PROPOSED HAUL ROAD FOR CAPE LIME (PTY) LTD., VREDENDAL, WESTERN CAPE.

Freshwater Assessment Report

For:

Cape Lime (Pty) Ltd

By:

Confluent Environmental

October 2020

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Declaration of Specialist Independence

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;
- I do not have any influence over decisions made by the governing authorities;
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- I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;
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- All the particulars furnished by me in this document are true and correct.

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September 2020

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1. INTRODUCTION

1.1 Project Background

Cape Lime (Pty) Ltd, a subsidiary of Afrimat Ltd, currently mines and processes limestone and dolomite on the Portion 1 of Farm 308, near Vredendal, Western Cape. The current activities entail, apart from mining of limestone and dolomite, crushing and screening of all mined material, as well as calcination of limestone in a fluid bed lime kiln. The markets currently served are water treatment, glass industry, aggregates, mineral fillers, steel making and chemical industries.

A new haul road (approximately 8.7 km long) is being applied for as part of an environmental authorisation for Cape Lime. The road will link the Maskam mine (located on the eastern side of the N7) to the existing processing plant. This road will be a significant shortcut for trucks delivering mined material to the crusher plant on the property. The proposed route will involve widening existing roads to a width of 15 m and constructing new sections of road.

1.2 Key Legislative Requirements

1.2.1 *National Environmental Management Act (NEMA, 1998)*

The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA regulations, the applicant is required to appoint an Environmental Assessment Practitioner (EAP) to undertake the EIA, as well as conduct the public participation process.

The objective of the Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the activities that have been identified. The purpose of these procedures is to provide the competent authority with adequate information to make decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorized, and that activities which are authorized are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

In accordance with the provisions of Sections 24 (5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982 as amended in 2017) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an Environmental Authorisation (EA). These Regulations provide a detailed description of the EIA process to be followed when applying for EA for any listed activity. The Regulations differentiate between a simpler Basic Assessment process, and a more comprehensive EIA process (activities listed in GN R. 984).

1.2.2 *National Water Act (NWA, 1998)*

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

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

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be
- A watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, a Water Use License (WUL) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

Given that the proposed road will cross several watercourses, the proposed activity does fall within the regulated area of a watercourse. Any water use activities that do occur within the regulated area of a watercourse must therefore be assessed using the DWS Risk Assessment Matrix (GN 509) to determine whether activities may be generally authorised (Low Risk according to the Risk Assessment Matrix) or require a WUL (Medium or High Risk according to the Risk Assessment Matrix).

1.3 Scope of Work

Based on the key legislative requirements listed above the scope of work for this report includes the following:

- Undertake a site visit to the study area;
- Delineate the freshwater ecosystems present along the proposed haul road;
- Determine the present ecological state, functional importance and conservation value of the freshwater ecosystems that could potentially be impacted by the proposed haul road;

- Describe and assess the significance of the potential impacts of the proposed haul road on freshwater ecosystems;
- Recommend mitigation measures (and the width of the required buffer areas) to minimise the potential negative impacts on freshwater ecosystems;
- Provide a summary of the findings in the form of a Freshwater Ecology Impact Assessment Report; and
- Compile a DWS Risk Assessment to determine the water use authorisation requirements for the proposed haul road.

2. METHODS

2.1 Desktop Assessment

A desktop assessment was conducted to contextualise affected watercourses in terms their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment:

- National Freshwater Ecosystem Priority Area (NFEPA) atlas (Nel at al., 2011);
- Western Cape Biodiversity Spatial Plan (CapeNature, 2017); and
- DWS hydrological spatial layers.

2.2 Baseline Assessment

A site visit was conducted on the 23rd of September 2020, with the objective of assessing and classifying the watercourses affected by the haul road; determining their Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), and assessing the impacts of the haul road on watercourses.

2.2.1 *Watercourse Classification*

Classification of watercourses is important as this determines the PES and EIS assessment methodologies that can be applied. Furthermore, classification of the watercourse provides a fundamental understanding of the hydrological and geomorphic drivers that characterise the watercourse and therefore assists in the interpretation of impacts to the watercourse. Watercourses were categorised into discrete hydrogeomorphic units (HGMs) based on their geomorphic characteristics, source of water and pattern of water flow through the watercourse. These HGMs were then classified according to Ollis et al. (2013).

2.2.2 *Present Ecological State*

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The PES of the watercourse was assessed using the Index of Habitat Integrity (IHI; Kleynhans, 1996). The IHI was regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and, therefore, produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively – Table 1) based on their degree of modification, along with a confidence rating based on the level of confidence in the score.

Weighting scores are used to assess the extent of modification for each criterion (x):

$$Weighted\ Score = \frac{IHI_x}{25} \times Weight_x$$

Where;

- IHI = rating score for the criteria (Table 1);
- 25 = maximum possible score for a criterion; and
- Weight = Weighting score for the criteria (Table 2).

Table 1: Descriptive classes for the assessment of habitat modifications (Kleynhans, 1996)

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

Table 2: Criteria and weights used for the assessment of instream and riparian zone habitat integrity

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**		**100**

The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified – **Error! Not a valid bookmark self-reference.**).

Table 3: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 – 19

2.2.3 *Ecological Importance and Sensitivity*

The ecological importance of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al. 1988; Milner 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity.

The ecological importance and sensitivity (EIS) of the watercourse was assessed using a method developed by Kleynhans (1999). In summary, several biological and aquatic habitat determinants are assigned a score ranging from 1 (low importance or sensitivity) to 4 (high importance or sensitivity). These determinants include the following:

- **Biodiversity support:**
  - Presence of Red Data species;
  - Presence of unique instream and riparian biota;
  - Use of the ecosystem for migration, breeding or feeding.
- **Importance in the larger landscape:**
  - Protection status of the watercourse;
  - Protection status of the vegetation type;
  - Regional context regarding ecological integrity;

  - Size and rarity of the wetland types present;
  - Diversity of habitat types within the wetland.
- **Sensitivity of the watercourse:**
  - Sensitivity of watercourse to changes in flooding regime;
  - Sensitivity of watercourse to changes in low flow regime, and
  - Sensitivity to water quality changes.

The median value of the scores for all determinants is used to assign an EIS category according to Table 4.

Table 4: Ecological importance and sensitivity categories. Interpretation of average scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high: Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and <=4	A
High: Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.	>2 and <=3	B
Moderate: Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use	>1 and <=2	C
Low/marginal: Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and <=1	D

2.3 Impact Assessment

Development activities typically impact on the following important drivers of aquatic ecosystems:

- *Hydrology:* Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes and base flows and modifications to general flow characteristics, including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river etc.);
- *Geomorphology:* This refers to the alteration of hydrological and geomorphological processes and drivers, and associated impacts to aquatic habitat and ecosystem goods and services primarily driven by changes to the sediment regime of the aquatic ecosystem and its broader catchment;

- *Modification of water quality:* This refers to the alteration or deterioration in the physical, chemical and biological characteristics of water within streams, rivers and wetlands, and associated impacts to aquatic habitat and ecosystem goods and services (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication etc.);
- *Fragmentation:* Loss of lateral and/or longitudinal ecological connectivity due to structures crossing or bordering watercourses (e.g. road or pipeline crossing a wetland);
- *Modification of aquatic habitat:* This refers to the physical disturbance of in-stream and riparian aquatic habitat and associated ecosystem goods and services including the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.)*;* and
- *Aquatic biodiversity:* Impacts on community composition (numbers and density of species) and integrity (condition, viability, predator prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site.

Modifications to these drivers ultimately influence the PES and EIS of a watercourse. Accordingly, impacts to the watercourse were described and assessed based on their potential to modify each of the above-mentioned drivers of aquatic ecosystem health, using the PES and EIS of the watercourse as a baseline against which to assess impacts. The impact assessment methodology is described in the appendix to this report (Appendix 1).

2.4 DWS Risk Assessment

The risk assessment matrix (Based on DWS 2015 publication: Section 21 (c) and (i) water use Risk Assessment Protocol) was implemented to assess risks for each activity associated with the construction and operational phase. The first stage of the risk assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions and methodology applied in the impact assessment are provided in Appendix 2 of this report. Risks were assessed assuming full implementation of recommended mitigation measures.

3. ASSUMPTIONS & LIMITATIONS

- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked;
- This assessment is based on the findings of a visual assessment of the site combined with available desktop resources. This study was not informed by detailed hydraulic, hydrological, faunal or floral assessments;
- The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. An effort has been made to substantiate all claims where applicable and necessary.

4. STUDY SITE

The haul road will extend from the N7 across from the entrance to Maskam Mine (Portion 5 of the Farm 511), pass through the Remaining Portion of Farm 308 (owned by the neighboring farmer) and into Portion 1 of Farm 308 (mine property). Two alternative routes have been proposed (Figure 1).

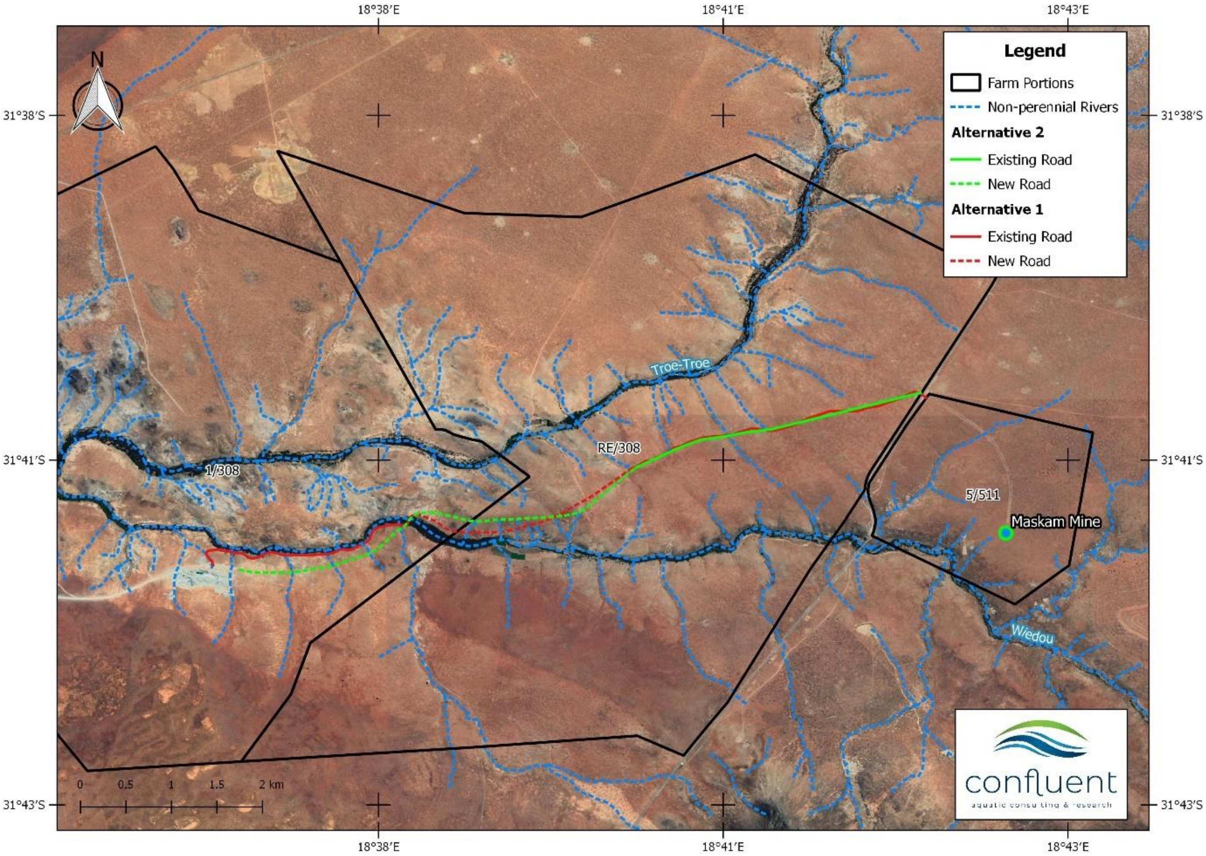

Figure 1: Proposed alternative routes for the haul road from Maskam Mine.

The properties and proposed haul road are located in quaternary catchment E33G of the Olifants-Doring Primary Catchment (Figure 2). The catchment area falls within the Western Coastal Belt (Ecoregion Level 2: 25.01) (Figure 3). The terrain morphology consists of undulating hills and closed hills and mountains with moderate to high relief. Altitude ranges between 0 - 700 m.a.m.s.l, and the rainfall is low (mean annual precipitation of 100 – 200 mm). Summers are very hot (mean daily maximum temperature of 24 to 32 ºC) and winters are mild (mean daily maximum temperature of 16 to 24 ºC).

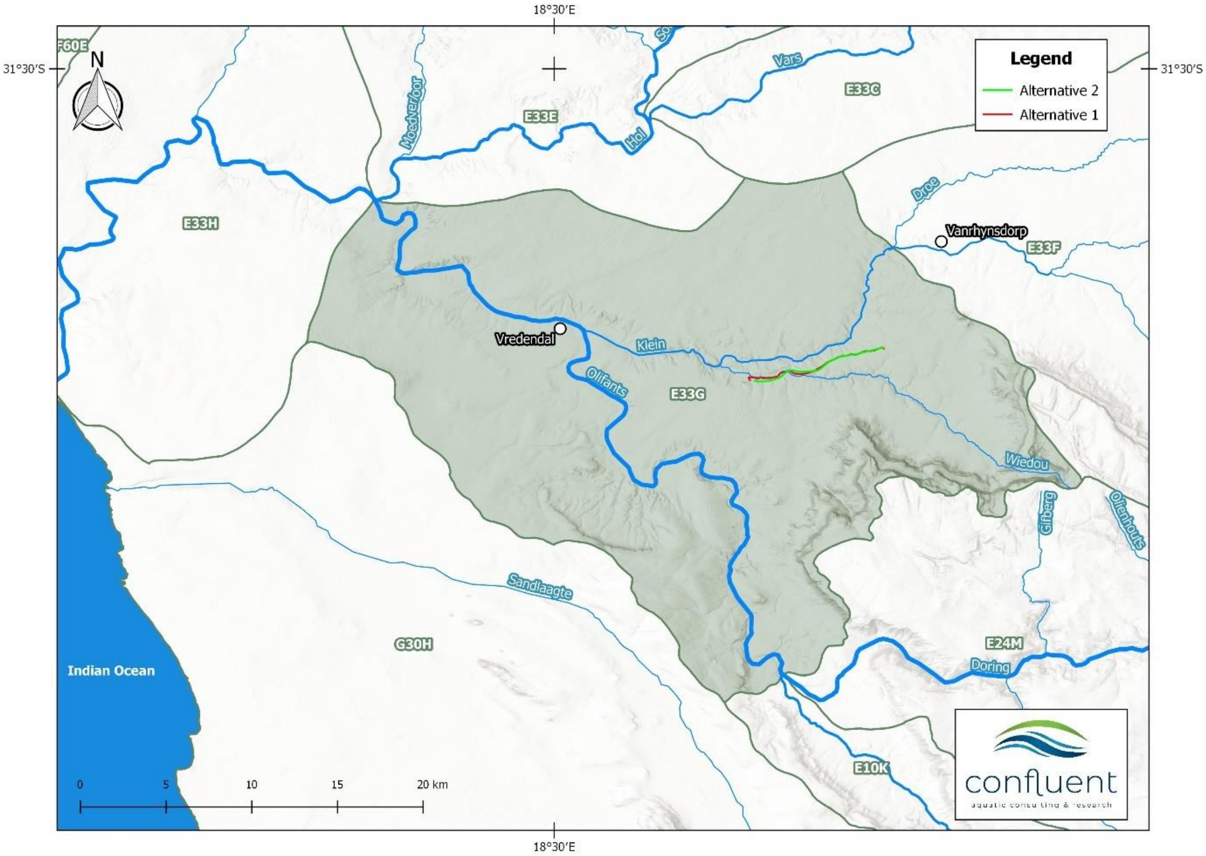

Figure 2: Location of the proposed haul road in quaternary catchment E33G.

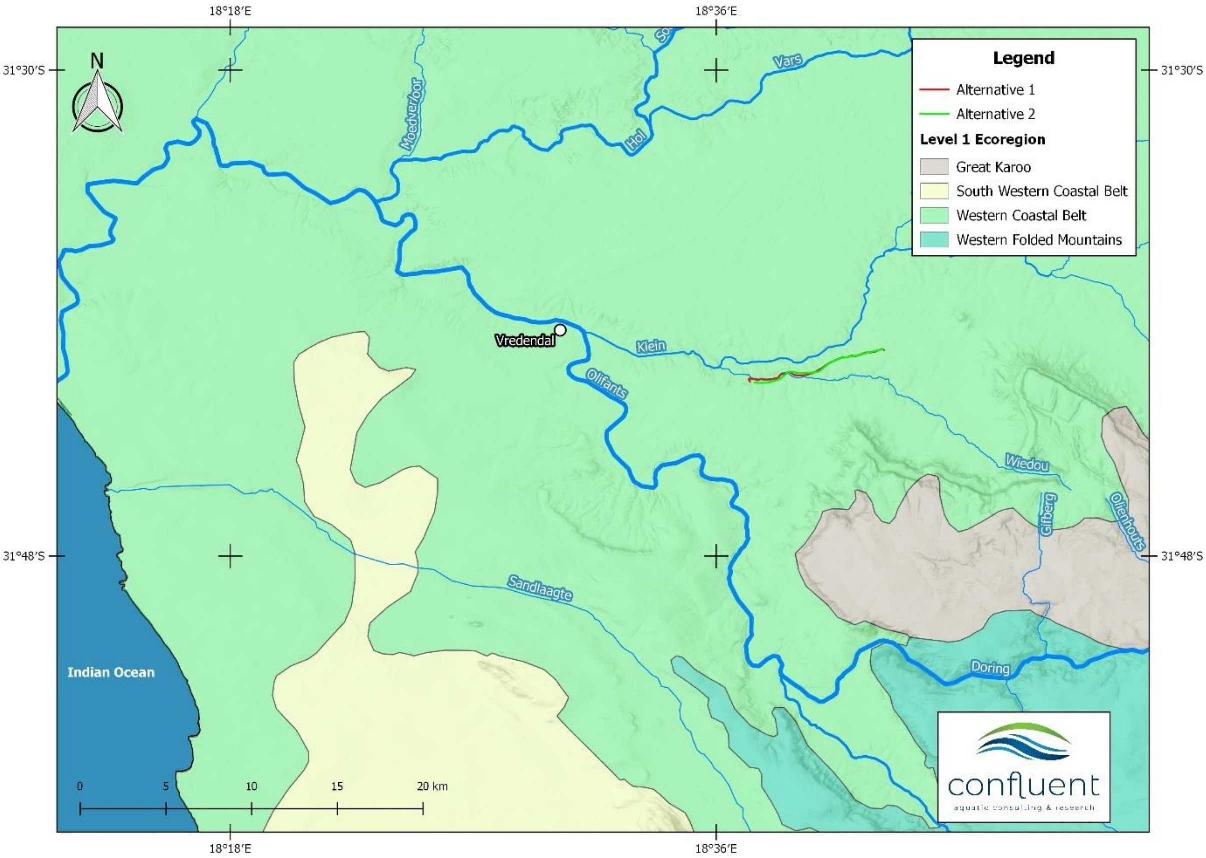

Figure 3: Map indicating the location of the proposed haul road in relation to Level 1 Ecoregions.

4.1 National Freshwater Ecosystem Priority Areas (NFEPA)

The proposed haul road runs along the catchment divide of sub-quaternary catchment (SQCs) 6733 and 6630 (Figure 4). The Wiedou and Troe-Troe are the main river reaches in SQC 6733 and 6630, respectively, and join to form the Klein River, which ultimately flows into the Olifants River. According to the National Freshwater Ecosystem Priority Atlas, neither of these SQCs have been classified as a Freshwater Ecosystem Priority Area (FEPA; Nel *et al.,* 2011). These SQCs are therefore not regarded as being important for conserving freshwater ecosystems at a national scale.

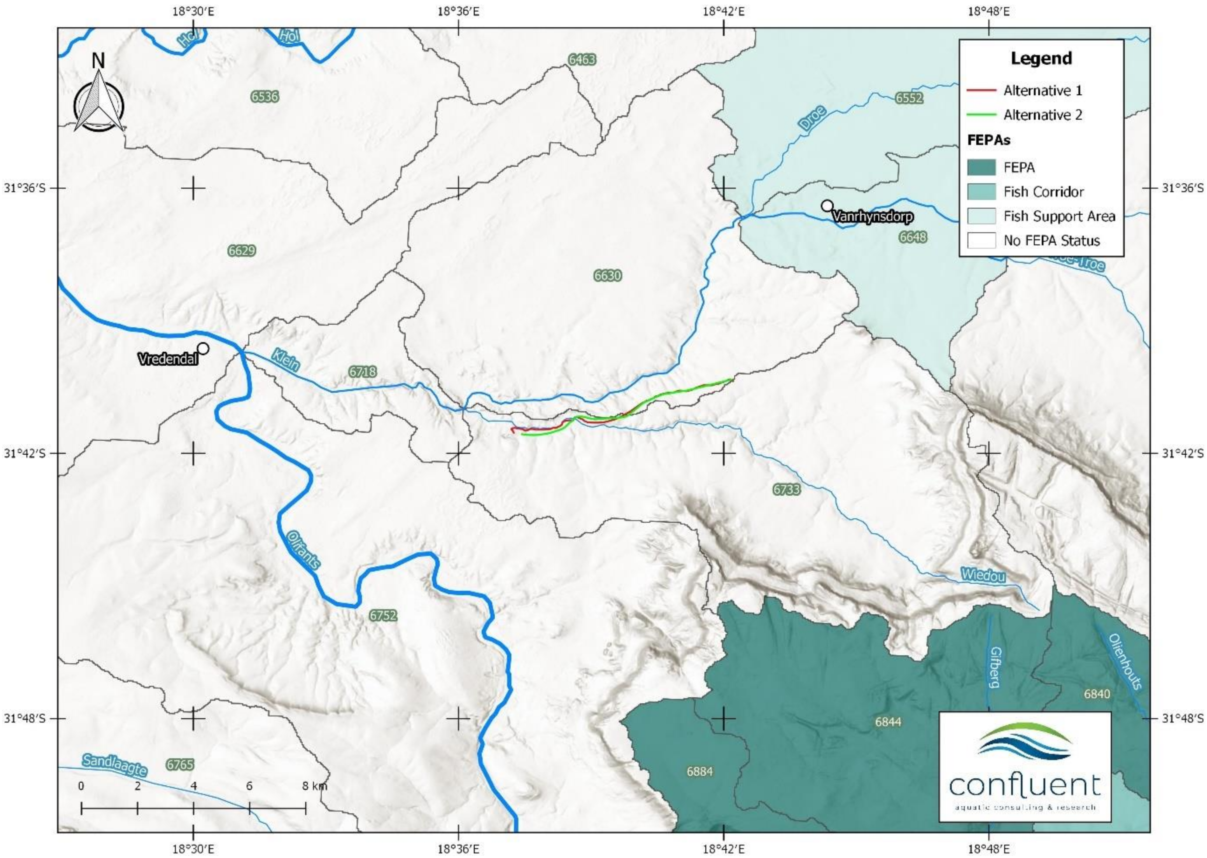

Figure 4: Map of the haul road in relation to FEPAs.

4.2 Western Cape Biodiversity Spatial Plan (WCBSP)

The proposed haul road traverses the Wiedou River, which, according to the WCBSP is classified as an aquatic Critical Biodiversity Area (CBA1) (Figure 5). In addition, the road traverses several small drainage lines that flow into the Troe Troe and Wiedou rivers, which have been classified as aquatic Ecological Support Areas (ESA1). The definition and management objectives of each of the provincial conservation categories are listed in (Table 5).

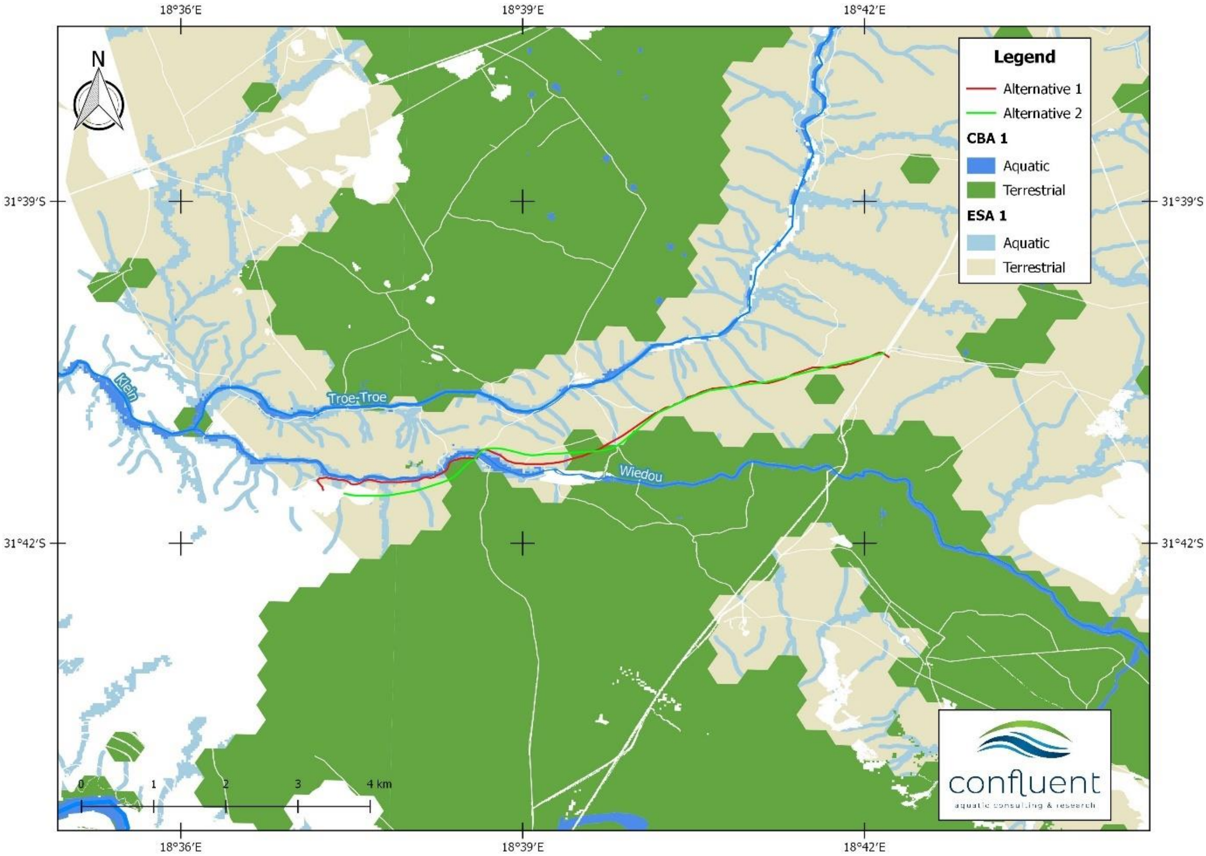

Figure 5: Map of the study site in relation to the Western Cape Biodiversity Spatial Plan (WCBSP).

Table 5: Definitions and management objectives of the Western Cape Biodiversity Spatial Plan.

Category	Definition	Management Objective
CBA1	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure	Maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate
ESA1	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs and are often vital for delivering ecosystem services.	Maintain in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.

5. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

5.1 Watercourse Classification

All watercourse affected by the proposed road alternatives were visited and classified according to Ollis et al. (2013). Each watercourse crossing has been assigned a code (Figure 6) and a brief description and photograph of affected watercourses is provided in Table 6.

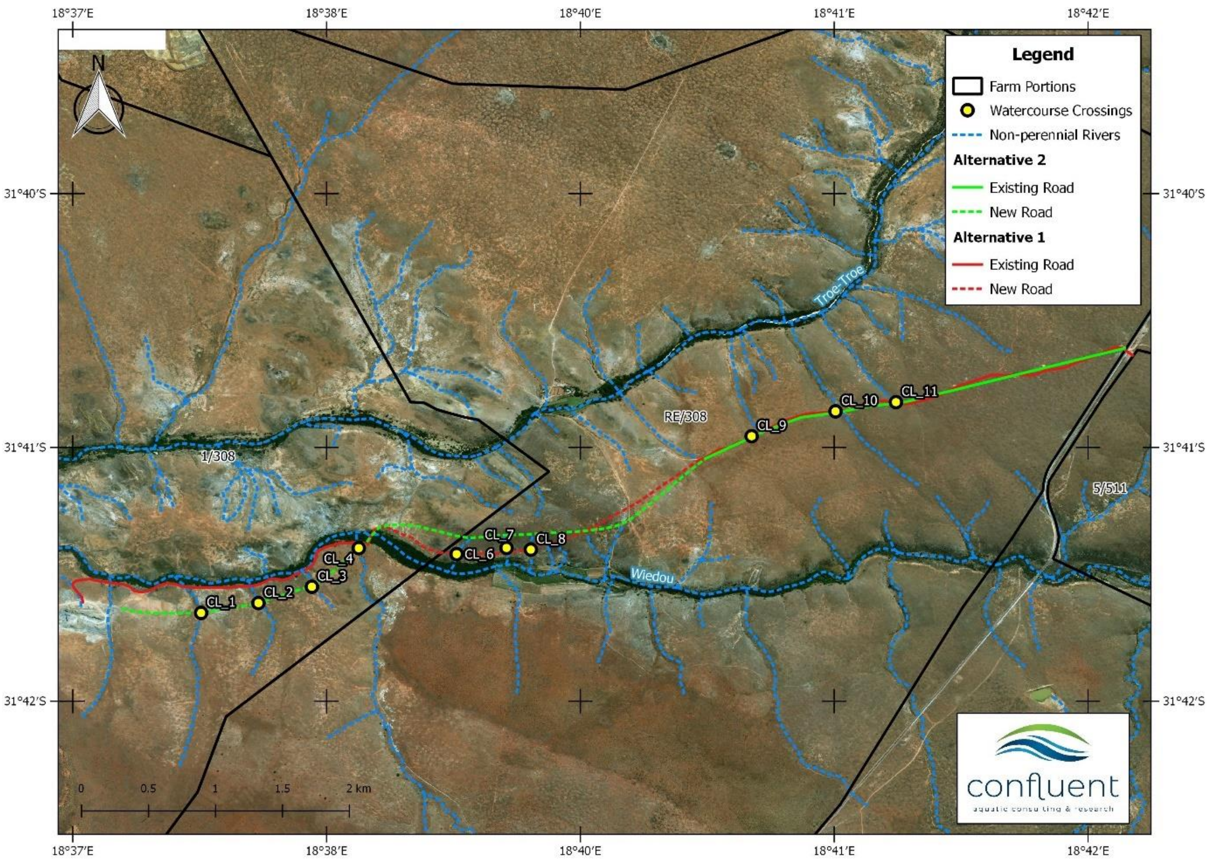

Figure 6: Proposed alternative routes in relation to watercourses and proposed stream crossings.

The Wiedou River is a non-perennial river which originates from the base of the Gifberg Mountain Range, joins the Troe Troe River and ultimately flows into the Olifants River. Flow in the river is intermittent and water flows for a relatively short period of time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years. The gradient of the river is low and the geomorphic zonation of the river can be classified as Lower Foothills (Geozone E), which is characterised by a lower gradient river reach, mixed-bed alluvial channel with sand and gravel dominating the bed. The profile of the channel cross-section is not incised (i.e. no distinct active channel is present) and is densely vegetated by *Vachellia karoo* thickets (Table 6), features which are indicative of highly intermittent and low velocity flows.

The tributary drainage lines flowing into the Wiedou and Troe Troe rivers are all non-perennial streams that are only likely to flow intermittently following heavy rainfall. The drainage lines vary from broad, unconfined channels/valleys to confined, incised channels and heavily eroded erosion gullies (Table 6). The confined, un-eroded channels that drain northwards into the Wiedou River, widen at their confluence with the river forming small alluvial fans at the break of slope between the tributaries and the valley floor. When they flow, the streams lose power over the fan surface which forms a hydrological and sediment buffer between the tributary and the main channel of the river. The eroded drainage lines result in an incised channel that cuts across the alluvial fan that connects the tributary directly to the main channel and the buffering effect of the fan is lost.

The drainage lines that run into the Wiedou River from the north are minor tributaries with very narrow, vegetated channels that run down a steeper gradient into the river (Table 6). The drainage lines in SQC 6630 drain northwards into the Troe Troe River. These tributaries run over a relatively gentle gradient and are characterised by poorly defined, unconfined channels in relatively broad valleys.

Table 6: Photographs at proposed stream crossings on Portion 1 of 308 and RE/308 (see Figure 6 for crossing locations).

Photograph	Description
	**CL_1:** Broad, unconfined channel. The profile of the channel will not require infilling and the road crossing can follow the profile of the channel. Opens up into an alluvial fan at confluence with Wiedou River. Crossed by Alternative 1 and 2.
	**CL_2:** Narrow, confined channel. The channel will require infilling at the road crossing to match the elevation of the top of the banks of the channel. Opens up into an alluvial fan at confluence with Wiedou River. Crossed by Alternative 1 and 2
	**CL_3:** Deeply incised erosion gulley. The channel will require infilling at the road crossing to match the elevation of the top of the banks of the channel. Crossed by Alternative 1 and 2.

Photograph	Description
	**CL_5:** Wiedou River. No distinctive active channel is present. The macro-channel is broad with gently sloping banks. There is an existing road crossing the river which will need to be widened. The approach to the crossing on both sides of the river is at a gentle gradient and represents an ideal crossing point. No infilling of the river channel will be required to elevate the road surface. Crossed by Alternative 1 and 2.
	**CL_6:** Very small, minor drainage lines with a distinct active channel. Road crossing will require infilling to cross the channel. Crossed by Alternative 1 only.
	**CL_7:** Narrow, unconfined valley, with no distinctive active channel. Crossed by Alternative 1 only.
	**CL_8:** Very small, minor drainage lines with a distinct active channel. Road crossing will require infilling to cross the channel. Crossed by Alternative 1 only.

Photograph	Description
	**CL_10:** Broad, unconfined valley, with no distinctive active channel. Existing road crossing will be widened and extend outwards into the unconfined valley. Road will follow profile of valley and no infilling required. Crossed by Alternative 1 and 2.
	**CL_10:** Broad, unconfined valley, with no distinctive active channel. Existing road crossing will be widened and extend outwards into the unconfined valley. Road will follow profile of valley and no infilling required. Crossed by Alternative 1 and 2.
	**CL_10:** Broad, unconfined valley, with no distinctive active channel. Existing road crossing will be widened and extend outwards into the unconfined valley. Road will follow profile of valley and no infilling required. Crossed by Alternative 1 and 2.

5.2 Present Ecological State (PES)

The channel of the Wiedou River is relatively broad and has no distinctive active channel or well-defined banks. The channel substrate is sandy and supports dense thickets of *Vachellia karoo* with minor invasions of *Prosopis glandulosa*. Several instream farm dams located high up in the SQC (immediately below the Gifberg Mountain Range) regulate flows further down in the Wiedou River. There are isolated areas of sheet and gulley erosion throughout the immediate catchment area which leads to increased sediment input into the main channel. Apart from these impacts, other anthropogenic impacts are minor and include low-level road crossings and minor encroachment of agricultural fields into the channel of the river (Table 7).

The PES of the Wiedou is therefore **C – Moderately Modified**. The riparian zone of the Wiedou River is largely unimpacted and is **A/B – Largely Natural**.

The drainage lines all originate from natural areas where the main impacts are associated with current (RE 308) and past (1/308) grazing of livestock. The most serious impact observed was gulley erosion in a few of the channels (CL_3 and CL_4). Sheet erosion occurs in places throughout the broader mine concession and on the neighbouring property. The channel width of the drainage lines is very narrow and given the highly intermittent flow of water in the channels a distinct riparian zone is generally not present. The more eroded channels are characterised by the sporadic presence of larger tree and shrub species that have established within the channel. Given the relatively low impacts on these drainage lines, the PES of instream and riparian habitat is **A/B – Largely Natural** (PES instream and riparian habitat for CL_3 and CL_4 is **C** and **D**, respectively).

Table 7: Instream IHI scores for watercourses crossed by the haul road.

Modification	Wiedou River	Drainage Lines
Water abstraction	**10 –** Abstraction from dams upstream in the catchment	**0 –** No abstraction
Flow modification	**10 –** Presence of upstream dams reduces flow	**0 –** No abstraction
Bed modification	**10 –** Increased sediment inputs as a result of erosion in the catchment	**5 –** Minor erosion in most channels (serious erosion in CL3 & CL4 – **20**)
Channel modification	**8 –** Farming activities within the channel.	5 – Channels largely unmodified (serious erosion in CL3 & CL4 – **20**)
Physico-chemical modification	**5 –** Minor inputs from agricultural activities upstream	**0 –** No impacts expected to impact on water quality
Inundation	**5 -** Minor inundation at existing road crossings	**5 –** Minor inundation at existing road crossings
Alien macrophytes	**0** – None	**0 -** None
Alien aquatic fauna	**0** - None	**0 -** None
Rubbish dumping	**4 –** Minor dumping in places	**4 –** Minor dumping in places
IHI score	**72 (C- Moderately Modified)**	**92 (A/B – Largely Natural)[1]**

[1] Instream PES of CL_3 and CL_4 is C (Moderately Modified)

Table 8: Riparian IHI scores for watercourses crossed by the road.

Modification	Wiedou River	Drainage Lines
Vegetation removal	**4** – Some minor vegetation removal	**4** – Some minor removal
Invasive vegetation	**9** – Minor invasion by *Prosopis glandulosa*	**4** – Minimal invasions
Bank erosion	**5 –** Minor erosion in sections of the river	**5 –** Minor bank erosion (serious erosion at CL_3 and CL_4 - **20**)
Channel modification	**8 –** Farming activities encroach into riparia zone.	**5–** Minor channel modification (serious erosion at CL_3 and CL_4 - **20**)
Water abstraction	**5** – Minimally affected by abstraction upstream.	**0** – None
Inundation	**0** - None	**0** - None
Flow modification	**0** – Riparian zone arid adapted and unaffected by flow modifications	**0** – Riparian zone arid adapted and unaffected by flow modifications
Physico-chemical modification	**2 –** Negligible modifications	**0 -** None
IHI Score[1]	**86 (B – Largely Natural)**	**91 (A/B – Largely Natural)[2]**

5.3 Ecological Importance & Sensitivity (EIS)

Given the highly intermittent hydroperiod of the Wiedou River, it is unlikely to be important with respect to hosting a diverse aquatic assemblage. Similarly, the intermittent flows, geomorphological characteristics and arid environment limits the diversity of aquatic habitat features and refuge and migration options for aquatic biota. The EIS of the Wiedou River is therefore **Moderate** (Table 9)**.** These characteristics are even less pronounced in the drainage lines feeding the Wiedou and Troe Troe rivers and their EIS is therefore considered to be **Low**.

[2] Riparian PES of CL_3 and CL_4 is D (Largely Modified)

Table 9: Ecological Importance and Sensitivity scores for the drainage line.

Determinant	Wiedou River	Drainage Lines
Presence of Rare & Endangered Species	**2** – Moderate probability of rare or endangered taxa.	**1** – Low probability of rare or endangered taxa.
Populations of Unique Species	**2 –** Moderate probability of arid adapted aquatic species.	**1** – Low probability of arid adapted aquatic species.
Intolerant Biota	**2** - Very low proportion of biota is expected to be dependent on flowing water for the completion of their life cycle.	**1** – Very low proportion of biota are expected to be dependent on flowing water for the completion of their life cycle.
Species/Taxon Richness	**2** - Low diversity of fauna and flora expected on a local scale.	**1** – Only expected to support arid adapted species following intermittent flow events.
Diversity of Habitat Types or Features	**1**– Non-perennial, with little geomorphological variation dominated by a sand substrate	**1**– Highly intermittent, small streams, with little geomorphological variation dominated by a sand substrate.
Refuge value of habitat types	**2** – Medium size non-perennial river which will offer some refuge following flooding events.	**1** – Highly intermittent, narrow, small streams with very low refuge value.
Sensitivity of habitat to flow changes	**2** – A non-perennial river in an arid environment which is likely to be sensitive to changes in flow.	**1** – Highly intermittent, arid environment which is likely to be sensitive to changes in flow.
Sensitivity to flow related water quality changes	**2** - The river is relatively small and has low assimilative capacity and is therefore sensitive to modifications in water quality.	**1** – Highly intermittent, non-perennial streams with low sensitivity to changes in water quality.
Migration route for instream and riparian biota	**2** – Migration route for riparian biota.	**1** – Limited migration for riparian biota.
Protection Status	**2** – Aquatic Critical Biodiversity Area	1 – Aquatic Ecological Support Areas
EIS Score	**1.9 (Moderate Importance and Sensitivity)**	**1 (Low Importance and Sensitivity)**

6. IMPACT ASSESSMENT

The new haul road will be a gravel road, built with the applicant's own road material (G5 material). The road will be 15 m wide. Where the road crosses narrow, confined or eroded watercourses (e.g. CL_2 to CL_4 and CL_6 to CL_8), the channel will be filled with run of mine material (boulders etc.) to elevate the road surface above the stream bed and overlaid with G5 material. No culverts are planned and waterflow will pass through voids in the run of mine material. For broader unconfined watercourses (e.g. CL_1, CL_5 and CL_9 to CL_11) the road will follow the profile of the channel, directly through the stream bed and will not be filled with run of mine material to elevate the road above the stream bed. Road crossings in broad unconfined valleys are expected to be negligible. The lack of any serious erosion or other disturbances at existing road crossings (e.g. CL_5 and CL_9 to CL_11) provides evidence of this statement.

Two alternative routes have been proposed (see Figure 7 and Figure 8). From the quarry on Portion 1 of Farm 308 (mining property), Alternative 1 follows an existing farm road that runs northwards down towards the Wiedou River and then runs eastwards along the edge of the river. The road crosses the river at an existing crossing and then proceeds eastwards in the direction of the N7, crosses over into the neighbouring property (RE/308) where it will eventually join an existing farm road. A new road will need to be constructed from the point the road crosses the Wiedou River till it meets up with the existing farm road in RE/308 and the existing road will be widened to 15 m. Alternative 1 runs within the bed of the Wiedou River (for approximately 2.3 km) and crosses several drainage lines on the southern and northern side of the river (Figure 7 and Figure 8). On the southern side the road crosses several alluvial fans associated with the drainage lines flowing from the south.

Alternative 2 runs eastwards from the quarry, further upslope, approximately 100 m away from the Wiedou River. The road crosses the Wiedou River at the same point as Alternative 1 and then proceeds eastwards at a higher elevation compared to Alternative 1. The road eventually meets up with the existing farm road at the same point as Alternative 1. Alternative 2 will require a new road to be constructed throughout its course in the mine property. Alternative 2 lies outside of the bed of the Wiedou River and crosses several drainage lines on the southern side of the river, but avoids the broader alluvial fans associated with tributaries draining into the river from the south. The section of the new road on the northern side of the Wiedou River almost follows the catchment divide and avoids crossing the small drainage lines that flow in a southerly direction into the Wiedou River (Figure 7 and Figure 8). Alternative 2 also involves straightening the existing road on RE/308 with a view to shortening the overall length of the road and minimising wear and tear on haul trucks.

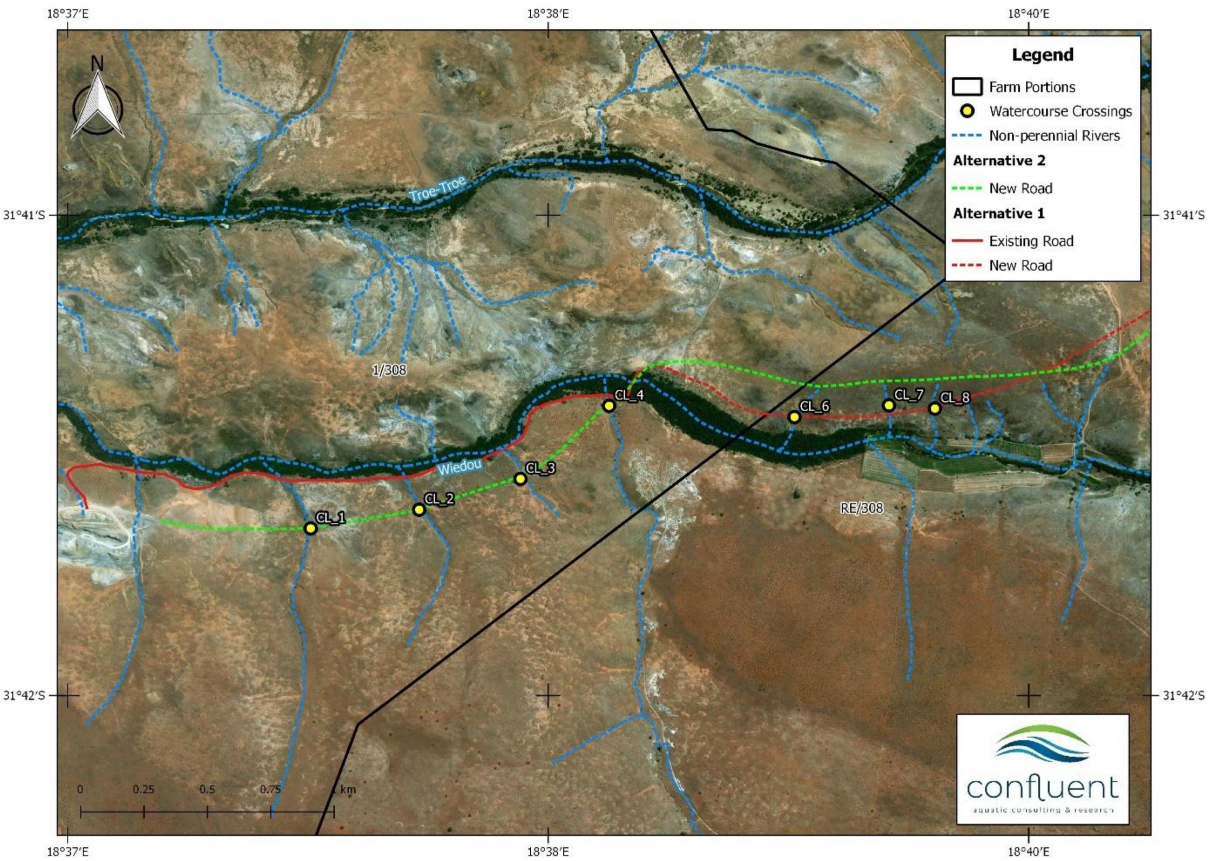

Figure 7: Watercourse crossings (CL_1 to CL_8) associated with Alternatives 1 and 2.

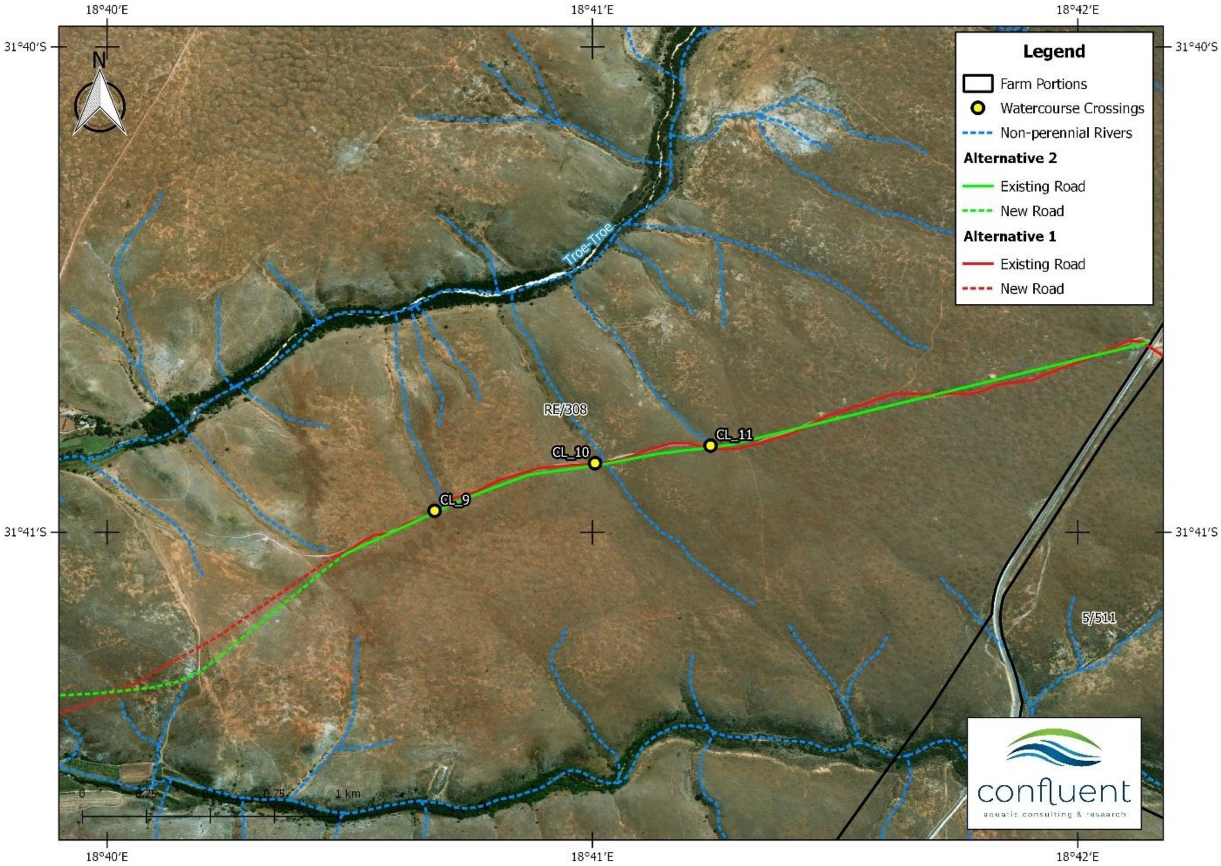

Figure 8: Watercourse crossing (CL_9 to CL_11) associated with Alternatives 1 and 2.

6.1 Layout and Design Phase

Operational phase impacts are primarily related to management of stormwater runoff and prevention of erosion of the bed and banks of watercourses. These impacts can be successfully mitigated through adequate adjustments to the design and layout of the road which can then be implemented during the construction phase of the project. In most instances the design has already included many of the proposed mitigation measures.

Impact 1: Impact of Layout & Design on Hydrology

The site is inherently arid with very low mean annual precipitation (< 200 mm). Flow in the Wiedou River and its tributaries is therefore expected to be highly intermittent, and the impact of road crossings on hydrology is therefore expected to be negligible and no impacts on base flows are expected. Stream crossings may result in localised areas of inundation upstream of crossings if barriers are created by the road. Mitigation options must therefore ensure the free flow of water on the rare occasion that the streams do flow. Using run of mine material to fill incised channels should still allow flow of water through the voids in the fill. Impacts associated with Alternative 2 are slightly lower due to the fact that this option crosses fewer drainage lines.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Low	Very low	Very low	Negligible
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Probably	Unlikely	Unlikely	Unlikely
Significance	**Minor (-44)**	**Negligible (-30)**	**Negligible (-30)**	**Negligible (-27)**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Stream crossings must be designed to allow the free flow of water following runoff generating rainfall events;
- Infill of, narrow confined channels must be with large rocks to ensure water can pass freely in between the voids of the fill;
- Roads passing through broad unconfined channels/valleys must be level with the stream bed and must not cause a physical barrier to water flow;
- In the event that barriers to flow cannot be avoided, then culverts must be placed at low points in the stream crossing to allow flow of water through the crossing. Culverts must be placed so that the invert is level with the bed of the channel and must avoid drop offs into the channel downstream of the crossing.

Impact 2: Impact of Layout & Design on Geomorphology

While the MAP is low, given the aridity of the environment and sparse vegetative cover, the area is susceptible to erosion and the construction and widening of roads at stream crossings leads to an increased risk of erosion during occasional rainfall events. Infilling of incised channels and erosion gullies with run of mine material will allow for diffuse flow through from upstream to downstream, reduce the energy of flow and could potentially alleviate erosion problems (particularly in eroded gullies) and prevent erosion in other channels. Over time the upstream side of the crossing may however fill with sediment which could lead to flows overtopping the road surface and entering the downstream channel from a point of higher elevation, creating a plunge effect which could lead to erosion downstream of the crossing. The creation of a broad flat road surface may also create preferential flow paths which could also lead to the formation of new erosion gullies. The location of a 2.3 km section of the road within the bed of the Wiedou River under Alternative 1, represents a particularly high erosion risk. Impacts associated with Alternative 2 are lower due to the fact that this option crosses fewer drainage lines and avoids the alluvial fans of the southern drainage line as well as the section in the bed and banks of the Wiedou River.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very high	Moderate	Moderate	Very low
Duration	Long term	Long term	Long term	Long term
Extent	Limited	Limited	Limited	Very limited
Probability	Likely	Probably	Likely	Probably
Significance	**Minor (-65)**	**Minor (-44)**	**Minor (-55)**	**Negligible (-32)**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Stream crossings must be designed to allow the free flow of water following runoff generating rainfall events;
- Erosion protection must be placed on the downstream side of the road crossing on incised channels. This can be in the form of loosely packed rock or a reno mattress. Alternatively, the run of mine infill can be sloped at an angle down towards the river-bed on the downstream side of the crossing.

Impact 3: Impact of Layout & Design on Aquatic Habitat

Construction and widening of the road will result in the loss of aquatic habitat at the stream crossings which cannot be mitigated. Alternative 2 will however significantly minimise the loss of aquatic habitat due to fact that the route involves fewer stream crossings and avoids a large stretch of the bed of Wiedou River and the alluvial fans associated with the tributaries draining from the south.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	High	No mitigation possible	Low	No mitigation possible
Duration	Ongoing		Ongoing	
Extent	Very limited		Very limited	
Probability	Certain		Certain	
Significance	**Moderate (-77)**		**Minor (-70)**	
Reversibility	Medium		Medium	
Irreplaceability	Low		Low	
Confidence	High		High	

Impact 4: Impact of Layout & Design on Fragmentation

Infilling of the incised confined channels will result in longitudinal fragmentation of these watercourses. To persist in any given landscape, most species move to recolonize habitats and maintain mixtures of genetic materials. Species also connect habitats through time if they possess needed morphological, physiological, or behavioural traits to persist in a habitat through periods of unfavourable environmental conditions. As these watercourses are highly intermittent it is unlikely that localised disruptions in connectivity will have a significant impact on the life history of aquatic organisms that are adapted to these systems. Organisms that inhabit these systems are typically r-strategists and rapidly complete parts of their life cycle when water is available. Terrestrial species (e.g. amphibians and insects) may also use temporary pools to rapidly complete phases of their life

cycle. The dependence on connected aquatic systems is therefore expected to be low. Impacts are slightly lower under Alternative 2 as fewer watercourses are crossed.				
Impact	**Alternative 1**		**Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very low	No mitigation required	Negligible	No mitigation required
Duration	Ongoing		Ongoing	
Extent	Very limited		Very limited	
Probability	Unlikely		Unlikely	
Significance	**Negligible (-27)**		**Negligible (-24)**	
Reversibility	High		High	
Irreplaceability	Medium		Low	
Confidence	Medium		High	

Impact 5: Impact of Layout & Design on Aquatic Biodiversity Given the highly intermittent flow regime of all watercourses, the aquatic biodiversity of the site is very low. The sites are likely to become important following heavy rainfall events when remaining temporary pools are likely to become important breeding sites for invertebrates and some vertebrates (e.g. amphibians).				
Impact	**Alternative 1**		**Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Low	No mitigation possible	Very low	No mitigation possible
Duration	Short term		Short term	
Extent	Very limited		Very limited	
Probability	Likely		Likely	
Significance	**Negligible (-35)**		**Negligible (-30)**	
Reversibility	High		High	
Irreplaceability	Low		Low	
Confidence	High		High	

6.2 Construction Phase Impacts

Impact 5: Construction Phase Impacts on Hydrology Given the aridity of the region, the impacts of the road construction on hydrology are expected to be negligible for both alternatives.				
Impact	**Alternative 1**		**Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Negligible	Negligible	Negligible	Negligible
Duration	Brief	Brief	Brief	Brief
Extent	Limited	Limited	Limited	Limited
Probability	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely
Significance	**Negligible (-5)**	**Negligible (-5)**	**Negligible (-5)**	**Negligible (-5)**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Construction activities should be timed to coincide with low rainfall probability (dry season) to avoid unnecessary diversion or impedance of flow in watercourses.

Impact 6: Construction Phase Impacts of Geomorphology

Excavation of the road route will expose bare soil to the environment and could lead to high rates of erosion and sedimentation under heavy rainfall events. Given the extreme aridity of the environment it is however unlikely that this impact will materialise. Alternative 1 would require extensive work being conducted within and directly adjacent to the Wiedou River and therefore represents a high intensity impact should a rainfall event occur. Alternative 2 results in less impact as fewer drainage lines will be crossed and the route will remain outside of the bed, banks and riparian area of the Wiedou River.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very high	Moderate	Moderate	Low
Duration	Short term	Short term	Brief	Brief
Extent	Local	Local	Limited	Limited
Probability	Probably	Unlikely	Probably	Unlikely
Significance	**Minor (-48)**	**Negligible (-30)**	**Negligible (-32)**	**Negligible (-21)**
Reversibility	Medium	Medium	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	Medium	Medium	High	High

Mitigation:

- Construction activities should be timed to coincide with low rainfall probability (dry season) to avoid erosion;
- Clear and remove all construction debris and materials, as well as any blockages of drainage structures; and
- Shape the road surface to avoid concentrated flow paths into watercourses.

Impact 7: Construction Phase Impacts on Water Quality

Construction vehicles used in the construction of the road will operate within watercourses at all crossings. Hydrocarbon spillages (from leaks or refuelling) can potentially contaminate the watercourses and may be mobilised further downstream during rainfall events. Impacts associated with Alternative 1 are higher as construction within a larger extent of the Wiedou River has the potential to mobilise pollutants at a more local scale.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Moderate	Low	Moderate	Low
Duration	Brief	Brief	Brief	Brief
Extent	Local	Limited	Limited	Limited
Probability	Probably	Unlikely	Probably	Unlikely
Significance	**Minor (-36)**	**Negligible (-21)**	**Negligible (-32)**	**Negligible (-21)**
Reversibility	High	High	High	High

Irreplaceability	Medium	Medium	Low	Low
Confidence	Medium	Medium	High	High

Mitigation:

- All potentially hazardous substances (e.g. diesel, oil etc.) should be stored in existing secure facilities in an appropriately bunded area that falls outside of the direction of preferential flow paths;
- Vehicles and machinery must be stored and maintained in existing mine facilities designated for the purpose;
- No refuelling of vehicles within close proximity to watercourses;
- Implementation of rapid response emergency spill procedures to deal with spills immediately, including the provision of a spill kit and training of staff to deal with such instances;
- Vehicles and equipment must be regularly serviced and maintained;
- Excavators and all other machinery and vehicles must be checked for oil and fuel leaks daily. No machinery or vehicles with leaks are permitted to work in the watercourse; and
- Watercourses should be inspected on a regular basis (at least weekly) for signs of pollution (e.g. fuel or oil spills). If signs of pollution are noted, immediate action should be taken to remedy the situation and, if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures.

Impact 8: Construction Phase Impacts on Aquatic Habitat & Biota

Impacts of the alternative routes on loss of aquatic habitat and biota have been assessed under the Design and Layout Phase. Additional impacts associated with the construction phase involve the loss of additional habitat and biota as a result of disturbances (e.g. from construction vehicles and machinery) that occur outside of the 15 m wide road alignment. This includes the establishment of alien invasive plant species that may establish in disturbed soils and drainage lines.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Low	Very low	Very low	Negligible
Duration	Short term	Brief	Short term	Brief
Extent	Very limited	Very limited	Very limited	Very limited
Probability	Likely	Unlikely	Likely	Unlikely
Significance	**Negligible (-35)**	**Negligible (-15)**	**Negligible (-30)**	**Negligible (-12)**
Reversibility	High	High	High	High
Irreplaceability	Medium	Medium	Low	Low
Confidence	Medium	Medium	High	High

Mitigation:

- Construction activities should be timed to coincide with low rainfall probability (dry season) so as to avoid disturbance of biota that may take advantage of temporarily inundated habitats;
- Areas where instream construction activities will take place (i.e. at watercourse crossings) must be clearly demarcated (e.g. with danger tape or brightly coloured beacons) so as to prevent unnecessary disturbance of instream and riparian habitat outside of these areas;
- Watercourses should be inspected on a regular basis (at least weekly) for signs of disturbance. If signs of disturbance are noted, immediate action should be taken to remedy the situation and,

if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures; and

- All new watercourse crossings must be routinely monitored for the establishment of Alien Invasive of Plants (AIPs) and eradicated if necessary.

6.3 Operational Phase Impacts

Impact 9: Operational Phase Impact on Hydrology

Over time, accumulation of sediment and debris at road crossings may cause obstructions which could impede flow or cause alternative preferential paths that may lead to erosion.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Low	Very low	Negligible	Negligible
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Probably	Unlikely	Probably	Unlikely
Significance	**Minor (-44)**	**Negligible (-30)**	**Minor (-36)**	**Negligible (-27)**
Reversibility	High	High	High	High
Irreplaceability	Medium	Medium	Low	Low
Confidence	Medium	Medium	High	High

Mitigation:

- Watercourse crossings must be routinely inspected following large rainfall events to ensure that there are no obstructions that may impede or divert flow in the Wiedou River and its tributaries during subsequent rainfall events.

Impact 10: Operational Phase Impact on Geomorphology

Over time, accumulation of sediment and debris at road crossings may cause obstructions which could cause alternative preferential paths that may lead to erosion of watercourses. For Alternative 1, the location of a large section of the road within the bed and banks of the Wiedou River represents a large erosion risk should a large flood event occur.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Very high	Very High	Moderate	Very low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Local	Limited	Very limited	Very limited
Probability	Likely	Likely	Probably	Unlikely
Significance	**Moderate (-75)**	**Minor (-70)**	**Minor (-44)**	**Negligible (-27)**
Reversibility	High	High	High	High
Irreplaceability	Medium	Medium	Low	Low
Confidence	Medium	Medium	High	High

Mitigation:

- Watercourse crossings must be routinely inspected following large rainfall events to ensure that road crossings are not causing erosion upstream or downstream of the crossing; and

- Any signs of erosion must be rehabilitated as soon as possible.

Impact 11: Operational Impacts on Aquatic Habitat

Extensive earth works may manifest in invasions of alien plant species in watercourses after completion of the construction phase.

Impact	Alternative 1		Alternative 2	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Moderate	Very low	Very low	Negligible
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Very limited	Very limited	Very limited
Probability	Probably	Probably	Probably	Unlikely
Significance	**Minor (-48)**	**Minor (-36)**	**Minor (-36)**	**Negligible (-24)**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- All watercourse crossings must be routinely monitored for the establishment Alien Invasive of Plants (AIPs) and eradicated if necessary.

7. DWS RISK ASSESSMENT

The risk assessment matrix (Based on DWS 2015 publication: Section 21 (c) and (i) water use Risk Assessment Protocol) was implemented to assess risks for activities associated with the construction and operational phase. The first stage of the risk assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions and methodology applied in the impact assessment are provided in Appendix 1 of this report. Risks were assessed assuming full implementation of recommended mitigation measures described in Section 6. Risk ratings for all activities fall within a **Low Risk** class (Table 10).

Given the low impact associated with all activities highlighted in this report, and according to Government Notice 509 of August 2016 (RSA, 2016) of the National Water Act, the proposed development of Erf 2353 is Generally Authorised and does not require a Water Use License. While the development is generally authorised, it is important to note that the water use activity should still be registered with the DWS. In this respect the following steps, as highlighted in the General Authorisation for Section 21 (c) and (i) water uses, are relevant:

1. Subject to the provisions of the General Authorisation, the applicant must submit the relevant registration forms to the responsible authority;
2. Upon completion of registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission;

3. On written receipt of a registration certificate from the Department, the applicant will be regarded as a registered water user and can only then commence with the water use as contemplated in the General Authorisation; and
4. The registration forms can be obtained from DWS Regional Offices or Catchment Management Agency office of the Department or from the Departmental website: http://www.dwa.gov.za/Projects/WARMS/Licensing/licensing1.aspx

Table 10: DWS Risk Assessment for Construction and Operational phases.

Phase	Activity	Aspect	Impact	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	PES & EIS
CONSTRUCTION & LAYOUT	Clearing of vegetation	Reshaping of soil surface	Alteration to flow regime & erosion of bed and banks	1	1	1	1	1	1	1	3	1	2	5	2	10	30	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 1 & 5 (Section 6)	**PES: Wiedou (C), Tributaries (A/B to D)** **EIS: Wiedou (Moderate), Tributaries (Low)**
		Exposure of soil to erosion	Sedimentation of aquatic habitat	1	2	2	1	2	1	1	4	1	2	5	2	10	35	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 2 & 6 (Section 6)	
	Construction of road across stream crossings	Spills and leakage of hydrocarbons and other pollutants	Toxicity to instream aquatic biota	1	1	1	1	1	1	1	3	1	2	5	2	10	30	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 7 (Section 6)	
		Infilling of streams	Disturbance to aquatic habitat	1	1	2	2	2	1	1	4	1	3	5	2	11	39	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 3 & 8 (Section 6)	
			Disturbance to aquatic biota	1	1	1	2	1	1	1	3	1	3	5	2	11	36	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 4, 5 & 8 (Section 6)	
OPERATIONAL PHASE	Stream crossings	Impedance of flow	Reduced peak flows	1	1	1	1	1	1	1	3	2	1	5	2	10	30	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 9 (Section 6)	
			Erosion of bed and banks	1	1	2	1	1	1	1	3	2	1	5	2	10	30	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 10 (Section 6)	

Phase	Activity	Aspect	Impact	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	PES & EIS
OPERATIONAL PHASE	Stream crossings	Physical barrier	Fragmentation of watercourse	1	1	1	1	1	1	1	3	5	1	5	1	12	36	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 4 (Section 6)	
		Establishment of alien invasive plant species	Alteration to instream and riparian habitat	1	1	2	1	1	1	1	3	5	1	5	1	12	39	Low	95	• Selection of Alternative 2 as preferred route. • See mitigation measures for Impact 11 (Section 6)	

8. CONCLUSION

The proposed haul road linking Maskam Mine to the processing plant will result in the crossing of several watercourses (the Wiedou River and tributaries of the Wiedou and Troe Troe rivers). The PES of these systems is generally high, ranging from C to A/B, indicating a relatively low level of anthropogenic impacts on these systems. Given the aridity of the environment and the highly intermittent nature of flow in these systems the EIS ranges from Low (for tributaries) to Moderate (for the Wiedou River).

Based on the impact assessment, Alternative 2 is regarded as the preferred option as this option crosses fewer tributaries, avoids the alluvial fans associated with tributaries draining from the south into the Wiedou River and also avoids a large section of the bed and banks of the Wiedou River. This alternative is consistent with the management objectives of aquatic CBAs which are to be maintained in a natural or near-natural state, with no further loss of natural habitat (the habitat loss associated with widening the existing road crossing is considered to be negligible). Only low-impact, biodiversity-sensitive land uses are appropriate.

Alternative 1, which would involve widening an existing section of 2.3 km jeep track road in the bed of the Wiedou River, is not consistent with the management objectives for aquatic CBAs and is therefore not recommended.

Crossings over the small drainage channels are also consistent with the management objective of ESAs which is to maintain them in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised. In this respect, road crossings in broad unconfined valleys are expected to be negligible. The lack of any serious erosion or other disturbances at existing road crossings (e.g. CL_5 and CL_9 to CL_11) provides evidence of this statement.

In conclusion the findings of this study indicate that impacts associated with Alternative 2 can be mitigated to acceptable levels and is therefore supported for environmental approval. Based on the outcome of the DWS Risk Assessment the road can be generally authorised and a WUL is not required.

9. REFERENCES

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10. APPENDICES

Appendix 1: Impact Assessment Methodology

Individual impacts for the construction and operational phase were identified and rated according to criteria which include their intensity, duration and extent. The ratings were then used to calculate the consequence of the impact which can be either negative or positive as follows:

Consequence = *type x (intensity + duration + extent)*

Where type is either negative (i.e. -1) or positive (i.e. 1). The significance of the impact was then calculated by applying the probability of occurrence to the consequence as follows:

Significance = *consequence x probability*

The criteria and their associated ratings are shown in Table 11.

Table 11: Categorical descriptions for impacts and their associated ratings

Rating	Intensity	Duration	Extent	Probability
1	Negligible	Immediate	Very limited	Highly unlikely
2	Very low	Brief	Limited	Rare
3	Low	Short term	Local	Unlikely
4	Moderate	Medium term	Municipal area	Probably
5	High	Long term	Regional	Likely
6	Very high	Ongoing	National	Almost certain
7	Extremely high	Permanent	International	Certain

Categories assigned to the calculated significance ratings are presented in Table 12.

Table 12: Value ranges for significance ratings, where (-) indicates a negative impact and (+) indicates a positive impact

Significance Rating	Range	
Major (-)	-147	-109
Moderate (-)	-108	-73
Minor (-)	-72	-36
Negligible (-)	-35	-1
Neutral	0	0
Negligible (+)	1	35
Minor (+)	36	72
Moderate (+)	73	108
Major (+)	109	147

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium or high (Table 13).

Table 13: Definition of reversibility, irreplaceability and confidence ratings.

Rating	Reversibility	Irreplaceability	Confidence
Low	Permanent modification, no recovery possible.	No irreparable damage and the resource isn't scarce.	Judgement based on intuition.
Medium	Recovery possible with significant intervention.	Irreparable damage but is represented elsewhere.	Based on common sense and general knowledge
High	Recovery likely.	Irreparable damage and is not represented elsewhere.	Substantial data supports the assessment

Appendix 2: DWS Risk Assessment Methodology

Definitions:

- An activity is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- An aspect is an 'element of an organizations activities, products and services which can interact with the environment'. The interaction of an aspect with the environment may result in an impact;
- Environmental impacts are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity;
- Resources are components of the biophysical environment and include the flow regime, water quality, habitat and biota of the affected watercourse; and
- Severity refers to the degree of change to the status of each of the receptors (Table 14). An overall severity score is calculated as the average of all scores receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- Spatial extent refers to the geographical scale of the impact (Table 15).
- Duration refers to the length of time over which the stressor will cause a change in the resource or receptor (Table 16).
- Frequency of activity refers to how often the proposed activity will take place (Table 17).
- Frequency of impact refers to the frequency with which a stressor (aspect) will impact on the resource (Table 18).

Method:

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary. In accordance with the method stipulated in the risk assessment key, all impacts for flow regime, water quality, habitat and biota were scored as a 5 (i.e. average Severity score of 5) as all activities will occur within the delineated boundary of the wetland.

Table 14: Scores used to rate the impact of the aspect on resource quality (flow regime, water quality, geomorphology, biota and habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5

Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland.

Table 15: Scores used to rate the spatial scale that the aspect is impacting on.

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table 16: Scores used to rate the duration of the aspects impact on resource quality

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5

Table 17: Scores used to rate the frequency of the activity

Annually or less	1
Bi-annually	2
Monthly	3
Weekly	4
Daily	5

Table 18: Scores used to rate the frequency of the activity's impact on resource quality

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table 19: Scores used to rate the extent to which the activity is governed by legislation

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5

Table 20: Scores used to rate the ability to identify and react to impacts of the activity on resource quality, people and property.

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table 21: Rating classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

Table 22: Calculations used to determine the risk of the activity to water resource quality

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence x Likelihood