLANT SPECIES							

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Agavaceae	*Agave americana*	Naturalized exotics not assessed for National Red List.	Not listed as an invader within the Eastern Cape Province	-	-	1; 2; 3; 5; 9
	Amaranthaceae	*Guilleminea densa*	Naturalized exotics not assessed for National Red List.	Not listed under CARA or NEM:BA: National List of Invasive Species	-	-	3; 4; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Asteraceae	*Hypochaeris radicata*	Naturalized exotics not assessed for National Red List.	Not listed under CARA or NEM:BA: National List of Invasive Species	-	-	4
	Asteraceae	*Xanthium spinosum*	Naturalized exotics not assessed for National Red List.	CARA Category 1 Not listed in terms of the NEM:BA: National List of Invasive Species	-	-	2; 5; 9
	Asteraceae	*Tagetes sp.*	Naturalized exotics not assessed for National Red List.	Not listed under CARA or NEM:BA: National List of Invasive Species	-	-	3

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Cactaceae	*Opuntia ficus-indica*	Naturalized exotics not assessed for National Red List.	CARA Category 1 NEM:BA Category 1b	-	-	1; 9
	Fabaceae	*Robinia pseudoacacia*	Naturalized exotics not assessed for National Red List.	CARA Category 2 Not listed in terms of the NEM:BA: National List of Invasive Species	-	-	Near sample 8

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Onagraceae	*Oenothera rosea*	Naturalized exotics not assessed for National Red List.	Not listed under CARA or NEM:BA: National List of Invasive Species	-	-	2
	Papaveraceae	*Argemone ochroleuca*	Naturalized exotics not assessed for National Red List.	CARA Category 1 NEM:BA Category 1b	-	-	2; 9

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	POACEAE	*Bromus catharticus*	Naturalized exotics not assessed for National Red List.	Not listed under CARA or NEM:BA: National List of Invasive Species	-	-	1; 3
	Rosaceae	*Rosa rubiginosa*	Naturalized exotics not assessed for National Red List.	CARA Category 1 Not listed in terms of the NEM:BA: National List of Invasive Species	-	-	8

PHOTOGRAPH	FAMILY	SPECIES	SA RED DATA LIST	PNCO	PROTECTED TREES	NEMBA	SAMPLING SITE
	Salicaceae	*Populus x canescens*	Hybrids not assessed for National Red List.	CARA Category 2 Not listed in terms of the NEM:BA: National List of Invasive Species	-	-	Near sample 8
	Solanaceae	*Nierembergia linariifolia*	Naturalized exotics not assessed for National Red List.	Not listed under CARA or NEM:BA: National List of Invasive Species	-	-	2

APPENDIX 2: LIST OF MAMMAL SPECIES.

Table A2: List of mammal species likely to occur on site.

COMMON NAME	SCIENTIFIC NAME	REGIONAL RED LIST STATUS (2016)	ENDEMIC	TOPS LISITNG (2007)	PNCO
CARNIVORA					
Spotted-necked Otter	*Hydrictis maculicollis*	**Vulnerable**	No	Protected	-
Striped Polecat	*Ictonyx striatus*	Least Concern	No	-	-
Aardwolf	*Proteles cristata*	Least Concern	No	-	Schedule II
Cape Fox	*Vulpes chama*	Least Concern	No	Protected	-
ARTIODACTYLA					
Mountain Reedbuck	*Redunca fulvorufula fulvorufula*	**Endangered**	*Near*	-	Schedule II
Springbok	*Antidorcas marsupialis*	Least Concern	No	-	Schedule II
Grey Rhebok	*Pelea capreolus*	**Near Threatened**	**Yes**	-	Schedule II
Greater Kudu	*Tragelaphus strepsiceros*	Least Concern	No	-	Schedule II
Bushpig	*Potamochoerus larvatus*	Least Concern	No	-	-
Blesbok	*Damaliscus pygargus phillipsi*	Least Concern	No	-	Schedule II
PRIMATES					
Chacma Baboon	*Papio ursinus*	Least Concern	No	-	-
Vervet Monkey	*Chlorocebus pygerythrus*	Least Concern	No	-	-
HYRACOIDEA					

COMMON NAME	SCIENTIFIC NAME	REGIONAL RED LIST STATUS (2016)	ENDEMIC	TOPS LISITNG (2007)	PNCO
Rock Hyrax	*Procavia capensis*	Least Concern	No	-	-
RODENTIA					
Cape Porcupine	*Hystrix africaeaustralis*	Least Concern	No	-	-
Sloggett's Vlei Rat	*Otomys sloggetti*	Least Concern	**Yes**	-	-
Cape Ground Squirrel	*Xerus inauris*	Least Concern	No	-	-
LAGOMORPHA					
Hewitt's Red Rock Hare	*Pronolagus saundersiae*	Least Concern	**Yes**	-	-
EULIPOTYPHLA					
Southern African Hedgehog	*Atelerix frontalis*	**Near Threatened**	No	Protected	Schedule II

APPENDIX 3: LIST OF HERPETOFAUNA.

Table A3: List of Herpetofauna likely to occur on site.

COMMON NAME	SCIENTIFIC NAME	REGIONAL RED LIST STATUS	ENDEMIC	CITES	ECENCO	QDS CODE (ADU, 2011)	
						3027AD	3027CB
AMPHIBIA (Amphibians) (SANBI 2004, Measey 2010 & 2014, IUCN 2021, ECNECO 1974)							
Bubbling Kassina	*Kassina senegalensis*	Least Concern	No	-	Schedule II		
African Clawed Frog	*Xenopus laevis*	Least Concern	No	-	Schedule II		
Poynton's River Frog	*Amietia poyntoni*	Least Concern	No	-	Schedule II		
Mountain Caco	*Cacosternum parvum*	Least Concern	No	-	Schedule II		
Boettger's Dainty Frog	*Cacosternum boettgeri*	Least Concern	No	-	Schedule II		
Common River Frog	*Amietia delalandii*	Least Concern	No	-	Schedule II		
Raucous Toad	*Bufo rangeri*	Least Concern	**Yes**	-	Schedule II		**X**
Cloud Toad	*Vandijkophrynus nubicola*	Least Concern	No	-	Schedule II		
TESTUDINES (Turtles & Tortoises) (SANBI 2014)							
Greater Padloper	*Homopus femoralis*	Least Concern	**Yes**	Appendix II	Schedule II		
Leopard Tortoise	*Stigmochelys pardalis*	Least Concern	No	Appendix II	Schedule II		
LACERTILIA (Lizards) (SANBI 2014)							

COMMON NAME	SCIENTIFIC NAME	REGIONAL RED LIST STATUS	ENDEMIC	CITES	ECENCO	QDS CODE (ADU, 2011)	
						3027AD	3027CB
Hall's Flat Gecko	*Afroedura halli*	Least Concern	**Yes**	-	Schedule II		**X**
Cape Thick-Toed Gecko	*Pachydactylus capensis*	Least Concern	No	-	Schedule II		
Southern Rock Agama	*Agama atra*	Least Concern	*Near*	-	Schedule II		**X**
Variable Skink	*Trachylepis varia*	Least Concern	No	-	Schedule II		
Variegated Skink	*Trachylepis variegata*	Least Concern	No	-	Schedule II		
Cape Skink	*Trachylepis capensis*	Least Concern	No	-	Schedule II		
Speckled Rock Skink	*Trachylepis punctatissima*	Least Concern	No	-	Schedule II		
Burchell's Sand Lizard	*Pedioplanis burchelli*	Least Concern	**Yes**	-	Schedule II		
Drakensburg Crag Lizard	*Pseudocordylus melanotus*	Least Concern	**Yes**	Appendix II	Schedule II		**X**
Eastern Cape Dwarf Chameleon	*Bradypodion ventrale*	Least Concern	**Yes**	Appendix II	Schedule II		
SERPENTES (Snakes) (SANBI 2014)							
Rhombic Egg Eater	*Dasypeltis scabra*	Least Concern	No	-	Schedule II		
Red-lipped Herald Snake	*Crotaphopeltis hotamboeia*	Least Concern	No	-	-		**X**
Yellow-bellied House Snake	*Lamprophis fuscus*	Least Concern	**Yes**	-	Schedule II		
Rinkhals	*Hemachatus haemachatus*	Least Concern	*Near*	-	-		
Puff adder	*Bitis bitis*	Least Concern	No	-	-		
Cape Cobra	*Naja nivea*	Least Concern	No	-	-		
Fork-marked Sand Snake	*Psammophis trinasalis*	Least Concern	No	-	-		

COMMON NAME	SCIENTIFIC NAME	REGIONAL RED LIST STATUS	ENDEMIC	CITES	ECENCO	QDS CODE (ADU, 2011)	
						3027AD	3027CB
Common Slug Eater	*Duberria lutrix*	Least Concern	**Yes**	-	Schedule II		
Montane Grass Snake	*Psammophis crucifer*	Least Concern	*Near*	-	-		
Mole Snake	*Pseudaspis cana*	Least Concern	No	-	Schedule II		
Spotted Grass Snake	*Psammophylax rhombeatus*	Least Concern	No	-	-		
Spotted Rock Snake	*Lamprophis guttatus*	Least Concern	*Near*	-	Schedule II		

APPENDIX 4: CES ASSESSMENT METHODOLOGY

Pre-Mitigation Evaluation Criteria

This rating scale adopts four (4) key factors to determine the overall significance of the impact prior to mitigation:

1. **Temporal Scale**: This scale defines the duration of any given impact over time. This may extend from the short-term (less than 5 years, equivalent to the construction phase) to permanent. Generally, the longer the impact occurs the greater the significance of any given impact.
2. **Spatial Scale:** This scale defines the spatial extent of any given impact. This may extend from the local area to an impact that crosses international boundaries. The wider the impact extends, the more significant it is likely to be.
3. **Severity/Benefits Scale:** This scale defines how severe negative impacts would be, or how beneficial positive impacts would be. This negative/positive scale is critical in determining the overall significance of any impacts.
4. **Likelihood Scale:** This scale defines the risk or chance of any given impact occurring. While many impacts generally do occur, there is considerable uncertainty in terms of others. The scale varies from unlikely to definite, with the overall impact significance increasing as the likelihood increases.

Table A5: Pre-Mitigation Evaluation Criteria.

TEMPORAL SCALE		
Short term	Less than 5 years	
Medium term	Between 5-20 years	
Long term	Between 20 and 40 years (a generation) and from a human perspective also permanent	
Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there	
SPATIAL SCALE		
Localised	At localised scale and a few hectares in extent	
Study Area	The proposed site and its immediate environs	
Regional	District and Provincial level	
National	Country	
International	Internationally	
SEVERITY SCALE	SEVERITY	BENEFIT
Slight	Slight impacts on the affected system(s) or party(ies)	Slightly beneficial to the affected system(s) and party(ies)
Moderate	Moderate impacts on the affected system(s) or party(ies)	Moderately beneficial to the affected system(s) and party(ies)
Severe/ Beneficial	Severe impacts on the affected system(s) or party(ies)	A substantial benefit to the affected system(s) and party(ies)

Very Severe/ Beneficial	Very severe change to the affected system(s) or party(ies)	A very substantial benefit to the affected system(s) and party(ies)
LIKELIHOOD SCALE		
Unlikely	The likelihood of these impacts occurring is slight	
May Occur	The likelihood of these impacts occurring is possible	
Probable	The likelihood of these impacts occurring is probable	
Definite	The likelihood is that this impact will definitely occur	

Table A6: Significance Descriptions.

SIGNIFICANCE RATE		DESCRIPTION
LOW NEGATIVE	LOW POSITIVE	*Impacts of low significance are typically acceptable impacts for which mitigation is desirable but not essential. The impact by itself is insufficient, even in combination with other low impacts, to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural environment or on social systems.*
MODERATE NEGATIVE	MODERATE POSITIVE	*Impacts of moderate significance are impacts that require mitigation. The impact is insufficient by itself to prevent the implementation of the project but in conjunction with other impacts may prevent its implementation. These impacts will usually result in a negative medium to long-term effect on the natural environment or on social systems.*
HIGH NEGATIVE	HIGH POSITIVE	*Impacts that are rated as being high are serious impacts and may prevent the implementation of the project if no mitigation measures are implemented, or the impact is very difficult to mitigate. These impacts would be considered by society as constituting a major and usually long-term change to the environment or social systems and result in severe effects.*
VERY HIGH NEGATIVE	VERY HIGH POSITIVE	*Impacts that are rated as very high are very serious impact which may be sufficient by itself to prevent the implementation of the project. The impact may result in permanent change. Very often these impacts are unmitigable and usually result in very severe effects or very beneficial effects.*

Post-Mitigation Criteria

Once mitigation measures are proposed, the following three (3) factors are then considered to determine the overall significance of the impact after mitigation.

1. **Reversibility Scale**: This scale defines the degree to which an environment can be returned to its original/partially original state.
2. **Irreplaceable loss Scale:** This scale defines the degree of loss which an impact may cause.
3. **Mitigation potential Scale:** This scale defines the degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

Table 8.3: Post-Mitigation Criteria.

REVERSIBILITY	
Reversible	*The activity will lead to an impact that can be reversed provided appropriate mitigation measures are implemented.*
Irreversible	*The activity will lead to an impact that is permanent regardless of the implementation of mitigation measures.*
IRREPLACEABLE LOSS	
Resource will not be lost	*The resource will not be lost/destroyed provided mitigation measures are implemented.*
Resource will be partly lost	*The resource will be partially destroyed even though mitigation measures are implemented.*
Resource will be lost	*The resource will be lost despite the implementation of mitigation measures.*
MITIGATION POTENTIAL	
Easily achievable	*The impact can be easily, effectively and cost effectively mitigated/reversed.*
Achievable	*The impact can be effectively mitigated/reversed without much difficulty or cost.*
Difficult	*The impact could be mitigated/reversed but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs.*
Very Difficult	*The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly.*

The following assumptions and limitations are inherent in the rating methodology:

- **Value Judgements**: Although this scale attempts to provide a balance and rigor to assessing the significance of impacts, the evaluation relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.
- **Cumulative Impacts**: These affect the significance rating of an impact because it considers the impact in terms of both on-site and off-site sources. This is particularly problematic in terms of impacts beyond the scope of the proposed development and the BA. For this reason, it is important to consider impacts in terms of their cumulative nature.
- **Seasonality**: Certain impacts will vary in significance based on seasonal change. Thus, it is difficult to provide a static assessment. Seasonality will need to be implicit in the temporal scale and, with management measures being imposed accordingly (e.g. dust suppression measures being implemented during the dry season).

APPENDIX 5: CURRICULUM VITAE OF PROJECT TEAM

APPENDIX 6: SPECIALIST DECLARATIONS

CES: PROPOSED SENQU RURAL WATER SUPPLY PROJECT, SENQU LOCAL MUNICIPALITY, EASTERN CAPE PROVINCE

Archaeological Impact Assessment

Prepared for: **CES**

Prepared by: **Exigo Sustainability**

Email info@exigo3.com
Tel +27 012 751 2160
Fax +27 086 607 2406

Postnet Suite 74,
Private Bag X04,
Menlo Park, 0102

Vat nr: 4910184854
Registration nr: 2006/011434/07

Innovation in Sustainability

www.exigo3.com

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF AREAS DEMARACTED FOR THE PROPOSED SENQU RURAL WATER SUPPLY PROJECT, SENQU LOCAL MUNICIPALITY, EASTERN CAPE PROVINCE

Conducted on behalf of:
CES

Compiled by:
Nelius Kruger (BA, BA Hons. Archaeology Pret.)

Reviewed by:
Robyn Thomson (EAP – CES)

DOCUMENT DISTRIBUTION LIST

Name	Institution
Robyn Thomson	CES

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Email info@exigo3.com
Tel +27 012 751 2160
Fax +27 086 607 2406

Postnet Suite 74,
Private Bag X04,
Menlo Park, 0102

Vat nr: 4910184854
Registration nr: 2006/011434/07

Innovation in Sustainability

www.exigo3.com

DECLARATION

I, Nelius Le Roux Kruger, declare that –

- I act as the independent specialist;
- I am conducting any work and activity relating to the proposed Senqu Rural Water Supply Project in an objective manner, even if this results in views and findings that are not favourable to the client;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have the required expertise in conducting the specialist report and I will comply with legislation, including the relevant Heritage Legislation (National Heritage Resources Act no. 25 of 1999, Human Tissue Act 65 of 1983 as amended, Removal of Graves and Dead Bodies Ordinance no. 7 of 1925, Excavations Ordinance no. 12 of 1980), the Minimum Standards: Archaeological and Palaeontological Components of Impact Assessment (SAHRA, AMAFA and the CRM section of ASAPA), regulations and any guidelines that have relevance to the proposed activity;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this declaration are true and correct.

Disclosure of Vested Interest
I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

Signature of Specialist
Company: Exigo Sustainability
Date: 23 March 2023

This Archaeological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the NEMA Table below.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
1.(1) (a) (i) Details of the specialist who prepared the report	Page 4, Section 1.2 and Addendum 1 of Report.	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.2 and Addendum 1 of Report.	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page 4 of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 1.3 and Section 1.4: Project Brief and Terms of Reference	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 4: Archaeo-Historical Context	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9: Statement of Significance and Impact Rating	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3: Method of Enquiry	-
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3: Method of Enquiry	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 9: Statement of Significance and Impact Rating	-
(g) An identification of any areas to be avoided, including buffers	Section 5: Results Archaeological Survey	-
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 9: Statement of Significance and Impact Rating	-
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.2: Limitations and Constraints	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 9: Statement of Significance and Impact Rating	
(k) Any mitigation measures for inclusion in the EMPr	Section 6.3: Management Actions Section 7: Recommendations	
(l) Any conditions for inclusion in the environmental authorisation	N/A	None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 6.3: Management Actions Section 7: Recommendations	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 & Section 7	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 6.3: Management Actions Section 7: Recommendations	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	Not applicable.
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 1.5: CRM: Legislation, Conservation and Heritage Management	

EXECUTIVE SUMMARY

This report details the results of an Archaeological Impact Assessment (AIA) for the proposed Senqu Rural Water Supply Project in the Sterkspruit areas in the Senqu Local Municipality, Eastern Cape Province. The project entails the construction and overhaul of bulk water supply infrastructure in a number of villages around Sterkspruit as well as the construction of new reservoirs. The report includes background information on the area's archaeology, its representation in Southern Africa, and the history of the larger area under investigation, survey methodology and results as well as heritage legislation and conservation policies. A copy of the report will be supplied to the South African Heritage Resources Agency (SAHRA) and recommendations contained in this document will be reviewed.

Project Title	Senqu Rural Water Supply Project
Project Location	**Rooisand Village: S30.46920° E27.38313°** **Maralaneng Village: S30.47026° E27.39633°** **Makojong Village: S30.47833° E27.38966°** **Enteni Village: S30.48422° E27.40861°** **Makheteng Village: S30.50627° E27.38362°** **Esilindile Village: S30.54541° E27.32686°** **Bamboespruit Village: S30.53181° E27.28822°** **Bensonvale Village: S30.57597° E27.36081°** **Litsheng Village: S30.58367° E27.34596°** **Magadla Village: S30.60639° E27.31606°** **Jozanas Nek Village: S30.61574° E27.33588°** **Kgampasi Village: S30.60162° E27.37183°** **Nkampini Village: S30.61120° E27.36391°** **Qoboshane Village: S30.60866° E27.38100°** **Magwiji Village: S30.62506° E27.36411°**
1:50 000 Map Sheet	3027AD & 3027CB
Farm Portion / Parcel	Sterkspruit Commonage
Magisterial District / Municipal Area	Senqu Local Municipality
Province	Eastern Cape Province

A number of archaeological and historical studies have been conducted in the Eastern Cape Province around the regional centre of Sterkspruit, most of which infer a varied and rich heritage landscape. The archaeological history of the Eastern Cape Province dates back to about 2 million years and possibly older. Several archaeological sites have been recorded in the landscape around Sterkspruit. The Albany Museum database holds limited information of archaeological sites for the Eastern Cape. However, records are held at several institutions including the University of the Transkei (now Walter Sisulu University), the University of Fort Hare, and the Rock Art Research Institute at the University of the Witwatersrand. Rock art research, mainly conducted by researchers from the Rock Art Research Institute, University of the Witwatersrand, have been conducted around the Barkly East, Ugie, Maclear, Dordrecht and other areas in the Southern Drakensberg escarpment of the north-eastern Cape. Middle Stone Age and Later Stone Age sites have also been excavated and researched during the 1970's. The literature shows evidence of an archaeological heritage that spans from the Early Stone Age, Middle Stone Age to the Later- Stone, as well as evidence of pastoralism and Iron Age farmers. Rock

paintings are prolific throughout Southern Drakensberg Mountains. The region is also significant historically as a frontier between hunter-gatherers, pastoralists, Nguni-speaking farming communities and European settlers.

An examination of historical aerial imagery and archive maps indicate that the larger project landscape had been altered by large-scale rural settlement, development and agriculture during the last century transforming the project area at large. This inference was confirmed during an archaeological site assessment during which *in situ* archaeological or heritage remains were encountered. The following recommendations are made based on general observations in the proposed Senqu Rural Water Supply Project in terms of heritage resources management.

- According to the South African Heritage Resources Agency Information System (SAHRIS) Palaeo Map, portions of the project area fall within a potentially sensitive fossiliferous zone and a Palaeontological Impact Assessment has been commissioned for the project. Should fossil remains such as fossil fish, reptiles or petrified wood be exposed during construction, these objects should carefully safeguarded and the relevant heritage resources authority (SAHRA) should be notified immediately so that the appropriate action can be taken by a professional palaeontologist.
- A number of Historical Period buildings and dwellings (**EXIGO-BEN-HP01, EXIGO-JN-HP01, EXIGO-JN-HP02, EXIGO-LIT-HP01, EXIGO-MAG-HP01, EXIGO-MAR-HP01, EXIGO-MAR-HP02**) are generally poorly preserved and the sites are of medium-low heritage significance. The sites occur in close proximity of the project development areas and it is primarily recommended that the proposed pipeline alignments be adjusted to avoid the resources and that a conservation buffer of at least 20m around the site be implemented. However, should impact on the sites prove inevitable, application should be made for destruction permits from the relevant Heritage Resources Authorities prior to site alteration or destruction. Generally, the site should be monitored by an informed ECO in order to avoid the destruction of previously undetected heritage remains
- Graves and burials identified within close proximity of the pipeline construction alignments (**EXIGO-BB-BP01 - EXIGO-BB-BP04, EXIGO-BEN-BP01, EXIGO-ENT-BP01 - EXIGO-ENT-BP02, EXIGO-ES-BP01 - EXIGO-ES-BP18, EXIGO-JN-BP01 - EXIGO-JN-BP08, EXIGO-KG-BP01, EXIGO-MAK-BP01 - EXIGO-MAK-BP02, EXIGO-MAR-BP01 - EXIGO-MAR-BP06, EXIGO-MAW-BP01 - EXIGO-MAW-BP03, EXIGO-MTN-BP01 - EXIGO-MTN-BP06, EXIGO-NP-BP01 - EXIGO-NP-BP03, EXIGO-QOB-BP01 - EXIGO-QOB-BP05, EXIGO-RS-BP01 - EXIGO-RS-BP02**) carry a Field Rating 4b and the sites are of high significance and these sites might be impacted on by the proposed project. In most of these cases, the graves and cemeteries are situated near roads or within settlements, often around or very close to homesteads and homestead buildings, roads and other infrastructure. These locations of human burials along the proposed alignment present challenges in terms of the conservation and management of these sensitive heritage receptors. As a primary measure, Heritage Authority (SAHRA) guidelines require a 100m conservation buffer for all burials but the implementation of this guideline might prove problematic and impractical in a number of instances considering the locations of many of the burials, as noted above. It is therefore recommended that a heritage conservation buffer of at least 10m be implemented around all graves. Where construction or digging risk encroaching on this conservation buffer, a temporary construction barricade should be erected around burials at risk in order to clearly demarcate the locations of the burials. A Site Management Plan (SMP) detailing strict site management conservation measures should be compiled for all burials in the project area. The SMP should stipulate training

of the assigned project ECO, site supervisors and contractors involved in the project on the heritage significance of the burial sites. The SMP should also include a heritage Chance Find procedure for accidental discovery of human remains should be included. All burials should be monitored by a trained on-site supervisor during all phases of development, and on a monthly basis by an informed ECO or by the heritage Specialist in order to detect any impact on the resource at the earliest opportunity.

- **Should impact on any human burial prove inevitable, full grave relocations are recommended for these burial grounds. This measure should be undertaken by a qualified archaeologist, and in accordance with relevant legislation, permitting, statutory permissions and subject to any local and regional provisions and laws and by-laws pertaining to human remains. A full social consultation process should occur in conjunction with the mitigation of cemeteries and burials (see Addendum B)**.
- Considering the localised nature of heritage remains, the general monitoring of the development progress by an ECO or by the heritage specialist is recommended for all stages of the project. Should any subsurface palaeontological, archaeological or historical material, or burials be exposed during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately.
- It is essential that cognisance be taken of the larger archaeological landscape of the area in order to avoid the destruction of previously undetected heritage sites. It should be stated that it is likely that further undetected archaeological remains might occur elsewhere in the Study Area along water sources and drainage lines, fountains and pans would often have attracted human activity in the past. Also, since Stone Age material seems to originate from below present soil surfaces in eroded areas, the larger landscape should be regarded as potentially sensitive in terms of possible subsurface deposits. Burials and historically significant structures dating to the Colonial Period occur on farms in the area and these resources should be avoided during all phases of construction and development, including the operational phases of the development.

Heritage resources occur in close proximity of the Senqu Rural Water Supply Project and these heritage receptors might be impacted on by the proposed project. However, these impacts can be mitigated and in the opinion of the author of this Archaeological Impact Assessment Report, the proposed Senqu Rural Water Supply Project may proceed from a culture resources management perspective, provided that mitigation measures are implemented where applicable, and provided that no subsurface heritage remains are encountered during any phase of development.

This report details the methodology, limitations and recommendations relevant to these heritage areas, as well as areas of proposed development. It should be noted that recommendations and possible mitigation measures are valid for the duration of the development process, and mitigation measures might have to be implemented on additional features of heritage importance not detected during this Phase 1 assessment (e.g., uncovered during the construction process).

Senqu Rural Water Supply Project Heritage Sites Locations

Site Code	Coordinate S E	Coordinate E	Short Description	Mitigation Action
BURIAL SITES				
EXIGO-BB-BP01	-30.5284311	27.28647701	Burial Site	**Site monitoring:** Continuous monitoring by trained on-sote supervisor and monthly monitoring by informed ECO or the heritage specialist. **Avoidance:** 10m conservation buffer, site management. **Site Management Plan:** Management measures for site conservation, training of ECO, site supervisors and contractors on significance of burials. Chance find procedure for the accidental discovery of human remains. **Grave relocation** subject to authorisations and permitting **if impacted on**.
EXIGO-BB-BP02	-30.5286049	27.27989092	Burial Site	
EXIGO-BB-BP03	-30.532162	27.27854412	Burial Site	
EXIGO-BB-BP04	-30.5340964	27.28176889	Burial Site	
EXIGO-BEN-BP01	-30.5707782	27.3491008	Burial Site	
EXIGO-ENT-BP01	-30.4829851	27.41074551	Burial Site	
EXIGO-ENT-BP02	-30.4918905	27.39555323	Burial Site	
EXIGO-ES-BP01	-30.5333154	27.3385272	Burial Site	
EXIGO-ES-BP02	-30.5351395	27.33735172	Burial Site	
EXIGO-ES-BP03	-30.5359562	27.33727654	Burial Site	
EXIGO-ES-BP04	-30.5380128	27.33691779	Burial Site	
EXIGO-ES-BP05	-30.5414783	27.3347473	Burial Site	
EXIGO-ES-BP06	-30.5378737	27.33990619	Burial Site	
EXIGO-ES-BP07	-30.5379553	27.33993159	Burial Site	
EXIGO-ES-BP08	-30.5393607	27.34088553	Burial Site	
EXIGO-ES-BP09	-30.5400304	27.34120823	Burial Site	
EXIGO-ES-BP10	-30.5413021	27.34155273	Burial Site	
EXIGO-ES-BP11	-30.5413904	27.34149414	Burial Site	
EXIGO-ES-BP12	-30.5437534	27.3402729	Burial Site	
EXIGO-ES-BP13	-30.54372	27.34002999	Burial Site	
EXIGO-ES-BP14	-30.5483506	27.30628395	Burial Site	
EXIGO-ES-BP15	-30.5459167	27.31014775	Burial Site	
EXIGO-ES-BP16	-30.5346775	27.3118673	Burial Site	
EXIGO-ES-BP17	-30.5349946	27.31194005	Burial Site	
EXIGO-ES-BP18	-30.5353338	27.31473098	Burial Site	
EXIGO-JN-BP01	-30.6069295	27.33594256	Burial Site	
EXIGO-JN-BP02	-30.6103655	27.33522875	Burial Site	
EXIGO-JN-BP03	-30.6194004	27.33297042	Burial Site	
EXIGO-JN-BP04	-30.6214359	27.33226868	Burial Site	
EXIGO-JN-BP05	-30.6285156	27.32837034	Burial Site	
EXIGO-JN-BP06	-30.6287186	27.32833464	Burial Site	
EXIGO-JN-BP07	-30.6291542	27.32767649	Burial Site	
EXIGO-JN-BP08	-30.6294062	27.32721875	Burial Site	
EXIGO-KG-BP01	-30.6074945	27.36892451	Burial Site	
EXIGO-MAK-BP01	-30.4761285	27.38865023	Burial Site	
EXIGO-MAK-BP02	-30.4777241	27.39292139	Burial Site	
EXIGO-MAR-BP01	-30.4727076	27.39332071	Burial Site	
EXIGO-MAR-BP02	-30.4711789	27.39569832	Burial Site	
EXIGO-MAR-BP03	-30.4717532	27.39800862	Burial Site	

EXIGO-MAR-BP04	-30.4726844	27.39592957	Burial Site	
EXIGO-MAR-BP05	-30.4751053	27.39672602	Burial Site	
EXIGO-MAR-BP06	-30.4762919	27.39760168	Burial Site	
EXIGO-MAW-BP01	-30.6242675	27.36086044	Burial Site	
EXIGO-MAW-BP02	-30.6252296	27.36127946	Burial Site	
EXIGO-MAW-BP03	-30.6288114	27.36456583	Burial Site	
EXIGO-MTN-BP01	-30.4980549	27.38331263	Burial Site	
EXIGO-MTN-BP02	-30.4988416	27.38173893	Burial Site	
EXIGO-MTN-BP03	-30.5026055	27.38648082	Burial Site	
EXIGO-MTN-BP04	-30.5134118	27.38584623	Burial Site	
EXIGO-MTN-BP05	-30.5148797	27.38292153	Burial Site	
EXIGO-MTN-BP06	-30.5151882	27.38261299	Burial Site	
EXIGO-NP-BP01	-30.6102161	27.36572446	Burial Site	
EXIGO-NP-BP02	-30.6132939	27.36159059	Burial Site	
EXIGO-NP-BP03	-30.6093157	27.36951912	Burial Site	
EXIGO-QOB-BP01	-30.6079117	27.38306344	Burial Site	
EXIGO-QOB-BP02	-30.6082479	27.38364925	Burial Site	
EXIGO-QOB-BP03	-30.6085079	27.38432751	Burial Site	
EXIGO-QOB-BP04	-30.6112967	27.38741297	Burial Site	
EXIGO-QOB-BP05	-30.6129024	27.38809157	Burial Site	
EXIGO-RS-BP01	-30.4718409	27.3817862	Burial Site	
EXIGO-RS-BP02	-30.4734581	27.38273352	Burial Site	
HISTORICAL PERIOD FEATURES				
EXIGO-BEN-HP01	-30.5798465	27.35609542	Historical Period Site	Site monitoring, avoidance, 20m conservation buffer. Destruction permitting if impacted on.
EXIGO-JN-HP01	-30.6134287	27.33474227	Historical Period Site	
EXIGO-JN-HP02	-30.6282794	27.32892154	Historical Period Site	
EXIGO-LIT-HP01	-30.590563	27.34124931	Historical Period Site	
EXIGO-MAG-HP01	-30.6094576	27.32257971	Historical Period Site	
EXIGO-MAR-HP01	-30.4725386	27.39388171	Historical Period Site	
EXIGO-MAR-HP02	-30.477693	27.40090356	Historical Period Site	

NOTATIONS AND TERMS/TERMINOLOGY

Absolute dating: Absolute dating provides specific dates or range of dates expressed in years.

Archaeological record: The archaeological record minimally includes all the material remains documented by archaeologists. More comprehensive definitions also include the record of culture history and everything written about the past by archaeologists.

Artefact: Entities whose characteristics result or partially result from human activity. The shape and other characteristics of the artefact are not altered by removal of the surroundings in which they are discovered. In the Southern African context examples of artefacts include potsherds, iron objects, stone tools, beads and hut remains.

Assemblage: A group of artefacts recurring together at a particular time and place, and representing the sum of human activities.

Context: An artefact's context usually consists of its immediate *matrix*, its *provenience* and its *association* with other artefacts. When found in *primary context*, the original artefact or structure was undisturbed by natural or human factors until excavation and if in *secondary context,* disturbance or displacement by later ecological action or human activities occurred.

Cultural Heritage Resource: The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

Cultural landscape: A cultural landscape refers to a distinctive geographic area with cultural significance.

Cultural Resource Management (CRM): A system of measures for safeguarding the archaeological heritage of a given area, generally applied within the framework of legislation designed to safeguard the past.

Feature: Non-portable artefacts, in other words artefacts that cannot be removed from their surroundings without destroying or altering their original form. Hearths, roads, and storage pits are examples of archaeological features

Impact: A description of the effect of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space.

Lithic: Stone tools or waste from stone tool manufacturing found on archaeological sites.

Matrix: The material in which an artefact is situated (sediments such as sand, ashy soil, mud, water, etcetera). The matrix may be of natural origin or human-made.

Midden: Refuse that accumulates in a concentrated heap.

Microlith: A small stone tool, typically knapped of flint or chert, usually about three centimetres long or less.

Monolith: A geological feature such as a large rock, consisting of a single massive stone or rock, or a single piece of rock placed as, or within, a monument or site.

Phase 1 CRM Assessment: An Impact Assessment which identifies archaeological and heritage sites, assesses their significance and comments on the impact of a given development on the sites. Recommendations for site mitigation or conservation are also made during this phase.

Phase 2 CRM Study: In-depth studies which could include major archaeological excavations, detailed site surveys and mapping / plans of sites, including historical / architectural structures and features. Alternatively, the sampling of sites by collecting material, small test pit excavations or auger sampling is required. Mitigation / Rescue involves planning the protection of significant sites or sampling through excavation or collection (in terms of a permit) at sites that may be lost as a result of a given development.

Phase 3 CRM Measure: A Heritage Site Management Plan (for heritage conservation), is required in rare cases where the site is so important that development will not be allowed and sometimes developers are encouraged to enhance the value of the sites retained on their properties with appropriate interpretive material or displays.

Provenience: Provenience is the three-dimensional (horizontal and vertical) position in which artefacts are found. Fundamental to ascertaining the provenience of an artefact is *association,* the co-occurrence of an artefact with other archaeological remains; and *superposition,* the principle whereby artefacts in lower levels of a matrix were deposited before the artefacts found in the layers above them, and are therefore older.

Random Sampling: A probabilistic sampling strategy whereby randomly selected sample blocks in an area are surveyed. These are fixed by drawing coordinates of the sample blocks from a table of random numbers.

Scoping Assessment: The process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an impact assessment. The main purpose is to focus the impact assessment on a manageable number of important questions on which decision making is expected to focus and to ensure that only key issues and reasonable alternatives are examined. The outcome of the scoping process is a Scoping Report that includes issues raised during the scoping process, appropriate responses and, where required, terms of reference for specialist involvement.

Site (Archaeological): A distinct spatial clustering of artefacts, features, structures, and organic and environmental remains, as the residue of human activity. These include surface sites, caves and rock shelters, larger open-air sites, sealed sites (deposits) and river deposits. Common functions of archaeological sites include living or habitation sites, kill sites, ceremonial sites, burial sites, trading, quarry, and art sites,

Stratigraphy: This principle examines and describes the observable layers of sediments and the arrangement of strata in deposits

Systematic Sampling: A probabilistic sampling strategy whereby a grid of sample blocks is set up over the survey area and each of these blocks is equally spaced and searched.

Trigger: A particular characteristic of either the receiving environment or the proposed project which indicates that there is likely to be an *issue* and/or potentially significant *impact* associated with that proposed development that may require specialist input. Legal requirements of existing and future legislation may also trigger the need for specialist involvement.

LIST OF ABBREVIATIONS

Abbreviation	Description
ASAPA	Association for South African Professional Archaeologists
AIA	Archaeological Impact Assessment
BP	Before Present
BCE	Before Common Era
BGG	Burial Grounds and Graves
CRM	Culture Resources Management
EIA	Early Iron Age (also Early Farmer Period)
EIA	Environmental Impact Assessment
EFP	Early Farmer Period (also Early Iron Age)
ESA	Earlier Stone Age
GIS	Geographic Information Systems
GPR	Ground Penetrating Radar
HIA	Heritage Impact Assessment
ICOMOS	International Council on Monuments and Sites
K2/Map	K2/Mapungubwe Period
LFP	Later Farmer Period (also Later Iron Age)
LIA	Later Iron Age (also Later Farmer Period)
LSA	Later Stone Age
MIA	Middle Iron Age (also Early later Farmer Period)
MRA	Mining Right Area
MSA	Middle Stone Age
NHRA	National Heritage Resources Act No.25 of 1999, Section 35
PHRA	Provincial Heritage Resources Authorities
SAFA	Society for Africanist Archaeologists
SAHRA	South African Heritage Resources Association
YCE	Years before Common Era (Present)

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1 BACKGROUND

1.1 Scope and Motivation

Exigo Sustainability was commissioned by CES for an Archaeological Impact Assessment (AIA) study for the proposed Senqu Rural Water Supply Project in the Senqu Local Municipality, Eastern Cape Province. The rationale of this AIA is to determine the presence of heritage resources such as archaeological and historical sites and features, graves and places of religious and cultural significance in previously unstudied areas; to consider the impact of the proposed project on such heritage resources, and to submit appropriate recommendations with regard to the cultural resources management measures that may be required at affected sites / features.

1.2 Project Direction

Exigo Sustainability's expertise ensures that all projects be conducted to the highest international ethical and professional standards. As archaeological specialist for Exigo Sustainability, Mr Neels Kruger acted as field director for the project; responsible for the assimilation of all information, the compilation of the final consolidated AIA report and recommendations in terms of heritage resources on the demarcated project areas. Mr Kruger is an accredited archaeologist and Culture Resources Management (CRM) practitioner with the Association of South African Professional Archaeologists (ASAPA), a member of the Society for Africanist Archaeologists (SAFA) and the Pan African Archaeological Association (PAA) as well as a Master's Degree candidate in archaeology at the University of Pretoria.

1.3 Project Brief and Previous HIA

The author was contracted to undertake a heritage assessment in the Sterkspruit area for the Senqu Rural Water Supply Project located in the Senqu Local Municipality, Eastern Cape Province. The project entails the proposed upgrade of water supply infrastructure across a number of villages, hereafter referred to as the "Senqu Rural Water Supply Project". Most of the infrastructure for the Senqu Rural Water Supply was built on the advent of democracy in late 1990's with no clear record available from the WSA. Currently the water supply is unreliable in most areas supplied by the Senqu Rural Water Supply.

The project consists of 15 villages in different wards of Senqu Local Municipality: Rooisand Village, Maralaneng Village, Makojong Village, Enteni Village, Makheteng Village, Esilindile Village, Bamboespruit Village, Bensonvale Village, Litsheng Village, Magadla Village, Jozanas Nek Village, Kgampasi Village, Nkampini Village, Qoboshane Village and the Magwiji Village.

The project scope includes **the following components**:

- Equipping of tested boreholes.
- Construction of pump houses for new boreholes.
- Construction of limited reticulation to the existing infrastructure and draw-offs for new boreholes.
- Construction of 4 new reservoirs where required.

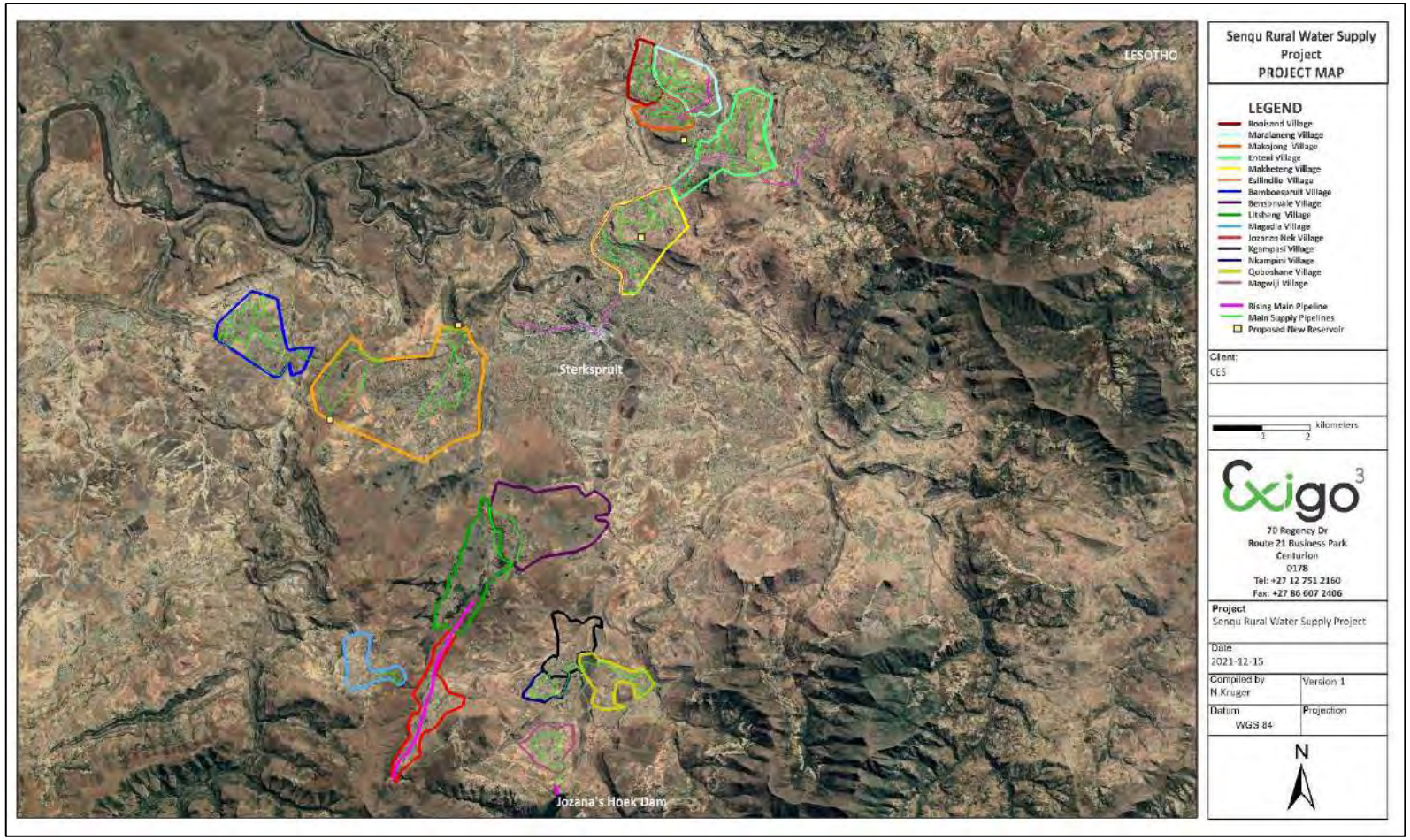

Figure 1-1: Aerial map indicating the pipeline alignments subject to the proposed Senqu Rural Water Supply Project.

1.4 Terms of Reference

Heritage specialist input into the Environmental Impact Assessment (EIA) process is essential to ensure that, through the management of change, developments still conserve our heritage resources. It is also a legal requirement for certain development categories which may have an impact on heritage resources. Thus, EIAs should always include an assessment of heritage resources. The heritage component of the EIA is provided for in the **National Environmental Management Act, (Act 107 of 1998)** and endorsed by section 38 of the **National Heritage Resources Act (NHRA - Act 25 of 1999)**. In addition, the NHRA protects all structures and features older than 60 years, archaeological sites and material and graves as well as burial sites. The objective of this legislation is to ensure that developers implement measures to limit the potentially negative effects that the development could have on heritage resources. Based hereon, this project functioned according to the following **terms of reference for** heritage specialist input**:**

- *Provide a detailed description of all archaeological artefacts, structures (including graves) and settlements which may be affected, if any.*
- *Assess the nature and degree of significance of such resources within the area.*
- *Establish heritage informants/constraints to guide the development process through establishing thresholds of impact significance;*
- *Assess and rate any possible impact on the archaeological and historical remains within the area emanating from the proposed development activities.*
- *Propose possible heritage management measures provided that such action is necessitated by the development.*
- *Liaise and consult with the South African Heritage Resources Agency (SAHRA*.

1.5 CRM: Legislation, Conservation and Heritage Management

The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

1.5.1 Legislation regarding archaeology and heritage sites

The South African Heritage Resources Agency (SAHRA) and its provincial offices aim to conserve and control the management, research, alteration and destruction of cultural resources of South Africa. It is therefore vitally important to adhere to heritage resource legislation at all times.

a. National Heritage Resources Act No 25 of 1999, section 35

According to the National Heritage Resources Act No 25 of 1999 (section 35) the following features are protected as cultural heritage resources:

a. Archaeological artifacts, structures and sites older than 100 years

b. Ethnographic art objects (e.g. prehistoric rock art) and ethnography

c. Objects of decorative and visual arts

d. Military objects, structures and sites older than 75 years

e. Historical objects, structures and sites older than 60 years

f. Proclaimed heritage sites

g. Grave yards and graves older than 60 years

h. Meteorites and fossils

i. Objects, structures and sites of scientific or technological value.

In addition, the national estate includes the following:

a. Places, buildings, structures and equipment of cultural significance

b. Places to which oral traditions are attached or which are associated with living heritage

c. Historical settlements and townscapes

d. Landscapes and features of cultural significance

e. Geological sites of scientific or cultural importance

f. Archaeological and paleontological importance

g. Graves and burial grounds

h. Sites of significance relating to the history of slavery

i. Movable objects (e.g. archaeological, paleontological, meteorites, geological specimens, military, ethnographic, books etc.)

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites. (35. [4] 1999:58)."

and

"No person may, without a permit issued by SAHRA or a provincial heritage resources agency-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals (36. [3] 1999:60)."

b. Human Tissue Act of 1983 and Ordinance on the Removal of Graves and Dead Bodies of 1925

Graves and burial grounds are commonly divided into the following subsets:

a. ancestral graves
b. royal graves and graves of traditional leaders
c. graves of victims of conflict
d. graves designated by the Minister
e. historical graves and cemeteries
f. human remains

Graves 60 years or older are heritage resources and fall under the jurisdiction of both the National Heritage Resources Act and the Human Tissues Act of 1983. However, graves younger than 60 years are specifically protected by the Human Tissues Act (Act 65 of 1983) and Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws. Such burial places also fall under the jurisdiction of the National Department of Health and the Provincial Health Departments.

c. National Heritage Resources Act No 25 of 1999, section 35

This act (Act 107 of 1998) states that a survey and evaluation of cultural resources must be done in areas where development projects, that will change the face of the environment, will be undertaken. The impact of the development on these resources should be determined and proposals for the mitigation thereof are made. Environmental management should also take the cultural and social needs of people into account. Any disturbance of landscapes and sites that constitute the nation's cultural heritage should be avoided as far as possible and where this is not possible the disturbance should be minimized and remedied.

1.5.2 Background to HIA and AIA Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. Heritage sites are frequently threatened by development projects and both the environmental and heritage legislation require impact assessments (HIAs & AIAs) that identify all heritage resources in areas to be developed. Particularly, these assessments are required to make recommendations for protection or mitigation of the impact of the sites. HIAs and AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources including archaeological and palaeontological sites that might occur in areas of developed and (b) make recommendations for protection or mitigation of the impact on the sites.

A detailed guideline of statutory terms and requirements is supplied in Addendum 1.

2 REGIONAL CONTEXT

2.1 Area Location

The proposed Senqu Rural Water Supply Project occurs in the landscape around the town of Sterkspruit in the Joe Gqabi District Municipality of the Eastern Cape Province. It is located approximately 15km north-east of Lady Grey and 60km east of Aliwal North and in on the south-western foothills of the Drakensberg. The R392 regional road routes through Sterkspruit and it connects to the R58 to Aliwal North. The project footprints appear on 1:50 000 map sheets **3027AD & 3027CB** (see Figure 2-1). Key geographical points for the project locations are:

- Rooisand Village: S30.46920° E27.38313°
- Maralaneng Village: S30.47026° E27.39633°
- Makojong Village: S30.47833° E27.38966°
- Enteni Village: S30.48422° E27.40861°
- Makheteng Village: S30.50627° E27.38362°
- Esilindile Village: S30.54541° E27.32686°
- Bamboespruit Village: S30.53181° E27.28822°
- Bensonvale Village: S30.57597° E27.36081°
- Litsheng Village: S30.58367° E27.34596°
- Magadla Village: S30.60639° E27.31606°
- Jozanas Nek Village: S30.61574° E27.33588°
- Kgampasi Village: S30.60162° E27.37183°
- Nkampini Village: S30.61120° E27.36391°
- Qoboshane Village: S30.60866° E27.38100°
- Magwiji Village: S30.62506° E27.36411°

2.2 Area Description: Receiving Environment

The project area lies within the Grassland Biome. The Grassland Biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu Natal and the Eastern Cape. The topography is mainly flat and rolling, but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level. Grasslands (also known locally as Grassveld) are dominated by a single layer of grasses. Trees are absent, except in a few localized habitats. The main alluvial targets of interest are confined to the Orange River in the area of Aliwal North. The plains within this land type are deemed to be covered predominantly by red-yellow apedal soils, with highly localized pockets of red-coloured, weakly structured sandy loam to sandy clay soils, and highly localized pockets of moderately structured clayey soils. The mountainous region is dominated by shallow, poorly developed soils and the substrate is often completely dominated by bedrock. The study area is drained mainly by means of surface run-off (sheet flow) with storm water collecting along roads and footpaths cutting through the area, to drain into large erosion gullies s that cut through the landscape.

2.3 Site Description

The study areas subject to this assessment are situated along gradually rolling hills, plains and high mountain rises around the urban zones of Sterkspruit. More specifically, the sites extend across the gradual and steep

slopes and river valleys in a landscape that has largely been transformed by historical and more recent human settlement, crop and livestock farming and urbanization. Original vegetation remains intact along rivers and water courses as well as high ridges and mountain peaks but disturbance agents such as agricultural activities such as ploughing and grazing cause severe surface erosion and decomposition of low-lying geomorphological deposits.

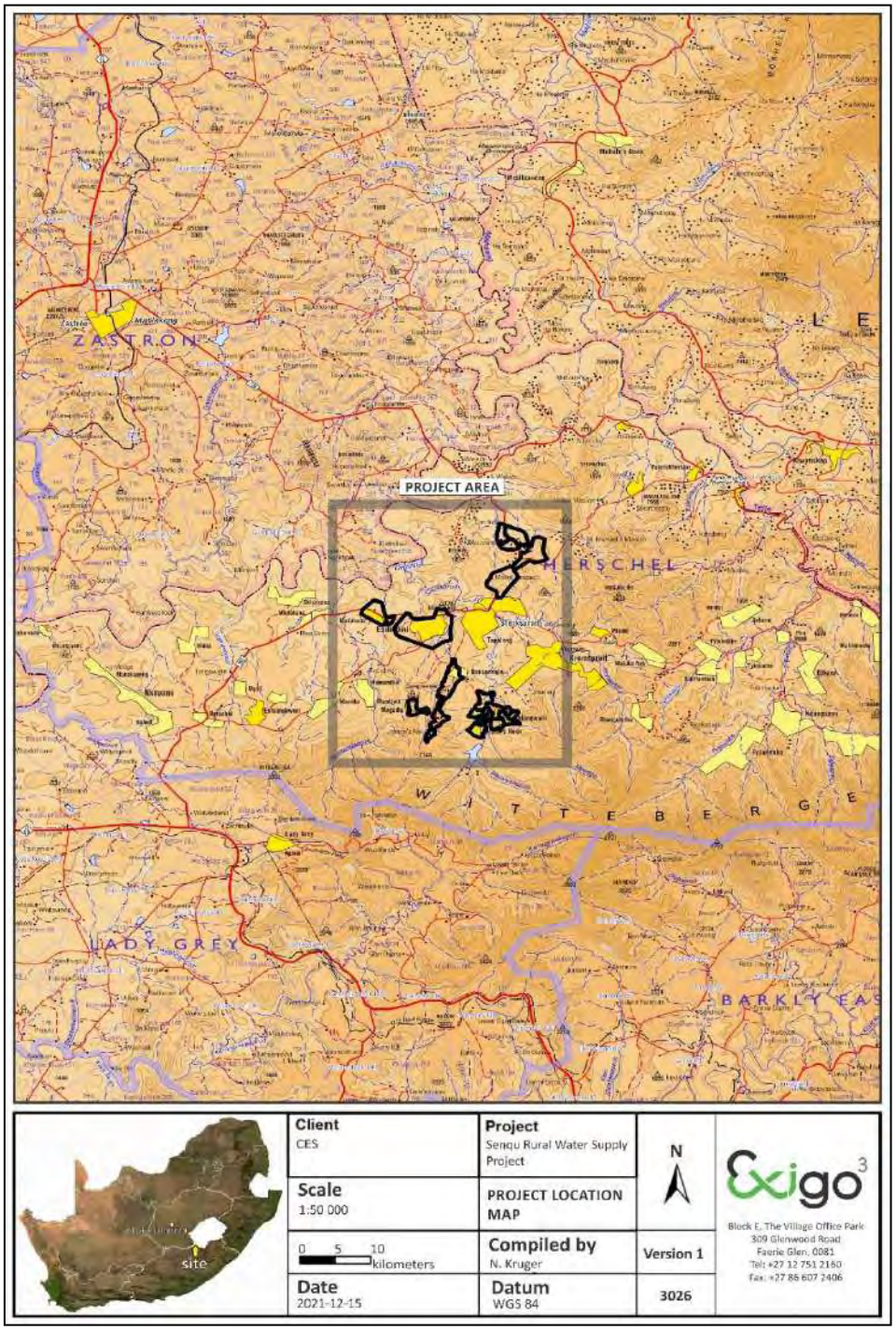

Figure 2-1: 1:50 00 Map representation of the location of the Senqu Rural Water Supply Project (sheet 3027AD & 3027CB).

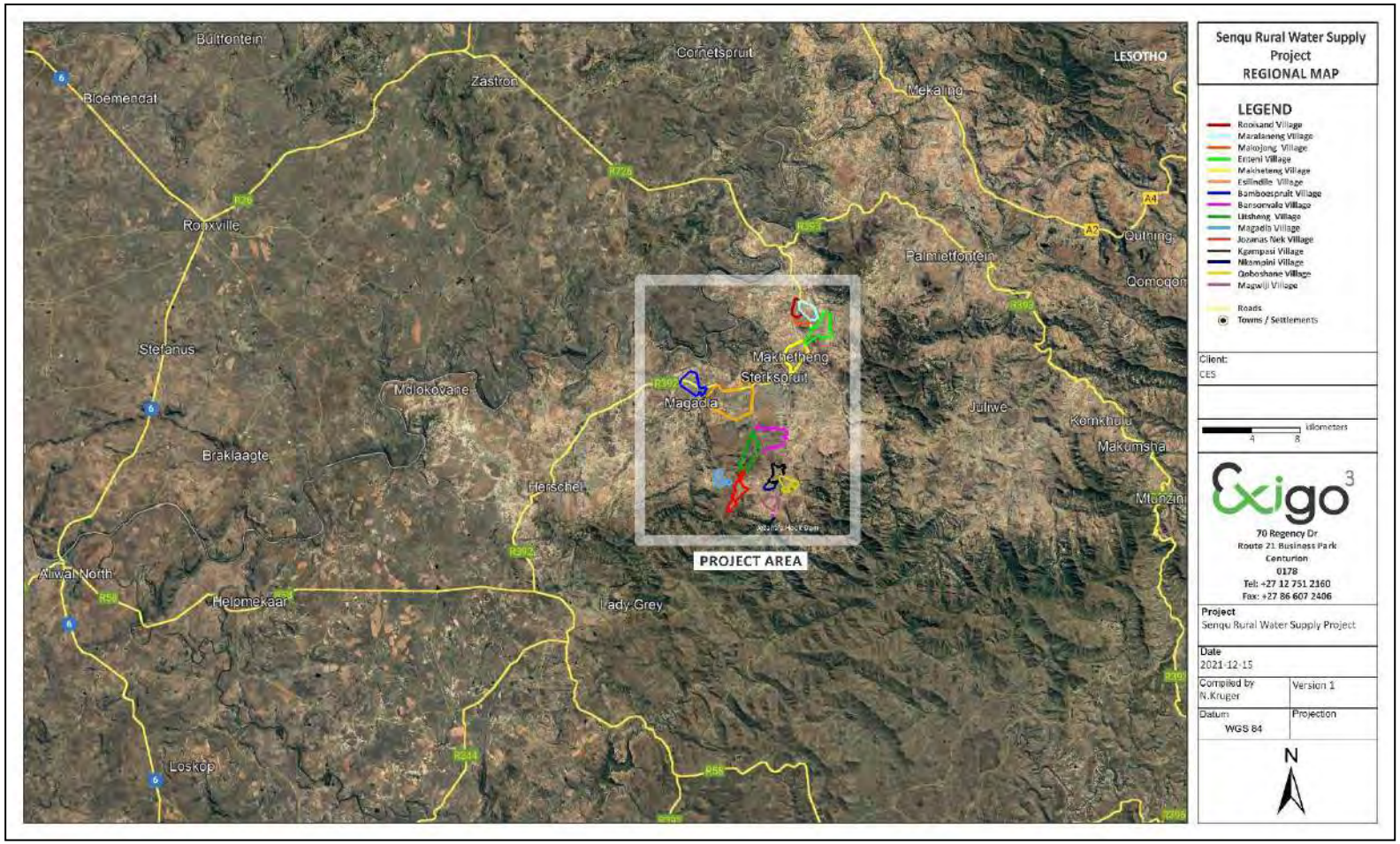

Figure 2-2: Aerial map providing a regional context for the proposed Senqu Rural Water Supply Project.

3 ARCHAEO-HISTORICAL CONTEXT

3.1 The archaeology of Southern Africa

Archaeology in Southern Africa is typically divided into two main fields of study, the **Stone Age** and the **Iron Age** or **Farmer Period**. The following table provides a concise outline of the chronological sequence of periods, events, cultural groups and material expressions in Southern African pre-history and history.

Table 1 Chronological Periods across Southern Africa

Period	Epoch	Associated cultural groups	Typical Material Expressions
Early Stone Age 2.5m – 250 000 YCE	Pleistocene	Early Hominins: *Australopithecines* *Homo habilis* *Homo erectus*	Typically large stone tools such as hand axes, choppers and cleavers.
Middle Stone Age 250 000 – 25 000 YCE	Pleistocene	First *Homo sapiens* species	Typically smaller stone tools such as scrapers, blades and points.
Late Stone Age 20 000 BC – present	Pleistocene / Holocene	*Homo sapiens sapiens* including San people	Typically small to minute stone tools such as arrow heads, points and bladelets.
Early Iron Age / Early Farmer Period 300 – 900 AD	Holocene	First Bantu-speaking groups	Typically distinct ceramics, bead ware, iron objects, grinding stones.
Middle Iron Age (Mapungubwe / K2) / early Later Farmer Period 900 – 1350 AD	Holocene	Bantu-speaking groups, ancestors of present-day groups	Typically distinct ceramics, bead ware and iron / gold / copper objects, trade goods and grinding stones.
Late Iron Age / Later Farmer Period 1400 AD -1850 AD	Holocene	Various Bantu-speaking groups including Venda, Thonga, Sotho-Tswana and Zulu	Distinct ceramics, grinding stones, iron objects, trade objects, remains of iron smelting activities including iron smelting furnace, iron slag and residue as well as iron ore.
Historical / Colonial Period ±1850 AD – present	Holocene	Various Bantu-speaking groups as well as European farmers, settlers and explorers	Remains of historical structures e.g. homesteads, missionary schools etc. as well as, glass, porcelain, metal and ceramics.

3.2 The Sterkspruit Area: Specific Themes.

The archaeological history of the Eastern Cape Province dates back to about 2 million years and possibly older. Several archaeological sites have been recorded in the landscape around Barkly East. The Albany Museum database holds limited information of archaeological sites for the north Eastern Cape, however, records are held at several institutions including the University of the Transkei (now Walter Sisulu University), the University of Fort Hare, and the Rock Art Research Institute at the University of the Witwatersrand. The literature shows evidence of an archaeological heritage that spans from the Early Stone Age, Middle Stone Age to the Later- Stone, as well as evidence of pastoralism and Iron Age farmers. Rock paintings are prolific throughout Southern Drakensberg Mountains. The region is also significant historically as a frontier between hunter-gatherers, pastoralists, Nguni-speaking farming communities and European settlers. White farmers, settling in the area since the middle of the 19th century, divided up the landscape into a number of farms, which even today form the framework for agricultural, residential and other forms of development.

3.2.1 Early History and the Stone Ages

According to archaeological research, the earliest ancestors of modern humans emerged some two to three million years ago. The remains of Australopithecine and *Homo habilis* have been found in dolomite caves and underground dwellings at places such as Sterkfontein and Swartkrans near Krugersdorp. *Homo habilis*, one of the Early Stone Age hominids, is associated with Oldowan artefacts, which include crude implements manufactured from large pebbles. The Acheulian industrial complex replaced the Oldowan industrial complex during the Early Stone Age. This phase of human existence was widely distributed across South Africa and is associated with *Homo erectus*, who manufactured hand axes and cleavers from as early as one and a half million years ago. Middle Stone Age sites dating from as early as two hundred thousand years ago have been found all over South Africa. Middle Stone Age hunter-gatherer bands also lived and hunted in the Orange and Vaal River valleys. These people, who probably looked like modern humans, occupied campsites near water but also used caves as dwellings. They manufactured a wide range of stone tools, including blades and point s that may have had long wooden sticks as hafts and were used as spears.

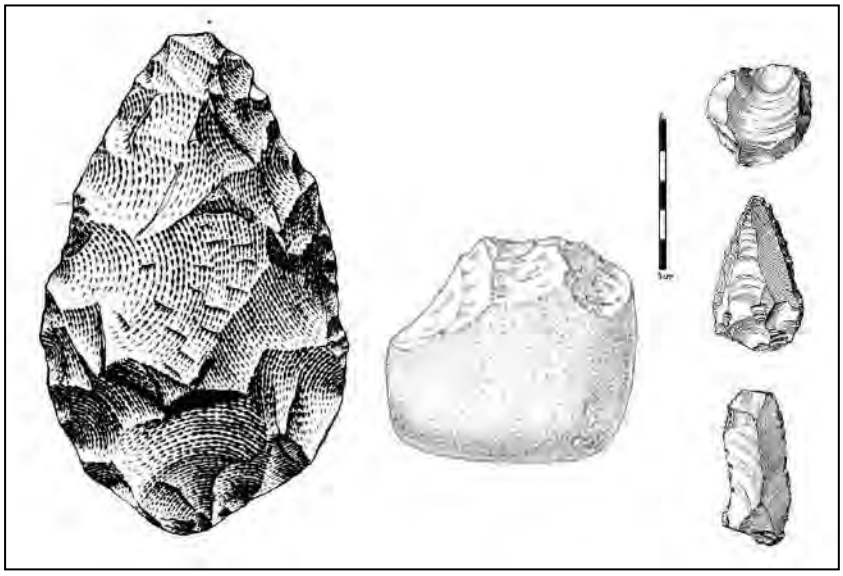

Figure 3-1: Typical ESA handaxe (left) and cleaver (center). To the right is a MSA scraper (right, top), point (right, middle) and blade (right, bottom).

Later Stone Age (LSA) sites occur both at the coast and inland as caves deposits, rock shelters, open sites and shell deposits. The majority of LSA archaeological sites in the Eastern Cape area would date from the past 10 000 years where San hunter-gatherers inhabited the landscape living in rock shelters and caves as well as on the open landscape. These latter sites are difficult to find because they are in the open veld and often covered by vegetation and sand. Sometimes these sites are only represented by a few stone tools and fragments of bone. The Southern Drakensberg was occupied by hunter-gatherers before 10 000 BP (Opperman 1987) but was subsequently abandoned in the Holocene after ca. 6 000 BP, only to be re-occupied by 3 000 BP (Tusenius 1989). Ecological evidence suggests that the southern Drakensberg may have been too dry to support the animals and plants needed for the existence of hunter-gatherer people between 6 000 and some time before 3 000 BP (Tusenius 1989). The north-eastern Cape forms a link between the better watered eastern half of South Africa and the drier west. The wettest conditions apparently existed around 2700 BP, probably correlating with an increase in human occupation in the Southern Drakensberg following the possible abandonment of that area during the dry phase(s) of preceding millennia (Rosen et al. 1999). The succession of stone artefact Industries within the LSA of the Drakensberg region of the north-eastern Cape demonstrates that the resources of this area, which is characterized by a steep ecological gradient, were consistently exploited throughout end Pleistocene and Holocene following the amelioration of conditions after the cold maximum of

the Late Pleistocene. The culture stratigraphic sequence if very comparable to that recorded in Lesotho, the middle Orange River basin and the southern and Eastern Cape (Opperman 1982). Bonawe (Opperman 1982) is a rock shelter situated below the escarpment about 7 km west of the town of Elliot. The site has been radiocarbon dated to 8 040 +- 100 B.P. and contained end-Pleistocene and Holocene material. Te Vrede is also a rock shelter situated below the escarpment near Ugie and was dated to 10 000 +-120 B.P. and 8 100 +-80 Pta-3204, containing end Pleistocene and Holocene material (Opperman 1982). The sites of Colwinton, Ravenscraig, Prospect and Wartrail occur above the escarpment within the Barkly East District north of the proposed area for development. Colwinton Rock Shelter contained end Pleistocene and Holocene material including faunal remains, stone artefacts and pottery (Opperman 1982). The stone tool analysis reveals a sequence of three industries in cultural sequence of the southern and eastern Cape, Lesotho and Middle Orange River).

3.2.2 The Later Stone Age (LSA) and Rock Art

The Late Stone Age commenced twenty thousand years ago or somewhat earlier. The various types of Later Stone Age industries scattered across the country are associated with the historical San and Khoi-Khoi people. The San were renowned as formidable hunter-gatherers, while the Khoi-Khoi herded cattle and small stock during the last two thousand years. Late Stone Age people manufactured tools that were small but highly effective, such as arrow heads and knives. Later Stone Age (LSA) sites occur both at the coast and inland as caves deposits, rock shelters, open sites and shell deposits. The majority of LSA archaeological sites in the Eastern Cape area would date from the past 10 000 years where San hunter-gatherers inhabited the landscape living in rock shelters and caves as well as on the open landscape. These latter sites are difficult to find because they are in the open veld and often covered by vegetation and sand. Sometimes these sites are only represented by a few stone tools and fragments of bone. The Southern Drakensberg was occupied by hunter-gatherers before 10 000 BP (Opperman 1987) but was subsequently abandoned in the Holocene after ca. 6 000 BP, only to be re-occupied by 3 000 BP (Tusenius 1989). Ecological evidence suggests that the southern Drakensberg may have been too dry to support the animals and plants needed for the existence of hunter-gatherer people between 6 000 and some time before 3 000 BP (Tusenius 1989). The north-eastern Cape forms a link between the better watered eastern half of South Africa and the drier west. The wettest conditions apparently existed around 2700 BP, probably correlating with an increase in human occupation in the Southern Drakensberg following the possible abandonment of that area during the dry phase(s) of preceding millennia (Rosen et al. 1999). The succession of stone artefact Industries within the LSA of the Drakensberg region of the north-eastern Cape demonstrates that the resources of this area, which is characterized by a steep ecological gradient, were consistently exploited throughout end Pleistocene and Holocene following the amelioration of conditions after the cold maximum of the Late Pleistocene. The culture stratigraphic sequence if very comparable to that recorded in Lesotho, the middle Orange River basin and the southern and Eastern Cape (Opperman 1982). The renowned San rock paintings of the Drakensberg region also belongs to the LSA period- although the majority were made between 4000 years ago and about 120 years ago. Rock Art can be in the form of rock paintings or rock engravings. Rock paintings occur on the walls of caves and rock shelters across southern Africa and are prolific in the Southern Drakensberg, north-eastern Cape extending the entire Drakensberg range into KwaZulu-Natal and Lesotho. Rock engravings are limited to the Karoo and Northern Cape Regions and do not generally occur within the north Eastern Cape region and former Transkei region. Rock art research within the Southern Drakensberg has been conducted by several researchers and students from the Rock Art Research Institute, University of the Witwatersrand, over a period of 25 years, with a well-established database of site from Maclear, Tsolo, Mthatha, Ugie, Dordrecht and the wider region and extent of the Drakensberg range and Maluti Mountains.

3.2.3 Pastoralism in the Eastern Cape

As noted above, Khoekhoe pastoralists or herders entered southern Africa about 2000 years ago, with domestic animals such as fat-tailed sheep and goats, travelling through the south towards the coast. Their economic

systems were directed by the accumulation of wealth in domestic stock numbers and their political make-up was more hierarchical than that of the hunter-gatherers. The most significant Khoekhoe pastoralist sites in the Eastern Cape include Scott'sCave near Patensie (Deacon 1967), Goedgeloof shell midden along the St. Francis coast (Binneman 2007) and Oakleigh rock shelter near Queenstown (Derricourt 1977). Often, these archaeological sites are found close to the banks of large streams and rivers. Little detailed pastoralist research has been conducted in the Mthatha area).

3.2.4 Iron Age / Farmer Period

The beginnings of the Iron Age (Farmer Period) in Southern Africa are associated with the arrival of a new Bantu speaking population group at around the third century AD. These newcomers introduced a new way of life into areas that were occupied by Later Stone Age hunter-gatherers and Khoekhoe herders. Distinctive features of the Iron Age are a settled village life, food production (agriculture and animal husbandry), metallurgy (the mining, smelting and working of iron, copper and gold) and the manufacture of pottery. Iron Age people moved into Southern Africa by c. AD 200, entering the area either by moving down the coastal plains, or by using a more central route. From the coast they followed the various rivers inland. Being cultivators, they preferred rich alluvial soils. The Iron Age can be divided into three phases. The Early Iron Age includes the majority of the first millennium A.D. and is characterised by traditions such as Happy Rest and Silver Leaves. The Middle Iron Age spans the 10th to the 13th Centuries A.D. and includes such well known cultures as those at K2 and Mapungubwe. The Late Iron Age is taken to stretch from the 14th Century up to the colonial period and includes traditions such as Icon and Letaba.

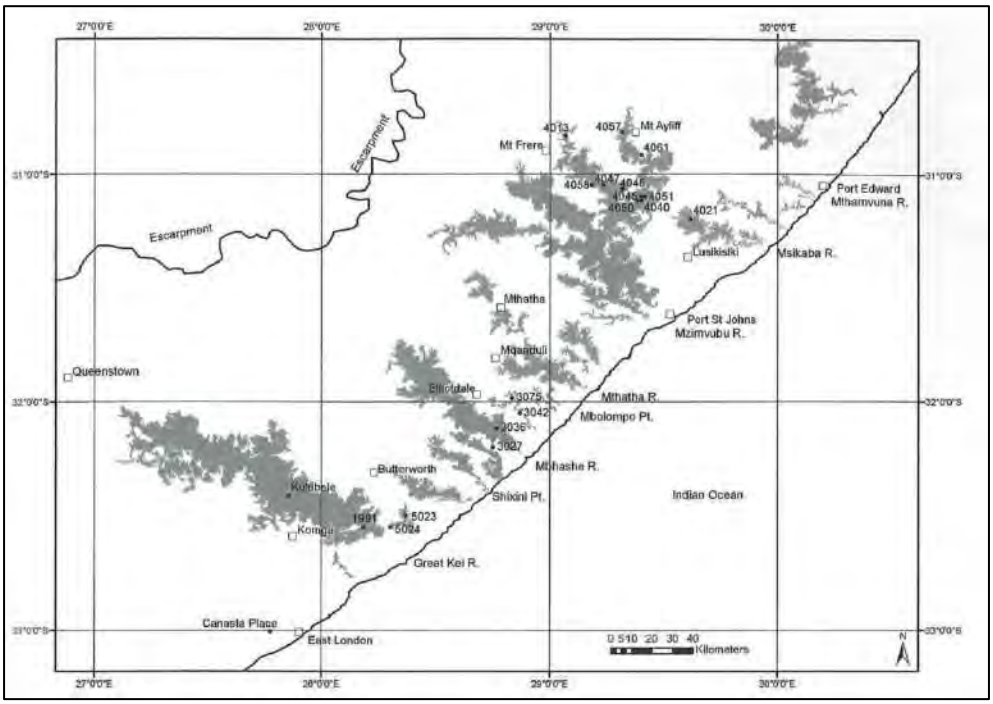

Figure 3-2: Early Iron Age farmer period sites in the Eastern Cape around Mthahta (after Feely & Bell-Cross 2011).

Even though much research has been conducted on the Iron Age (IA) across southern Africa, only a small portion has focused on the Eastern Cape. A few important Eastern Cape Early Iron Age Sites (EIA) sites include Kulubele situated in the Kei River Valley near Khomga (Binneman 1996), Ntsitsana situated in the interior Transkei, 70 km west of the coast, along the Mzimvubu River (Prins & Granger 1993), and Canasta Place situated on the west bank of the Buffalo River (Nogwaza 1994). Previous investigations into the EIA in the Transkei and Ciskei include work at Buffalo River Mouth (Wells 1934; Laidler 1935), at Chalumna River Mouth

(Derricourt 1977) and additional research by Feely (1987) and Prins (1989). The first EIA farming communities during the first millennium AD preferred to occupy river valleys within the eastern half of southern Africa owing to the summer-rainfall climate that was conducive for growing millet and sorghum. The closest documented and well-researched Early Iron Age site, to Elliot is located within the Great Kei River Valley. The site is situated some 200 m below the plateau and 60 km inland from the coast, within the borders of the Transkei, approximately 100 km up the coast towards Durban. There has in the past been some speculation that Early Iron Age populations may have spread well south of the Transkei into the Ciskei, possibly up to the Great Fish River (Binneman et al. 1992), however, no further research has been undertaken to confirm these statements. A closer Early Iron Age site has been documented to the south of East London (Cronin 1982). Thicker and decorated pottery sherds, kraals, possible remains of domesticated animals, upper and lower grindstones and storage pits are associated for identifying EIA sites. The sites are generally large settlements, but the archaeological visibility may in most cases be difficult owing to the organic nature of the homesteads. Metal and iron implements are also associated with EIA communities.

The Later Iron Age (LIA) is not only distinguished from the EIA by greater regional diversity of pottery styles but is also marked by extensive stone wall settlements. LIA sites in the Eastern Cape Province occur adjacent to the major rivers in low lying river valleys but also along ridge crests above the 800m contour. The LIA in the project area can be ascribed to the Mpondomise, Thembu, and Xhosa tribal clusters or their immediate predecessors (Feely 1987). It is also possible that some stone walled sites, especially those incorporating shelters or caves, were constructed by hybrid San/Nguni groups. Trade played a major role in the economy of LIA societies. Goods were traded locally and over long distances. The main trade goods included metal, salt, grain, cattle and thatch. This led to the establishment of economically driven centres and the growth of trade wealth. Keeping of domestic animals, metal work and the cultivation of crops continued with a change in the organisation of economic activities (Maggs, 1989; Huffman 2007). Hilltop settlements are mainly associated with LIA settlement patterns that occurred during the second millennium AD. Later Iron Age settlements have been formally recorded by the Albany Museum and cover a relatively extended area in comparison with the Early Iron Age settlement patterns. With the exception of the Tembu, stone buildings which characterizes the Iron Age sites of Sotho areas, is absent in the Transkei and Ciskei, and a pattern of some mobility without, it is presumed, a stone working technology of significance, makes the allocation of sites a major problem (Derricourt 1973).

3.2.5 Later History: Reorganization, Colonial Contact and living heritage

The Eastern Cape region is typically viewed by historians as a frontier zone. This area was the meeting place between an aggressively expanding colonial frontier and the southernmost distribution of black Bantu-speaking farming communities in Africa (Huffman 2007). It is well known in the historical literature for the nine frontier wars that were fought here between the settlers of the Cape colony and the Xhosa nation between 1779 and 1879 (see below). Whereas white colonial settlement expanded north and eastwards from Table Bay, in modern Cape Town, some 350 years ago Bantu-speaking agro pastoralists, the predecessors of the Xhosa nation, inhabited areas to the east of the Sundays river already since 1300 years ago (Binneman et al 1992). For many centuries their movement further west and south were hindered by a climatic frontier that prevented these small-scale subsistence farmers from cultivating summer-rainfall crops, such as millet and sorghum, their main source of food. Adding to climatic constraints, the first Bantu speaking pioneers encountered other indigenous population groups in these more marginal areas as did colonial agents many centuries later. These were the Khoisan - the direct descendants of the first modern people to have emerged in Africa some 200 000 years ago. These people had from the time of van Riebeeck become popularly known as the San or Bushmen and Khoekhoen or Hottentots. Whereas the Khoekhoen typically lived closer to the coastal areas where they could find adequate grazing for their cattle and sheep the San hunter-gatherers lived further inland in areas not favoured by either Khoekhoen pastoralists or

Bantu-speaking agropastoralists. Nevertheless, the Eastern Cape became the contact zone between these different cultures both in the historical and prehistoric past.

By the closing decades of the 18th century, South Africa had fallen into two broad regions: west and east. Colonial settlement dominated the west, including the winter rainfall region around the Cape of Good Hope, the coastal hinterland northward toward the present-day border with Namibia, and the dry lands of the interior.

Trekboers moved into, and occupied Khoekhoe and remnant hunter-gatherer land. Indigenous farmers controlled both the coastal and valley lowlands and the Highveld of the interior in the east, where summer rainfall and good grazing made mixed farming economies possible A large group of British settlers arrived in the eastern Cape in 1820; this, together with a high European birth rate and wasteful land usage, produced an acute land shortage, which was alleviated only when the British acquired more land through massive military intervention against Africans on the eastern frontier. Until the 1840s the British vision of the colony did not include African citizens and most of these groups were expelled across the Great Fish River, the unilaterally proclaimed eastern border of the colony. The first step in this process included attacks in 1811–12 by the British army on the Xhosa groups, the Gqunukhwebe and Ndlambe. An attack by the Rharhabe-Xhosa on Graham's Town in 1819 provided the pretext for the annexation of more African territory, to the Keiskamma River. Various Rharhabe-Xhosa groups were driven from their lands throughout the early 1830s. They counterattacked in December 1834, and Governor Benjamin D'Urban ordered a major invasion the following year, during which thousands of Rharhabe-Xhosa died. The British crossed the Great Kei River and ravaged territory of the Gcaleka-Xhosa as well; the Gcaleka chief, Hintsa, invited to hold discussions with British military officials, was held hostage and died trying to escape. The British colonial secretary, Lord Glenelg, who disapproved of D'Urban's policy, halted the seizure of all African land east of the Great Kei. D'Urban's initial attempt to rule conquered Africans with European magistrates and soldiers was overturned by Glenelg; instead, for a time, Africans east of the Keiskamma retained their autonomy and dealt with the colony through diplomatic agents However, after further fighting with the Rharhabe-Xhosa on the eastern frontier in 1846, Governor Colonel Harry Smith finally annexed, over the next two years, not only the region between the Great Fish and the Great Kei rivers (establishing British Kaffraria) but also a large area between the Orange and Vaal rivers, thus establishing the Orange River Sovereignty. These moves provoked further warfare in 1851–53 with the Xhosa (joined once more by many Khoe), with a few British politicians ineffectively trying to influence events. Between 1811 and 1858 colonial aggression deprived Africans of most of their land between the Sundays and Great Kei rivers and produced poverty and despair. From the mid-1850s British magistrates held political power in British Kaffraria, destroying the power of the Xhosa chiefs. Following a severe lung sickness epidemic among their cattle in 1854–56 the Xhosa killed many of their remaining cattle and in 1857–58 grew few crops in response to a millenarian prophecy that this would cause their ancestors to rise from the dead and destroy the whites. Many thousands of Xhosa starved to death, and large numbers of survivors were driven into the Cape Colony to work. British Kaffraria fused with the Cape Colony in 1865, and thousands of Africans newly defined as Fingo resettled east of the Great Kei, thereby creating Fingoland. The Transkei, as this region came to be known, consisted of the hilly country between the Cape and Natal. It became a large African reserve and grew in size when those parts that were still independent were annexed in the 1880s and '90s.

The first Europeans in the area would have been the 'trekboers' looking for grazing for their cattle. It is known that these farmers were moving around in the area for 20 to 30 years before the first settlements were founded. Aliwal North was founded in 1849 to be the magisterial centre of the new Albert District, which was proclaimed in 1848 (le Roux et al 2008). Aliwal North was located within the Buffelsvlei division of the Albert District. The town of Lady Grey, south-east of Sterkspruit was established on the farm Waaihoek,

purchased by the Dutch Reformed Church of Aliwal North on 30 April 1857 for the purpose of founding a new congregation. It was named in honour of Eliza Lucy Grey (née Spencer), daughter of Sir Richard Spencer, and wife of Sir George Grey the Cape governor. The first municipality of Lady Grey was proclaimed in 1893.

4 METHOD OF ENQUIRY

4.1 Sources of Information

Data from detailed desktop, aerial and field studies were employed in order to sample surface areas systematically and to ensure a high probability of heritage site recording.

4.1.1 Desktop Study

The larger landscape around Sterkspruit has not been well documented in terms of its archaeology and history but available academic papers and research articles supplied a historical context for the proposed project and archival sources, aerial photographs, historical maps and local histories were used to create a baseline of the landscape's heritage. In addition, the study drew on available unpublished Heritage Assessment reports to give a comprehensive representation of known sites in the study area.

4.1.2 Aerial Survey

Aerial photography is often employed to locate and study archaeological sites, particularly where larger scale area surveys are performed. This method was applied to assist the foot and automotive site surveys where depressions, variation in vegetation, soil marks and landmarks were examined. Specific attention was given to shadow sites (shadows of walls or earthworks which are visible early or late in the day), crop mark sites (crop mark sites are visible because disturbances beneath crops cause variations in their height, vigour and type) and soil marks (e.g., differently coloured or textured soil (soil marks) might indicate ploughed-out burial mounds). Attention was also given to moisture differences, as prolonged dampening of soil as a result of precipitation frequently occurs over walls or embankments. In addition, historical aerial photos obtained during the archival search were scrutinized and features that were regarded as important in terms of heritage value were identified and if they were located within the boundaries of the project area, they were physically visited in an effort to determine whether they still exist and in order to assess their current condition and significance. By superimposing high frequency aerial photographs with images generated with Google Earth as well as historical aerial imagery, potential sensitive areas were subsequently identified and geo-referenced. These areas served as referenced points from where further vehicular and pedestrian surveys were carried out.

4.1.3 Mapping of sites

Merging data generated during the desktop study and the aerial survey, the project area was plotted on historical and more recent 1:50 000 topographic maps of the Sterkspruit area. These maps were then superimposed on high-definition aerial representations in order to graphically demonstrate the geographical locations and distribution of potentially sensitive landscapes.

4.1.4 Field Survey

Archaeological survey implies the systematic procedure of the identification of archaeological sites. An archaeological survey of the project alignments, routes and impact areas was conducted in November 2021. The process encompassed a systematic field survey in accordance with standard archaeological practice by which heritage resources are observed and documented. In order to sample surface areas systematically and to ensure a high probability of site recording, the project areas were systematically surveyed on foot where

pipeline alignments and reservoir locations were investigated. GPS reference points identified during the aerial survey were also visited and random spot checks were made (see detail in previous section). Using a Garmin Montana GPS objects and structures of archaeological / heritage value were recorded and photographed with a Samsung Digital camera. Real time aerial orientation, by means of a mobile Google Earth application was also employed to investigate possible disturbed areas during the survey.

4.2 Limitations

The site survey for the Senqu Rural Water Supply Project AIA primarily focused around areas tentatively identified as sensitive and of high heritage probability (i.e., those noted during the mapping and aerial survey) as well as areas of potential high human settlement catchment In terms of on-site limitations during the survey, the following should be noted:

- The project areas subject to this assessment are accessed via local roads connecting to the R56 road. Access control is not applied to the areas relevant to this assessment and no restrictions were encountered during the site visit.
- The surrounding vegetation in the study area landscape is mostly comprised out of mixed grasslands and scattered trees in areas that has largely been transformed by human settlement and farming activities where pioneering species occur in places. The general visibility at the time of the site inspection (November 2021) proved to be a minor constraint in the project area.

Cognisant of the constraints noted above, it should be stated that the possibility exists that individual sites could be missed due to the localised nature of some heritage remains as well as the possible presence of sub-surface archaeology. Therefore, maintaining due cognisance of the integrity and accuracy of the archaeological survey, it should be stated that the heritage resources identified during the study do not necessarily represent all the heritage resources present in the project area. The subterranean nature of some archaeological sites, dense vegetation cover and visibility constraints sometimes distort heritage representations and any additional heritage resources located during consequent development phases must be reported to the Heritage Resources Authority or an archaeological specialist.

Figure 3-1: View of the Jozanas Hoek dam at the southern offset of the project area.

Figure 3-2: View of the river valley in the Qoboshane area.

Figure 3-3: View of the Kgampasi project area, looking east.

Figure 3-4: View of a section of the Jozanas Nek project area, looking north.

Figure 3-5: View of an access road in the Magadla project area.

Figure 3-6: View of old water pipeline infrastructure in the Litsheng area.

Figure 3-7: View of the Makheteng project area to the south.

Figure 3-8: View of the Enteni Village project area to the west.

Figure 3-9: General surroundings in the Sterkspruit project area, looking north.

Figure 3-10: View of general surroundings in the Sterkspruit CBD.

Figure 3-11: View of general surroundings in the Maralaneng project area.

4.3 Impact Assessment

For consistency among specialists, impacts were rated and assessed using an Impact and Risk Assessment Methodology provided by CES[1], for the Scoping Phase of the EIA process in accordance with the requirement of EIA Regulations. **Please refer to Section 6 and Addendum 2**.

5 RESULTS: OFF-SITE DESKTOP AND ARCHAEOLOGICAL SITE SURVEYS

5.1 The Off-Site Desktop Survey

The history and archaeology of the larger Eastern Cape Province is relatively well known but in the larger Sterkspruit region little systematic archaeological research has been conducted and, as such the heritage landscape is somewhat of an enigma. In terms of heritage resources, the archaeological landscape surrounding the project area is primarily well known for the occurrence of Iron Age farmer sites and Colonial remnants. However, no particular reference to archaeological sites or features of heritage potential were recorded during an examination of literature thematically or geographically related to the project area. A careful analysis of historical aerial imagery and an archive map of areas subject to this assessment indicate a landscape which has been transformed over centuries by human activity relating to agriculture and settlement. These sources indicate a relatively densely populated region heavily relying on historical agriculture and livestock farming.

An analysis of historical aerial imagery and archive maps reveals the following (see Figure 5-1 to Figure 5-6):

- Large numbers of settlements, delineated by so-called “huts”, are indicated on topographic maps of the area dating to 1960. The map infers intensive agriculture and human settlement in the Sterkspruit area during the last century.
- Van Warmelo (1935) indicates a number of Hlubi and Thembu Sotho groups residing in and around Sterkspruit and the project area in 1935.
- Sterkspruit appears on the South African War, 1899-1902 Maps of Rouxville (1900) as well as a map of the Zastron Region compiled by the Cape of Good Hope in 1909.

[1] CES Risk Assessment Methodologies Internal guideline document, 2019

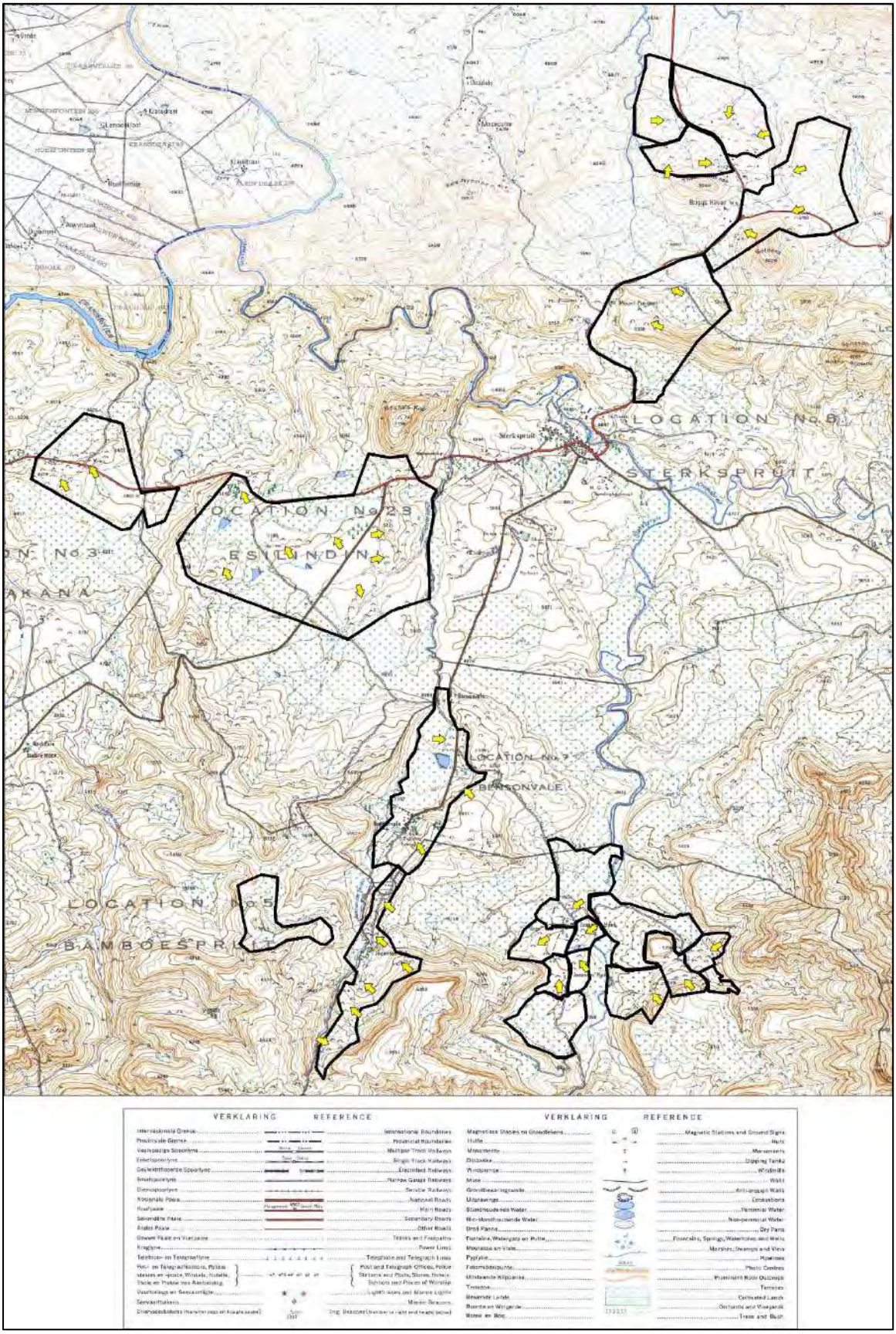

Figure 5-1: A historical topographic map of the Sterkspruit area dating to 1960 indicating the location of the project alignments (black outlines) in the past decades. The yellow arrows indicate settlements and man-made structures within the project area at the time.

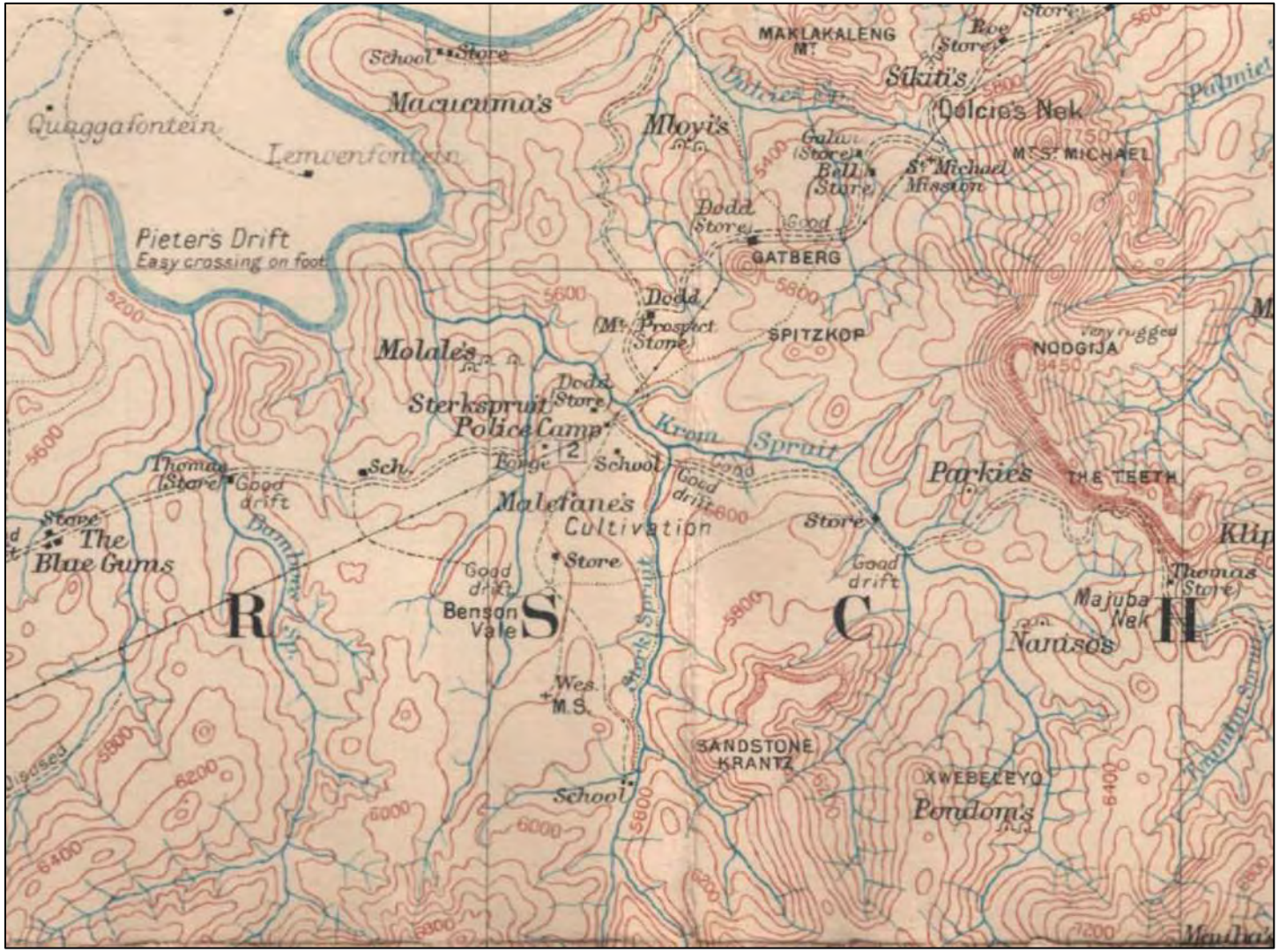

Figure 5-2: An excerpt of the South African War, 1899-1902 Maps of Rouxville (1900) – note the presence of Sterkspruit.

Figure 5-3: An excerpt of a map of the Zastron Region compiled by the Cape of Good Hope in 1909 of Sterkspruit.

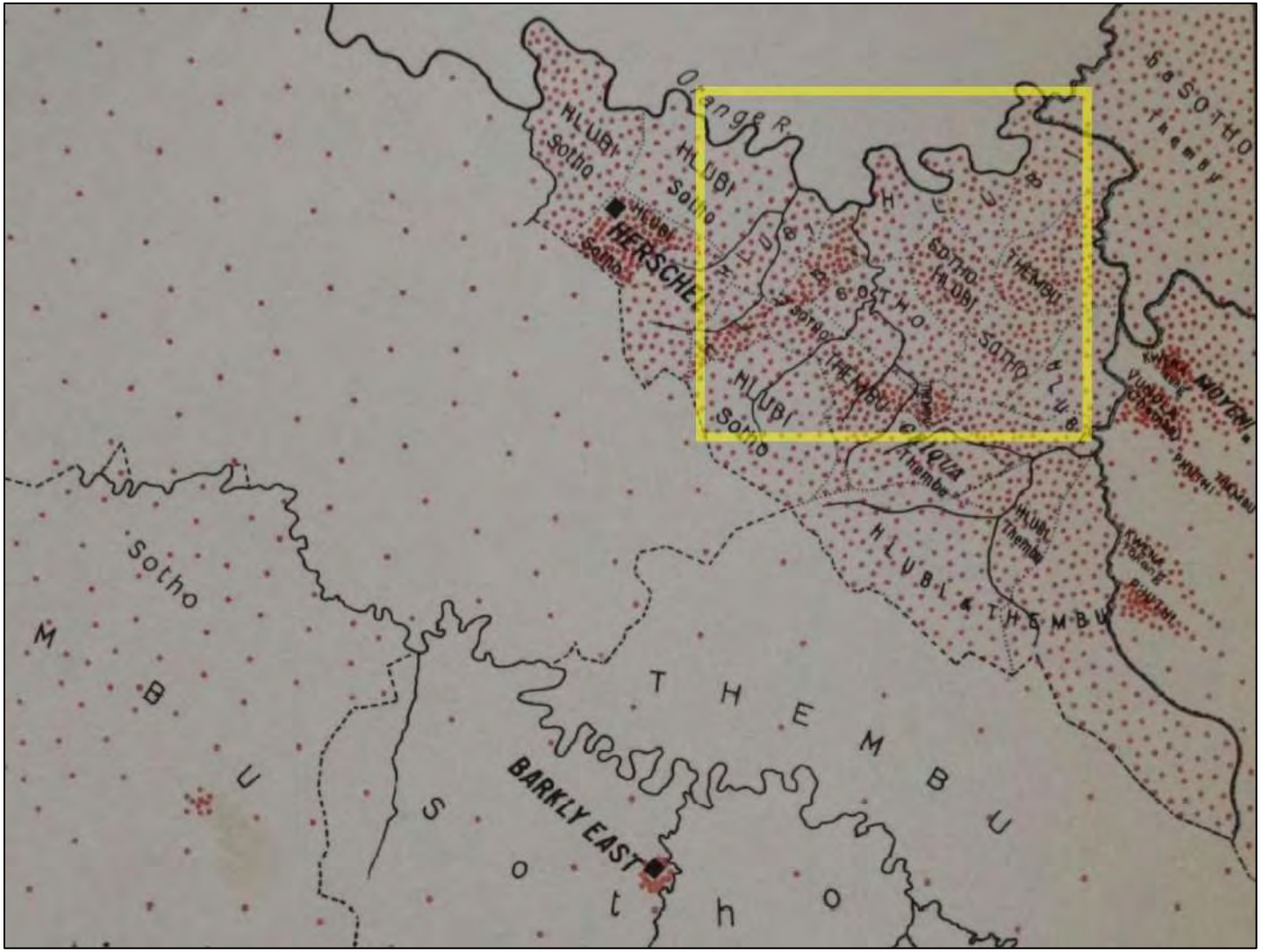

Figure 5-3: An excerpt of Van Warmelo's Map of the project landscape dating to 1935. Each red dot represents "10 taxpayers". Note that the project area was densely populated by a number of Hlubi and Thembu Sotho groups residing in and around Sterkspruit and the project area in 1935.

5.2 The Archaeological Site Survey

Features and structures possibly dating to the Historical Period were identified in close proximity of the pipeline routes in the study areas. Even though temporal contexts for the structures could not be ascertained, it might be assumed that, generally the features probably date to the early to mid-20th century.

These inferences are based on the following observations:

- Even though of low quality and resolution, aerial imagery dating to the first part of the 20th century suggests that the structures were present in the landscape in the early 1900's.
- As a general rule, southern African Iron Age farming communities constructed irregular circular stock enclosures. Squarely built enclosures only appear consequent to Colonial contact, which implies that cattle kraals identified in the villages did not belong to Iron Age stock farmers, but rather later more recent family units.

The close proximity of many of the features to other similar homesteads currently in use, might suggest that these sites were occupied during early phases of the same occupational period of current homesteads in the area.

5.2.1 Rooisand, Maralaneng and Makojong Villages

a. Historical Period Sites

- **EXIGO-MAR-HP01** -30.47253865 27.39388171
  Field Rating: 4b High Significance

The remains of a sandstone dwelling were documented in the Maralaneng settlement. At the site, the partially collapsed remains of a square building with sandstone walls which are plastered up in the interior occur at an old homestead. A clear temporal context for the structures is not known but the site might be older than 60 years. Material culture such as glass, metal and plastic were observed in association with the building. The feature, which is of low heritage significance due to its poor preservation and loss of historical context, occurs in close proximity of the water pipeline alignment and peripheral impact on the site is anticipated.

Figure 5-4: View of a stone dwelling at Site EXIGO-MAR-HP01.

- **EXIGO-MAR-HP02** -30.47769302 27.40090356
  Field Rating: 4b High Significance

The remains of another sandstone dwelling were documented in the Maralaneng settlement. Here, the partially collapsed remains of a square building with sandstone walls which are plastered up in the interior occur in an open field. A clear temporal context for the structures is not known but the site might be older than 60 years. Material culture such as glass, metal and plastic were observed in association with the building. The feature, which is of low heritage significance due to its poor preservation and loss of historical context, occurs in close proximity of the water pipeline alignment and peripheral impact on the site is anticipated.

Figure 5-5: View of a stone dwelling at Site EXIGO-MAR-HP02.

b. Burial Sites

- **EXIGO-RS-BP01** -30.47184085 27.3817862
  Field Rating: 4b High Significance

At least 4 graves were noted next to homesteads in the Rooisand area. Two of the graves are indicated by rough elongated stone cairns filled in with soil two other burials were recently redressed with brick grave dressings. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-6: View of a burial at Site EXIGO-RS-BP01.

- **EXIGO-RS-BP02** -30.47345806 27.38273352
  Field Rating: 4b High Significance

A cemetery containing a number of graves occurs in an open field in Rooisand. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. Some of the graves are enclosed in iron fences and palisades but the site is generally not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-7: View of a burial at Site EXIGO-RS-BP02.

- **EXIGO-MAR-BP01** -30.47270763 27.39332071
  Field Rating: 4b High Significance

At least 4 graves were noted near homesteads in the Maralaneng area. The graves are indicated by soil mounds with rocks as headstones and covered with surface grass. The site is not maintained and the condition of the burials is poor. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-8: View of a burial at Site EXIGO-MAR-BP01.

- **EXIGO-MAR-BP02** -30.47117894 27.39569832
  Field Rating: 4b High Significance

A single grave occurs within a homestead complex in Maralaneng. The grave is indicated by marble slab grave dressing with marble headstones enclosed in a fence. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-9: View of a burial at Site EXIGO-MAR-BP02.

- **EXIGO-MAR-BP03** -30.47175318 27.39800862
  Field Rating: 4b High Significance

At least 4 graves were noted within a homestead complex in the Maralaneng area. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. The site is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-10: View of a burial at Site EXIGO-MAR-BP03.

- **EXIGO-MAR-BP04** -30.47268441 27.39592957
  Field Rating: 4b High Significance

Two graves were noted in an open field next to a homestead in the Maralaneng area. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. The site is not maintained and the condition of the burials is poor. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-11: View of a burial at Site EXIGO-MAR-BP04.

- **EXIGO-MAR-BP05** -30.47510527 27.39672602
  Field Rating: 4b High Significance

A family cemetery containing a number of occurs near a homestead complex in Maralaneng. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-12: View of a burial at Site EXIGO-MAR-BP05.

- **EXIGO-MAR-BP06** -30.4762919 27.39760168
  Field Rating: 4b High Significance

At least 5 graves were noted in an open field in the Maralaneng area. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. The site is not maintained and the

condition of the burials is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-13: View of a burial at Site EXIGO-MAR-BP06.

- **EXIGO-MAK-BP01** -30.47612853 27.38865023
  Field Rating: 4b High Significance

A single grave occurs in an open fields among Sisal Trees in Makojong. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-14: View of a burial at Site EXIGO-MAK-BP01.

- **EXIGO-MAK-BP02** -30.47772411 27.39292139
  Field Rating: 4b High Significance

At least 3 graves were noted in a homesteads complex in the Makojong area. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. The site is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-15: View of a burial at Site EXIGO-MAK-BP02.

5.2.2 Enteni and Makheteng Villages

a. Burial Sites

- **EXIGO-ENT-BP01** -30.4829851 27.41074551
  Field Rating: 4b High Significance

A family cemetery containing a large number of graves occurs in an open field in Enteni. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-16: View of a burial at Site EXIGO-ENT-BP01.

- **EXIGO-ENT-BP02** -30.49189053 27.39555323
  Field Rating: 4b High Significance

Another family cemetery containing a large number of occurs near a homestead complex in Enteni. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. Some of the burials are enclosed in fences and the site seems to be maintained, the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-17: View of a burial at Site EXIGO-ENT-BP02.

- **EXIGO-MTN-BP01** -30.49805492 27.38331263
  Field Rating: 4b High Significance

A double grave was noted in a homestead complex in the Makheteng area. The grave is indicated by a brick base covered with a marble slap and engraves marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-18: View of a burial at Site EXIGO-MTN-BP01.

- **EXIGO-MTN-BP02** -30.49884165 27.38173893
  Field Rating: 4b High Significance

A single grave occurs in an open field in Makheteng. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-19: View of a burial at Site EXIGO-MTN-BP02.

- **EXIGO-MTN-BP03** -30.50260546 27.38648082
  Field Rating: 4b High Significance

Another single grave was noted in an open field in the Makheteng area. The grave is indicated by rough elongated stone cairn filled in with soil and covered with surface grass. The site is not maintained and the condition of the burial is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burial should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-20: View of a burial at Site EXIGO-MTN-BP03.

- **EXIGO-MTN-BP04** -30.51341183 27.38584623
  Field Rating: 4b High Significance

A single grave occurs in a homestead complex Makheteng. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and

a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-21: View of a burial at Site EXIGO-MTN-BP04.

- **EXIGO-MTN-BP05** -30.51487975 27.38292153
  Field Rating: 4b High Significance

At least 4 graves were noted in homestead complex in the Makheteng area. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. The site is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-22: View of a burial at Site EXIGO-MTN-BP05.

- **EXIGO-MTN-BP06** -30.5151882 27.38261299
  Field Rating: 4b High Significance

A single grave occurs in a homestead complex Makheteng. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and

a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-23: View of a burial at Site EXIGO-MTN-BP06.

5.2.3 Esilindile and Bamboespruit Villages

a. Burial Sites

- **EXIGO-ES-BP01** -30.53331541 27.3385272
  Field Rating: 4b High Significance

A family cemetery containing a large number of graves occurs in an open field in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-24: View of a burial at Site EXIGO-ES-BP01.

- **EXIGO-ES-BP02** -30.53513948 27.33735172
  Field Rating: 4b High Significance

At least 3 graves were noted within a homestead complex in the Esilindile area. The graves are indicated by rough elongated stone cairns filled in with stones and covered with surface grass. The site is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-25: View of a burial at Site EXIGO-ES-BP02.

- **EXIGO-ES-BP03** -30.53595621 27.33727654
  Field Rating: 4b High Significance

A family cemetery containing at least 6 graves occurs in an open field next to a road in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. Single graves are enclosed in a fences but the site is not maintained and the

condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-26: View of a burial at Site EXIGO-ES-BP03.

- **EXIGO-ES-BP04** -30.5380128 27.33691779
  Field Rating: 4b High Significance

A cemetery containing a large amount graves occurs near homesteads in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is enclosed in a fence, it seems to be maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-27: View of a burial at Site EXIGO-ES-BP04.

- **EXIGO-ES-BP05** -30.54147829 27.3347473
  Field Rating: 4b High Significance

Another single grave was noted in a homestead complex in the Esilindile area. The grave is indicated by rough elongated stone cairn filled in with soil and covered with surface grass. The site is not maintained and the condition of the burial is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burial should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-28: View of a burial at Site EXIGO-ES-BP05.

- **EXIGO-ES-BP06** -30.53787366 27.33990619
  Field Rating: 4b High Significance

A small family cemetery containing at least 4 graves occurs in a homestead complex in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-29: View of a burial at Site EXIGO-ES-BP06.

- **EXIGO-ES-BP07** -30.5379553 27.33993159
  Field Rating: 4b High Significance

At least 4 graves were noted in an open field in the Esilindile area. The graves are indicated by marble slabs, and engrave marble headstones. The site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-30: View of a burial at Site EXIGO-ES-BP07.

- **EXIGO-ES-BP08** -30.53936069 27.34088553
  Field Rating: 4b High Significance

A single grave occurs behind a homestead complex Esilindile. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-31: View of a burial at Site EXIGO-ES-BP08.

- **EXIGO-ES-BP09** -30.5400304 27.34120823
  Field Rating: 4b High Significance

Another single grave occurs in an open field in Esilindile. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-32: View of a burial at Site EXIGO-ES-BP09.

- **EXIGO-ES-BP10** -30.54130211 27.34155273
  Field Rating: 4b High Significance

A cemetery containing at least 8 graves occurs near homestead complexes in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones and other graves are indicated by elongated stone mounds covered with soil. Some burials are enclosed in fences but the site is not maintained

and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-33: View of a burial at Site EXIGO-ES-BP10.

- **EXIGO-ES-BP11** -30.54139037 27.34149414
  Field Rating: 4b High Significance

A family cemetery containing a number of graves, occurs near a homestead complex in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-34: View of a burial at Site EXIGO-ES-BP11.

- **EXIGO-ES-BP12** -30.54375339 27.3402729
  Field Rating: 4b High Significance

A double grave was noted in a homestead complex in the Esilindile area. The grave is indicated a brick base covered with a marble slab and engraved marble headstone. The site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-35: View of a burial at Site EXIGO-ES-BP12.

- **EXIGO-ES-BP13** -30.54372003 27.34002999
  Field Rating: 4b High Significance

A family cemetery containing a number of graves occurs near a homestead complex in Esilindile . Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-36: View of a burial at Site EXIGO-ES-BP13.

- **EXIGO-ES-BP14** -30.54835062 27.30628395
  Field Rating: 4b High Significance

A single grave occurs in crop field in Esilindile. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-37: View of a burial at Site EXIGO-ES-BP14.

- **EXIGO-ES-BP15** -30.54591668 27.31014775
  Field Rating: 4b High Significance

Another single grave occurs in a homestead complex in Esilindile. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-38: View of a burial at Site EXIGO-ES-BP15.

- **EXIGO-ES-BP16** -30.53467747 27.3118673
  Field Rating: 4b High Significance

A large family cemetery occurs in an open field in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-39: View of a burial at Site EXIGO-ES-BP16.

- **EXIGO-ES-BP17** -30.53499464 27.31194005
  Field Rating: 4b High Significance

A vast cemetery occurs along a road in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is

not enclosed in a fence, it is not maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-40: View of a burial at Site EXIGO-ES-BP17.

- **EXIGO-ES-BP18** -30.53533377 27.31473098
  Field Rating: 4b High Significance

Another large cemetery occurs in an open field in Esilindile. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-41: View of a burial at Site EXIGO-ES-BP18.

- **EXIGO-BB-BP01** -30.52843111 27.28647701
  Field Rating: 4b High Significance

A large cemetery containing a vast number of graves in an open field in Bamboespruit Village. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-42: View of a burial at Site EXIGO-BB-BP01.

- **EXIGO-BB-BP02** -30.52860495 27.27989092
  Field Rating: 4b High Significance

Another large cemetery occurs in an open field in Bamboespruit Village. Some of the graves are indicated by marble slab grave dressings with marble headstones, others are indicated by brick structures fashioned with ceramic tiles with brick headstones and other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-43: View of a burial at Site EXIGO-BB-BP02.

- **EXIGO-BB-BP03** -30.53216198 27.27854412
  Field Rating: 4b High Significance

A double grave was noted near homestead complexes in the Bamboespruit Village. The grave is indicated a brick base covered with a marble slab and engraved marble headstone. The site is maintained enclosed in a fence, the condition of the burials is good. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-44: View of a burial at Site EXIGO-BB-BP03.

- **EXIGO-BB-BP04** -30.53409643 27.28176889
  Field Rating: 4b High Significance

A family cemetery containing at least 14 graves, occurs near a homestead complex in Bamboespruit Village. One of the graves is indicated by a brick structures fashioned with ceramic tiles and the other graves are indicated by elongated stone mounds covered with soil. The site is not enclosed in a fence, it is not

maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-45: View of a burial at Site EXIGO-BB-BP04.

5.2.4 Bensonvale and Litsheng Villages

a. Historical Period Sites

- **EXIGO-BEN-HP01** -30.57984654 27.35609542
  Field Rating: 4b High Significance

The poorly preserved remains of a dwelling were documented in the Bensonvale Village. Here, single sections of stone walls with window remain of the dwelling. A clear temporal context for the structures is not known but the remains might be older than 60 years. No material culture was observed in association with the remains and the structures are not well preserved. The feature, which is of low heritage significance due to its poor preservation and loss of historical context, occurs in close proximity of the water pipeline alignment and peripheral impact on the site is anticipated.

Figure 5-46: View of the remains of a stone dwelling at Site EXIGO-BEN-HP01.

- **EXIGO-LIT-HP01** -30.59056297 27.34124931
  Field Rating: 4b High Significance

The remains of the so-called "Bensonvale Training School" occurs in the larger Litsheng Village area. Here, the remains of houses, classrooms, hostels as well as graves were noted. The remains might be older than 60 years and the site is generally of medium heritage significance. The site occurs away from the water pipeline alignment and no impact on the site is anticipated.

Figure 5-47: View of building remains at the old Bensonvale Training School at Site EXIGO-LIT-HP01.

b. Burial Sites

- **EXIGO-BEN-BP01** -30.57077816 27.3491008
  Field Rating: 4b High Significance

At least 4 graves were noted in an open field in the Bensonvale Village. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. The site is not maintained and the condition of the burials is poor. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively,

the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-48: View of a burial at Site EXIGO-BEN-BP01.

- **EXIGO-BEN-BP02** -30.57326985 27.35406498
  Field Rating: 4b High Significance

A double grave was noted next to a homestead complex in Bensonvale Village. The grave is indicated a brick base covered with a marble slab and engraved marble headstone. The site is enclosed in a fence, maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-49: View of a burial at Site EXIGO-BEN-BP02.

5.2.5 Magadla and Jozanas Nek Villages

a. Historical Period Sites

- **EXIGO-MAG-HP01** -30.60945762 27.32257971
  Field Rating: 4b High Significance

A partially intact stone rondavel was noted documented in the Magadla Village. The wall of the rondavel was constructed out of sandstone and material culture such as tin and glass were noted at the site. A clear temporal context for the structure is not known but the remains might be older than 60 years. The feature, which is of low heritage significance due to its poor preservation and loss of historical context, occurs in close proximity of the water pipeline alignment and peripheral impact on the site is anticipated.

Figure 5-50: View of the remains of a stone rondavel at Site EXIGO-MAG-HP01.

- **EXIGO-JN-HP01** -30.61342872 27.33474227
  Field Rating: 4b High Significance

A large sandstone building probably dating to the Historical period was documented in the Jozanas Nek Village. The rectangular building was constructed out of plastered and painted sandstone with a pitch roof and wooden doors and windows. The building is currently used a shop and liquor store for Jozanas Nek. A clear temporal context for the structures is not known but the building is probably older than 60 years. The feature, which is of medium-low heritage significance occurs in close proximity of the water pipeline alignment and peripheral impact on the site is anticipated.

Figure 5-51: View of a Historical Period building used as a store at Site EXIGO-JN-HP01.

- **EXIGO-JN-HP02** -30.62827944 27.32892154
  Field Rating: 4b High Significance

Two partially intact stone rondavels were noted documented in the Jozanas Nek Village. The walls of the rondavels were constructed out of sandstone and material culture such as tin and glass were noted at the site. A clear temporal context for the structures is not known but the remains might be older than 60 years. The features, which are of low heritage significance due to poor preservation and loss of historical context, occurs in close proximity of the water pipeline alignment and peripheral impact on the site is anticipated.

Figure 5-52: View of the remains of stone rondavels at Site EXIGO-JN-HP02.

b. Burial Sites

- **EXIGO-JN-BP01** -30.60692947 27.33594256
  Field Rating: 4b High Significance

A family cemetery containing at least 8 graves occurs on a small ridge in Jozanas Nek Village. Some of the graves are indicated by marble slab grave dressings with marble headstones and other graves are indicated by elongated stone mounds covered with soil. Many of the graves are enclosed in fences and the site is in a

fair state of conservation. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-53: View of a burial at Site EXIGO-JN-BP01.

- **EXIGO-JN-BP02** -30.61036547 27.33522875
  Field Rating: 4b High Significance

A small family cemetery containing an unknown number of graves, occurs near a homestead complex in Jozanas Nek Village. One of the graves is indicated by marble slab grave dressing with a marble headstones and the other graves are indicated by elongated soil mounds with crude headstones. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-54: View of a burial at Site EXIGO-JN-BP02.

- **EXIGO-JN-BP03** -30.6194004 27.33297042
  Field Rating: 4b High Significance

A small family cemetery containing at least 4 graves occurs in a homestead complex in Jozanas Nek Village. The graves are indicated by marble slab grave dressings with marble headstones. The site is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-55: View of a burial at Site EXIGO-JN-BP03.

- **EXIGO-JN-BP04** -30.62143587 27.33226868
  Field Rating: 4b High Significance

At least 3 graves were noted in an open field in the Jozanas Nek Village. Two of the graves are indicated by marble slab grave dressings with marble headstones and another is indicated by a rough elongated stone cairn filled in with soil. The site is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-56: View of a burial at Site EXIGO-JN-BP04.

- **EXIGO-JN-BP05** -30.62851556 27.32837034
  Field Rating: 4b High Significance

A family cemetery containing at least 9 graves occurs at a homestead complex in Jozanas Nek Village. The graves are indicated by brick structures fashioned with ceramic tiles with brick headstones. The site is not enclosed in a fence, it is not maintained and the condition of the burials is fair. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-57: View of a burial at Site EXIGO-JN-BP05.

- **EXIGO-JN-BP06** -30.62871857 27.32833464
  Field Rating: 4b High Significance

Another family cemetery containing at least 4 graves occurs at a homestead complex in Jozanas Nek Village. The graves are indicated by brick structures fashioned with ceramic tiles with brick headstones. The site is not enclosed in a fence, it is maintained and the condition of the burials is good. The burial site is of high

heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-58: View of a burial at Site EXIGO-JN-BP06.

- **EXIGO-JN-BP07** -30.62915417 27.32767649
  Field Rating: 4b High Significance

A family cemetery containing at least 5 graves occurs in a homestead complex in Jozanas Nek Village. The graves are indicated by marble slab grave dressings with marble headstones, the site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-59: View of a burial at Site EXIGO-JN-BP07.

- **EXIGO-JN-BP08** -30.62940622 27.32721875
  Field Rating: 4b High Significance

At least 6 graves were noted in an open field in the Jozanas Nek Village area. The graves are indicated by rough elongated stone cairns filled in with soil and covered with surface grass. Some burials hold rocks as headstones. The site is not maintained and the condition of the burials is poor. The burial site is of high heritage significance, it is situated in close proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-60: View of a burial at Site EXIGO-JN-BP08.

5.2.6 Kgampasi, Nkampini, Qoboshane and Magwiji

a. Burial Sites

- **EXIGO-KG-BP01** -30.6074945 27.36892451
  Field Rating: 4b High Significance

A family cemetery containing at least 3 graves occurs near a homestead complex in Kgampasi Village. Two of the graves are indicated by marble slab grave dressings with marble headstones and the other grave is indicated by elongated stone mound covered with soil. The site is enclosed in a fence, it is maintained and the condition of the burials is good where one grave is covered with a blanket. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-61: View of a burial at Site EXIGO-KG-BP01.

- **EXIGO-NP-BP01** -30.6102161 27.36572446
  Field Rating: 4b High Significance

A family cemetery containing at least 4 graves occurs in a homestead complex in Nkampini Village. The graves are indicated by marble slab grave dressings with marble headstones, the site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-62: View of a burial at Site EXIGO-NP-BP01.

- **EXIGO-NP-BP02** -30.61329385 27.36159059
  Field Rating: 4b High Significance

A family cemetery containing at least 12 graves occurs in a homestead complex in Nkampini Village. The graves are indicated by marble slab grave dressings with marble headstones, the site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-63: View of a burial at Site EXIGO-NP-BP02.

- **EXIGO-NP-BP03** -30.60931572 27.36951912
  Field Rating: 4b High Significance

A single grave occurs in an open field in Nkampini Village. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-64: View of a burial at Site EXIGO-NP-BP03.

- **EXIGO-QOB-BP01** -30.60791175 27.38306344
  Field Rating: 4b High Significance

A family cemetery containing at least 5 graves occurs next to a stock kraal in Qoboshane Village. The graves are indicated by marble slab grave dressings with marble headstones, the site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-65: View of a burial at Site EXIGO-QOB-BP01.

- **EXIGO-QOB-BP02** -30.60824795 27.38364925
  Field Rating: 4b High Significance

Another family cemetery containing at least 4 graves occurs in a homestead complex in Qoboshane Village. The graves are indicated by marble slab grave dressings with marble headstones, the site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed.

Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-66: View of a burial at Site EXIGO-QOB-BP02.

- **EXIGO-QOB-BP03** -30.60850787 27.38432751
  Field Rating: 4b High Significance

A single grave occurs in a homestead complex in Qoboshane Village. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-67: View of a burial at Site EXIGO-QOB-BP03.

- **EXIGO-QOB-BP04** -30.6112967 27.38741297
  Field Rating: 4b High Significance

A family cemetery containing at least 7 graves occurs in an open field in Qoboshane Village. The graves seem of older age where they have been constructed out of connected filled in with small stones. The burials hold engraved marble headstones. The site is not enclosed in a fence and some of the graves are dilapidated. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-68: View of a burial at Site EXIGO-QOB-BP04.

- **EXIGO-QOB-BP05** -30.61290242 27.38809157
  Field Rating: 4b High Significance

A family cemetery containing at least 5 graves occurs next to a homestead complex in Qoboshane Village. The graves are indicated by marble slab grave dressings with marble headstones and some of the burials are enclosed in palisade fences with brick fence posts. The site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-69: View of a burial at Site EXIGO-QOB-BP05.

- **EXIGO-MAW-BP01** -30.62426752 27.36086044
  Field Rating: 4b High Significance

At least 2 graves occur in a homestead complex in Magwiji Village. The one grave is indicated by marble slab grave dressings with marble headstone and the other burial is indicated by an elongated soil heap. The site is not maintained but the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-70: View of a burial at Site EXIGO-MAW-BP01.

- **EXIGO-MAW-BP02** -30.6252296 27.36127946
  Field Rating: 4b High Significance

A single grave occurs in a homestead complex in Magwiji Village. The grave is indicated by a brick platform and marble headstone. The site is maintained and the condition of the burial is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments

and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-71: View of a burial at Site EXIGO-MAW-BP02.

- **EXIGO-MAW-BP03** -30.62881144 27.36456583
  Field Rating: 4b High Significance

A family cemetery containing at least 7 graves occurs in a homestead complex in Magwiji Village. Most of the graves are indicated by marble slab grave dressings with marble headstones and others are indicated by elongated stone mounds covered with soil. The site is maintained and the condition of the burials is good. The burial site is of high heritage significance, it is situated in the general proximity of proposed pipeline construction alignments and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-72: View of a burial at Site EXIGO-MAW-BP03.

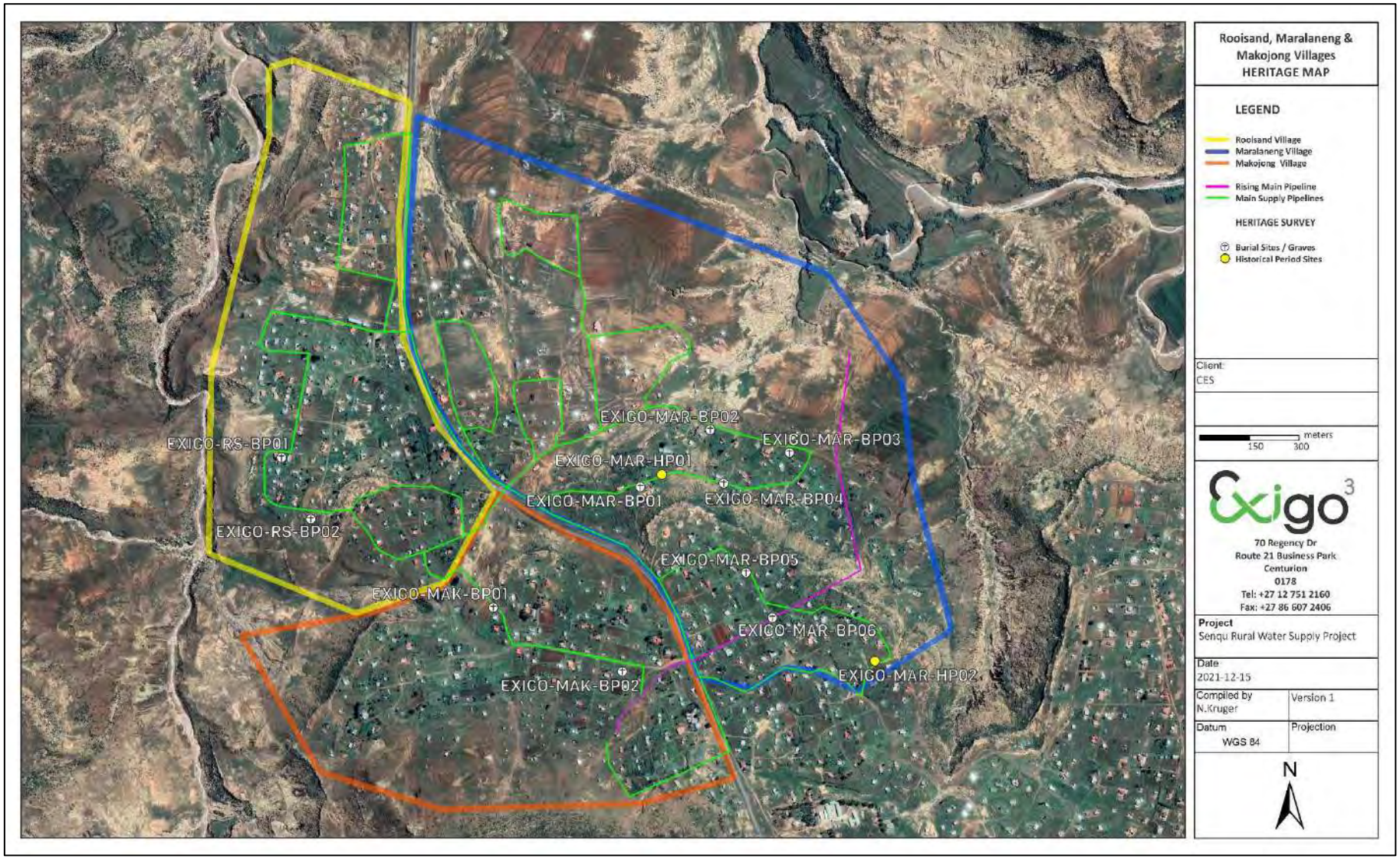

Figure 5-73: Aerial map indicating the locations of occurrences of heritage potential in the Rooisand Village, Maralaneng Village and Makojong Village, discussed in the text.

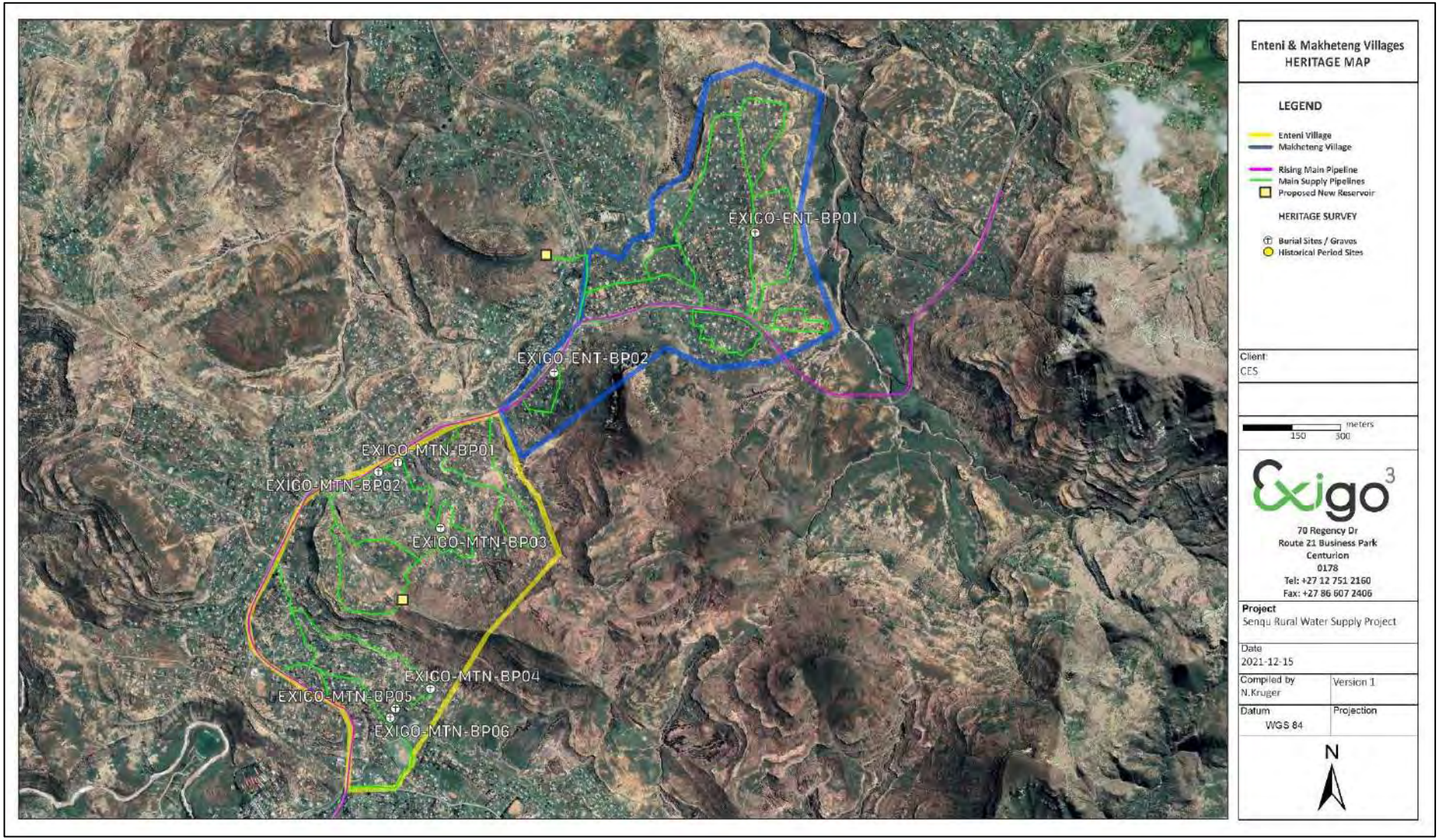

Figure 5-74: Aerial map indicating the locations of occurrences of heritage potential in the Enteni Village and the Makheteng Village, discussed in the text.

Figure 5-75: Aerial map indicating the locations of occurrences of heritage potential in the Esilindile Village and the Bamboespruit Village, discussed in the text.

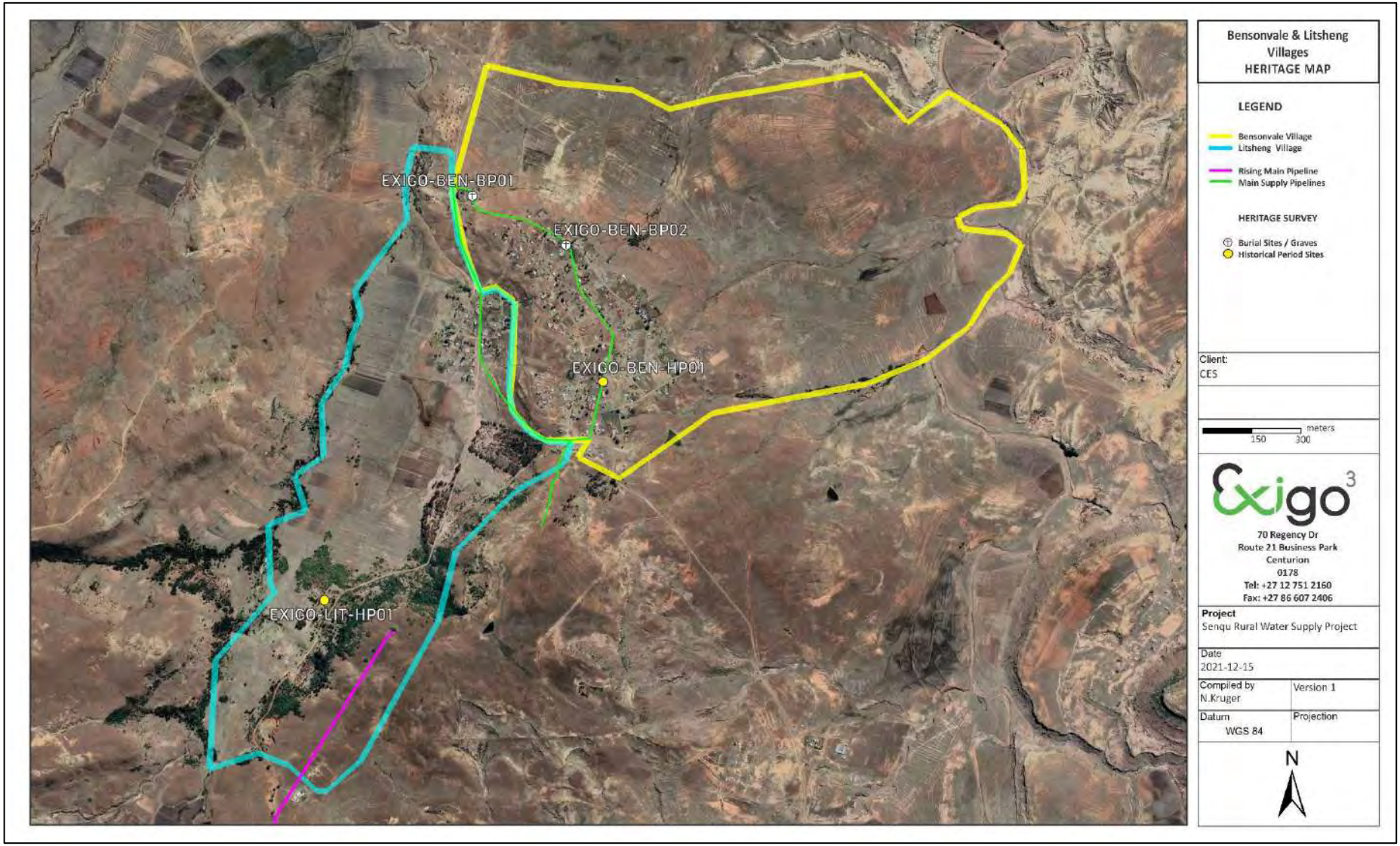

Figure 5-76: Aerial map indicating the locations of occurrences of heritage potential in the Bensonvale Village and Litsheng Village, discussed in the text.

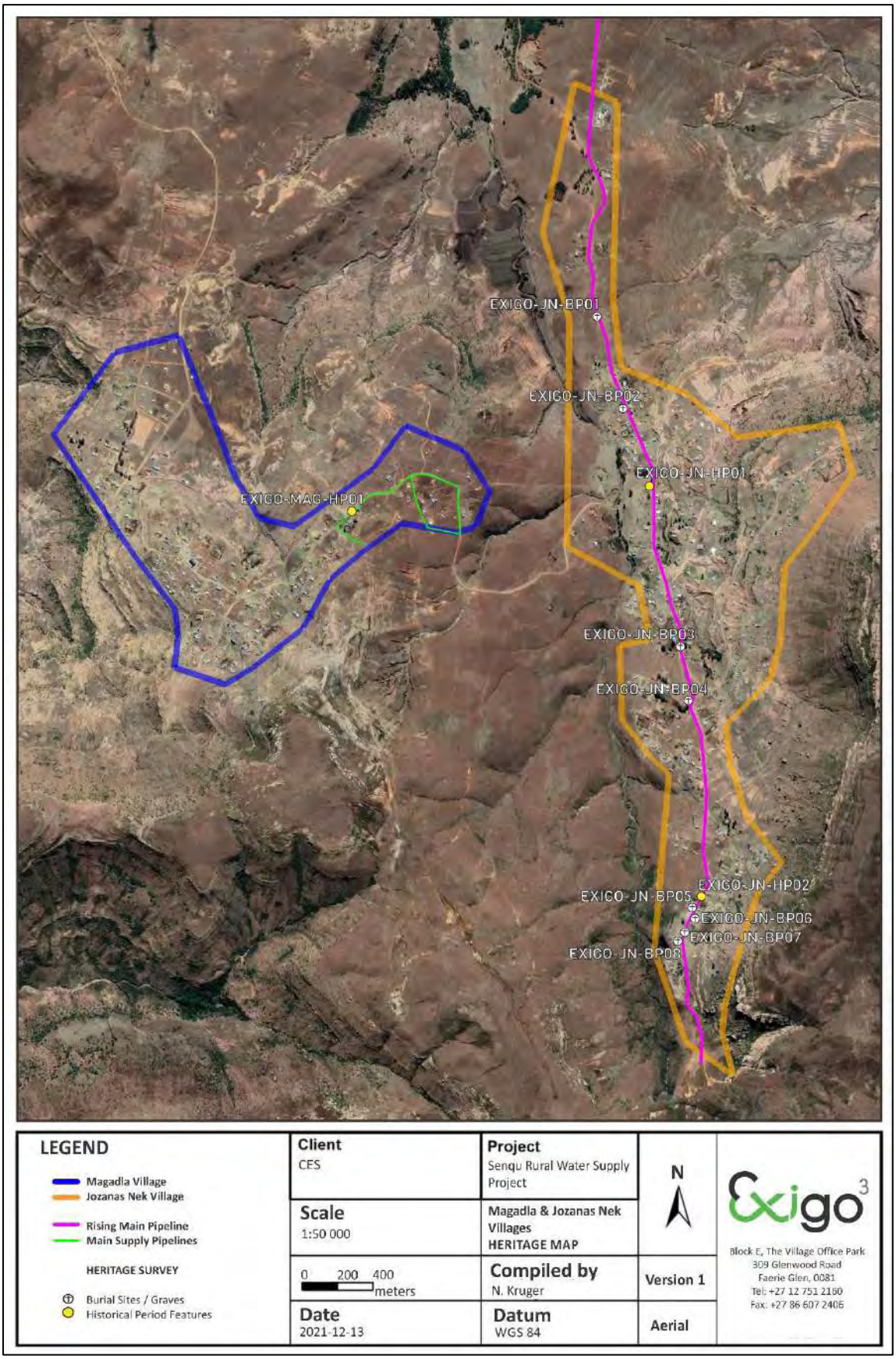

Figure 5-77: Aerial map indicating the locations of occurrences of heritage potential in the Magadla Village and the Jozanas Nek Village, discussed in the text.

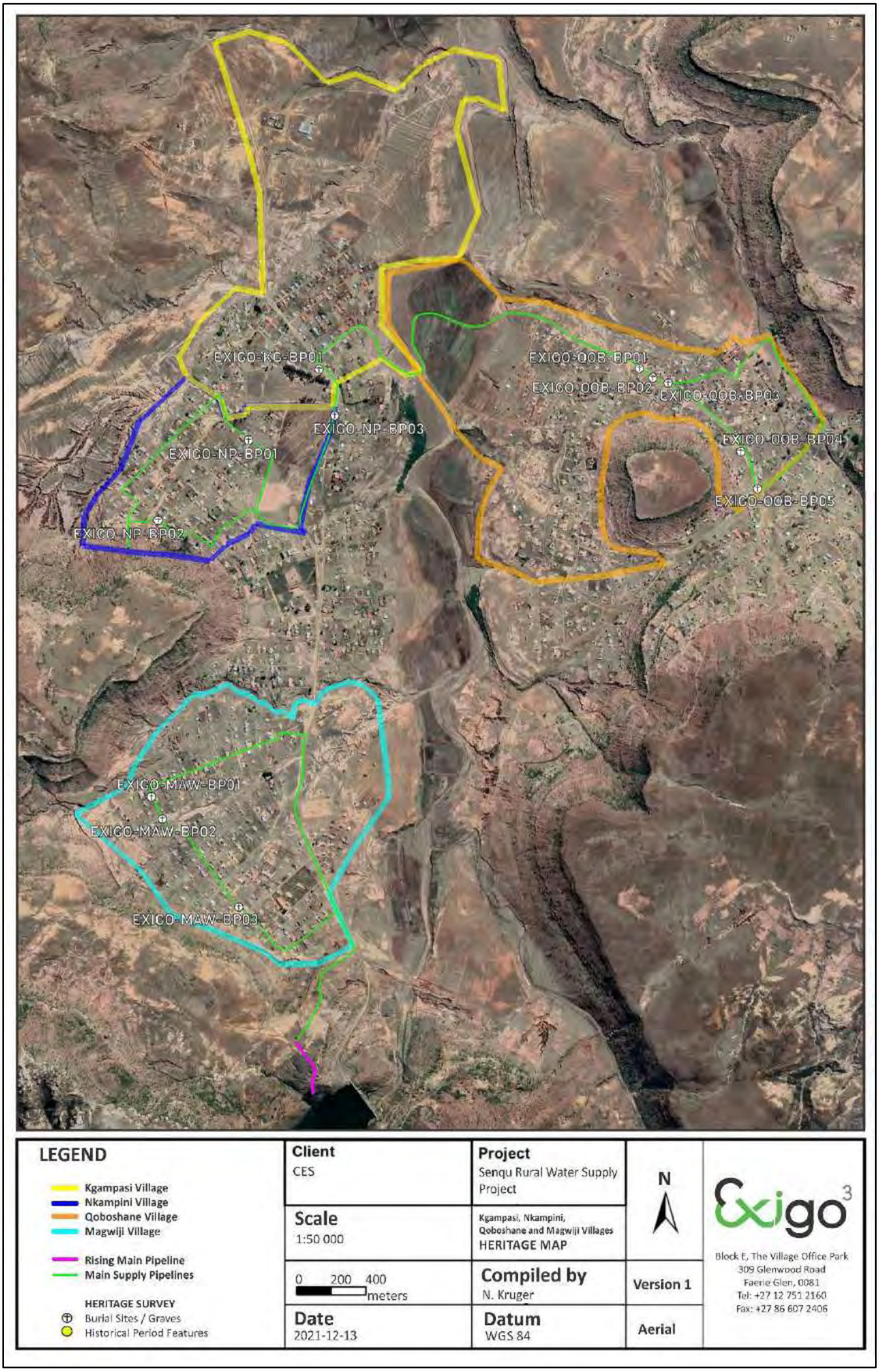

Figure 5-78: Aerial map indicating the locations of occurrences of heritage potential in the Kgampasi Village, Nkampini Village, Qoboshane Village and Magwiji Village, discussed in the text.

6 RESULTS: STATEMENT OF SIGNIFICANCE AND IMPACT RATING

6.1 Potential Impacts and Significance Ratings[2]

The following section provides a background to the identification and assessment of possible impacts and alternatives, as well as a range of risk situations and scenarios commonly associated with heritage resources management. A guideline for the rating of impacts and recommendation of management actions for areas of heritage potential within the study area is supplied in Section 10.2 of Addendum 3.

6.1.1 General assessment of impacts on resources

Generally, the value and significance of archaeological and other heritage sites might be impacted on by any activity that would result immediately or in the future in the destruction, damage, excavation, alteration, removal or collection from its original position, any archaeological material or object (as indicated in the National Heritage Resources Act (No 25 of 1999)). Thus, the destructive impacts that are possible in terms of heritage resources would tend to be direct, once-off events occurring during the initial construction period. However, in the long run, the proximity of operations in any given area could result in secondary indirect impacts. The EIA process therefore specifies impact assessment criteria which can be utilised from the perspective of a heritage specialist study which elucidates the overall extent of impacts.

6.1.2 Direct impact rating

Direct or primary effects on heritage resources occur at the same time and in the same space as the activity, e.g., loss of historical fabric through demolition work. **Indirect effects or secondary effects** on heritage resources occur later in time or at a different place from the causal activity, or as a result of a complex pathway, e.g. restriction of access to a heritage resource resulting in the gradual erosion of its significance, which is dependent on ritual patterns of access (refer to Section 10.3 in the Addendum for an outline of the relationship between the significance of a heritage context, the intensity of development and the significance of heritage impacts to be expected).

Heritage receptors were found in the project zones and potential impacts to heritage resources is foreseen.

The following table summarizes impacts to the heritage landscape of the project areas:

[2] Based on: W inter, S. & Baumann, N. 2005. *Guideline for involving heritage specialists in EIA processes: Edition 1.*

Impact Assessment: Archaeology

Criteria	Nature	Temporal Scale	Spatial Scale	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Impact 1: Loss of Heritage Resources										
Without Mitigation	Negative	Short term	Study area	Slight	Definite	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE
With Mitigation	Negative	Short term	Study area	Slight	Definite	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE

Impact Assessment: Built Environment (EXIGO-BEN-HP01, EXIGO-JN-HP01, EXIGO-JN-HP02, EXIGO-LIT-HP01, EXIGO-MAG-HP01, EXIGO-MAR-HP01, EXIGO-MAR-HP02)

Criteria	Nature	Temporal Scale	Spatial Scale	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Impact 1: Loss of Heritage Resources										
Without Mitigation	Negative	Short term	Study area	Slight	Definite	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE
With Mitigation	Negative	Short term	Study area	Slight	Definite	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE

Impact Assessment: Cultural Landscape

Criteria	Nature	Temporal Scale	Spatial Scale	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Impact 1: Loss of Heritage Resources										
Without Mitigation	Negative	Short term	Study area	Slight	Definite	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE
With Mitigation	Negative	Short term	Study area	Slight	Definite	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE

Impact Assessment: Human Burial Sites (EXIGO-BB-BP01 - EXIGO-BB-BP04, EXIGO-BEN-BP01, EXIGO-ENT-BP01 - EXIGO-ENT-BP02, EXIGO-ES-BP01 - EXIGO-ES-BP18, EXIGO-JN-BP01 - EXIGO-JN-BP08, EXIGO-KG-BP01, EXIGO-MAK-BP01 - EXIGO-MAK-BP02, EXIGO-MAR-BP01 - EXIGO-MAR-BP06, EXIGO-MAW-BP01 - EXIGO-MAW-BP03, EXIGO-MTN-BP01 - EXIGO-MTN-BP06, EXIGO-NP-BP01 - EXIGO-NP-BP03, EXIGO-QOB-BP01 - EXIGO-QOB-BP05, EXIGO-RS-BP01 - EXIGO-RS-BP02)

Criteria	Nature	Temporal Scale	Spatial Scale	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Impact 1: Loss of Heritage Resources										
Without Mitigation	Negative	Permanent	Regional	Severe/ Beneficial	Definite	VERY HIGH NEGATIVE	Irreversible	Resource will be lost	Achievable	VERY HIGH NEGATIVE
With Mitigation	Negative	Short term	Study area	Slight/ Slightly Beneficial	Unlikely	LOW NEGATIVE	Irreversible	Resource will not be lost	Achievable	LOW NEGATIVE

6.2 Evaluation Impacts

Previous studies conducted in the larger Eastern Cape landscape around the project area suggest a rich and diverse archaeological landscape. The Sterkspruit landscape has been inhabited continuously in prehistoric and historical times where large portions of land have been transformed for agriculture and ruralisation. Cognisance should be taken of archaeological material that might be present in surface and sub-surface deposits.

6.2.1 Archaeology

The study did not identify any archaeological receptors which will be directly impacted by the proposed project and no impact on archaeological sites or features is anticipated**.**

6.2.2 Built Environment

A number of Historical Period remains of homesteads and buildings relating to rural settlement occur in the general landscape but the project area has varied significance in terms of the built environment. In addition, no highly significant old buildings, structures, or features in the direct project surround remains intact and no impact on the built environment is anticipated**.**

6.2.3 Cultural Landscape

The larger area comprises a rich cultural horizon and the natural landscape surrounding the proposed project encompasses open grasslands and river valleys, typical of the rural areas of the Eastern Cape. The cultural landscape holds Herder sites, Iron Age remains, Colonial Period farmsteads and Historical towns. However, the proposed project is unlikely to result in a significant impact on the cultural landscape of this area.

6.2.4 Graves / Human Burials Sites

A large number of burial sites were located in the study area in close proximity of the pipeline construction alignments. These receptors are of high significance for their social and cultural value. The potential impact on the resources is anticipated to be HIGH but this impact rating can be limited to a NEGLIBLE impact by the implementation of mitigation measures (avoidance, site management, site monitoring / grave relocation) for the sites, if / when required. It should be noted that graves and cemeteries often occur within settlements or around homesteads in the rural areas of the Eastern Cape, and they are also randomly scattered around archaeological and historical settlements. The probability of informal human burials encountered during development should thus not be excluded. In addition, human remains and burials are commonly found close to archaeological sites; they may be found in "lost" graveyards, or occur sporadically anywhere as a result of prehistoric activity, victims of conflict or crime. It is often difficult to detect the presence of archaeological human remains on the landscape as these burials, in most cases, are not marked at the surface. Human remains are usually observed when they are exposed through erosion. In some instances, packed stones or rocks may indicate the presence of informal pre-colonial burials. If any human bones are found during the course of construction work, then they should be reported to an archaeologist and work in the immediate vicinity should cease until the appropriate actions have been carried out by the archaeologist. Where human remains are part of a burial, they would need to be exhumed under a permit from SAHRA (for pre-colonial burials as well as burials later than about AD 1500). Should any unmarked human burials/remains be found during the course of construction, work in the immediate vicinity should cease and the find must immediately be reported to the archaeologist, or the South African Heritage Resources Agency (SAHRA). Under no circumstances may burials be disturbed or removed until such time as necessary statutory procedures required for grave relocation have been met.

Heritage resources occur in close proximity of the Senqu Rural Water Supply Project and these heritage receptors might be impacted on by the proposed project. However, these impacts can be mitigated and in the opinion of the author of this Archaeological Impact Assessment Report, the proposed Senqu Rural Water Supply Project may proceed from a culture resources management perspective, provided that mitigation measures are implemented where applicable, and provided that no subsurface heritage remains are encountered during any phase of development.

6.3 Management actions

Recommendations for relevant heritage resources management actions are vital to the conservation of heritage resources. A general guideline for recommended management actions is included in Section 10.4 of Addendum 3.

OBJECTIVE: prevent unnecessary disturbance and/or destruction of previously undetected heritage receptors.

For the Historical Period structure of medium-low heritage significance within the project area the following are required in terms of heritage management and mitigation:

- **EXIGO-BEN-HP01, EXIGO-JN-HP01, EXIGO-JN-HP02, EXIGO-LIT-HP01, EXIGO-MAG-HP01, EXIGO-MAR-HP01, EXIGO-MAR-HP02**

PROJECT COMPONENT/S	All phases of construction and operation.		
POTENTIAL IMPACT	Damage/destruction of sites.		
ACTIVITY RISK/SOURCE	Digging foundations and trenches into sensitive deposits that are not visible at the surface.		
MITIGATION: TARGET/OBJECTIVE	To conserve the historical fabric of the sites and to locate undetected heritage remains as soon as possible after disturbance so as to maximize the chances of successful rescue/mitigation work.		
MITIGATION: ACTION/CONTROL		**RESPONSIBILITY**	**TIMEFRAME**
Fixed Mitigation Procedure (**required**)			
Site Monitoring: Regular examination of trenches and excavations.		ECO, HERITAGE ASSESSMENT PRACTITIONER	Monitor as frequently as practically possible.
Preferred Mitigation Procedure			
Avoidance: Implement a heritage conservation buffer of at least 20m around the heritage resource, redesign the proposed footprint to avoid the heritage resource and the proposed conservation buffer.		DEVELOPER	All phases of construction and operation.
Alterative Mitigation Procedure (**if preferred mitigation procedure is not feasible**)			
Destruction Permitting: Apply for destruction permit if impacted on.		HERITAGE ASSESSMENT PRACTITIONER	Prior to the commencement of construction and earth-moving.
PERFORMANCE INDICATOR	Archaeological sites are discovered and mitigated with the minimum amount of unnecessary disturbance.		
MONITORING	Successful location of sites by person/s monitoring.		

For the highly significant burial sites occurring within the project area the following are required in terms of heritage management and mitigation:

- **EXIGO-BB-BP01 - EXIGO-BB-BP04, EXIGO-BEN-BP01, EXIGO-ENT-BP01 - EXIGO-ENT-BP02, EXIGO-ES-BP01 - EXIGO-ES-BP18, EXIGO-JN-BP01 - EXIGO-JN-BP08, EXIGO-KG-BP01, EXIGO-MAK-BP01 - EXIGO-MAK-BP02, EXIGO-MAR-BP01 - EXIGO-MAR-BP06, EXIGO-MAW-BP01 - EXIGO-MAW-BP03, EXIGO-MTN-BP01 - EXIGO-MTN-BP06, EXIGO-NP-BP01 - EXIGO-NP-BP03, EXIGO-QOB-BP01 - EXIGO-QOB-BP05, EXIGO-RS-BP01 - EXIGO-RS-BP02**

PROJECT COMPONENT/S	All phases of construction and operation.		
POTENTIAL IMPACT	Damage/disturbance to subsurface burials and surface burial features.		
ACTIVITY RISK/SOURCE	Digging foundations and trenches into sensitive deposits that are not visible at the surface.		
MITIGATION: TARGET/OBJECTIVE	To locate human burials as soon as possible after disturbance so as to maximize the chances of successful rescue/mitigation work.		
MITIGATION: ACTION/CONTROL		**RESPONSIBILITY**	**TIMEFRAME**
Preferred Mitigation Procedure			
Avoidance: Implement a heritage conservation buffer of at least 10m from all burials / graves. Where digging / construction encroaches on this buffer, erect a temporary construction barricade around burials to clearly indicate the location of burials. Implement a site management plan detailing strict site management conservation measures. Training of ECO, site supervisors and contractors on significance of burials is required. Chance find procedure for the accidental discovery of human remains should be included in SMP.		DEVELOPER QUALIFIED HERITAGE SPECIALIST	Prior to the commencement of construction and earth-moving.
Alterative Mitigation Procedure (**if preferred mitigation procedure is not feasible**)			
Grave Relocation: Relocation of burials and documentation of site, full social consultation with affected parties, possible conservation management and protection measures. Subject to authorisations and relevant permitting from heritage authorities and affected parties.		QUALIFIED HERITAGE SPECIALIST	Prior to the commencement of construction and earth-moving.
Fixed Mitigation Procedure (**required**)			
Site Monitoring: The project site in the vicinity of this receptor should be continuously monitored by a trained on-site supervisor. The monthly monitoring by informed ECO familiar with the heritage occurrences of the site or the heritage specialist is required. This should entail regular examination of trenches and excavations and site clearing in order to detect and preserve previously undocumented heritage receptors.		ECO	Monitor as frequently as practically possible.
PERFORMANCE INDICATOR	Archaeological sites are discovered and mitigated with the minimum amount of unnecessary disturbance.		
MONITORING	Successful location of sites by person/s monitoring.		

7 RECOMMENDATIONS

The larger landscape of the Eastern Cape Province and the Sterkspruit area is rich in pre-historical and historical remnants since the area is highly suitable for pre-colonial habitation. The proposed Senqu Rural Water Supply Project zones have been transformed by historical and recent human settlement, farming as well as ruralisation. Here, the landscape seems to have been inhabited continuously for centuries in prehistoric and historical times and a number of sites of heritage potential were noted in the project zones.

The following recommendations are made based on general observations in the proposed Senqu Rural Water Supply Project in terms of heritage resources management.

- According to the South African Heritage Resources Agency Information System (SAHRIS) Palaeo Map, portions of the project area fall within a potentially sensitive fossiliferous zone and a Palaeontological Impact Assessment has been commissioned for the project. Should fossil remains such as fossil fish, reptiles or petrified wood be exposed during construction, these objects should carefully safeguarded and the relevant heritage resources authority (SAHRA) should be notified immediately so that the appropriate action can be taken by a professional palaeontologist.
- A number of Historical Period buildings and dwellings (**EXIGO-BEN-HP01, EXIGO-JN-HP01, EXIGO-JN-HP02, EXIGO-LIT-HP01, EXIGO-MAG-HP01, EXIGO-MAR-HP01, EXIGO-MAR-HP02**) are generally poorly preserved and the sites are of medium-low heritage significance. The sites occur in close proximity of the project development areas and it is primarily recommended that the proposed pipeline alignments be adjusted to avoid the resources and that a conservation buffer of at least 20m around the site be implemented. However, should impact on the sites prove inevitable, application should be made for destruction permits from the relevant Heritage Resources Authorities prior to site alteration or destruction. Generally, the site should be monitored by an informed ECO in order to avoid the destruction of previously undetected heritage remains
- Graves and burials identified within close proximity of the pipeline construction alignments (**EXIGO-BB-BP01 - EXIGO-BB-BP04, EXIGO-BEN-BP01, EXIGO-ENT-BP01 - EXIGO-ENT-BP02, EXIGO-ES-BP01 - EXIGO-ES-BP18, EXIGO-JN-BP01 - EXIGO-JN-BP08, EXIGO-KG-BP01, EXIGO-MAK-BP01 - EXIGO-MAK-BP02, EXIGO-MAR-BP01 - EXIGO-MAR-BP06, EXIGO-MAW-BP01 - EXIGO-MAW-BP03, EXIGO-MTN-BP01 - EXIGO-MTN-BP06, EXIGO-NP-BP01 - EXIGO-NP-BP03, EXIGO-QOB-BP01 - EXIGO-QOB-BP05, EXIGO-RS-BP01 - EXIGO-RS-BP02**) carry a Field Rating 4b and the sites are of high significance and these sites might be impacted on by the proposed project. In most of these cases, the graves and cemeteries are situated near roads or within settlements, often around or very close to homesteads and homestead buildings, roads and other infrastructure. These locations of human burials along the proposed alignment present challenges in terms of the conservation and management of these sensitive heritage receptors. As a primary measure, Heritage Authority (SAHRA) guidelines require a 100m conservation buffer for all burials but the implementation of this guideline might prove problematic and impractical in a number of instances considering the locations of many of the burials, as noted above. It is therefore recommended that a heritage conservation buffer of at least 10m be implemented around all graves. Where construction or digging risk encroaching on this conservation buffer, a temporary construction barricade should be erected around burials at risk in order to clearly demarcate the locations of the burials. A Site Management Plan (SMP) detailing strict site management conservation measures should be compiled for all burials in the project area. The SMP should stipulate training of the assigned project ECO, site supervisors and contractors involved in the project on the heritage significance of the burial sites. The SMP

should also include a heritage Chance Find procedure for accidental discovery of human remains should be included. All burials should be monitored by a trained on-site supervisor during all phases of development, and on a monthly basis by an informed ECO or by the heritage Specialist in order to detect any impact on the resource at the earliest opportunity.

- **Should impact on any human burial prove inevitable, full grave relocations are recommended for these burial grounds. This measure should be undertaken by a qualified archaeologist, and in accordance with relevant legislation, permitting, statutory permissions and subject to any local and regional provisions and laws and by-laws pertaining to human remains. A full social consultation process should occur in conjunction with the mitigation of cemeteries and burials (see Addendum B)**.
- Considering the localised nature of heritage remains, the general monitoring of the development progress by an ECO or by the heritage specialist is recommended for all stages of the project. Should any subsurface palaeontological, archaeological or historical material, or burials be exposed during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately.
- It is essential that cognisance be taken of the larger archaeological landscape of the area in order to avoid the destruction of previously undetected heritage sites. It should be stated that it is likely that further undetected archaeological remains might occur elsewhere in the Study Area along water sources and drainage lines, fountains and pans would often have attracted human activity in the past. Also, since Stone Age material seems to originate from below present soil surfaces in eroded areas, the larger landscape should be regarded as potentially sensitive in terms of possible subsurface deposits. Burials and historically significant structures dating to the Colonial Period occur on farms in the area and these resources should be avoided during all phases of construction and development, including the operational phases of the development.

In addition to these site-specific recommendations, careful cognizance should be taken of the following:

- As Palaeontological remains occur where bedrock has been exposed, all geological features should be regarded as sensitive.
- Water sources such as drainage lines, fountains and pans would often have attracted human activity in the past. As Stone Age material the larger landscape should be regarded as potentially sensitive in terms of possible subsurface deposits.

8 GENERAL COMMENTS AND CONDITIONS

This AIA report serves to confirm the extent and significance of the heritage resources of the proposed Senqu Rural Water Supply Project area. The larger heritage horizon encompasses rich and diverse archaeological landscapes and cognisance should be taken of heritage resources and archaeological material that might be present in surface and sub-surface deposits. If, at any stage, any possible archaeological material culture discoveries are made, the operations must be stopped and a qualified archaeologist be contacted for an assessment of the find. Such material culture might include:

- Formal Earlier Stone Age stone tools.
- Formal MSA stone tools.
- Formal LSA stone tools.
- Potsherds
- Iron objects.
- Beads made from ostrich eggshell and glass.
- Ash middens and cattle dung deposits and accumulations.
- Faunal remains.
- Human remains/graves.
- Stone walling or any sub-surface structures.
- Historical glass, tin or ceramics.
- Fossils.

If such site were to be encountered or impacted by any proposed developments, recommendations contained in this report, as well as endorsement of mitigation measures as set out by AMAFA, SAHRA, the National Resources Act and the CRM section of ASAPA will be required. It must be emphasised that the conclusions and recommendations expressed in this archaeological heritage sensitivity investigation are based on the visibility of archaeological sites/features and may not therefore, represent the area's complete archaeological legacy. Many sites/features may be covered by soil and vegetation and might only be located during sub-surface investigations. If subsurface archaeological deposits, artefacts or skeletal material were to be recovered in the area during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately **(*cf*. NHRA (Act No. 25 of 1999)**, Section 36 (6)). It must also be clear that Archaeological Specialist Reports will be assessed by the relevant heritage resources authority (SAHRA).

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10 ADDENDUM 1: HERITAGE LEGISLATION BACKGROUND

10.1 CRM: Legislation, Conservation and Heritage Management

The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

10.1.1 Legislation regarding archaeology and heritage sites

The South African Heritage Resources Agency (SAHRA) and their provincial offices aim to conserve and control the management, research, alteration and destruction of cultural resources of South Africa. It is therefore vitally important to adhere to heritage resource legislation at all times.

b. National Heritage Resources Act No 25 of 1999, section 35

According to the National Heritage Resources Act of 1999 a historical site is any identifiable building or part thereof, marker, milestone, gravestone, landmark or tell older than 60 years. This clause is commonly known as the "60-years clause". Buildings are amongst the most enduring features of human occupation, and this definition therefore includes all buildings older than 60 years, modern architecture as well as ruins, fortifications and Iron Age settlements. "Tell" refers to the evidence of human existence which is no longer above ground level, such as building foundations and buried remains of settlements (including artefacts).

The Act identifies heritage objects as:

- objects recovered from the soil or waters of South Africa including archaeological and palaeontological objects, meteorites and rare geological specimens
- visual art objects
- military objects
- numismatic objects
- objects of cultural and historical significance
- objects to which oral traditions are attached and which are associated with living heritage
- objects of scientific or technological interest
- any other prescribed category

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority-

(d) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(e) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(f) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(g) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites. (35. [4] 1999:58)."

and

"No person may, without a permit issued by SAHRA or a provincial heritage resources agency-

(h) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(i) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(j) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals (36. [3] 1999:60)."

c. Human Tissue Act of 1983 and Ordinance on the Removal of Graves and Dead Bodies of 1925

Graves 60 years or older are heritage resources and fall under the jurisdiction of both the National Heritage Resources Act and the Human Tissues Act of 1983. However, graves younger than 60 years are specifically protected by the Human Tissues Act (Act 65 of 1983) and the Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925) as well as any local and regional provisions, laws and by-laws. Such burial places also fall under the jurisdiction of the National Department of Health and the Provincial Health Departments. Approval for the exhumation and re-burial must be obtained from the relevant Provincial MEC as well as the relevant Local Authorities.

10.1.2 Background to HIA and AIA Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. Heritage sites are frequently threatened by development projects and both the environmental and heritage legislation require impact assessments (HIAs & AIAs) that identify all heritage resources in areas to be developed. Particularly, these assessments are required to make recommendations for protection or mitigation of the impact of the sites. HIAs and AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources including archaeological and palaeontological sites that might occur in areas of developed and (b) make recommendations for protection or mitigation of the impact on the sites.

The National Heritage Resources Act (Act No. 25 of 1999, section 38) provides guidelines for Cultural Resources Management and prospective developments:

"38. *(1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a*

development categorised as:

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site:

(i) exceeding 5 000 m^2 in extent; or

(ii) involving three or more existing erven or subdivisions thereof; or

(iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority,

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development."

And:

"The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(k) The identification and mapping of all heritage resources in the area affected;

(l) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;

(m) an assessment of the impact of the development on such heritage resources;

(n) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

(o) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(p) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(q) plans for mitigation of any adverse effects during and after the completion of the proposed development (38. [3] 1999:64)."

Consequently, section 35 of the Act requires Heritage Impact Assessments (HIAs) or Archaeological Impact Assessments (AIAs) to be done for such developments in order for all heritage resources, that is, all places or objects of aesthetics, architectural, historic, scientific, social, spiritual, linguistic or technological value or significance to be protected. Thus any assessment should make provision for the protection of all these heritage components, including archaeology, shipwrecks, battlefields, graves, and structures older than

60 years, living heritage, historical settlements, landscapes, geological sites, palaeontological sites and objects.Heritage resources management and conservation

10.2 Assessing the Significance of Heritage Resources

Archaeological sites, as previously defined in the National Heritage Resources Act (Act 25 of 1999) are places in the landscape where people have lived in the past – generally more than 60 years ago – and have left traces of their presence behind. In South Africa, archaeological sites include hominid fossil sites, places where people of the Earlier, Middle and Later Stone Age lived in open sites, river gravels, rock shelters and caves, Iron Age sites, graves, and a variety of historical sites and structures in rural areas, towns and cities. Palaeontological sites are those with fossil remains of plants and animals where people were not involved in the accumulation of the deposits. The basic principle of cultural heritage conservation is that archaeological and other heritage sites are valuable, scarce and *non-renewable.* Many such sites are unfortunately lost on a daily basis through development for housing, roads and infrastructure and once archaeological sites are damaged, they cannot be re-created as site integrity and authenticity is permanently lost. Archaeological sites have the potential to contribute to our understanding of the history of the region and of our country and continent. By preserving links with our past, we may not be able to revive lost cultural traditions, but it enables us to appreciate the role they have played in the history of our country.

- Categories of significance

Rating the significance of archaeological sites, and consequently grading the potential impact on the resources is linked to the significance of the site itself. The significance of an archaeological site is based on the amount of deposit, the integrity of the context, the kind of deposit and the potential to help answer present research questions. Historical structures are defined by Section 34 of the National Heritage Resources Act, 1999, while other historical and cultural significant sites, places and features, are generally determined by community preferences. The guidelines as provided by the NHRA (Act No. 25 of 1999) in Section 3, with special reference to subsection 3 are used when determining the cultural significance or other special value of archaeological or historical sites. In addition, ICOMOS (the Australian Committee of the International Council on Monuments and Sites) highlights four cultural attributes, which are valuable to any given culture:

- *Aesthetic value:*

Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria include consideration of the form, scale, colour, texture and material of the fabric, the general atmosphere associated with the place and its uses and also the aesthetic values commonly assessed in the analysis of landscapes and townscape.

- *Historic value:*

Historic value encompasses the history of aesthetics, science and society and therefore to a large extent underlies all of the attributes discussed here. Usually a place has historical value because of some kind of influence by an event, person, phase or activity.

- *Scientific value:*

The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality and on the degree to which the place may contribute further substantial information.

- *Social value:*

Social value includes the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a certain group.

It is important for heritage specialist input in the EIA process to take into account the heritage management structure set up by the NHR Act. It makes provision for a 3-tier system of management including the South Africa Heritage Resources Agency (SAHRA) at a national level, Provincial Heritage Resources Authorities (PHRAs) at a provincial and the local authority. The Act makes provision for two types or forms of protection of heritage resources; i.e. formally protected and generally protected sites:

Formally protected sites:

- Grade 1 or national heritage sites, which are managed by SAHRA
- Grade 2 or provincial heritage sites, which are managed by the provincial HRA (MP-PHRA).
- Grade 3 or local heritage sites.

Generally protected sites:

- Human burials older than 60 years.
- Archaeological and palaeontological sites.
- Shipwrecks and associated remains older than 60 years.
- Structures older than 60 years.

With reference to the evaluation of sites, the certainty of prediction is definite, unless stated otherwise and if the significance of the site is rated high, the significance of the impact will also result in a high rating. The same rule applies if the significance rating of the site is low. The significance of archaeological sites is generally
ranked into the following categories.

Significance	Rating Action
No significance: sites that do not require mitigation.	None
Low significance: sites, which may require mitigation.	2a. Recording and documentation (Phase 1) of site; no further action required 2b. Controlled sampling (shovel test pits, augering), mapping and documentation (Phase 2 investigation); permit required for sampling and destruction
Medium significance: sites, which require mitigation.	3. Excavation of representative sample, C14 dating, mapping and documentation (Phase 2 investigation); permit required for sampling and destruction [including 2a & 2b]
High significance: sites, where disturbance should be avoided.	4a. Nomination for listing on Heritage Register (National, Provincial or Local) (Phase 2 & 3 investigation); site management plan; permit required if utilised for education or tourism
High significance: Graves and burial places	4b. Locate demonstrable descendants through social consulting; obtain permits from applicable legislation, ordinances and regional by-laws; exhumation and reinterment [including 2a, 2b & 3]

Furthermore, the significance of archaeological sites was based on six main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter),
- Social value,
- Uniqueness, and
- Potential to answer current and future research questions.

11 ADDENDUM 2: IMPACT ASSESSMENT METHODOLOGY

11.1 Issues Identification Matrix

Impacts were rated and assessed using an Impact and Risk Assessment Methodology provided by CES, for the Scoping Phase of the EIA process in accordance with the requirement of EIA Regulations. Here, two parameters and five factors are considered when assessing the significance of the identified issues, and each is scored. ***Significance*** is achieved by ranking the five criteria presented in Table 1 below, to determine the overall significance of an issue. The ranking for the "effect" (which includes scores for duration; extent; consequence and probability) and reversibility / mitigation are then read off the matrix presented in Table 2 below, to determine the overall significance of the issue. The overall significance is either negative or positive.

- ***Duration*** - The temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

- ***Extent*** - The spatial scale defines the physical extent of the impact.

- ***Consequence*** - The consequence scale is used in order to, as far as possible, objectively evaluate how severe a number of negative impacts associated with the issue
under consideration might be, or how beneficial a number of positive impacts associated with the issue under consideration might be.

- The ***probability*** of the impact occurring - The likelihood of impacts taking place as a result of project actions arising from the various alternatives. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development and alternatives. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

- ***Reversibility / Mitigation*** – The degree of difficulty of reversing and/or mitigating the various impacts ranges from easily achievable to very difficult. The four categories used are listed and explained in Table 1 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty

11.2 Assessing Impacts

The CES rating scale used in this assessment takes into consideration the following criteria, and includes the new criteria for assessing post mitigation significance (residual impacts), by incorporating the principles of reversibility and irreplaceability:

- **Nature of impact** (Negative or positive impact on the environment).
- **Type of impact** (Direct, indirect and/or cumulative effect of impact on the environment).
- **Duration, Extent, Probability** (see **Table** below)

Duration (Temporal Scale)		Score
Short term	Less than 5 years	1
Medium term	Between 5-20 years	2
Long term	Between 20 and 40 years (a generation) and from a human perspective also permanent	3
Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there	4
Extent (Spatial Scale)		
Localised	At localised scale and a few hectares in extent	1
Study Area	The proposed site and its immediate environs	2
Regional	District and Provincial level	3
National	Country	3
International	Internationally	4
Probability (Likelihood)		
Unlikely	The likelihood of these impacts occurring is slight	1
May Occur	The likelihood of these impacts occurring is possible	2
Probable	The likelihood of these impacts occurring is probable	3
Definite	The likelihood is that this impact will definitely occur	4

- Severity or benefits

Impact Severity (The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or affected party)		Score
Very severe	**Very beneficial**	**4**
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.	
Severe	**Beneficial**	**3**
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.	
Moderately severe	**Moderately beneficial**	**2**
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing the sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.	
Slight	**Slightly beneficial**	**1**
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.	
No effect	**Don't know/Can't know**	
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.	

** In certain cases it may not be possible to determine the severity of an impact thus it may be determined: Don't know/Can't know*

The scores for the three criteria in the Tables above are added to obtain a composite score. They must then be considered against the severity rating to determine the overall significance of an activity. This is because the severity of the impact is far more important than the other three criteria. The overall significance is then obtained by reading off the matrix presented in the table below. The overall significance is either negative or positive (Criterion 1) and direct, indirect or cumulative (Criterion 2).

SEVERITY	COMPOSITE DURATION, EXTENT & PROBABILITY SCORE									
	3	4	5	6	7	8	9	10	11	12
Slight	3	4	5	6	7	8	9	10	11	12
Mod severe	3	4	5	6	7	8	9	10	11	12
Severe	3	4	5	6	7	8	9	10	11	12
Very severe	3	4	5	6	7	8	9	10	11	12

The **environmental significance** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

OVERALL SIGNIFICANCE
(The combination of all the above criteria as an overall significance)

VERY HIGH NEGATIVE | **VERY BENEFICIAL**

These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects.
Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance.
Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.

HIGH NEGATIVE | **BENEFICIAL**

These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light.
Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated.
Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.

MODERATE NEGATIVE | **SOME BENEFITS**

These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial.
Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.

LOW NEGATIVE | **FEW BENEFITS**

These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect.
Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels.
Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.

NO SIGNIFICANCE

There are no primary or secondary effects at all that are important to scientists or the public.
Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.

DON'T KNOW

In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information.
Example: The effect of a particular development on people's psychological perspective of the environment.

11.3 Post Mitigation Significance

Once mitigation measure are proposed, the following criteria are then used to determine the overall post mitigation significance of the impact:

- Reversibility: The degree to which an environment can be returned to its original/partially original state.
- Irreplaceable loss: The degree of loss which an impact may cause.

Mitigation potential: The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table 5 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

Reversibility	
Reversible	*The activity will lead to an impact that can be reversed provided appropriate mitigation measures are implemented.*
Irreversible	*The activity will lead to an impact that is permanent regardless of the implementation of mitigation measures.*
Irreplaceable loss	
Resource will not be lost	*The resource will not be lost/destroyed provided mitigation measures are implemented.*
Resource will be partly lost	*The resource will be partially destroyed even though mitigation measures are implemented.*
Resource will be lost	*The resource will be lost despite the implementation of mitigation measures.*
Mitigation potential	
Easily achievable	*The impact can be easily, effectively and cost effectively mitigated/reversed.*
Achievable	*The impact can be effectively mitigated/reversed without much difficulty or cost.*
Difficult	*The impact could be mitigated/reversed but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs.*
Very Difficult	*The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly.*

12 ADDENDUM 3: GRAVE RELOCATION AND SITE MANAGEMENT: STATUTORY MANDATE

12.1 Archaeology, graves and the law

Note that four categories of graves can be identified. These are:
- Graves younger than 60 years;

- Graves older than 60 years, but younger than 100 years;

- Graves older than 100 years; and

- Graves of victims of conflict or of individuals of royal descent

In terms of Section 36(3) of the National Heritage Resources Act, no person may, without a permit issued by the relevant heritage resources authority:
(a) destroy, damage, alter, exhume or remove from its original position of otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
(b) destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
(c) bring onto or use at a burial ground or grave referred to in paragraph
(a) Or (b) any excavation, or any equipment which assists in the detection or recovery
of metals.

Human remains that are less than 60 years old are subject to provisions of the Human Tissues Act (Act 65 of 1983) and to local regulations. Exhumation of graves must conform to the standards set out in the Ordinance on Excavations (Ordinance no. 12 of 1980) (replacing the old Transvaal Ordinance no. 7 of 1925). Permission must also be gained from the descendants (where known), the National Department of Health, Provincial Department of Health, Premier of the Province and local police. Furthermore, permission must also be gained from the various landowners (i.e. where the graves are located and where they are to be relocated) before exhumation can take place.
A registered undertaker can only handle human remains or an institution declared under the Human Tissues Act (Act 65 of 1983 as amended).

Unidentified/unknown graves are also handled as older than 60 until proven otherwise.
Summary of applicable legislation and legal requirements:

- Human Tissue Act (Act 65 of 1983 as amended).
- Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925)
- Ordinance on Excavations (Ordinance no. 12 of 1980)
- Local and regional provisions, laws and by-laws
- National Heritage Resources Act (Act no. 25 of 1999)
- Permit from SAHRA for removal of human remains

12.2 Graves: necessary procedures

When graves are located in an area demarcated for development, the following mitigation options might be considered:

- **Conservation:** The establishment of a 50 meter buffer zone around the burial place which is fenced off and, maintained and conserved. *This option is generally recommended as the relocation of burial places is an extremely complicated, time consuming and sensitive process.*

- **Mitigation and relocation:** In the event where impact on the burial place will occur, mitigation measures may entail full grave relocation. Such a relocation process must be undertaken by suitably qualified individuals with a proven track record. The relocation must also be undertaken in full cognisance of all relevant legislation, including the specific requirements of the National Heritage Resource Act (Act no. 25 of 1999). Furthermore, a concerted effort must also be made to identify all buried individuals and to contact their relatives and descendants. Other legislative measures which may be of relevance include the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925), the Human Tissues Act (Act no. 65 of 1983, as amended), the Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws that may be in place.

Methodology for grave relocations:

- **Documentation:** Physical documentation of graves and determining context of graves prior to exhumation: Photographic, GPS, Site Map, Historical Background.
- **Public Notices:** In order to locate and notify descendant families, notices (in compliance with the National Heritage Resources Act) must be placed on the site/s, indicating the intent of relocation. These notices, translated into at least 3 languages, have to remain in place for a minimum of 60 days. Additionally, newspaper adverts and notices on local radio stations announcements are required.
- **Social consultation:** If any descendant families were located during initial consultation/public participation phases, a full social consultation action will lodged.
- **Permit application:** Application for a permit from SAHRA can only be obtained after all necessary consent documents from descendant families, landowners and relevant authorities have been secured.
- **Exhumation & relocation**

The exhumation, investigation and reburial of the burial place may commence after SAHRA has issued relevant permits and permissions

13 ADDENDUM 4: CONVENTIONS USED TO ASSESS THE SIGNIFICANCE OF HERITAGE

13.1 Site Significance Matrix

According to the NHRA, Section 2(vi) the **significance** of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these. The following matrix is used for assessing the significance of each identified site/feature.

2. SITE EVALUATION			
2.1 Heritage Value (NHRA, section 2 [3])	High	Medium	Low
It has importance to the community or pattern of South Africa's history or pre-colonial history.			
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.			
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.			
It is of importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.			
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.			
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.			
It has marked or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).			
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.			
It has significance through contributing towards the promotion of a local sociocultural identity and can be developed as a tourist destination.			
It has significance relating to the history of slavery in South Africa.			
It has importance to the wider understanding of temporal changes within cultural landscapes, settlement patterns and human occupation.			
2.2 Field Register Rating			
National/Grade 1 [should be registered, retained]			
Provincial/Grade 2 [should be registered, retained]			
Local/Grade 3A [should be registered, mitigation not advised]			
Local/Grade 3B [High significance; mitigation, partly retained]			
Generally Protected A [High/Medium significance, mitigation]			
Generally protected B [Medium significance, to be recorded]			
Generally Protected C [Low significance, no further action]			
2.3 Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Local			
Specific community			

13.2 Impact Assessment Criteria

The following table provides a guideline for the rating of impacts and recommendation of management actions for sites of heritage potential.

Significance of the heritage resource

This is a statement of the nature and degree of significance of the heritage resource being affected by the activity. From a heritage management perspective it is useful to distinguish between whether the significance is embedded in the physical fabric or in associations with events or persons or in the experience of a place; i.e. its visual and non-visual qualities. This statement is a primary informant to the nature and degree of significance of an impact and thus needs to be thoroughly considered. Consideration needs to be given to the significance of a heritage resource at different scales (i.e. sitespecific, local, regional, national or international) and the relationship between the heritage resource, its setting and its associations.

Nature of the impact

This is an assessment of the nature of the impact of the activity on a heritage resource, with some indication of its positive and/or negative effect/s. It is strongly informed by the statement of resource significance. In other words, the nature of the impact may be historical, aesthetic, social, scientific, linguistic or architectural, intrinsic, associational or contextual (visual or non-visual). In many cases, the nature of the impact will include more than one value.

Extent

Here it should be indicated whether the impact will be experienced:

- On a site scale, i.e. extend only as far as the activity;
- Within the immediate context of a heritage resource;
- On a local scale, e.g. town or suburb
- On a metropolitan or regional scale; or
- On a national/international scale.

Duration

Here it should be indicated whether the lifespan of the impact will be:

- Short term, (needs to be defined in context)
- Medium term, (needs to be defined in context)
- Long term where the impact will persist indefinitely, possibly beyond the operational life of the activity, either because of natural processes or by human intervention; or
- Permanent where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Of relevance to the duration of an impact are the following considerations:

- Reversibility of the impact; and
- Renewability of the heritage resource.

Intensity

Here it should be established whether the impact should be indicated as:

- Low, where the impact affects the resource in such a way that its heritage value is not affected;
- Medium, where the affected resource is altered but its heritage value continues to exist albeit in a modified way; and
- High, where heritage value is altered to the extent that it will temporarily or permanently be damaged or destroyed.

Probability

This should describe the likelihood of the impact actually occurring indicated as:

- Improbable, where the possibility of the impact to materialize is very low either because of design or historic experience;
- Probable, where there is a distinct possibility that the impact will occur;
- Highly probable, where it is most likely that the impact will occur; or
- Definite, where the impact will definitely occur regardless of any mitigation measures

Confidence

This should relate to the level of confidence that the specialist has in establishing the nature and degree of impacts. It relates to the level and reliability of information, the nature and degree of consultation with I&AP's and the dynamic of the broader socio-political context.

- High, where the information is comprehensive and accurate, where there has been a high degree of consultation and the socio-political context is relatively stable.
- Medium, where the information is sufficient but is based mainly on secondary sources, where there has been a limited targeted consultation and socio-political context is fluid.
- Low, where the information is poor, a high degree of contestation is evident and there is a state of socio-political flux.

Impact Significance

The significance of impacts can be determined through a synthesis of the aspects produced in terms of the nature and degree of heritage significance and the nature, duration, intensity, extent, probability and confidence of impacts and can be described as:

- Low; where it would have a negligible effect on heritage and on the decision
- Medium, where it would have a moderate effect on heritage and should influence the decision.
- High, where it would have, or there would be a high risk of, a big effect on heritage. Impacts of high significance should have a major influence on the decision;
- Very high, where it would have, or there would be high risk of, an irreversible and possibly irreplaceable negative impact on heritage. Impacts of very high significance should be a central factor in decision-making.

13.3 Direct Impact Assessment Criteria

The following table provides an outline of the relationship between the significance of a heritage context, the intensity of development and the significance of heritage impacts to be expected

	TYPE OF DEVELOPMENT			
HERITAGE CONTEXT	**CATEGORY A**	**CATEGORY B**	**CATEGORY C**	**CATEGORY D**
CONTEXT 1 High heritage Value	Moderate heritage impact expected	High heritage impact expected	Very high heritage impact expected	Very high heritage impact expected
CONTEXT 2 Medium to high heritage value	Minimal heritage impact expected	Moderate heritage impact expected	High heritage impact expected	Very high heritage impact expected
CONTEXT 3 Medium to low heritage value	Little or no heritage impact expected	Minimal heritage impact expected	Moderate heritage impact expected	High heritage impact expected
CONTEXT 4 Low to no heritage value	Little or no heritage impact expected	Little or no heritage impact expected	Minimal heritage value expected	Moderate heritage impact expected

NOTE: A DEFAULT "LITTLE OR NO HERITAGE IMPACT EXPECTED" VALUE APPLIES WHERE A HERITAGE RESOURCE OCCURS OUTSIDE THE IMPACT ZONE OF THE DEVELOPMENT.

HERITAGE CONTEXTS	CATEGORIES OF DEVELOPMENT
Context 1: Of high intrinsic, associational and contextual heritage value within a national, provincial and local context, i.e. formally declared or potential Grade 1, 2 or 3A heritage resources **Context 2:** Of moderate to high intrinsic, associational and contextual value within a local context, i.e. potential Grade 3B heritage resources. **Context 3:** Of medium to low intrinsic, associational or contextual heritage value within a national, provincial and local context, i.e. potential Grade 3C heritage resources	**Category A: Minimal intensity development** - No rezoning involved; within existing use rights. - No subdivision involved. - Upgrading of existing infrastructure within existing envelopes - Minor internal changes to existing structures - New building footprints limited to less than 1000m2. **Category B: Low-key intensity development** - Spot rezoning with no change to overall zoning of a site. - Linear development less than 100m - Building footprints between 1000m2-2000m2

Context 4: Of little or no intrinsic, associational or contextual heritage value due to disturbed, degraded conditions or extent of irreversible damage.	- Minor changes to external envelop of existing structures (less than 25%) - Minor changes in relation to bulk and height of immediately adjacent structures (less than 25%). **Category C: Moderate intensity development** - Rezoning of a site between 5000m2-10 000m2. - Linear development between 100m and 300m. - Building footprints between 2000m2 and 5000m2 - Substantial changes to external envelop of existing structures (more than 50%) - Substantial increase in bulk and height in relation to immediately adjacent buildings (more than 50%) **Category D: High intensity development** - Rezoning of a site in excess of 10 000m2 - Linear development in excess of 300m. - Any development changing the character of a site exceeding 5000m2 or involving the subdivision of a site into three or more erven. - Substantial increase in bulk and height in relation to immediately adjacent buildings (more than 100%)

13.4 Management and Mitigation Actions

The following table provides a guideline of relevant heritage resources management actions is vital to the conservation of heritage resources.

No further action / Monitoring

Where no heritage resources have been documented, heritage resources occur well outside the impact zone of any development or the primary context of the surroundings at a development footprint has been largely destroyed or altered, no further immediate action is required. Site monitoring during development, by an ECO or the heritage specialist are often added to this recommendation in order to ensure that no undetected heritage\ remains are destroyed.

Avoidance

This is appropriate where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact. Mitigation is not acceptable or not possible. This measure often includes the change / alteration of development planning and therefore impact zones in order not to impact on resources.

Mitigation

This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated to a degree of medium to low significance, e.g. the high to medium impact of a development on an archaeological site could be mitigated through sampling/excavation of the remains. Not all negative impacts can be mitigated.

Compensation

Compensation is generally not an appropriate heritage management action. The main function of management actions should be to conserve the resource for the benefit of future generations. Once lost it cannot be renewed. The circumstances around the potential public or heritage benefits would need to be exceptional to warrant this type of action, especially in the case of where the impact was high.

Rehabilitation

Rehabilitation is considered in heritage management terms as a intervention typically involving the adding of a new heritage layer to enable a new sustainable use. It is not appropriate when the process necessitates the removal of previous historical layers, i.e. restoration of a building or place to the previous state/period. It is an appropriate heritage management action in the following cases:

- The heritage resource is degraded or in the process of degradation and would benefit from rehabilitation.
- Where rehabilitation implies appropriate conservation interventions, i.e. adaptive reuse, repair and maintenance, consolidation and minimal loss of historical fabric.
- Where the rehabilitation process will not result in a negative impact on the intrinsic value of the resource.

Enhancement

Enhancement is appropriate where the overall heritage significance and its public appreciation value are improved. It does not imply creation of a condition that might never have occurred during the evolution of a place, e.g. the tendency to sanitize the past. This

management action might result from the removal of previous layers where these layers are culturally of low significance and detract from the significance of the resource. It would be appropriate in a range of heritage contexts and applicable to a range of resources. In the case of formally protected or significant resources, appropriate enhancement action should be encouraged. Care should, however, be taken to ensure that the process does not have a negative impact on the character and context of the resource. It would thus have to be carefully monitored

PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED SENQU RURAL WATER SUPPLY PROJECT, JOE GQABI DISTRICT MUNICIPALITY, SENQU LOCAL MUNICIPALITY EASTERN CAPE PROVINCE

Compiled for:

Exigo^3 Sustainability (Pty) Ltd
70 Regency Drive
Route 21 Business Park
Centurion
Pretoria 0178
Republic of South Africa

Compiled by
Banzai Environmental

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE:

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 11	
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the	Section 5 – Geological and	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
environmental sensitivities of the site including areas to be avoided, including buffers;	Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 12	
(l) Any conditions for inclusion in the environmental authorisation	Section 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 11	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed to conduct the Palaeontological Impact Assessment for the Senqu Rural Project, Joe Gqabi District Municipality, Senqu Local Municipality, in the Eastern Cape Province. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the planned development area and to evaluate the potential impact of the proposed development on the Palaeontological Heritage.

The proposed Senqu Water Project is underlain by Quaternary alluvium, Jurassic dolerite and the Late Triassic to Early Jurassic Elliot Formation of the Stormberg Group (Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Quaternary alluvium is moderate, that of the Jurassic dolerite is Zero as it is igneous in origin while that of the Eliot Formation is Very High (Almond and Pether, 2009; Almond *et al*., 2013). Most of the site is underlain by Jurassic dolerite.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 16 October 2021. No visible evidence of fossiliferous outcrops was found, although the northern portion of the Sterkspruit area is well known for its well-preserved dinosaur fossils and an overall medium palaeontological sensitivity is allocated to the development footprint. It is thus considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area. And the construction of the development may thus be authorised in its whole extent.

It is thus recommended that:

- The Environmental Control Officer (ECO), responsible for the development should be aware of the possibility of finding fossils in the Elliot Formation of the Stormberg Group (Karoo Supergroup).
- Training of accountable supervisory personnel by a qualified palaeontologist in the recognition of fossil heritage is necessary.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: Eastern Cape Provincial Heritage Resources Authority (ECPHRA), 16 Commissioner Street, East London, 5201, South Africa. Tel: 043 745 0888. Fax: 043 745 0889., email: info@ecphra.org.za; Web: https://www.ecphra.org.za/) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012). It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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Appendix A: CV

1 INTRODUCTION

Most of the infrastructure for the Senqu Rural Water Supply was built on the advent of democracy in late 1990's with no clear record available from the WSA. Currently the water supply is unreliable in most areas supplied by the Senqu Rural Water Supply. The project consists of 15 villages in different wards of Senqu Local Municipality: Dulcies Nek, Mbini, Bamboespruit, Majokong, Rooisand, Enteni, Esilindint, Bensonvale, Magwiji, Magadla, Jozanas Nek, Madakane, Ngutu, Maralaneng and Makheteng (**Figures 1-5**).

The project scope includes **the following components**:

- Equipping of tested boreholes.
- Construction of pump houses for new boreholes.

Construction of limited reticulation to the existing infrastructure and draw-offs for new boreholes.

***Figure 1**: Google Earth Image (2021) indicating the locality of the proposed* Senqu Rural Water Supply Project, Senqu Local Municipality, in the Eastern Cape Province.

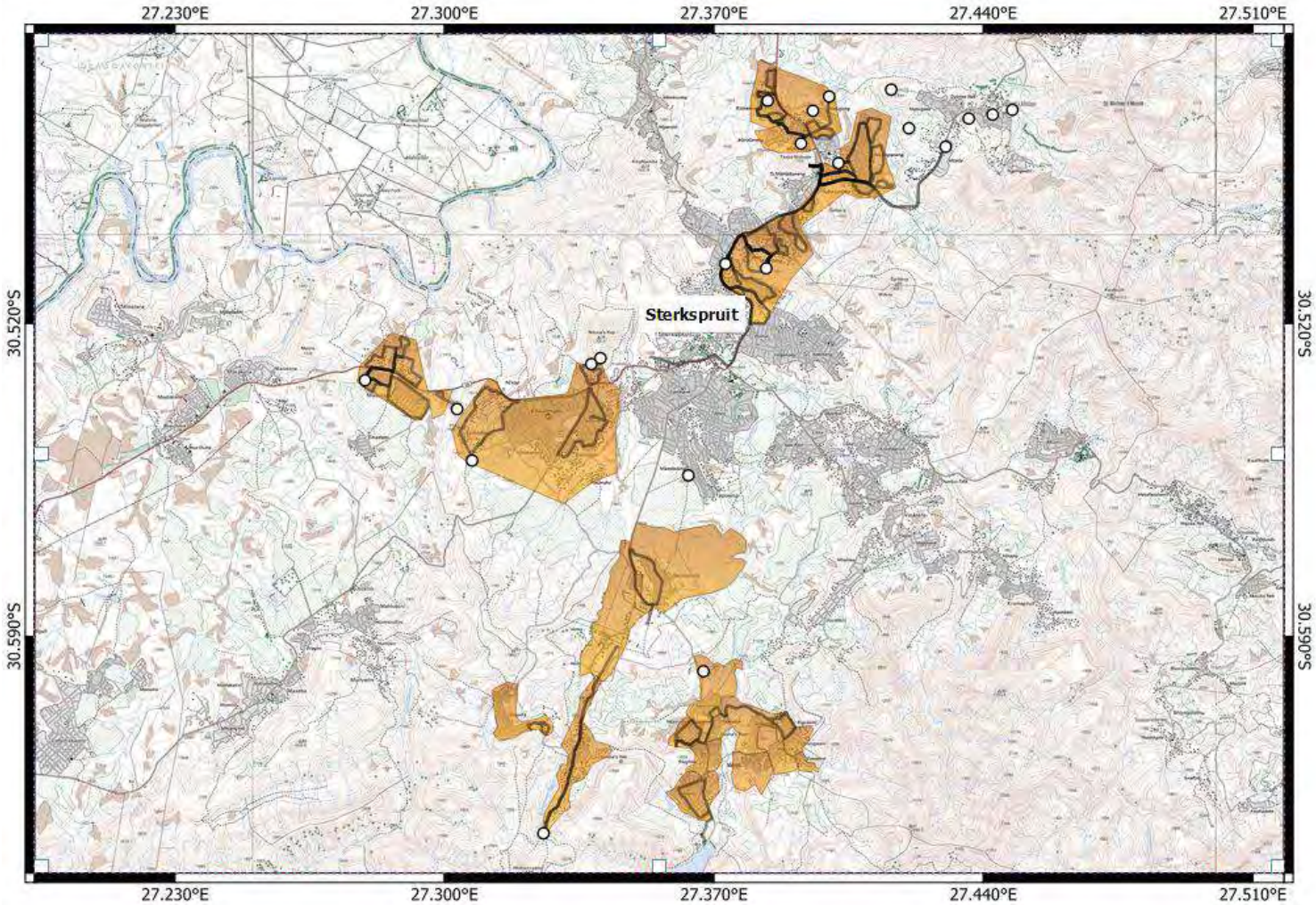


***Figure 2**: Locality map of project in its regional context.*

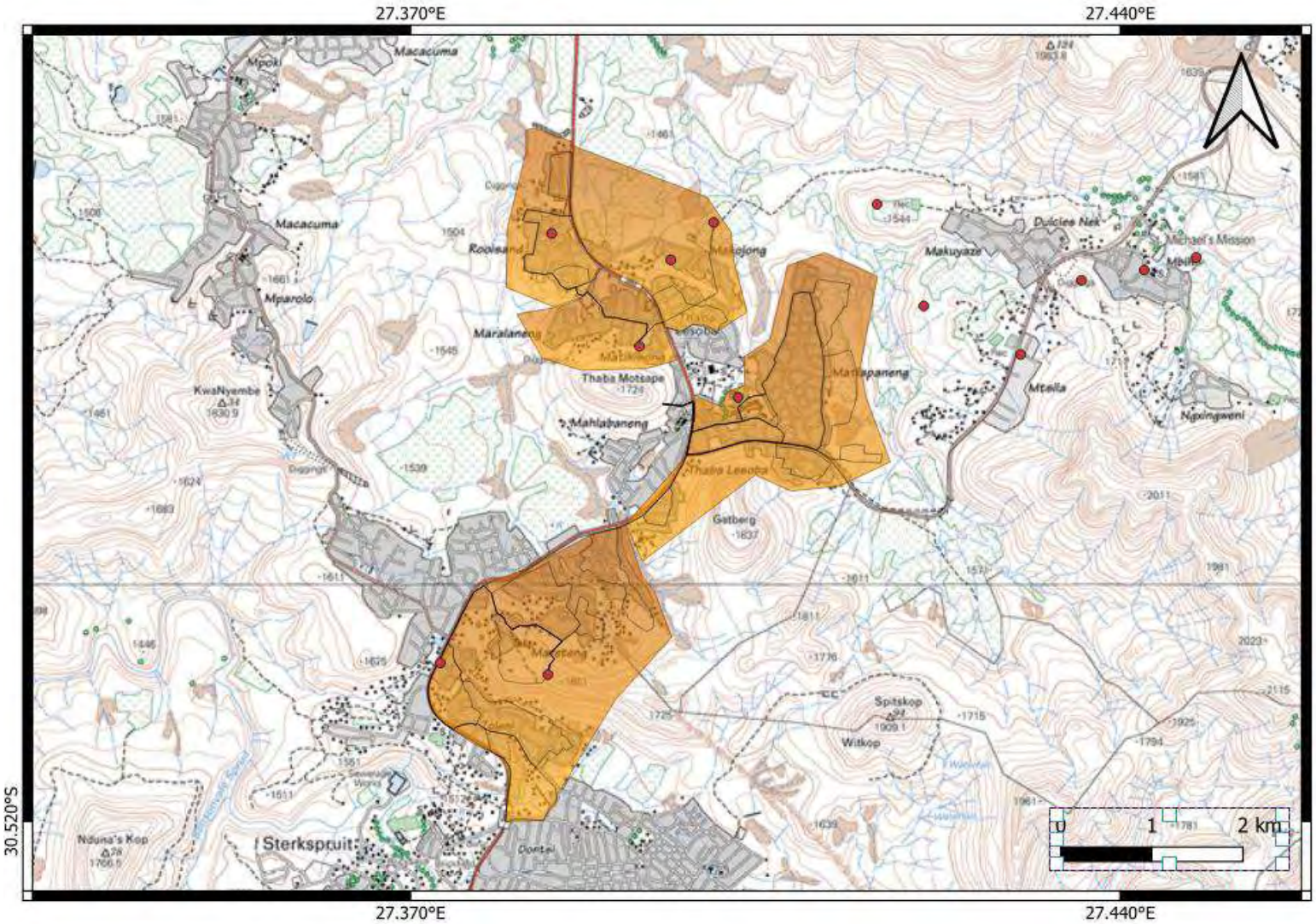


Figure 3: North-eastern section

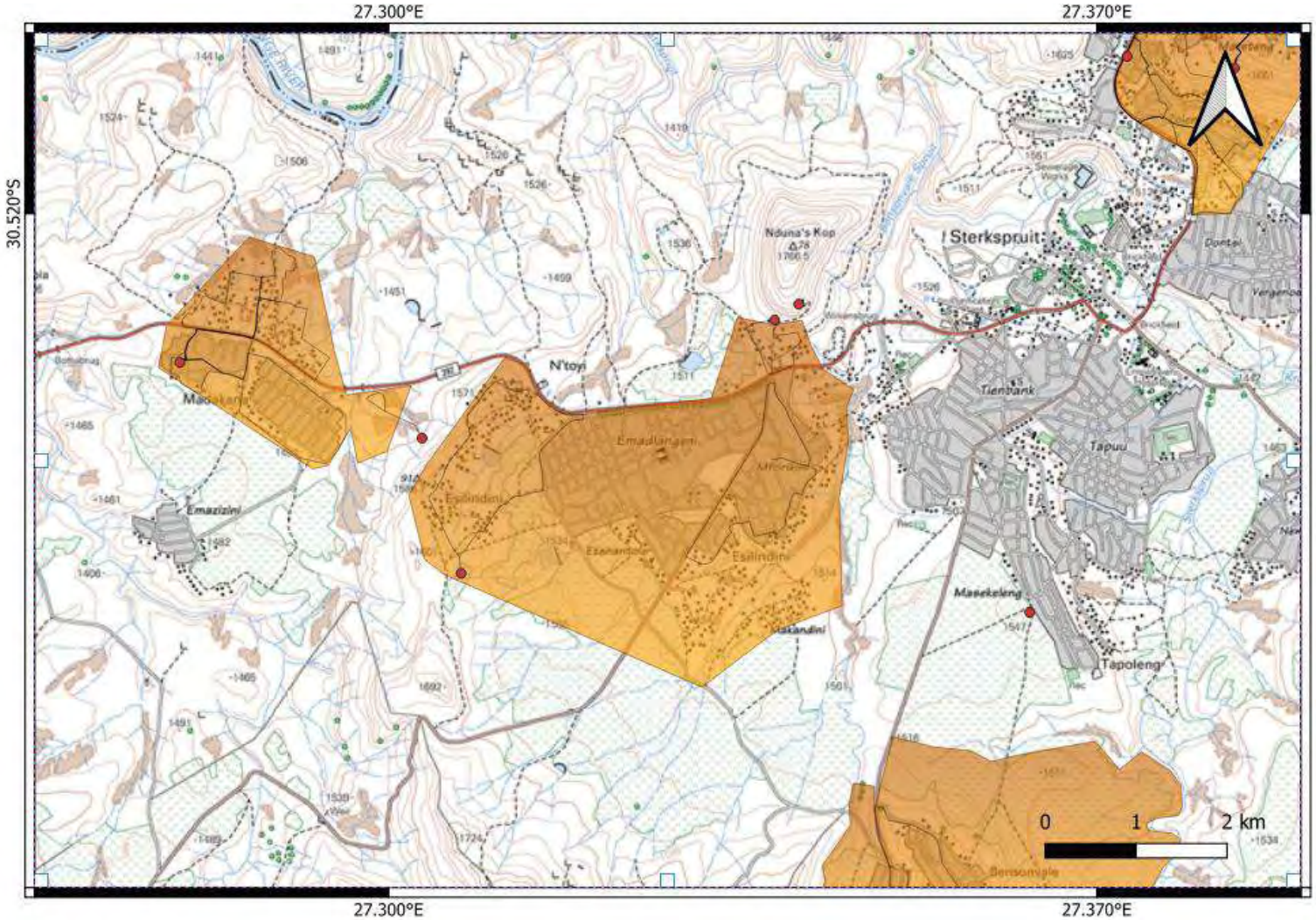


Figure 4: Western section

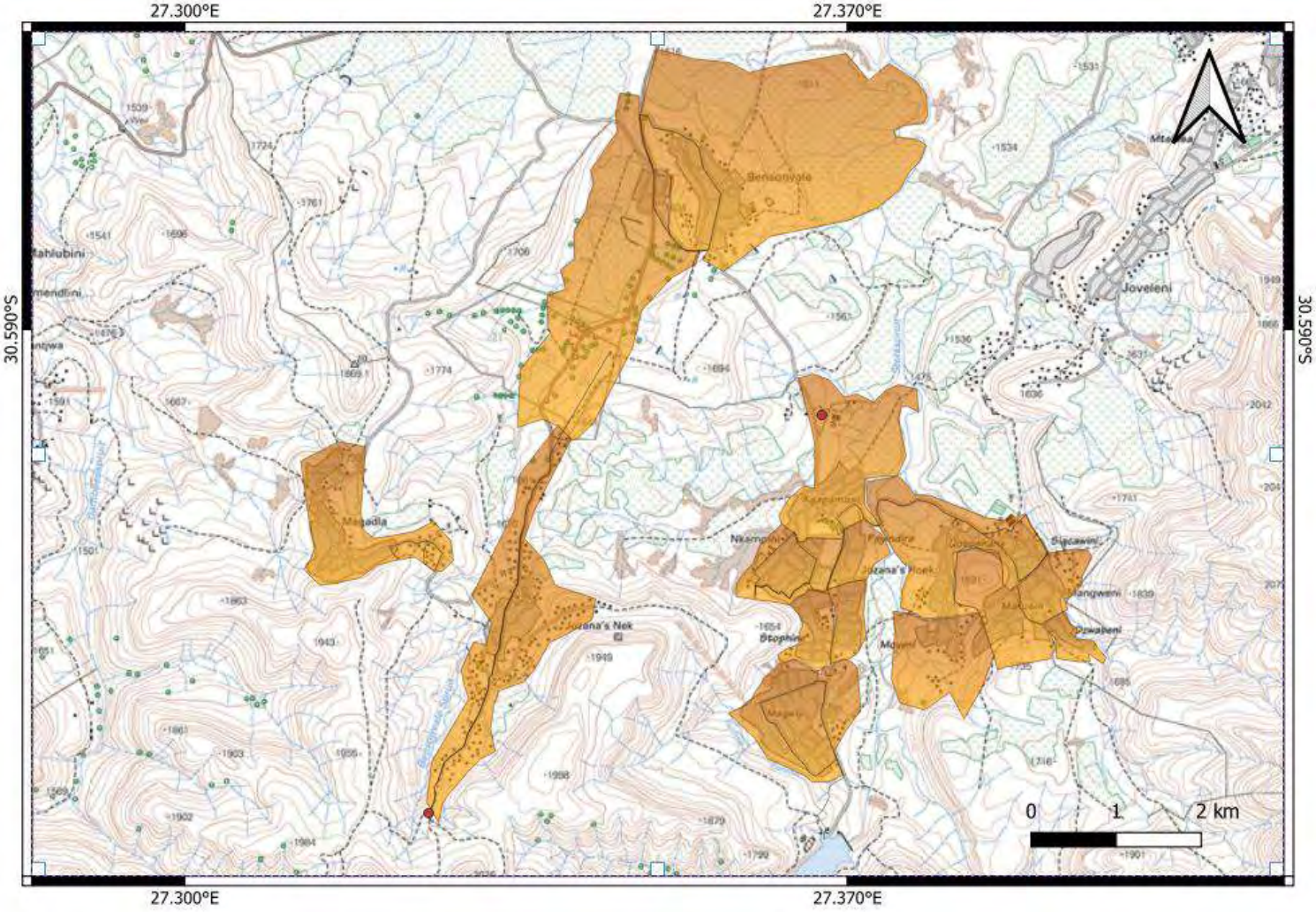


***Figure 5**:* Southern section

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "…*identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*".

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m^2 in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are to: 1) identify rock formations (exposed and subsurface) that are deemed to be paleontologically significant 2) calculate the palaeontological significance of these formations(referring to the literature and Palaeontological Impact Assessments for previous documentation of heritage in the same area), and by conducting a field investigation to identify exposed and potential heritage 3) comment on the potential impact of the development (exposed and/or potential fossil resources) and 4) to recommend how the developer should protect or mitigate damage to fossil resources.

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided);

- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Senqu Rural Water Supply Project, in the Eastern Cape Province is depicted on the 1: 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience, Pretoria). According to this map the proposed development is underlain by Quaternary sediments (yellow, single bird figure), Jurassic dolerite (Jd, red) and the Late Triassic to Early Jurassic Elliot Formation ($T_{RE,}$ orange) of the Stormberg Group (**Figure 6-11**).

The Quaternary **alluvium** deposits are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). These sediments are found at or near the Earth's surface. Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments or larger spreads onshore. These sediments comprise of floodplain and stream deposits. Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termite heaps/ mounds and rhizoliths (root casts).

The **Karoo igneous province** is one of the worlds classic continental basalt (CFB) provinces. This province consists of intrusive and extrusive rocks that occur over a large area (Duncan et al, 2006). Generally, the flood basalts do not contribute to prominent volcanic structures, but instead are formed by successive eruptions from a set of fissures that form sub-horizontal lava flows (sills and dykes) varying in thickness. This lava caps the landscape on which they formed. Today this flood basalt province is preserved as erosional fragments of a more extensive lava cap that covered much of southern Africa in the geological past. It is estimated that the Karoo lava outcrop currently covered at least 140 000 km^2 while it was larger in the past [~2 000 000 km^2 (Cox 1970, 1972)]. The Karoo Igneous Province comprises of a large volume of flood basalts as well as silicic volcanic rocks. These units are comprised of rhyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and are thus classified as rheoignimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic

eruptions took place. Lock *et al* (1974) found evidence in the Eastern Cape that in early stages of volcanism magma interacted with ground water to produce volcaniclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales *et al* (1984) also found pillow lavas and associated hyaloclastite breccias and thin lenses of fluviatile sandstones interbedded with the lowermost magmas.

Large areas of the development are underlain by these igneous sediments that does not contain fossils. Sediments of the Elliot Formation immediate next to the igneous sediments most probably have been baked.

The Karoo Igneous Province can be divided into the Lebombo Group and the Drakensberg Group.

Table 2: Formal stratigraphic units of the Karoo Igneous Province

Karoo Igneous Province			
Drakensberg Group		Lebombo Group	
Formation	Rock Type	Formation	Rock Type
		Movene	Basalt
		Mbuluzi	Rholite
		Jozini	Rhyodacite
Lesotho	Basalt	Sabie River	Basalt
Barkley East	Basalt	Letaba	Picritic basalt
		Mashikri	Nephelinite

All Upper Triassic-Lower Jurassic continental red beds of South Africa are part of the **Elliot Formation**. This red-bed succession consists of mudstone; immature, fine- to medium-grained sandstones; siltstone; strong red-purple-maroon diagenetic colouration mostly of the argillaceous lithologies and lacking widespread marker beds. The Elliot type area in the south of the basin has a maximum thickness of 460 to 480m, thinning northwards in the direction of KwaZuluNatal and the Free State Drakensberg where the thickness varies between 28 and 150 m. The formation was generally deposited in a fluviolacustrine environment that consists of two different types of sandstone (lower and upper part of the Formation). These different sandstones formed by different fluvial depositional styles. The upper part of the Formation generally comprises of tabular, multi-storey sheet sandstones and associated facies caused by loessic, aeolian ephemeral, fluvial, and playa lake processes (Visser and Botha, 1980; Eriksson, 1984, 1985; Smith et al., 1993; Bordy et al., 2004b). In the lower part of the Formation the sandstones consist of multi-storey, asymmetrical channelfills. Scientist belief that these sediments were deposits of perennial, moderately meandering fluvial systems (Botha, 1968; Visser and Botha, 1980; Smith et al., 1993; Bordy et al., 2004b). In the distal Drakensberg regions more, the lower part of the Formation diminished in thickness. This part of the Formation is dominated by an association of seasonal to ephemeral

anastomosing rivers with loessic floodplain fines, and semi-arid sheetflood deposits (Eriksson, 1984, 1985). The differences in fluvial style were generated by changes in the tectonic setting (like tectonic pulses and associated subsidence) as well as climatic conditions.

This Formation is palaeontologically very important as it is known for its early dinosaur fauna that includes prosauropods, the richest known sauropodomorphs (McPhee, McPhee 2017), ornithischians, rare amphibians, turtles, crocodilians and crocodylomorphs, fish, cynodont therapsids and early mammals. Other fossils include crustaceans, insects, woods, and tetrapod trackways (ichnofossils) (Bordy *et al*., 2015).

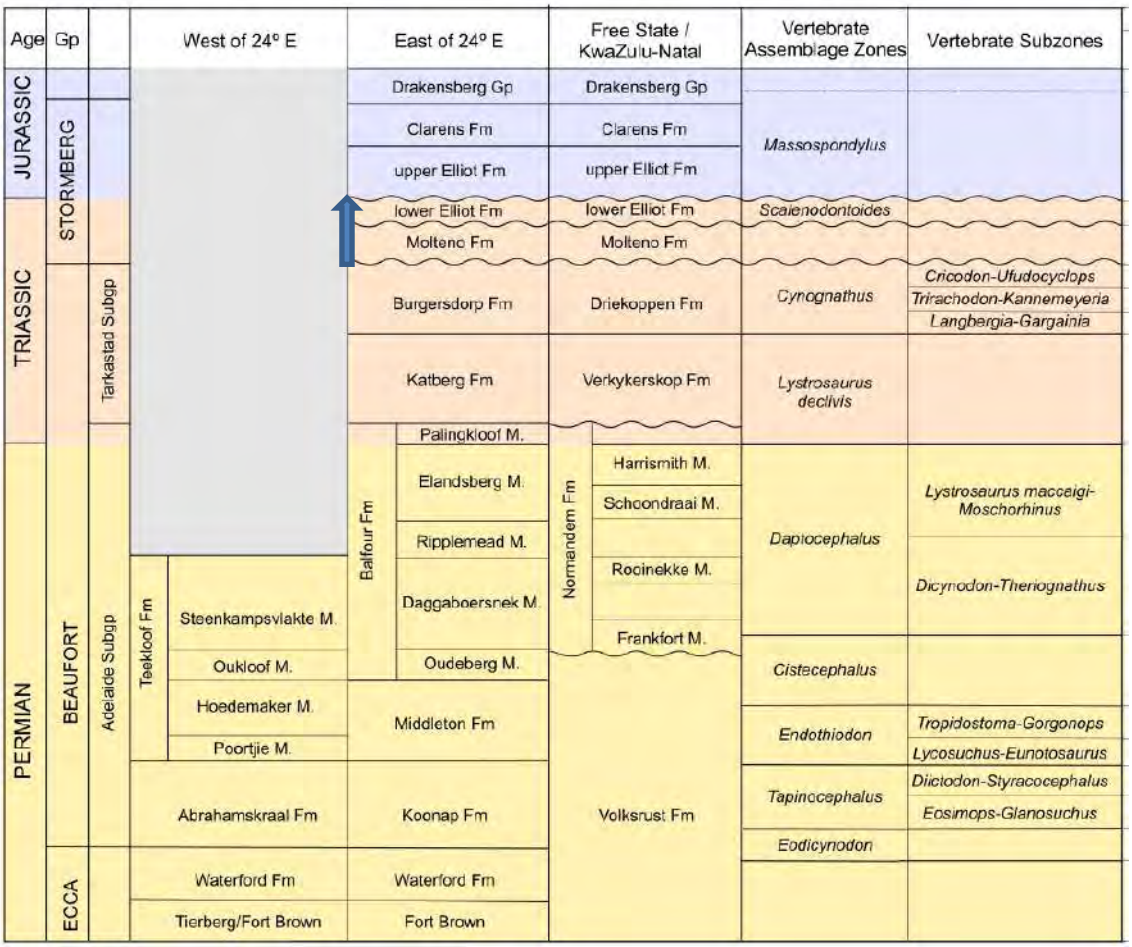


Figure 6*: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa. Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphis position of the taxa that have only been recovered from a single bed. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member. Elliot Formation is indicated by the blue arrow.*

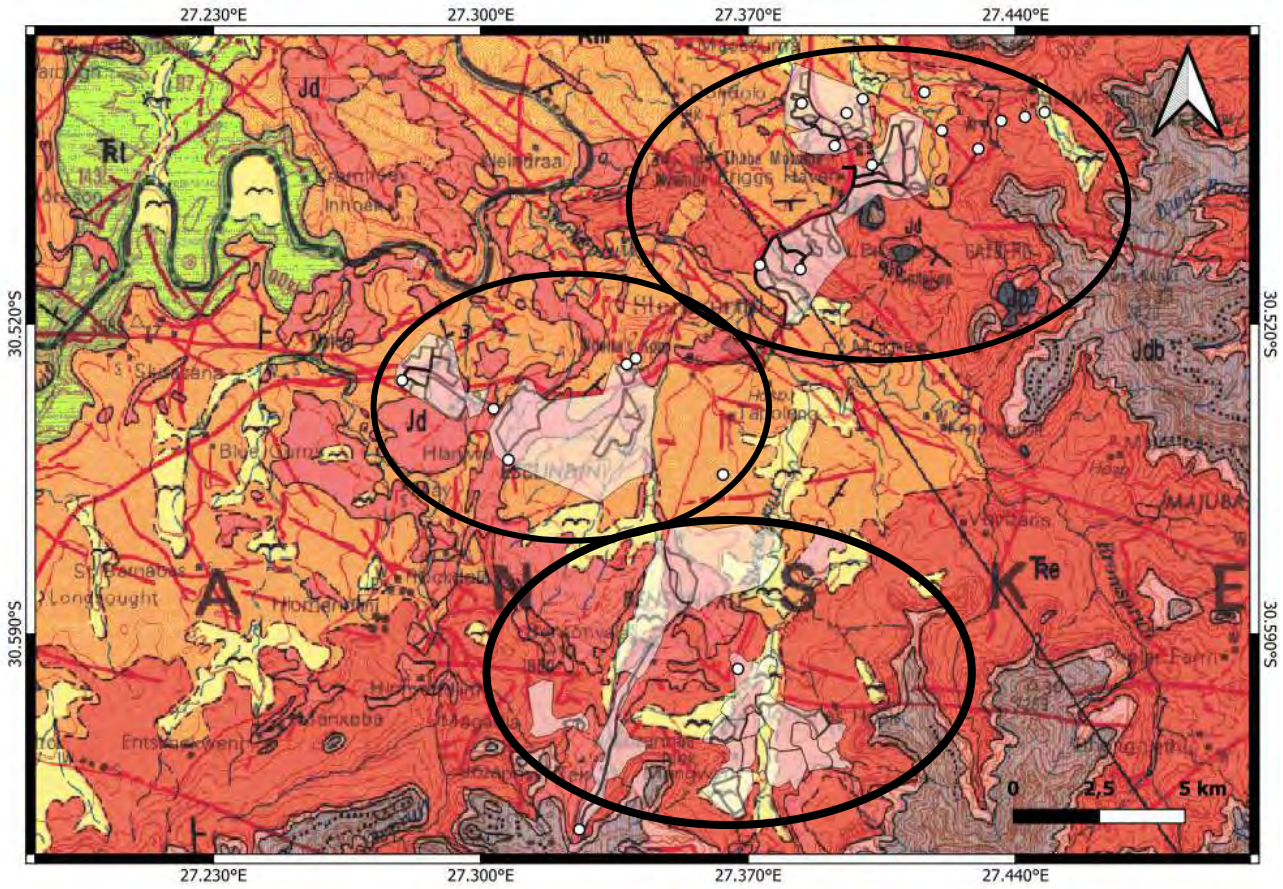


Figure 7: Extract of the 1: 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience, Pretoria) indicating the geology of the proposed Senqu Rural Water Supply Project, in the Eastern Cape Province. The proposed development is underlain by Quaternary alluvium (yellow), Jurassic dolerite (Jd) and the Elliot Formation of the Stormberg Group

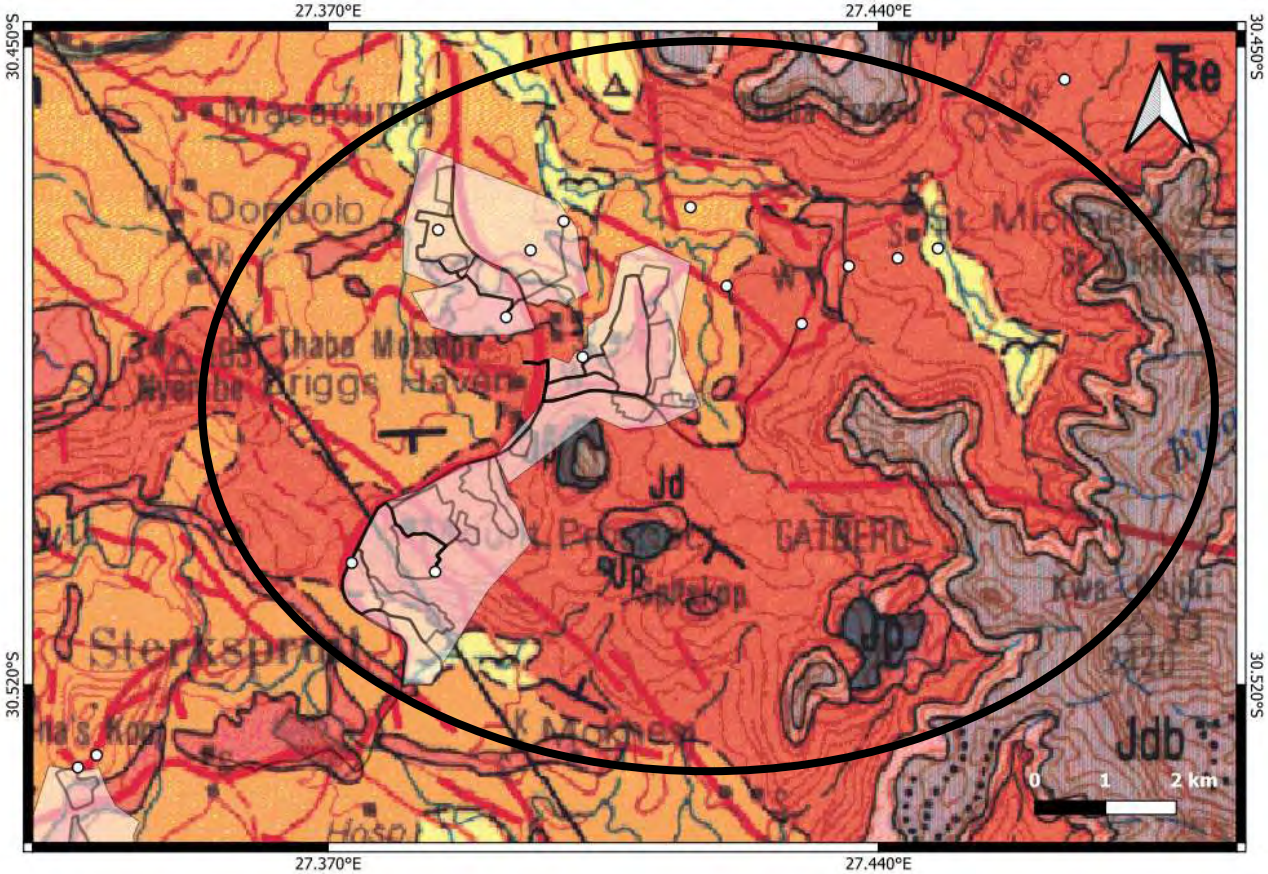


Figure 8: Extract of the 1: 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience, Pretoria) indicating the geology of the north-eastern section of the proposed Senqu Rural Water Supply Project, in the Eastern Cape Province. The proposed development is underlain by Quaternary alluvium (yellow), Jurassic dolerite (Jd) and the Elliot Formation of the Stormberg Group

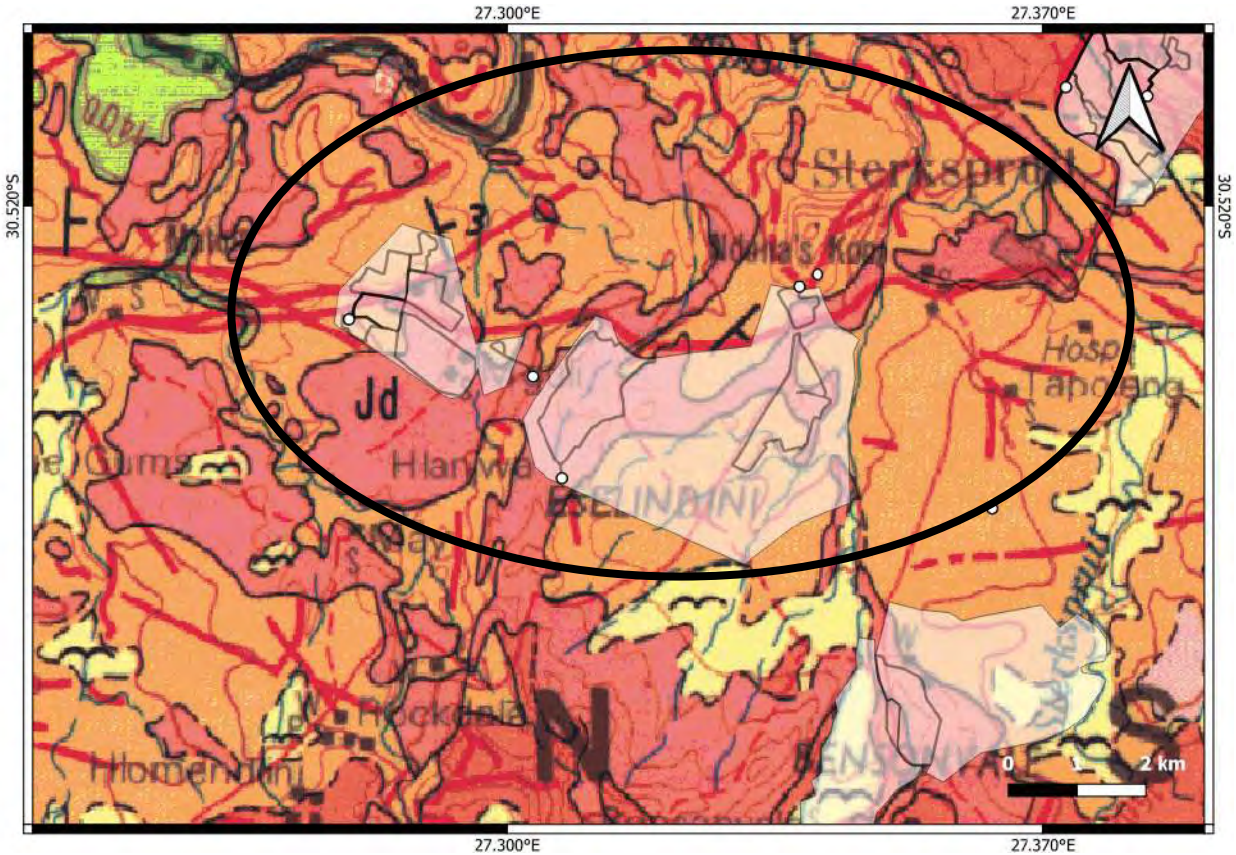


Figure 9: Extract of the 1: 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience, Pretoria) indicating the geology of the middle section of the proposed Senqu Rural Water Supply Project, in the Eastern Cape Province. The proposed development is underlain by Quaternary alluvium (yellow), Jurassic dolerite (Jd) and the Elliot Formation of the Stormberg Group

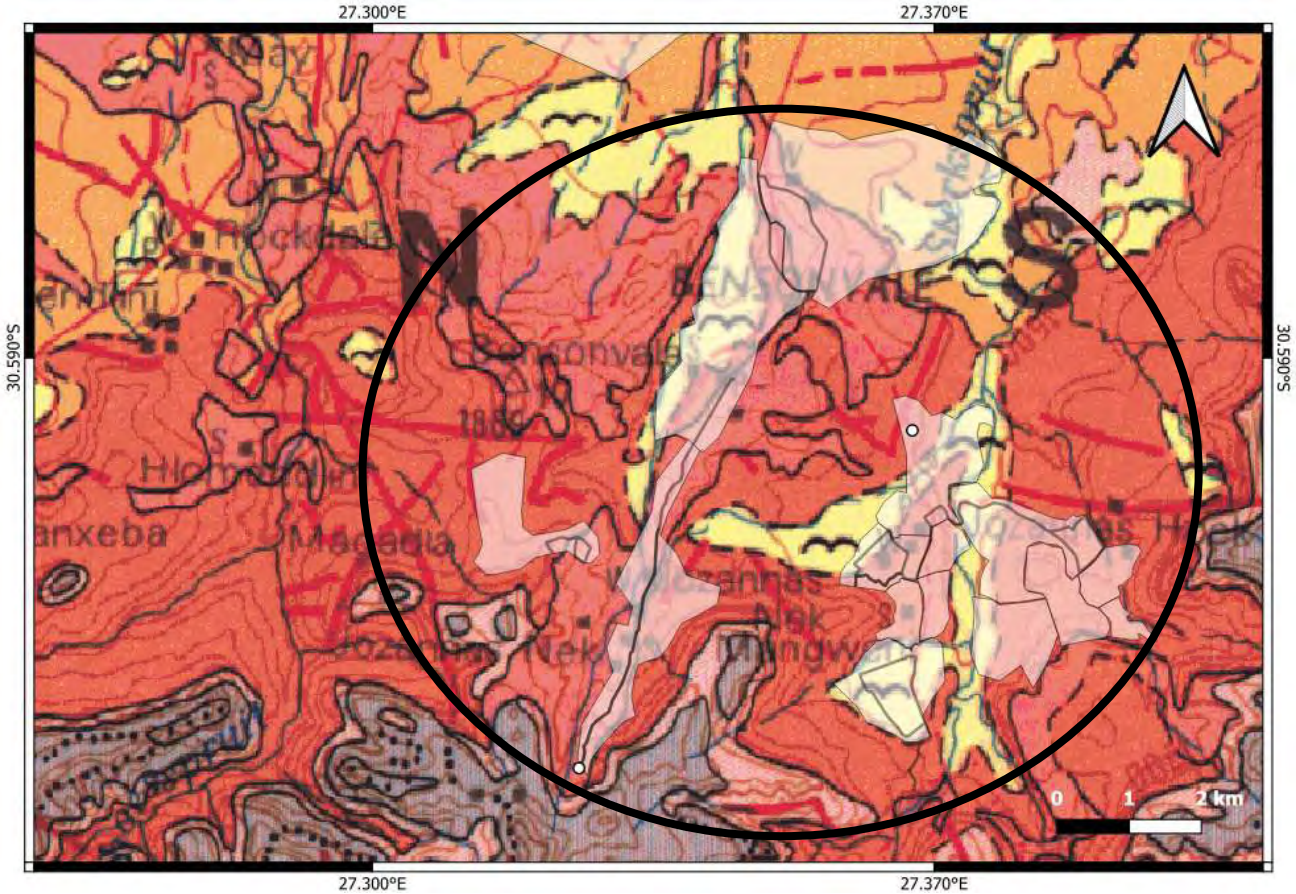
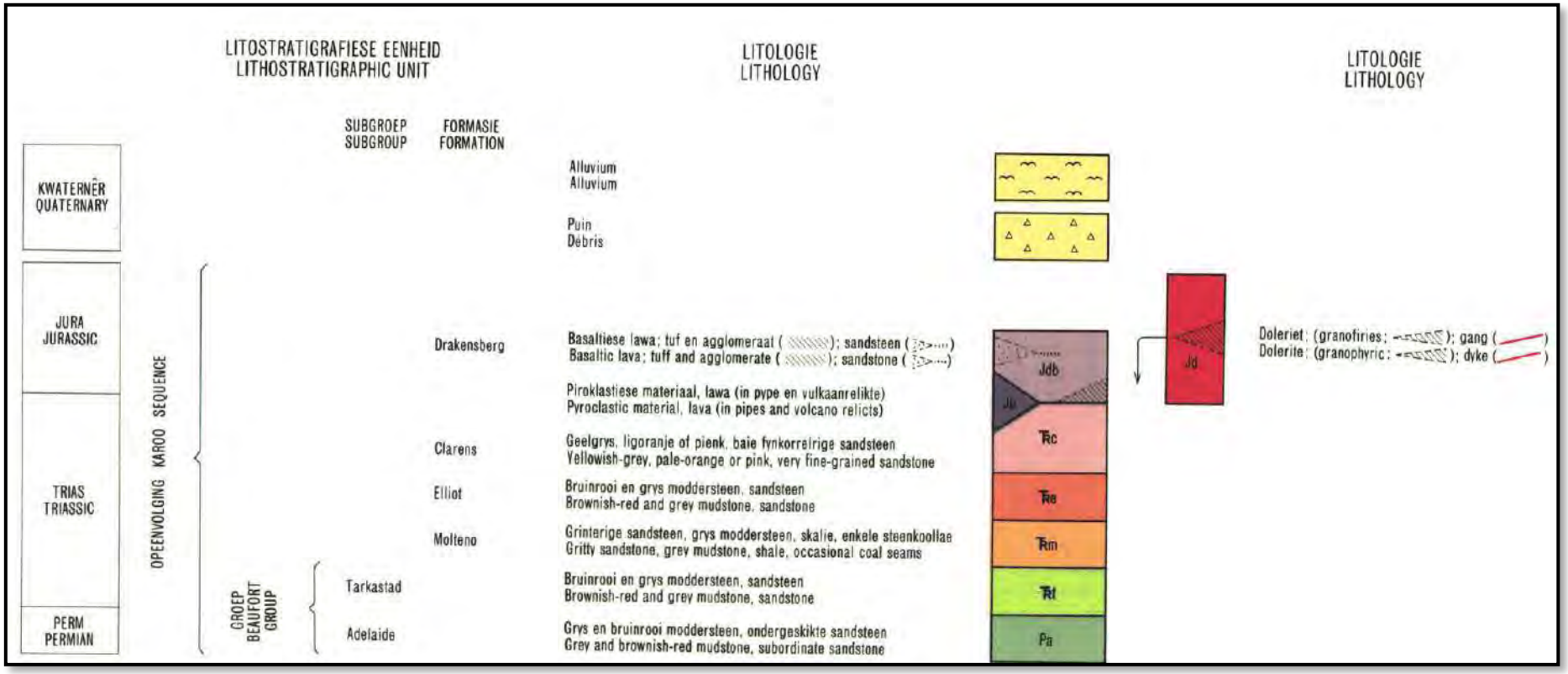


Figure 10: Extract of the 1: 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience, Pretoria) indicating the geology of the southern section of the proposed Senqu Rural Water Supply Project, in the Eastern Cape Province. The proposed development is underlain by Quaternary alluvium (yellow), Jurassic dolerite (Jd) and the Elliot Formation (T_{RE})of the Stormberg Group.

Legend to the 1: 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience, Pretoria)



Quaternary	yellow, sing bird figure		alluvium
Drakensberg Formation	Jdb	purple	Basaltic lava, tuff and agglomerate and sandstone; Pyroclastic material, lava (in pipes and volcanic relics)
Jurassic dolerite-	Jd-	red	
Elliot Formation	T_{RE}	Brownish-red and grey mudstone Stormberg Supegroup	

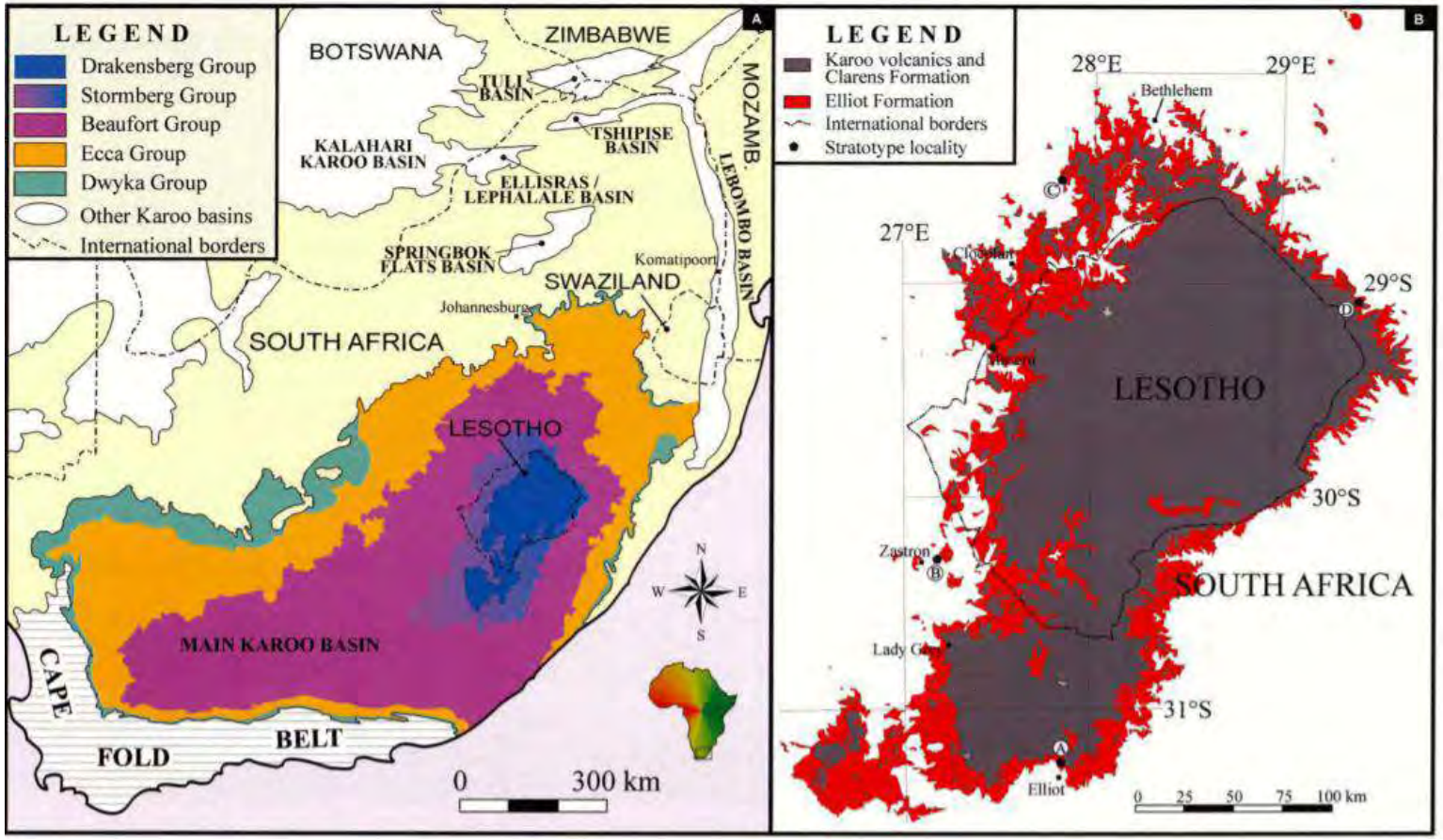


***Figure 11**: Distribution maps of the Elliot Formation in Southern Africa (A) and within the main Karoo Basin (B). [Figure taken form Bordy et al, 2015].*

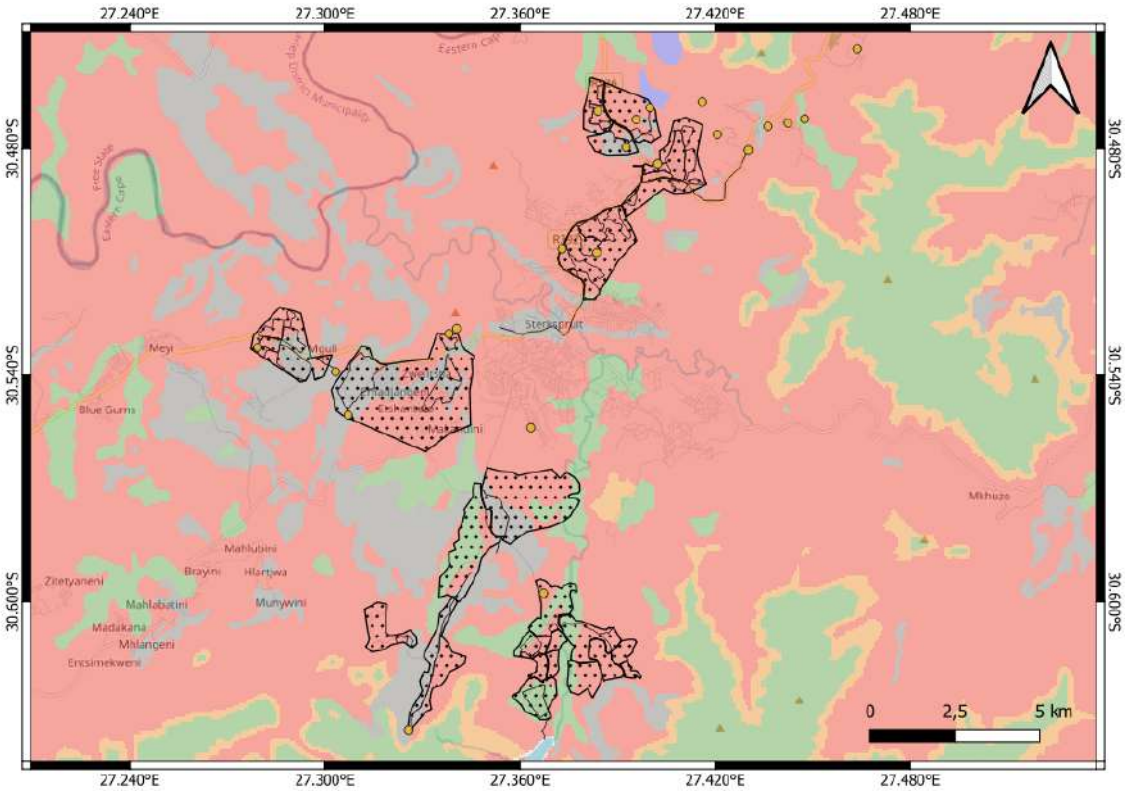


Figure 12: Extract of the 1 in 250 000 SAHRIS PalaeoMap (Council of Geosciences) indicating the location of the proposed development.

Proposed mixed-use development is indicated in black. According to the SAHRIS Palaeosensitivity map (Figure 12) the proposed development is underlain by sediments with a Very High (red) Medium (green) low (blue) and Zero (grey) Palaeontological Significance. Relevant Sensitivities are indicated in Bold.

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**Field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**desktop study is required**
BLUE	**LOW**	**no palaeontological studies are required however a protocol for finds is required**
GREY	**INSIGNIFICANT/ZERO**	**no palaeontological studies are required**
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed project entails 15 villages in different wards of Senqu Local Municipality:

- Dulcies Nek,
- Mbini,
- Bamboespruit,
- Majokong,
- Rooisand,
- Enteni,
- Esilindint,
- Bensonvale,
- Magwiji,
- Magadla,
- Jozanas Nek,
- Madakane,
- Ngutu,
- Maralaneng and
- Makheteng

These villages can be accessed via Sterkspruit through R58 east from Aliwal North and then R392 towards Sterkspruit Town

Table 3: Project locality

Location	*Latitude*	*Longitude*
Sterkspruit	*-30.529492°*	*27.373648°*

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological Impact Assessment reports in the same area, aerial photos and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is sourced to provide information on the existence of fossils in an area which was not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. **A field-assessment will thus improve the accuracy of the desktop assessment.**

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984);
- 1: 250 000 Geological map : 250 000 3026 Aliwal North Geological map (1983) (Council of Geoscience)
- A Google Earth map with polygons of the proposed development was obtained from Exigo.

9 SITE VISIT

The northern Sterkspruit area is known for its beautifully preserved dinosaur fossils. A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 16 October 2021. However, no visible evidence of fossiliferous outcrops was identified in the proposed development area. Large areas of the development is underlain by igneous sediments that does not contain fossils. Sediments of the Elliot Formation immediate next to the igneous sediments most probably have been baked.

Figure 13*: Jozanas Hoek Dam, the most southern portion of the development where the raw water abstraction takes place. The area is underlain by dolerite and superficial Quaternary sediments as well as vegetation.*

Figure 14*:Quaternary superficial sediments overlying the Elliot Formation*

GPS coordinates -30.635278S; 27.367778E

Figure 15: Water pipeline crossing a stream

GPS coordinates -30.620278S; 27.368333E

Figure 16::Proposed pipeline in Jozanas Neck. Grass in the foreground with small bushes in the donga.

GPS coordinates -30.609722S; 27.369444E

Figure 17:*Reservoir with loose rocks in the foreground. No fossiliferous outcrops*

GPS coordinates -30.597778S; 27.364722E

Figure 18:*Reservoir on flats.*

GPS coordinates -30.556111S; 27.373611E

Figure 19*:Water tanks in grass with a few isolated loose rocks, no fossiliferous outcrops*

GPS coordinates - -30.530000S 27.285278E

Figure 20:. Loose rocks overlying Quaternary sediments

GPS coordinates -30.535278S 27.349444E

Figure 21:Pipeline route along the R392, surface is covered by grass with no outcrops

GPS coordinates -30.530278S 27.358611E

Figure 22:Reservoir

GPS coordinates -30.439167S 27.375833E

Figure 23:Borehole locality in Rooiwal
GPS coordinates -30.453611S 27.463611E

10 IMPACT ASSESSMENT METHODOLOGY

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 4: The rating system

NATURE

The Nature of the Impact is the possible destruction of fossil heritage		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		

1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		

1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: [(**Extent (1) + probability (3) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect (3)] x magnitude/intensity (2).** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

10.1 Summary of Impact Tables

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures, the damage or destruction of any palaeontological

materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur. A negative medium Significance has been allocated to the proposed development.

Table 5: Summary of Impacts

	Site	Probability	Duration	Magnitude	Reversibility	Irreplicable Loss	Cumulative Effect	Significance
Pre-mitigation	1	2	4	4	4	4	2	68
Post--mitigation	1	2	4	2	4	4	2	32

11 FINDINGS AND RECOMMENDATIONS

The proposed Senqu Water Project is underlain by Quaternary alluvium, Jurassic dolerite and the Late Triassic to Early Jurassic Elliot Formation of the Stormberg Group (Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Quaternary alluvium is moderate, that of the Jurassic dolerite is Zero as it is igneous in origin while that of the Eliot Formation is Very High (Almond and Pether, 2009; Almond *et al*., 2013). Most of the site is underlain by Jurassic dolerite.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 16 October 2021. No visible evidence of fossiliferous outcrops was found, although the northern portion of the Sterkspruit area is well known for its well-preserved dinosaur fossils and an overall medium palaeontological sensitivity is allocated to the development footprint. It is thus considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area. And the construction of the development may thus be authorised in its whole extent.

It is thus recommended that:

- The Environmental Control Officer (ECO), responsible for the development should be aware of the possibility of finding fossils in the Elliot Formation of the Stormberg Group (Karoo Supergroup).
- Training of accountable supervisory personnel by a qualified palaeontologist in the recognition of fossil heritage is necessary.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. These discoveries

ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: Eastern Cape Provincial Heritage Resources Authority (ECPHRA), 16 Commissioner Street, East London, 5201, South Africa. Tel: 043 745 0888. Fax: 043 745 0889., email: info@ecphra.org.za; Web: https://www.ecphra.org.za/) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012). It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

12 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

12.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA).** According to Section 3 of the Act, all Heritage resources include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

12.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

12.3 Introduction

This informational document is intended for workmen and foremen on the construction site. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

12.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.

- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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Appendix A – Elize Butler CV

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 26 years in Palaeontology

EDUCATION:

B.Sc Botany and Zoology, 1988
University of the Orange Free State

B.Sc (Hons) Zoology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part-time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

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