Appendix 6:

Aquatic Impact Assessment

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AQUATIC BIODIVERSITY IMPACT ASSESSMENT

EXPANSION OF DRIEFONTEIN QUARRY, BREDASDORP

DATE: 26 January 2023

PREPARED FOR:

Afrimat Aggregates (Pty) Ltd
021 917 8840
Tyger Valley Office Park No. 2, Cnr. Willie van Schoor Avenue &Old Oak Road, Bellville, 7530

PREPARED BY:

Debbie Fordham
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Version 1

Executive Summary

Afrimat Aggregates propose to expand the mining area of the existing Driefontein quarry, near the town of Bredasdorp. Upstream Consulting were appointed to undertake the aquatic biodiversity impact assessment for the proposed expansion of the mining area to inform the Section 102 application.

The Driefontein Quarry is located within in quaternary catchment G50E of the Overberg East Sub Water Management Area. It is also located within the Overberg Region Strategic Water Source Area for groundwater water. The major rivers in this catchment are the Poort and Kars rivers which merge into the Heuningnes River to the south. The study area gently slopes towards the Kars River, which is a perennial Lower Foothills river. Surface runoff from the property largely flows eastwards to enter the Droe River. The Droe River was historically a small tributary of the Kars River system but has become disconnected from the surface drainage network by decades of land alterations. Any surface flow towards the south is either diverted for agriculture or infiltrates the ground before reaching the Kars River. The area has a long history of landscape alterations due to agricultural activities associated with sheep farming and grain cultivation. These activities have resulted in river and wetland habitat loss and modification.

Four watercourses were identified and mapped within a 500m radius of the proposed Mining Right Area. Subsequent screening determined that two wetlands (referred to as HGM1 and HGM2) may potentially be impacted upon by the project and required further assessment. HGM1 is a channelled valley bottom wetland associated with the Droe River which is situated approximately 150m east of the mine. Past agricultural activities have resulted in the loss of more than half of the channelled valley bottom wetland and significantly modified any remaining habitat. The narrow band of remaining wetland is restricted to the channel with lateral connectivity severed. The Droe River wetland (HGM1) was determined to be in a Largely Modified condition, falling within the 'D' Ecological Category following PES assessment. It was also determined to be of Low importance with regards to Ecoservices and EIS. HGM2 is an artificial depression wetland which has formed within the excavated quarry bottom. In low areas, the groundwater table has risen above the quarry floor to form shallow inundated areas. With time, the prolonged flooding altered the soil characteristics, creating anaerobic conditions, within which hydrophytic vegetation has established. The open water is dominated by the submerged macrophyte, *Potamogeton pectinatus*, while obligate wetland species (such as *Bolboschoenus maritimus* and *Typha capensis*) occupy the shallower areas and edges. The artificial wetland habitat now supports aquatic fauna throughout their life-cycles, such as water-birds, invertebrates and frogs. Additionally, it is a perennial source of water for many terrestrial species in the area. The EcoServices assessment determined that the HGM2 wetland has an overall Moderate ecological importance and sensitivity rating (EIS).

The impact significance of the proposed project was assessed for each potential impact. It was determined that, after mitigation, the aquatic biodiversity impacts will be of Low significance. The HGM1 Droe River wetland, located more than 100m from the proposed mining area, is

unlikely to be impacted by the project. After the adoption of the aquatic buffer zone and basic mitigation measures, there is a negligible risk of any indirect impacts to the remaining wetland. The HGM2 wetland will be disturbed by the continuation of the mining in the site. The faunal and vegetation communities inhabiting the site may temporarily be impacted. The adoption of mitigation measures will minimise these impacts to acceptable levels.

Therefore, the specialist has no objection to the expansion of the mining area provided that the mitigation measures within this report are adopted into the EMPr and monitored.

Specialist Assessment Protocol Index

Report reference to Table 1 - Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity

2. Aquatic Biodiversity Specialist Assessment	
2.1. The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP), with expertise in the field of aquatic sciences.	Debbie Fordham SACNASP Registration number 119102 (Ecology)
2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.	Section 1- Introduction 1.1 –Location & 1.2 – Project description
2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:	
2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including;	Section 6 – Affected Environment Section 7 - Results
(a) aquatic ecosystem types; and (b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	Section 6.1 – Drainage Network Section 7.1 – Identified habitat
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	Very High 1.4 -Screening tool results Section 6.5 – Conservation context Section 6.4 - SAIIAE
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	Section 6 – Affected Environment CBA 1 Wetland, NWM5 Wetland
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:	Section 7. Delineated aquatic habitat Section 6 & 7 – Affected Environment & Results
(a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and (b) the historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain	Section 6.1 – Drainage network Section 7.1 – Identified aquatic habitat

habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	Section 6.7 –Historic land use
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a “low” sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	Section 7 – Results
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions:	
2.5.1. is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Refer to Section 9 – Impact assessment and tables
2.5.2. is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?	
2.5.3. how will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:	Section 8 – Potential Impacts
(a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); (b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub-catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water uses and related activities change;	Section 8 – Potential Impacts
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include:	Section 9 – Impact Significance Assessment
(a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system); (b) quantity of water 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); (c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); (d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); (e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and	Refer to Section 9 – Impact assessment and tables Section 8 – Potential Impacts Section 9 Impact Assessment

(f) 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.);	
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially:	Low Impact (after mitigation) Section 9 – Impact Significance Assessment
(a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	Section 8 – discussion of identified impacts
2.5.6. how will the proposed development impact 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?	Section 8 and Impact Table of Section 9
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: (a) size of the estuary; (b) availability of sediment; (c) wave action in the mouth; (d) protection of the mouth; (e) beach slope; (f) volume of mean annual runoff; and (g) extent of saline intrusion (especially relevant to permanently open systems).	None
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Appendix 2 – Specialist curriculum vitae
2.7.2. a signed statement of independence by the specialist;	Below Declaration of Independence –Page vi
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	4.2 – Site assessment Section 4 – Approach and methodology Section 5 - Assumptions
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Section 4 – Approach and methodology

Declaration of Independence

SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of the Environmental Impact Assessment Regulations and the National Environmental Management Act (Act 107 of 1998), any subsequent amendments and any relevant National and / or Provincial Policies related to biodiversity assessments. This also includes the minim requirements as stipulated in the National Water Act (Act 36 of 1998), as amended in Water Use Licence Application and Appeals Regulations, 2017 Government Notice R267 in Government Gazette 40713 dated 24 March 2017, which includes the minimum requirements for an Aquatic Biodiversity Report.

Report prepared by: Debbie Fordham (Ecology 119102)

Expertise / Field of Study: Registered SACNASP ecologist, with 10 years of working experience, specialising in aquatic ecology. Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape. She is a member of scientific organisations such as the Society of Wetland Scientists (SWS), the South African Wetland Society (SAWS), and the Southern African Association of Geomorphologists (SAAG).

I, **Debbie Fordham** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs Fisheries and Forestry and or Department of Water and Sanitation.

Signed:…  .... Date:…26 January 2023…………

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1 INTRODUCTION

Afrimat Aggregates (Operations) (Pty) Ltd (hereafter referred to as Afrimat) propose to expand the mining area of the existing Driefontein quarry. The activity is located approximately 3km south of the town of Bredasdorp, on Farm 396 (previously known as Farm Zand Fontein No. 185 Ptn 12). The latest national desktop databases identify a watercourse within the surrounding area, and the DFFE Screening tool identifies the area as having Very High Sensitivity for the Aquatic Biodiversity Theme. Therefore, an aquatic biodiversity impact assessment is required to inform the MPRDA Section 102 amendment application for the extension of the excavation area.

Debbie Fordham of Upstream Consulting has been appointed by Afrimat to undertake the aquatic biodiversity impact assessment for the proposed expansion of the mining area of Driefontein Quarry.

1.1 LOCATION

The site is located approximately 3km south of Bredasdorp in the Southern Overberg region of the Western Cape. It lies on the northern edge of the Agulhas Plain, about 160 km south-east of Cape Town and 35 km north of Cape Agulhas, the southernmost tip of Africa. The Mining Right area is located on Farm 396 (Previously known as Farm Zand Fontein No. 185 Ptn 12) (Figure 1). The Section 102 application is for the extension of an additional 11.6759 Ha Mining Right Area to total 51.4651 Ha.

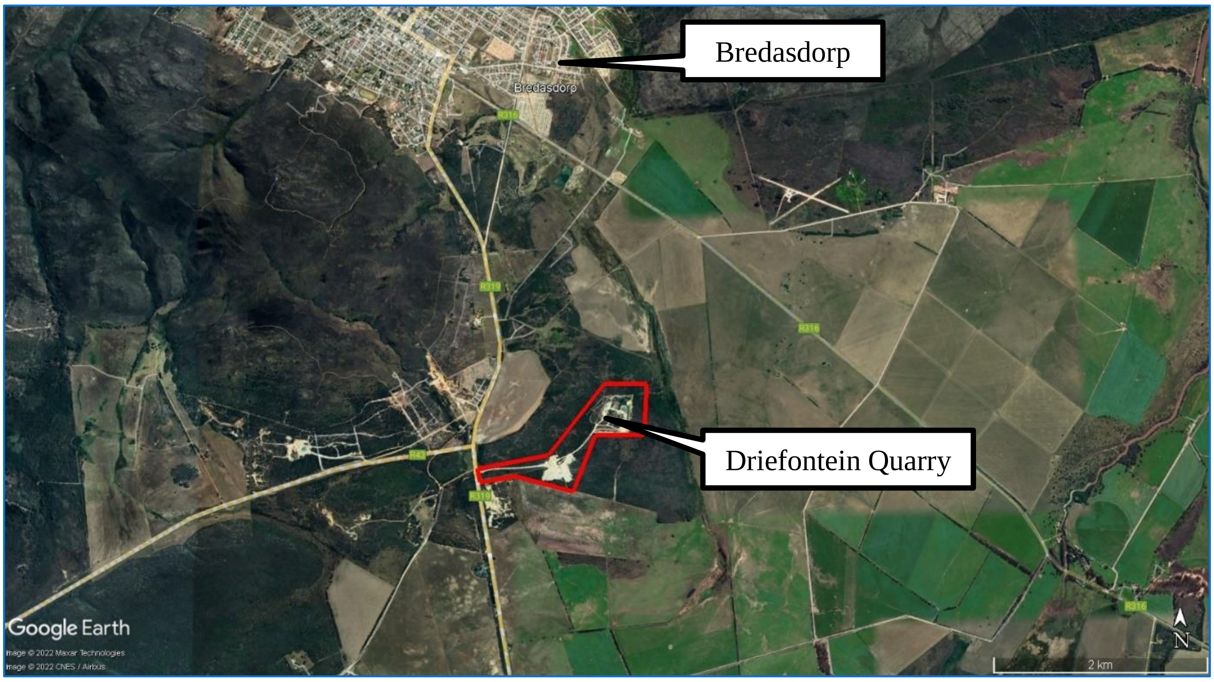


Figure 1: The location of the site in relation to the town of Bredasdorp in the Western Cape

1.2 PROJECT DESCRIPTION

Since the early 1990s, the Driefontein Quarry has supplied the Bredasdorp and surrounding area with aggregate material for building and civil engineering projects. It is an overburden stripping, drill and blast, haul, and crush operation. Hard rock is mined using conventional drilling and blasting method. The loosened material is loaded to haul trucks by excavators and transported to the primary crusher. The material is then processed at the crushing plant to produce aggregate that is stockpiled until it is sold to clients.

In late 2021, the mine management determined that mine reserves are becoming limited within the approved Mining Right area. Therefore, a Section 102 application is being made to extend the already existing Mining Right Area (which currently has a total area of 39.7892 Ha) by an additional 11.6759 Ha (to total 51.4651 Ha). This extension intends to expand the excavation area only. All the current infrastructure will not be amended in this application and any new reserves obtained will be produced at the same production rate as current levels. Figure 2 below shows the existing footprint (pale blue) and the proposed extension area (yellow).

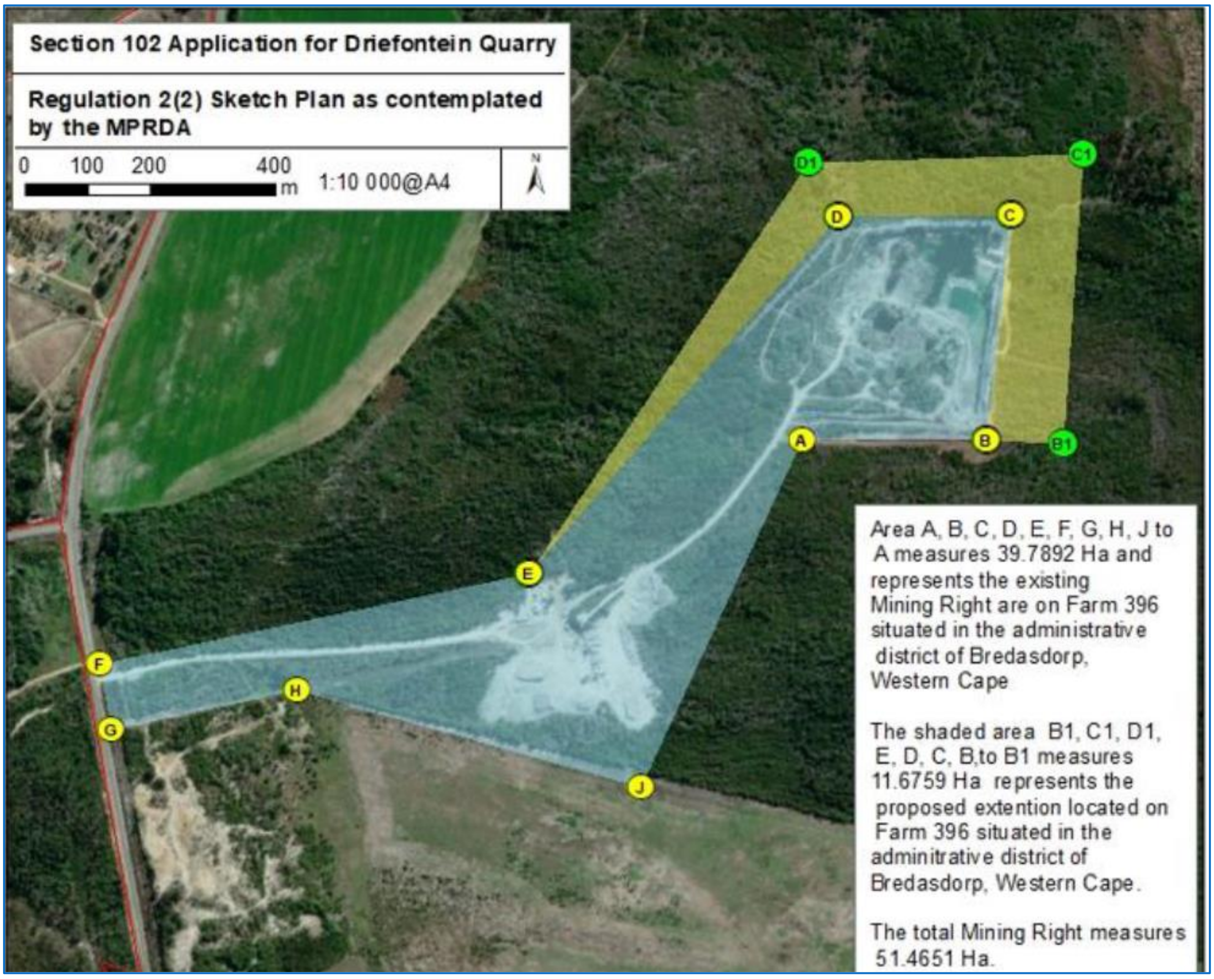


Figure 2: Map showing the proposed expansion area in yellow (Afrimat 2022)

According to the Draft Scoping Report (Afrimat 2022), the current mine is mined to a depth of ±12m below ngl after overburden removal. The future mining is anticipated to continue to a similar depth. Figure 3 shows the mine layout and the proposed mine plan. The excavation will be expanded by drilling and blasting ±20m wide benches until the excavation reaches the perimeter topsoil berms.

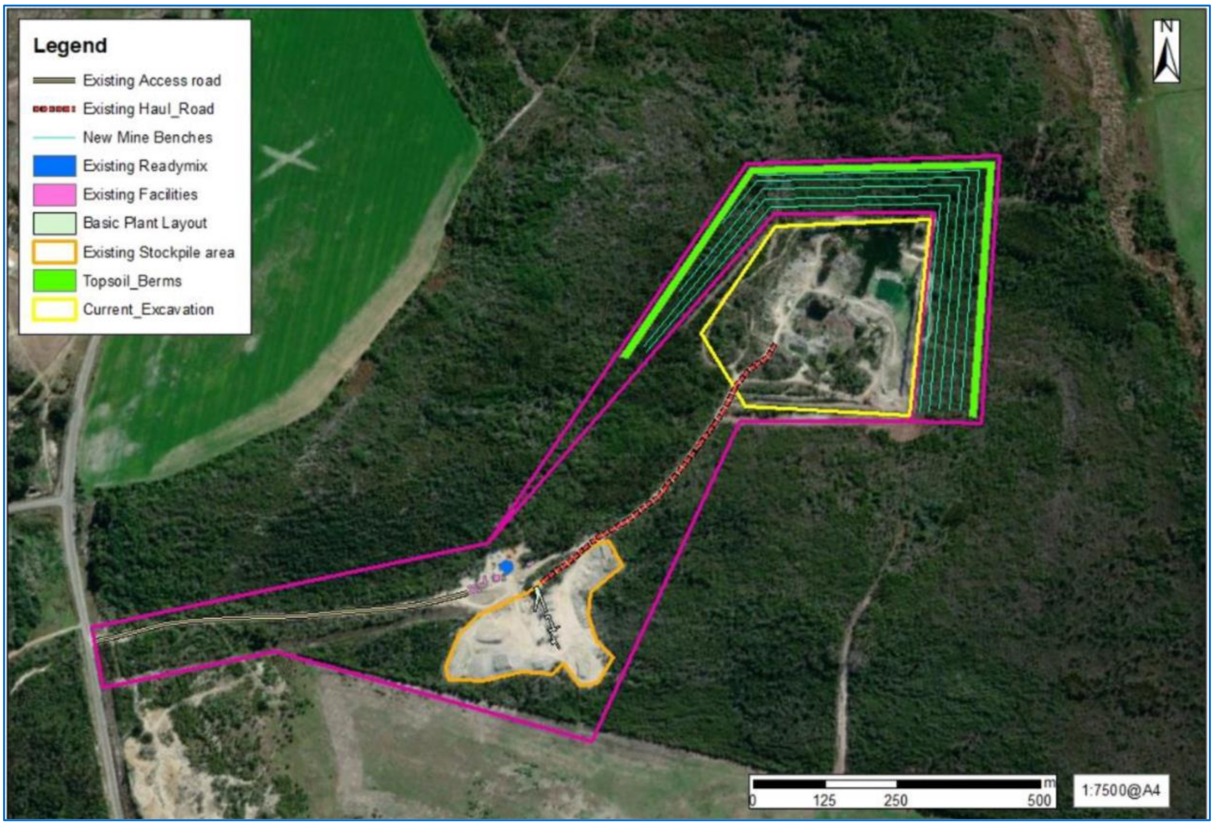


Figure 3: Mining method and site layout (provided in the Draft Scoping Report by Afrimat 2022)

This site is located above a major aquifer, and in the current excavation, groundwater is already exposed, as groundwater depth is approximately only 15m below the surface. Artificial wetland habitat has formed in areas within the quarry pit (Figure 4).

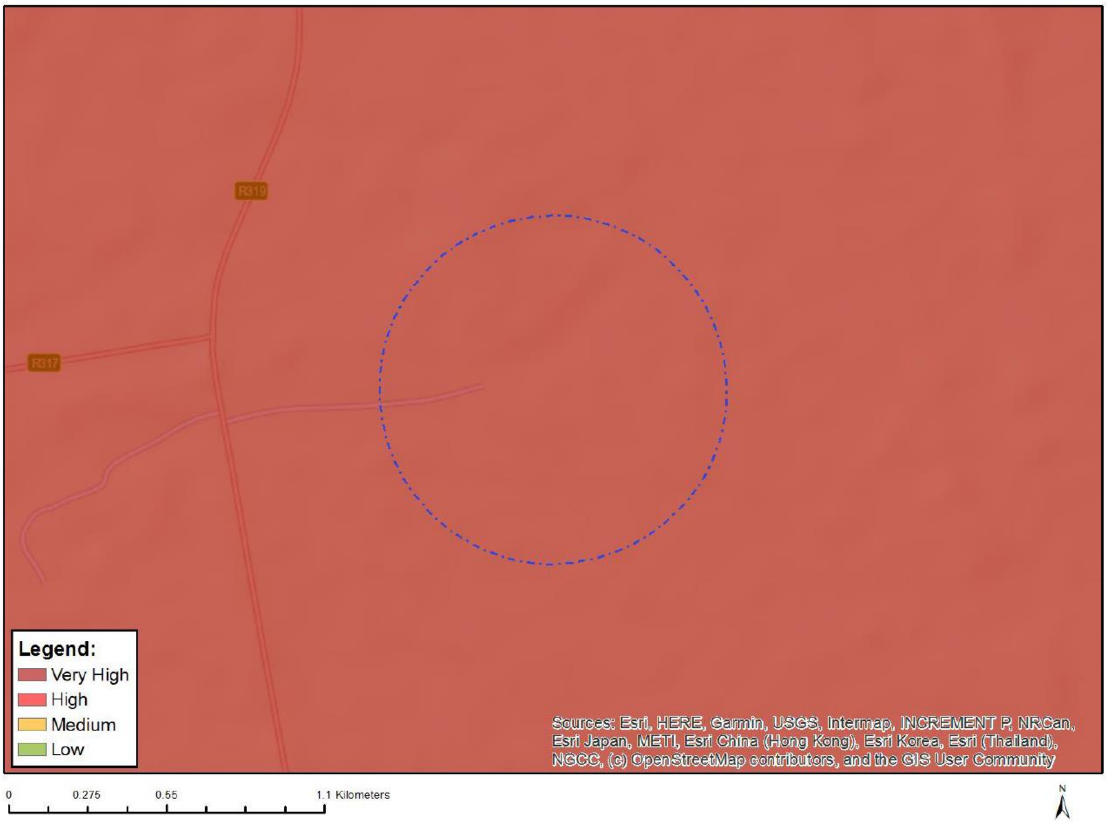
Figure 4: Open water within the excavated area as a result of mining into the shallow aquifer

1.3 SCREENING TOOL RESULTS

The National Web based Environmental Screening Tool was utilised for this proposal in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, to screen the proposed site for any environmental sensitivity. The Screening Tool identifies related exclusions and/ or specific requirements including specialist studies applicable to the proposed site. The Screening Tool allows for the generating of a Screening Report referred to in Regulation 16 (1) (v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation. Requirements for the assessment and reporting of impacts of development on aquatic biodiversity are set out in the 'Protocol for the assessment and reporting of environmental impacts on aquatic biodiversity published in Government Notice No. 648, Government Gazette 45421, on the 10 of May 2020.

According to the Screening Report, the site has areas of “Very High” aquatic sensitivity and requires the assessment and reporting of impacts on Aquatic Biodiversity (Figure 5). The site verification assessment was undertaken and is attached as a Site Verification Report in Appendix 3. The Very High aquatic biodiversity sensitivity rating for parts of the site was confirmed. Therefore, the Aquatic Biodiversity Impact Assessment report was required and has been compiled in accordance with the latest NEMA Minimum Requirements and Protocol for Specialist Aquatic Biodiversity Impact Assessment (10 May 2020).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity	Feature(s)
Very High	Aquatic CBAs
Very High	Strategic water source area
Very High	Freshwater ecosystem priority area quinary catchments

Figure 5: Aquatic biodiversity sensitivity map of the study area from the Screening Report

2 RELEVANT LEGISLATION

The protection of water resources is essential for sustainable development and therefore many policies and plans have been developed, and legislation promulgated, to protect these sensitive ecosystems. The proposed project must abide by the relevant legislative requirements. Table 1 below shows an outline of the environmental legislation relevant to the project.

Table 1: Relevant environmental legislation

Legislation	Relevance
South African Constitution 108 of 1996	The constitution includes the right to have the environment protected
National Environmental Management Act 107 of 1998	Outlines principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state. Chapter 1(4r) states that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. Section 24 of NEMA requires that the potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation, must be investigated and assessed prior to implementation, and reported to the authority.
Environmental Impact Assessment (EIA) Regulations	The 2014 regulations have been promulgated in terms of Chapter 5 of NEMA and were amended on 7 April 2017 in Government Notice No. R. 326. In addition, listing notices (GN 324-327) lists activities which are subject to an environmental assessment.
Mineral And Petroleum Resources Development Act, 2002 (MPRDA) (as amended).	DMR in terms of the MPRDA in legal extension of "ownership" of the mineral rights through the Section 102 Mining Right Amendment and their mandated jurisdiction under the NEMA in respect of mining matters.
The National Water Act 36 of 1998	The proposed project may require a Water Use License (WUL) in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998 and this must be secured prior to the commencement of activities. Chapter 4 of the National Water Act addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use of water.
Conservation of Agricultural Resources Act (Act 43 of 1983)	The Conservation of Agricultural Resources Act (CARA) is to provide for the conservation of the natural agricultural resources by the maintenance of production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.
National Environmental Management: Biodiversity Act No. 10 of 2004	This is to provide for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits.

3 TERMS OF REFERENCE

- Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information (including but not limited to the South African Inventory of Inland Aquatic Ecosystems (SAIIAE), vegetation, CBAs, Threatened ecosystems, any Red data book information, NFEPA data, broader catchment drainage and protected areas).
- Desktop delineation and illustration of all watercourses within and surrounding the study area utilising available site-specific data such as aerial photography, contour data and water resource data.
- Prepare a map demarcating the respective watercourses or wetland/s, within the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence while classifying the hydrogeomorphic type of the respective water courses / wetlands in relation to present land-use and their current state. The maps depicting demarcated waterbodies will be delineated to a scale of 1:10 000, following the methodology described by the DWS.
- A risk/screening assessment of the identified aquatic ecosystems to determine which ones will be impacted upon and therefore require ground truthing and detailed assessment.
- Ground truthing, identification, delineation and mapping of the aquatic ecosystems in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*.
- Classification of the identified aquatic ecosystems in accordance with the, 'National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis *et al.* 2013) and WET-Ecoservices (Kotze et al. 2009).
- Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland and riparian habitats.
- Identification, prediction and description of potential impacts on aquatic habitat during the construction and operational phases of the project. Impacts are described in terms of their extent, intensity, and duration. The other aspects that must be included in the evaluation are probability, reversibility, irreplaceability, mitigation potential, and confidence in the evaluation.
- All direct, indirect, and cumulative impacts for each alternative will be rated with and without mitigation to determine the significance of the impacts.
- Recommend actions that should be taken to avoid impacts on aquatic habitat, in alignment with the mitigation hierarchy, and any measures necessary to restore disturbed areas or ecological processes.
- Rehabilitation guidelines for disturbed areas associated with the proposed project and monitoring.

4 APPROACH AND METHODS

This study followed the approaches of several national guidelines with regards to wetland/ riparian assessment. See Appendix 1. The following approach to the aquatic habitat assessment is undertaken:

4.1 DESKTOP ASSESSMENT METHODS

The contextualization of the study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information (i.e. existing data for coastal management lines, NFEPA identified rivers and wetlands, critical biodiversity areas (WBSP 2017), estuaries, vegetation units, ecosystem threat status, catchment boundaries, geology, land uses, etc.) in a Geographical Information System (GIS). A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Assessment of 2018 (Van Deventer *et al.* 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourses and the coastal dynamic. The conservation planning information aids in the determination of the level of importance and sensitivity, management objectives, and the significance of potential impacts.

Following this, desktop delineation and illustration of all watercourses within the study area was undertaken utilising available site-specific data such as aerial photography, contour data and water resource data. Digitization and mapping were undertaken using QGIS 3.19 GIS software. These results, as well as professional experience, allowed for the identification of sensitive habitat that could potentially be impacted by the project and therefore required ground truthing and detailed assessment.

4.2 BASELINE ASSESSMENT METHODS

A site assessment was conducted on the 16th of January 2023 to confirm desktop findings, gather additional information, and define the boundaries of the aquatic habitat. General observations were made with regards to the vegetation, fauna and current impacts. The identified aquatic ecosystems were classified in accordance with the, '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009).

Infield delineation was undertaken with a hand-held GPS (Figure 6), for mapping of any potentially affected aquatic ecosystems, in alignment with standard field-based procedures in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*. The delineation is based upon observations of the landscape setting, topography, vegetation and soil characteristics (using a hand held soil auger for wetland soils).

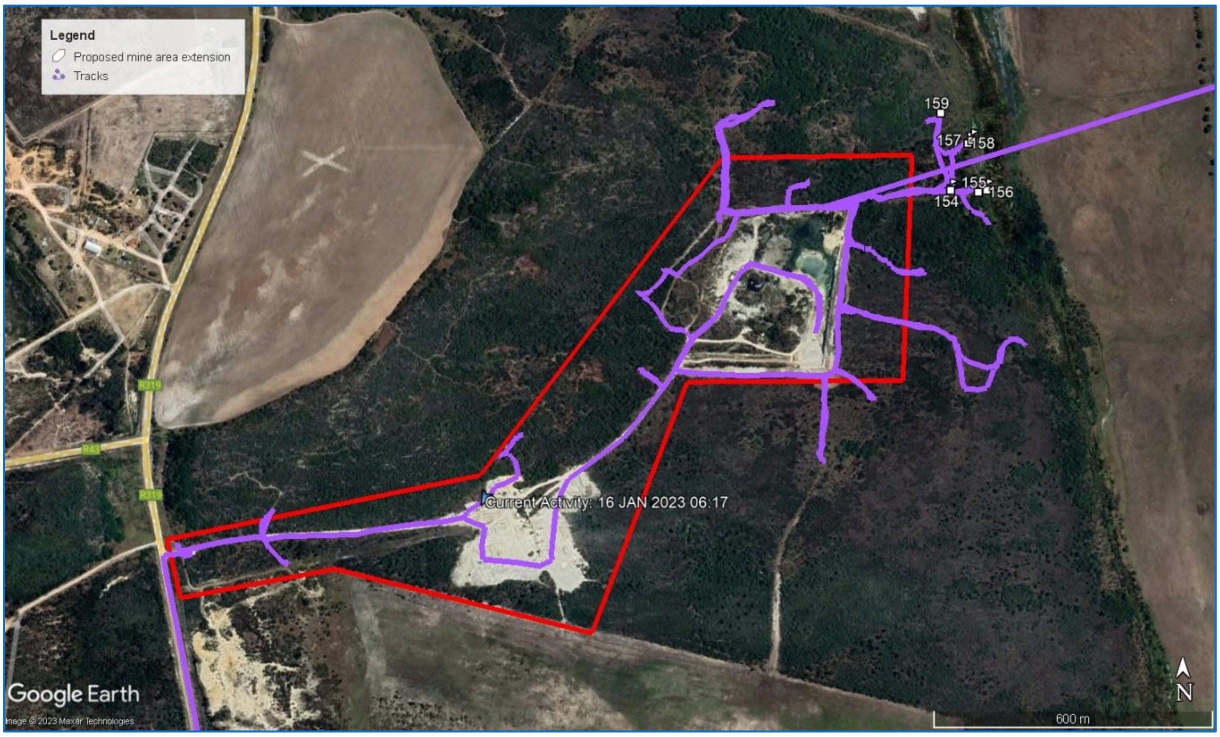


Figure 6: Map showing the GPS tracks associated with the fieldwork

Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats was undertaken utilising:

- Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
- DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS

Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitat was undertaken utilising:

- The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 2 WET-Health assessment tool Version 2 (Macfarlane et al. 2020), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation.
- The WET-Ecoservices tool (Kotze et al., 2020) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing).

4.3 Impact Assessment Methods

The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined. Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring. Unknown parameters are given the highest score as significance scoring follows the Precautionary Principle. A methodology for assigning scores to the respective impacts is described in Appendix 1.

Cumulative impacts affect the significance ranking of an impact because the impact is taken in consideration of both onsite and offsite sources. For example, pollution making its way into a river from a development may be within acceptable national standards. Activities in the surrounding area may also create pollution which does not exceed these standards. However, if both onsite and offsite pollution activities take place simultaneously, the total pollution level may exceed the standards. For this reason, it is important to consider impacts in terms of their cumulative nature.

4.4 Mitigation and Monitoring

Actions are thereafter recommended to prevent and mitigate the identified impacts on aquatic habitat, in alignment with the mitigation hierarchy, as well as any measures necessary to restore disturbed areas or ecological processes. No-Go Areas will be determined, and any necessary monitoring protocol will be developed.

5 ASSUMPTIONS AND LIMITATIONS

- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this can miss certain ecological information due to seasonality, thus limiting accuracy and confidence.
- The locations of the proposed activities were extrapolated from data provided by the client.
- The assessment of impacts from mining on the local groundwater table is not within the scope of this study. It is recommended that geohydrological specialist input be sought.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of aquatic ecosystems, it is important to note that the current extent and classification is reported on here.
- The site has a long history of landscape transformation and is thus dominated by densely infested alien vegetation, which makes delineation of aquatic ecosystems very difficult as vegetation is one of the key features used to delineate riparian and wetland habitat.

- 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.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed activities, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota (e.g. fish, invertebrates, microphytes, etc.) was undertaken, and not deemed necessary.
- 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.
- The report is restricted to the assessment of aquatic biodiversity, and while related, it does not include the assessment of terrestrial impacts (existing or residual).
- The scope of work did not include water quality sampling and the water quality characteristics were inferred from the biophysical characteristics of the area and catchment land uses.
- 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 projects. The degree of confidence is considered high.

6 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The desktop/ screening study was informed by the available datasets relevant to water resources, as well as historic and the latest aerial imagery, to develop an understanding of the fluvial processes of the study area. A significant amount of the latest spatial data has been provided through the products of the 2018 National Biodiversity Assessment (NBA). The NBA is the primary tool for monitoring and reporting on the state of biodiversity in South Africa. It is used to inform policies, strategies and actions in a range of sectors for managing and conserving biodiversity more effectively. The desktop study was followed by the detailed site assessment. The general biophysical characteristics of the study area are described below.

6.1 GEOLOGY AND CLIMATE

The climate is typical of the winter rainfall region with dry summers and wet winters. The rainfall varies from 400 to 600 mm per annum and the prevailing winds come from the south, especially in summer.

The geology of the quarry site consists of quarzitic sandstone of the Nardouw Subgroup of the Table Mountain Group (Figure 7). The quarzitic sandstone is fractured and has depth of a few hundred meters below the overburden which is 2-3.5m on the extension area in the north and east. However, directly east of the proposed Mining Right Area, towards the Droe River, the substrate changes abruptly to contain calcified dune sand, limestone, and conglomerate of the marine-related geological formations of the Bredasdorp Group.

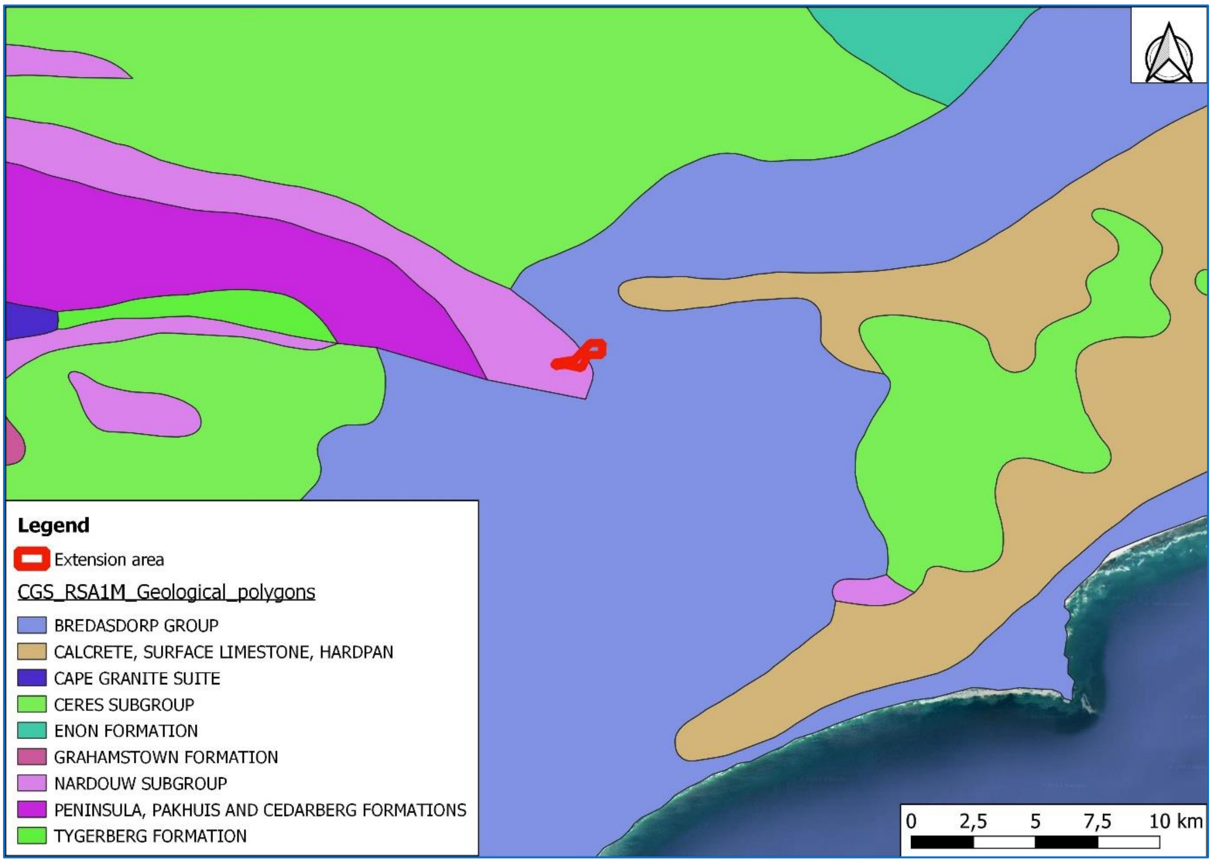


Figure 7: 1: 1 000 000 SA Geological Map of the Mining Right area

6.2 DRAINAGE NETWORK

The site falls within the Southern Coastal Belt Ecoregion which is described by Kleynhans *et al.* (2005) as an area of hills and mountains with moderate to high relief and surrounding plains varying in altitude from sea level to 700 MASL.

The Driefontein Quarry is located within in quaternary catchment G50E of the Overberg East Sub Water Management Area (Figure 8). The major rivers in this catchment are the Poort and Kars rivers which merge into the Heuningnes River to the south. The study area gently slopes towards the Kars River, which is a perennial Lower Foothills river. According to the 2018 NBA, the river has a PES in the E category and an ecosystem threat status of Critically Endangered.

Surface runoff from the property largely flows eastwards to enter the Droe River. The Droe River was historically a small tributary of the Kars River system but has become disconnected from the surface drainage network by decades of land alterations. Any surface flow towards the south is either diverted for agriculture or infiltrates the ground before reaching the Kars River.

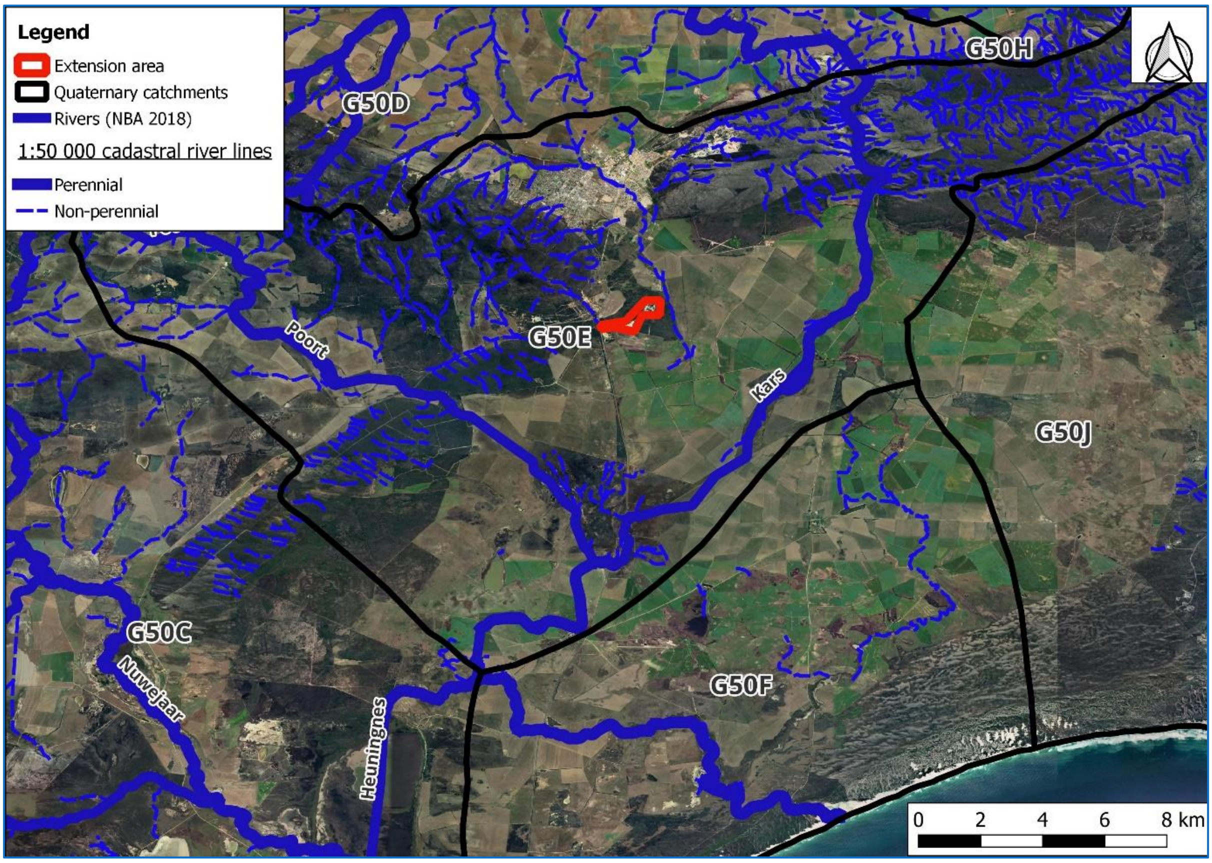


Figure 8: Map of the Mining Right area in quaternary catchment G50E

6.3 GROUNDWATER

The quarry is located within the Overberg Region Strategic Water Source Area for groundwater water (Figure 9). A Strategic Water Source Area (SWSA) is one where the water that is supplied is considered to be of national importance for water security (Le Maitre *et al.* 2018). Surface water SWSAs are found in areas with high rainfall and produce most of the runoff. Groundwater SWSAs have high groundwater recharge and are located where the groundwater forms a nationally important resource. There are 22 national-level SWSAs for surface water (SWSA-sw) and 37 for groundwater (SWSA-gw). The SWSA-gw cover 9% of the area of South Africa, account for 15% of the recharge, 46% of the groundwater used by agriculture and 47% of the groundwater used by industry. About 24% of the settlements that are reliant on groundwater lie within SWSA-gw, equivalent to 10% of all settlements in South Africa. They account for up to 42% of the baseflow in their areas and have a key role in sustaining surface water flows during the dry season.

The protection and restoration of Strategic Water Source Areas (SWSAs) is of direct benefit to all downstream users and this dependence needs to be considered in decisions relating to these primarily headwater catchments. The protection of both water quantity (flows) and quality must be addressed. Any failure to address impacts on water quality or quantity will have impacts on the water security all those depending on that water downstream. Groundwater is the main or only source of water for numerous towns and settlements across the country so protecting the capture zone, specifically for municipal supply well-fields, the recharge area, and the integrity of the aquifers is very important as well (Le Maitre *et al.* 2018).

Figure 9: Map showing the site within the Overberg Region SWSA for groundwater

6.4 VEGETATION

The latest national vegetation map (VEGMAP 2018) indicates that the Mining Right Area is situated within two vegetation units, namely Agulhas Limestone Fynbos and Agulhas Sand Fynbos (Figure 10). Limestone fynbos is the endemic-rich vegetation associated with the Bredasdorp Formation limestones. These vegetation units are classified as Vulnerable and Endangered, respectively.

However, the property is densely infested by alien trees such as *Acacia longifolia*, *Acacia saligna* and Eucalyptus species (blue gums).

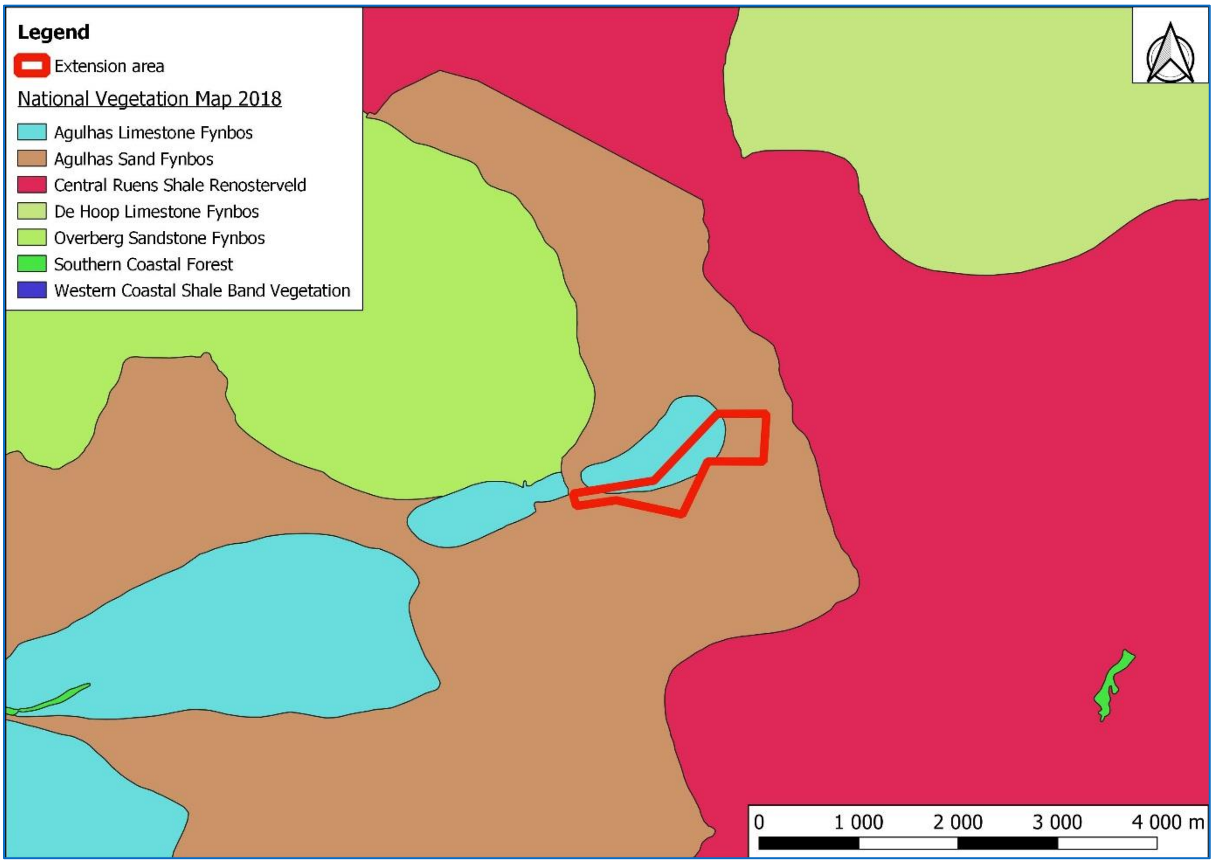


Figure 10: National Vegetation Map (SANBI 2018) of the study area

6.5 South African Inventory of Inland Aquatic Ecosystems

A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the 2018 National Biodiversity Assessment (Van Deventer *et al.* 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands. The National Wetland Map 5 (NWM5) includes inland wetlands and estuaries, associated with river line data and many other data sets. Figure 11 shows the NWM5 desktop data relative to the proposed Mining Right Area. The map suggests the presence of a large floodplain wetland in the east, and a small channelled valley bottom wetland in the west.

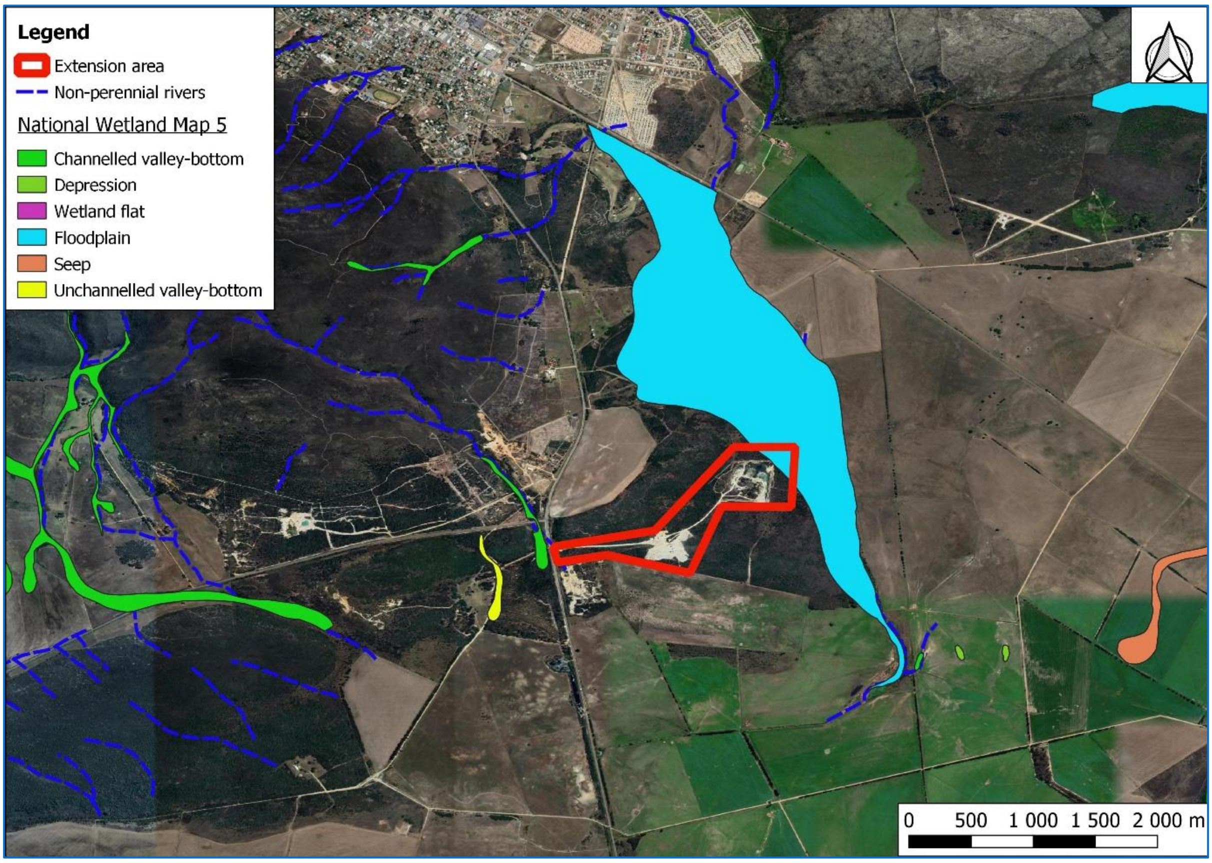


Figure 11: The project site in relation to the National Wetland Map Version 5 (CSIR, 2018)

6.6 CONSERVATION CONTEXT

The Western Cape Biodiversity Spatial Plan (WCBSP, 2017) produced a map of biodiversity priority areas, Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with Protected Areas, are important for the persistence of a viable representative sample of all ecosystem types and species, as well as the long-term ecological functioning of the landscape as a whole. The primary purpose of the map is to guide decision-making about where best to locate development. Critical Biodiversity Areas (CBA's) are required to meet biodiversity targets. According to the WCBSP, these areas have high biodiversity and ecological value and therefore must be kept in a natural state without further loss of habitat or species.

The 2017 WCBSP map in Figure 12 shows both CBA 1 and ESA 1 Aquatic features within the site. This can be attributed to the artificial wetland with open water in the quarry pit, and the Droe River wetland system to the east. However, the other features mapped as aquatic were not evident on site. The reasons for the BSP classification include SA Vegetation Type (4.97), Threatened SA Vegetation Type (12.4), Threatened Vertebrate (34.74), Water resource protection (3.95), and Wetland Type (5.6), as a result of the presence of the following features:

Feature_1: Agulhas Limestone Fynbos (VU (D1))
Feature_2: Agulhas Sand Fynbos (EN)
Feature_3: Bontebok Natural Distribution Range

Feature_4: Cape Mountain Zebra
Feature_5: South Coast Limestone Fynbos Channelled Valley Bottom Wetland
Feature_6: South Coast Sand Fynbos Channelled Valley Bottom Wetland
Feature_7: South Coast Sand Fynbos Flat Wetland
Feature_8: South Coast Sand Fynbos Valleyhead Seep Wetland
Feature_9: Watercourse protection- Southern Coastal Belt

No endemic or conservation worthy species (Listed or Protected) were observed or have been recorded within the site. Due to the artificial nature of the quarry pit wetland, it is likely that only disturbance-tolerant species occur with a low level of biodiversity. The Heuningberg Local Nature Reserve is located 1.5km to the north-west of the site.

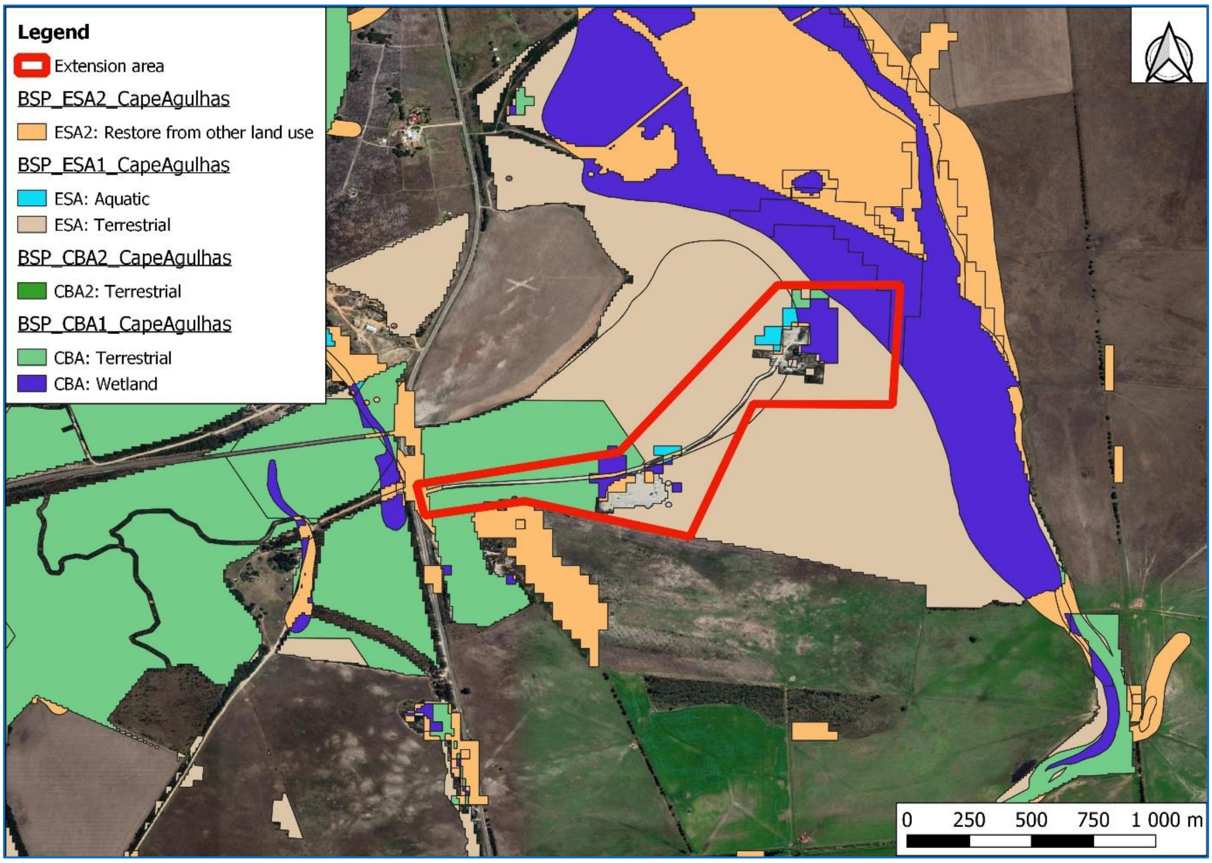


Figure 12: Map of the site in relation to conservation priority areas identified in the WCBSP (2017)

6.7 LAND USE

The area has a long history of landscape alterations due to agricultural activities associated with sheep farming and grain cultivation. These activities have resulted in river and wetland habitat loss and modification. The Droe River, situated east of the site, has over time been subjected to vegetation clearance, soil disturbance, and channel straightening, to accommodate for pastures and cropland. Additionally, the watercourse is indirectly impacted by pollutants from farming, as well as upstream development (such as the town, golf course, and municipal wastewater treatment works).

The quarry and associated processing area has transformed approximately 25 Ha of the property. Aerial photography from 1981 shows that, prior to mining, the site itself was in a largely undisturbed natural state (Figure 13). However, by 2006 the remaining vegetation surrounding the quarry, is densely infested by alien invasive plant species and there is evidence of a veldfire (Figure 14).

Figure 13: Historical aerial photography from 1981 with the red polygon indicating the general location of the quarry operations.

Figure 14: Satellite imagery of the site in 2006

7 RESULTS

The aquatic habitats within a 500 metre radius of the proposed Mining Right Area were identified and mapped on a desktop level utilising available data. In order to identify the wetland/river types, using Kotze *et al.* (2009) and Ollis *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. Following the desktop findings, the infield site assessment (conducted on the 16th of January 2023) confirmed the location and extent of these systems. Subsequent screening provided an indication of which of these systems may potentially be impacted upon by the project. There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is located in the landscape. The findings are detailed in this section below.

7.1 DELINEATION AND CLASSIFICATION

Following the contextualisation of the study area with the available desktop data, a site visit was conducted to groundtruth the findings and delineate the aquatic habitat and map it within the 500m radius study area. The additional information collected in the field allowed for the development of an improved baseline wetland delineation map (Figure 15).

Four watercourses were identified and mapped within a 500m radius of the proposed Mining Right Area. In order to identify the wetland types, using Kotze et al. (2009) and Ollis *et al.* (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. For reference purposes, the identified HGM units were named as follows:

HGM1 – channelled valley bottom wetland on the Droe River
HGM2 – artificial wetland in the excavated quarry pit
HGM3 – depression wetland
HGM4 – seep wetland

Figure 15 shows the above-listed wetlands in relation to the Mining Right Area and 500m radius study area.

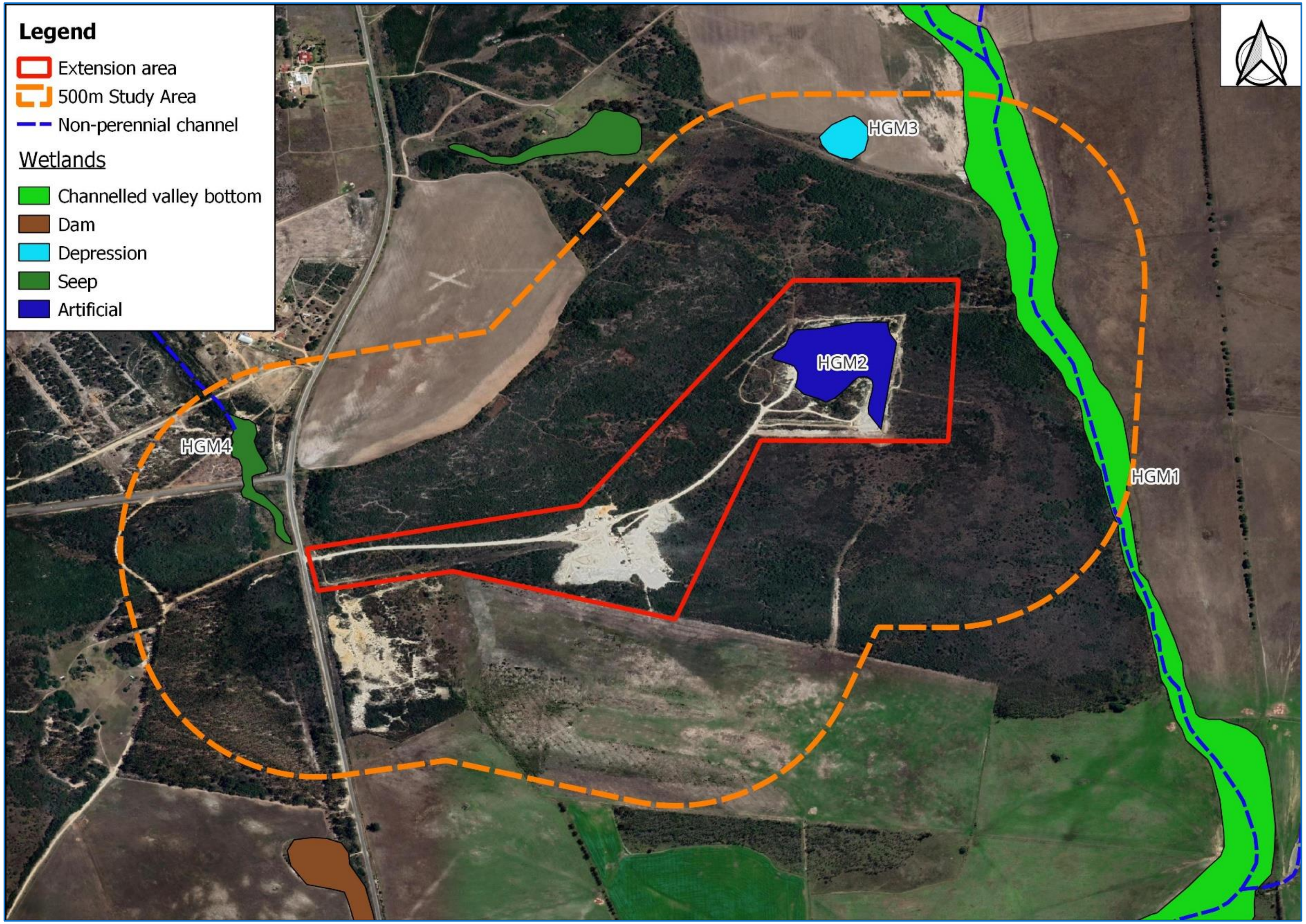


Figure 15: Map of the delineated aquatic habitat

7.2 SCREENING

Subsequent screening provided an indication of which of these systems may potentially be impacted upon by the project and required further assessment. There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is located in the landscape.

The proposed expansion of the excavation area will directly impact upon artificial wetland habitat in the existing quarry pit and has the potential to indirectly impact upon the remaining wetland habitat of the Droe River.

Screening investigations confirmed that the other wetlands (HGM3 and HGM4) have a very low risk of being impacted upon and were therefore not assessed further.

Refer to Table 2 below for a summary of the screening assessment findings.

Table 2: Summary of the screening assessment of aquatic habitat within the 500m radius study area

HGM	Wetland Classification	Name	Flow/ Inundation	NWM 5	CBA Aquatic	Characteristic Potentially Impacted				Risk	Need For Assessment	Justification
						Geom	Veg & Biota	Water Quality	Flow			
HGM 1	Channelled valley bottom	Droe River	Seasonal	Y	Y	Y	N	Y	N	Medium	YES	The excavation area is located approximately 150-200m west, and upslope, of the Droerivier wetland. Without the application of mitigation there is potential for the system to be indirectly impacted by the mining. Therefore, it was determined that this HGM unit should be assessed further.
HGM 2	Artificial	Quarry pit	Permanent	N	Y	Y	Y	Y	N	High	YES	The mining has resulted in a large pit of open water which has formed wetland habitat over time. During expansion, the artificial wetland habitat will be directly disturbed during quarrying. It was therefore assessed further.
HGM 3	Depression	Unknown	Seasonal	N	Y	N	N	N	N	Low	NO	The wetland is located more than 300m from the proposed extended mining right boundary, on a separate property. and will not receive any surface runoff from the quarry. It is unlikely to be impacted and was not assessed further.
HGM 4	Seep	Unknown	Temporary	Y	Y	N	N	N	N	Low	NO	A remnant seep wetland is located on the other side of the tar road and a great distance away from the proposed quarry expansion area. It will not be impacted by the excavations and was not assessed further.

7.3 DESCRIPTION OF AFFECTED AQUATIC HABITAT

7.3.1 HGM1

HGM1 is a channelled valley bottom wetland associated with the Droe River which is situated approximately 150m east of the mine. The Droe river flows through the town of Bredasdorp in a southerly direction, near the mine, before disappearing all together due to agricultural use. There is some remaining wetland habitat along this system, but it is not in a natural condition (Figure 16).

Historically, the broad valley bottom of the Droe River would have been occupied by a large wetland system. Past agricultural activities have resulted in the loss of more than half of the channelled valley bottom wetland and significantly modified any remaining habitat. Cultivated lands and alien invasive plants have encroached right up to the channel banks, which have been straightened and stabilised (constructed levees) to direct flow away from fields. Additionally, the flow regime has been altered by damming and abstraction upstream, as well as the discharge of treated effluent into the system from the wastewater treatment works. This, combined with agricultural/ golf course fertilizers and contaminated urban runoff, has decreased the water quality and changed the flow regime.

The narrow band of remaining wetland is restricted to the channel with lateral connectivity severed. The channel is vegetated by reeds (*Typha capensis*), which proliferate in such disturbed, nutrient-rich areas (Figure 17). The artificial levee is covered with alien Kikuyu grass (*Pennisetum clandestinum*) and Port Jackson willow (*Acacia saligna)* trees.

Figure 16: Photograph of the HGM1 wetland channel and constructed levee covered in Kikuyu grass.

Figure 17: Photograph of the excavated channel dominated by Typha capensis.

7.3.2 HGM2

HGM2 is an artificial depression wetland which has formed within the excavated quarry bottom (Figure 18). In low areas, the groundwater table has risen above the quarry floor to form shallow inundated areas. With time, the prolonged flooding altered the soil characteristics, creating anaerobic conditions, within which hydrophytic vegetation has established. The open water is dominated by the submerged macrophyte, *Potamogeton pectinatus*, while obligate wetland species (such as *Bolboschoenus maritimus* and *Typha capensis*) occupy the shallower areas and edges (Figure 19).

The artificial wetland habitat now supports aquatic fauna throughout their life-cycles, such as water-birds, invertebrates and frogs. Additionally, it is a perennial source of water for many terrestrial species in the area. So, while the wetland is not natural in origin, it is preforming many of the ecological functions typical of depression wetland habitat.

Figure 18: Photograph of the open water within the excavated quarry pit

Figure 19: Photograph of the wetland habitat (HGM2) that has formed as a result of quarrying

7.4 PRESENT ECOLOGICAL STATE (PES)

The assessment of wetland Present Ecological State (PES) was completed using WET-Health Version 2 (Macfarlane *et al.*, 2020). The WET-Health tool is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition. The PES assessment was conducted for the Droe River wetland (HGM1) but not for the quarry pit waterbody (HGM2). The HGM2 wetland is artificial and therefore has no 'reference' state with which to conduct a PES assessment.

The suite of tools developed for WET-Health Version 2 assesses wetland PES based on four modules: (1) Hydrology, (2) Geomorphology, (3) Water quality, and (4) Vegetation. The theoretical reference characteristics of the HGM1 wetland were, in this case, estimated largely from the position in the landscape and the remaining features, and it was assessed as a channelled valley bottom wetland type. HGM1 scored poorly in all aspects due to the significant deviation from estimated reference condition (Table 3).

Overall, the Droe River wetland (HGM1) was determined to be in a Largely Modified condition, falling within the 'D' Ecological Category following PES assessment. This category is indicative of a system which has been subject to a significant loss of natural habitat, biota and basic ecosystem functions. The wetland has less than 50% ecological function and form remaining along its entire length. However, the quarry is not the reason for the poor state and the mine expansion is unlikely to cause any further decline in wetland health.

Table 3: WET-Health 2 assessment results

PES Outcomes				
	Wetland PES Summary			
Wetland name	Droe River wetland			
Assessment Unit	HGM 1 – channelled valley bottom			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5,9	6,0	3,9	5,6
PES Score (%)	41%	40%	61%	44%
Ecological Category	D	E	C	D
Combined Impact Score	5,4			
Combined PES Score (%)	46%			
Combined Ecological Category	D			

** Note that water quality testing was not undertaken and was therefore inferred from catchment and site land use and activities.*

7.5 ECOSYSTEM SERVICES AND FUNCTIONAL IMPORTANCE

A WET-Ecoservices (Version 2) field-based assessment was undertaken to assess the ecosystem services supplied by the HGM1 and HGM2 wetland hydrogeomorphic units (Kotze *et al.* 2020). The assessment technique has recently been revised and now distinguishes clearly both ecosystem services' supply and the demand for all ecosystem services. This helps determine the potential of the wetland for delivering ecosystem services, by understanding its capacity to produce a service while also considering the societal demand for that service.

7.5.1 HGM1

It was determined that the HGM1 channelled valley bottom wetland has a Low importance score with regards to Ecoservices (Table 4). While the wetland supports ecological functions to a small extent (such as streamflow regulation, sediment trapping, pollution control, and carbon storage), there is a very limited demand for these services. This is largely due to the disconnectivity from the stream network and highly modified present ecological state. There is a low level of biodiversity compared to what it would naturally support and no rare or threatened aquatic species were encountered on site. However, there is some demand for the provisioning services, such as water supply and cultivation, due to the surrounding agricultural land uses. However, the results indicate that the overall importance of the system for all ecosystem services is Low to Very Low relative to that supplied by other wetlands. The system is disconnected from downstream systems which lessens its significance on a landscape scale. Habitat has become fragmented and no longer supports many ecosystem services.

Table 4: WET-Ecoservices assessment results for HGM1

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,7	0,0	0,0	Very Low
	Stream flow regulation	1,8	0,3	0,5	Very Low
	Sediment trapping	1,1	0,0	0,0	Very Low
	Erosion control	0,8	0,3	0,0	Very Low
	Phosphate assimilation	1,2	0,0	0,0	Very Low
	Nitrate assimilation	1,1	0,2	0,0	Very Low
	Toxicant assimilation	1,2	0,1	0,0	Very Low
	Carbon storage	1,6	0,0	0,1	Very Low
	Biodiversity maintenance	0,0	3,0	0,0	Very Low
PROVISIONING SERVICE	Water for human use	2,4	0,7	1,2	Low
	Harvestable resources	0,5	0,0	0,0	Very Low

	Food for livestock	0,0	0,3	0,0	Very Low
	Cultivated foods	1,8	0,3	0,5	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,9	0,0	0,0	Very Low
	Education and Research	0,9	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

7.5.2 HGM2

The EcoServices assessment determined that the HGM2 wetland has an overall Moderate ecological importance and sensitivity rating (EIS). This is because, although the HGM 2 wetland is artificial in origin, it supplies permanent water and provides aquatic habitat for a variety of animal species. Additionally, despite the current low demand for its use, the easily accessible and large volume of fresh water is an important provisioning service for society (scoring Moderately High). However, the wetland is artificial, does not support any threatened species, and is not connected to the stream network, which severely limits it supply of ecoservices and associated importance in the landscape (scoring Low to Very Low in these respects). Refer to Table 5 for a breakdown of the ecosystem service assessment results.

Table 5: WET-Ecoservices assessment results for HGM2

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,0	0,0	0,0	Very Low
	Stream flow regulation	0,0	0,0	0,0	Very Low
	Sediment trapping	0,5	0,0	0,0	Very Low
	Erosion control	0,4	0,7	0,0	Very Low
	Phosphate assimilation	0,4	0,0	0,0	Very Low
	Nitrate assimilation	0,2	0,0	0,0	Very Low
	Toxicant assimilation	0,4	0,0	0,0	Very Low
	Carbon storage	0,9	0,0	0,0	Very Low
	Biodiversity maintenance	1,4	2,0	0,9	Low
PROVISIONING SERVICES	Water for human use	4,0	0,3	2,7	Moderately High
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	0,0	0,0	0,0	Very Low

	Cultivated foods	1,3	0,0	0,0	Very Low
CULTURAL SERVICES	Tourism and Recreation	3,0	0,0	1,5	Moderately Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	2,0	0,0	0,5	Very Low

7.6 AQUATIC BUFFER ZONE

An aquatic impact buffer zone is defined as a zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels (Macfarlane and Bredin, 2016). Aquatic buffer zones are designed to act as barriers between human activities and sensitive water resources in order to protect them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions and have therefore been adopted as a standard measure to protect water resources and associated biodiversity.

Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane & Bredin (2017) for wetlands was used. These buffer models are based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of activity, as well as the proposed alteration of hydrological flows. Based then on the information known for the site, the buffer model recommends a 35m buffer zone between wetland habitat and the activities (Figure 20). This buffer zone can be easily adhered to as it does not enter the proposed Mining Right Area.

Note that no buffer zone is required for the artificial wetland habitat which has developed within the mined area, but other mitigation measures should be adopted during operations to minimise impacts upon the aquatic fauna in this area.

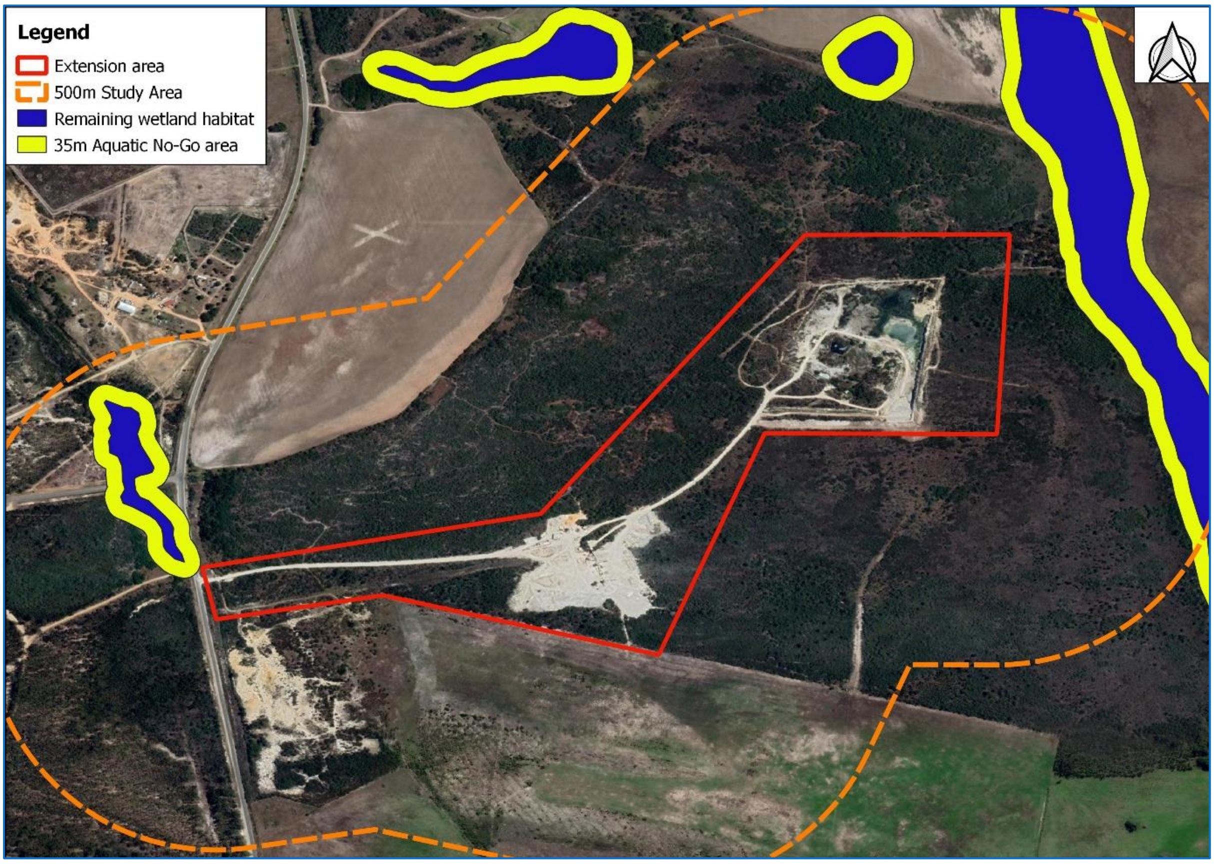


Figure 20: Map of the recommended aquatic buffer zone from the remaining wetlands

8 POTENTIAL IMPACTS

This simple type of quarry operation, within this specific environment, results in very localised activities and a relatively small direct and indirect disturbance footprint. The site is not connected to the stream network, The work is conducted from within the quarry pit and any impacts can largely be confined to the site itself. There are no natural aquatic habitats within the proposed site, only the artificial wetland areas within the existing quarry pit.

The HGM1 Droe River wetland, located more than 100m from the proposed mining area, is unlikely to be impacted by the project. After the adoption of the aquatic buffer zone and basic mitigation measures, there is a negligible risk of indirect impacts to the remaining wetland from disturbance, noise or dust. Surface run-off from the Mining Right Area is also unlikely to reach the wetland, but this can easily be ensured with mitigation. Therefore, if the buffer is adopted as a No-Go area, and stormwater runoff from the site is contained, the project will not change the characteristics of the HGM1 watercourse.

The HGM2 wetland, which has artificially formed within the quarry pit, will be disturbed by the continuation of the mining in the site. The faunal and vegetation communities inhabiting the site may temporarily be impacted. Additionally, any hydrocarbon spills from machinery can contaminate the open water of the pit. The adoption of mitigation measures will minimise these impacts to acceptable levels.

There may be positive aquatic biodiversity impacts if the end land use, following decommissioning, is conservation orientated. It is likely that the extension of the excavation area will result in additional inundated areas which could form wetland characteristics over time. Therefore, the continuation of mining will ultimately result in an increase in extent of aquatic habitat in the area. Additionally, should the mine adopt an alien invasive plant control plan, there would be a positive indirect impact on water resources from the removal of the dense strands of thirsty alien trees. However, these potentially positive impacts cannot be assessed as the future state of the quarry pit and the end land use of the property is undetermined.

The cumulative impacts associated with the project are low as there is no mining taking place within any watercourses and the potential impacts are highly localised. However, any changes to the aquifer as a result of mining could cumulatively impact upon water resources of the area (and this would require geohydrological input to be determined). There are no impacts associated with the No-Go Alternative from an aquatic biodiversity perspective.

The following identified impacts of the mining were assessed, which are aligned with those contained in the Biodiversity Assessment Protocol and detailed in Table 6 below:

Table 6: Impacts assessed in alignment with the Biodiversity Assessment Protocol

Biodiversity Assessment Protocol Impacts found applicable to this project	**Impacts assessed in this report below**
Faunal and vegetation communities inhabiting the site	Impact 1
Changes in numbers and density of species	Impact 1
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Impact 2
Cumulative Impacts	Impact 3

Impact 1: Disturbance or loss of wetland habitat and biota

The disturbance of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of biota caused by vegetation clearing and excavation, as well as encroachment and colonisation of habitat by invasive alien plants.

Impact 2: Potential impact on localised surface water quality

Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in species diversity. During all phases of the project there is potential for hydrocarbon pollution from heavy vehicles These impacts can largely be avoided with the implementation of mitigation measures, adherence to the EMP, and appropriate monitoring/ site management.

Impact 3: Cumulative impacts on the aquatic resources of the area

Cumulative impacts on the environment can result from broader, long-term changes and not only as a result of a single activity or development. They are rather from the combined effects of many activities overtime. No residual cumulative impacts upon aquatic habitat are anticipated. Positive impacts can be achieved though improved land management, including alien tree removal, the rehabilitation of indigenous vegetation, and including conservation objectives into the end land use plan.

9 IMPACT SIGNIFICANCE

The significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed. The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined. There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position of the system in the landscape.

The impact significance of the proposed project was assessed for each potential impact (Tables 7, 8, and 9). It was determined that, after mitigation, the aquatic biodiversity impacts will be of Low significance.

The mitigation of negative impacts on biodiversity and ecosystem goods and services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the specific area being affected. Mitigation requires the adoption of the precautionary principle and proactive planning that is enabled through a mitigation hierarchy. Its application is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA 2013). Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place.

Table 7: Impact assessment for disturbance of wetland habitat and biota

Phase:	Site preparation, Operation				
Nature:	Negative				
Impact:	Spatial	Temporal	Magnitude	Likelihood	Significance
Before mitigation	Local	Long term	Low	Definite	Medium
After mitigation	Site	Medium term	Minor	Very Probable	Very Low
Irreplaceable loss	No				

Reversible	Partially
Potential to mitigate	High

Recommended mitigation measures:

- To prevent impacting upon HGM1, an aquatic buffer zone of 35m (minimum) should be applied from any remaining aquatic habitat on the Droe River. The proposed buffer must be adopted as a No-Go Zone for any activities excepting alien plant removal.
- To minimize impacts upon HGM2, where possible, quarry operations within the pit should work on one face at a time, to allow for any aquatic fauna to move and seek refuge in another wet area of the pit.
- During site preparation (before blasting etc.) near the artificial wetland areas in the pit, should any nests or aquatic fauna need to be moved, CapeNature must be consulted to advise, and assist if needed.
- Any fauna (frogs, snakes, fledglings, etc.) that are found within the working area must be moved to the closest point of similar habitat type outside of the areas to be impacted, ideally into the Droe River corridor.
- Removed wetland vegetation and soils can be transplanted in other areas of the pit to aid rehabilitation as work progresses.
- During decommissioning, the banks should be sloped/terraced and stabilized. Any deep excavation areas in the pit can be infilled to promote a shallow waterbody.

Table 8: Impact assessment for localised changes to surface water quality

Phase:	Operation				
Nature:	Negative				
Impact	Spatial	Temporal	Magnitude	Likelihood	Significance
Before mitigation	Site	Medium term	Low	Probable	Low
After mitigation	Site	Short term	Minor	Improbable	Very Low
Irreplaceable loss	No				
Reversible	Yes				
Potential to mitigate	High				

Recommended mitigation measures:

- Prevent any potential sources of pollution from entering the surrounding environment (e.g. litter, hydrocarbons from vehicles & machinery, etc.) and any solid domestic waste must be removed and disposed of offsite. Vehicles must be maintained to prevent leaks.
- No surface runoff from the excavation area should not be directed into the surrounding environment. Measures, such as a low contour berm, can be installed outside of the disturbance area, to capture sediment and promote infiltration before leaving the mining right area. Remove any accumulated sediment deposited after heavy rainfall events and maintain the berm.

- Where possible, topsoil removed during the mining phase must be conserved and used in the rehabilitation. It can potentially be used to create the stormwater berms and then replaced following decommissioning.
- Compliance with the mitigation recommendations must be audited by a suitably qualified independent Environmental Control Officer with an appropriately timed audit report. Monitoring for non-compliance must be done on a daily basis by the mine managers.

Table 9: Impact assessment for cumulative impacts

Phase:	Site preparation, Operation and decommissioning				
Nature:	Negative				
Impact	Spatial	Temporal	Magnitude	Likelihood	Significance
Before mitigation	Regional	Permanent	Low	Improbable	Low
After mitigation	Local	Long-term	Minor	Highly improbable	Very Low
Irreplaceable loss	Partial				
Reversible	Recoverable				
Potential to mitigate	Moderate				

<u>Recommended mitigation measures:</u>

- Improved land management, including alien tree removal, the rehabilitation of indigenous vegetation, and including conservation objectives into the end land use plan.
- Groundwater monitoring

10 CONCLUSION

The aquatic habitats within a 500 meter radius of the proposed mining area were identified and mapped on a desktop level utilising available data. Following the desktop findings, a site assessment was conducted to verify the location and extent of these systems. It was determined that a channelled valley bottom wetland associated with the Droe River, and an artificial depression wetland within the excavated quarry bottom, required detailed assessment.

The impact significance of the proposed project was assessed for each potential impact. It was determined that, after mitigation, the aquatic biodiversity impacts will be of Low significance. The HGM1 Droe River wetland, located more than 100m from the proposed mining area, is unlikely to be impacted by the project. After the adoption of the aquatic buffer zone and basic mitigation measures, there is a negligible risk of any indirect impacts to the remaining wetland. The HGM2 wetland, which has artificially formed within the quarry pit, will be disturbed by the continuation of the mining in the site. The faunal and vegetation communities inhabiting the site may temporarily be impacted. Additionally, any hydrocarbon spills from machinery can contaminate the open water of the pit. The adoption of mitigation measures will minimise these impacts to acceptable levels.

The proposed project requires a Water Use License (WUL) in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998 and this must be secured prior to the commencement of activities.

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APPENDIX 1 –DETAILED METHODOLOGY

For reference the following definitions are as follows:

- **Drainage line**: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may not be present.
- **Perennial and non-perennial:** Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contains flows for short periods, such as a few hours or days in the case of drainage lines.
- **Riparian**: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).
- **Wetland**: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).
- **Water course**: as per the National Water Act means -
  (a) a river or spring;
  (b) a natural channel in which water flows regularly or intermittently;
  (c) a wetland, lake or dam into which, or from which, water flows; and
  (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks

11.1 WETLAND DELINEATION AND HGM TYPE IDENTIFICATION

Wetland delineation includes the confirmation of the occurrence of wetland and a determination of the outermost edge of the wetland. The outer boundary of wetlands was identified and delineated according to the Department of Water Affairs wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005a). Wetland indicators were used in the field delineation of the wetlands: position in landscape, vegetation and soil wetness (determined through soil sampling with a soil auger and the examining the degree of mottling).

Four specific wetland indicators were used in the detailed field delineation of wetlands, which include:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

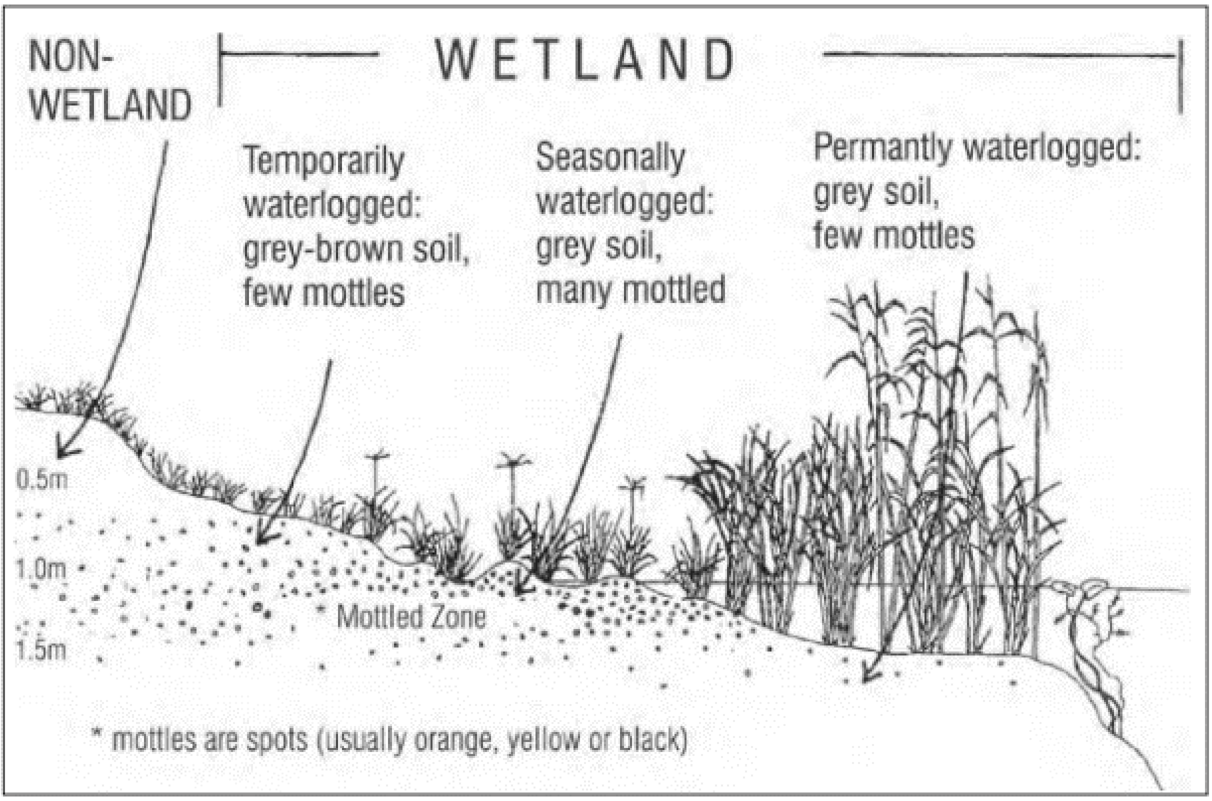

Figure A12.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained (perhaps for several centuries).

The permanent, seasonal and temporary wetness zones can be characterised to some extent by the soil wetness indicators that they display (Table A12.1a)

A12.1a: Soil Wetness Indicators in the various wetland zones

TEMPORARY ZONE	**SEASONAL ZONE**	**PERMANENT ZONE**

Minimal grey matrix (<10%)	Grey matrix (<10%)	Prominent grey matrix
Few high chroma mottles	Many low chroma mottles present	Few to no high chroma mottles
Short periods of saturation (less than three months per annum)	Significant periods of wetness (at least three months per annum)	Wetness all year round (possible sulphuric odour)

Table A12.1b: Relationship between wetness zones and vegetation types and classification of plants according to occurrence in wetlands

Vegetation	Temporary Wetness Zone	Seasonal Wetness Zone	Permanent Wetness Zone
Herbaceous	Predominantly grass species; mixture of species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Dominated by: (1) emergent plants, including reeds (*Phragmites australis*), a mixture of sedges and bulrushes (Typha capensis), usually >1m tall; or (2) floating or submerged aquatic plants.
Woody	Mixture of woody species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas.	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species, which are restricted to wetland areas. Morphological adaptations to prolonged wetness (e.g. prop roots).
Symbol	Hydric Status	Description/Occurrence	
Ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)	
Fw/F+	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas	
F	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas	
Fd/F-	Facultative dryland species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)	
D	Dryland species	Almost always grow in drylands	

In order to identify the wetland types, using Kotze *et al.* (2009) and Ollie *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. These have been defined based on the geomorphic setting of the wetland in the landscape (e.g. hillslope or valley bottom, whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated), how water flows through the wetland (diffusely or channelled) and how water exits the wetland (Figure A12.1b).

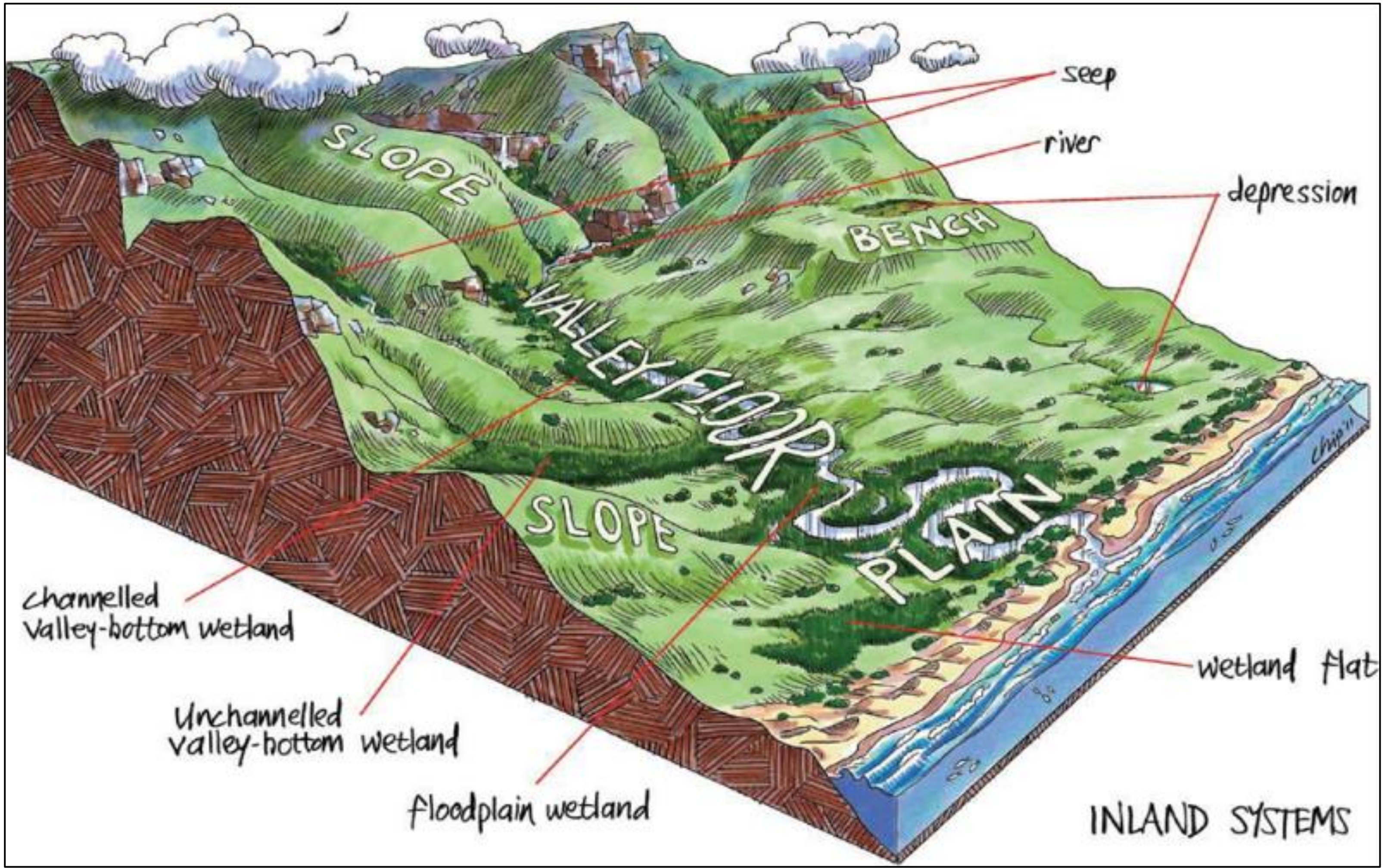

Figure A12.1b: Illustration of wetland types and their typical landscape setting (From Ollis <u>et al.</u> 2013)

11.2 DELINEATION OF RIPARIAN AREAS

Riparian zones are described as “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas” i , Riparian zones can be thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (Figure 12.2a). Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel.

Like wetlands, riparian areas can be identified using a set of indicators. The indicators for riparian areas are: - **Landscape position**; - Alluvial soils and recently deposited material; - **Topography** associated with riparian areas; and - **Vegetation** associated with riparian areas. Landscape Position As discussed above, a typical landscape can be divided into 5 main units), namely the: - Crest (hilltop); - Scarp (cliff); - Midslope (often a convex slope); - Footslope (often a concave slope); and - Valley bottom. Amongst these landscape units, riparian areas are only likely to develop on the valley bottom landscape units (i.e. adjacent to the river or stream channels; along the banks comprised of the sediment deposited by the channel). Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. Whilst the presence of alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas, it can be used to confirm the topographical and vegetative indicators. Quaternary alluvial soil deposits are often indicated on geological maps, and whilst the extent of these quaternary alluvial deposits usually far exceeds the extent of the contemporary riparian zone; such indicators are useful in identifying areas of the landscape where wider riparian zones may be expected to occur.

Topography and recently deposited material associated with riparian areas The National Water Act definition of riparian zones refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised “macro-channels” which are typical of many of southern Africa’s eastern seaboard rivers. Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus the likely presence of wetlands. Vegetation associated with riparian areas unlike the delineation of wetland areas, where redoxymorphic features in the soil are the primary indicator, the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs: - in species composition relative to the adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

As with the delineation approach for wetlands, the field delineation method for riparian areas focuses on two main indicators of riparian zones: - **Vegetation Indicators**, and - **Topography** of the banks of the river or stream.

Additional verification can be obtained by examining for any recently alluvial deposited material to indicate the extent of flooding and thus obtain at least a minimum riparian zone width. The following procedure should be used for delineation of riparian zones: A good rough indicator of the outer edge of the riparian areas is the edge of the macro channel bank. This is defined as the outer bank of a compound channel, and should not be confused with the active river or stream channel bank. The macro-channel is an incised feature, created by uplift of the subcontinent which caused many rivers to cut down to the underlying geology and creating a sort of "restrictive floodplain" within which one or more active channels flow. Floods seldom have any known influence outside of this incised feature. Within the macro-channel, flood benches may exist between the active channel and the top of the macro channel bank. These depositional features are often covered by alluvial deposits and may have riparian vegetation on them. Going (vertically) up the macro channel bank often represents a dramatic decrease in the frequency, duration and depth of flooding experienced, leading to a corresponding change in vegetation structure and composition.

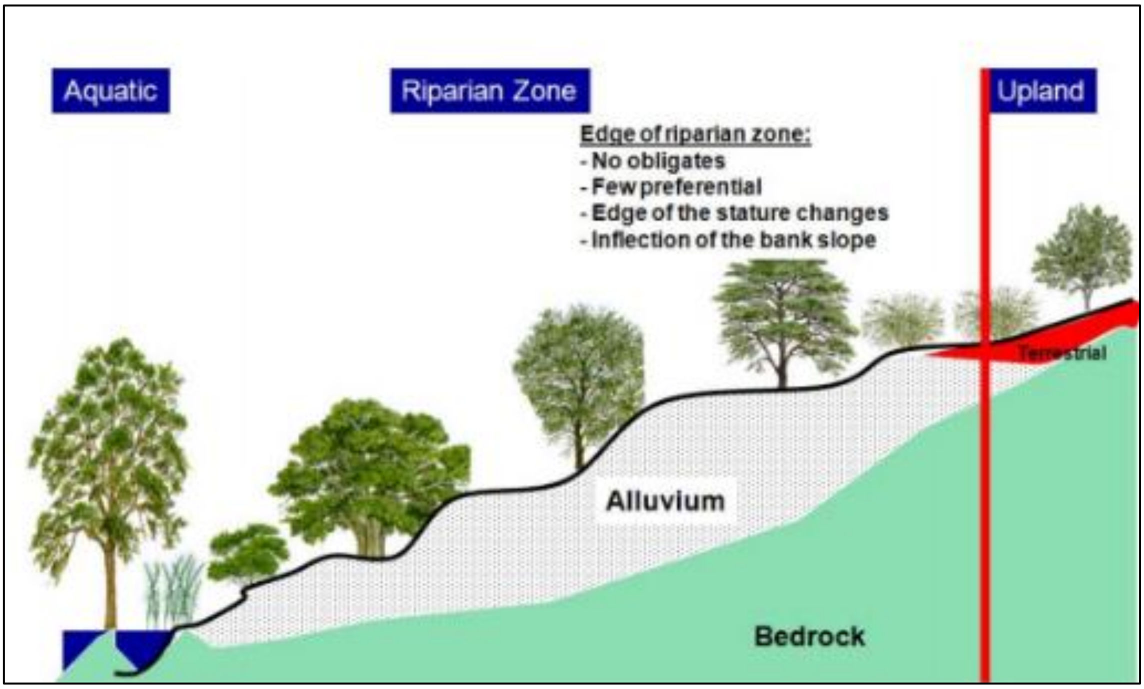

Figure A12.2a: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. Note the coincidence of the inflection (in slope) on the bank with the change in vegetation structure and composition. The edge of the riparian zone coincides with an inflection point on the bank; where there are not obligates upslope; few preferential. The boundary also coincides with the outer edge of the stature differences (DWAF 2008).

11.3 PRESENT ECOLOGICAL STATE (PES) – WETLANDS

WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology and vegetation. For the purposes of rehabilitation planning and assessment, WET-Health helps users understand the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps diagnose the cause of wetland degradation so that rehabilitation workers can design appropriate interventions that treat both the symptoms and causes of degradation. WET-Health is tailored specifically for South African conditions and has wide application, including assessing the Present Ecological State of a wetland.

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils. This module focuses on changes in water inputs as a result of changes in catchment activities and characteristics that affect water supply and its timing, as well as on modifications within the wetland that alter the water distribution and retention patterns within the wetland.

Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland. This module focuses on evaluating current geomorphic health through the presence of indicators of excessive sediment inputs and/or losses for clastic (minerogenic) and organic sediment (peat).

Vegetation is defined in this context as the vegetation structural and compositional state. This module evaluates changes in vegetation composition and structure as a consequence of current and historic onsite transformation and/or disturbance.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. The tool attempts to standardise the way that impacts are calculated and presented across each of the modules. This takes the form of assessing the spatial extent of impact of individual activities and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact (Table A12.2a).

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table A12.2b, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

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

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

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

Table A12.2a: Guideline for interpreting the magnitude of impact on integrity

Impact Category	**Description**	**Score**
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 – 10

Table A12.2b. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane et al., 2008).

Impact Category	Description	Range	Pes Category
None	Unmodified, natural.	0 – 0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features	6 – 7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10	F

11.4 WETLAND FUNCTIONAL IMPORTANCE (GOODS AND SERVICES)

WET-EcoServices is used to assess the goods and services that individual wetlands provide, thereby aiding informed planning and decision making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 20 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (e.g. floodplain). Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors (e.g. flow pattern through the wetland).

The overall goal of WET-EcoServices is to assist decision makers, government officials, planners, consultants and educators in undertaking quick assessments of wetlands, specifically in order to reveal the ecosystem services that they supply. This allows for more informed planning and decision making. WET-EcoServices includes the assessment of several ecosystem services (listed in Table A12.4a) - that is, the benefits provided to people by the ecosystem.

Ecosystem services supplied by wetlands	Indirect benefits	Regulating and supporting benefits		Flood attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
				Streamflow regulation	Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
				Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance[2]**			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits		Provision of water for human use	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
				Provision of harvestable resources	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
				Provision of cultivated foods	The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits		Cultural heritage	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
				Tourism and recreation	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
				Education and research	Sites of value in the wetland for education or research

Table A12.4a: Ecosystem services assessed by WET-Ecoservices

11.5 PRESENT ECOLOGICAL STATE (PES) – RIPARIAN

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

DWAF have developed a modified IHI, designed to accommodate the time constraints associated with desktop assessments or for instances where a rapid assessment of river conditions is required. The protocol does not distinguish between instream and riparian habitat and addresses six simple metrics to obtain an indication of Present Ecological State (PES). Each of the criteria are rated on a scale of 0 (close to natural) to 5 (critically modified) (Table A1.1) according to the following metrics:

- Bed modification
- Flow modification
- Inundation
- Bank condition
- Riparian zone condition
- Water quality modification

This assessment was informed by (i) a site visit where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and landuses / activities that could have a detrimental impact on river ecosystems.

Table A1.1: The rating scale for each of the various metrics in the assessment

Rating Score	Impact Class	Description
0	None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.
0.5 - 1.0	Low	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.
1.5 - 2.0	Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.
2.5 - 3.0	Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.
3.5 - 4.0	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 influenced.

4.5 - 5.0	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.

The six metric ratings of the HGM under assessment are then averaged, resulting in one value. This value determines the Habitat Integrity PES category for the HGM (Table A1.2).

Table A1.2: The habitat integrity PES categories

Habitat Integrity PES Category	Description
A: Natural	Unmodified, natural.
B: Good	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C: Fair	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D: Poor	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E: Seriously modified	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F: Critically modified	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.

11.6 ECOLOGICAL IMPORTANCE & SENSITIVITY – RIPARIAN

The ecological importance of a wetland/river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; 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 (Table A1.3).

The scores assigned to the criteria in Table A1.3 were used to rate the overall EIS of each mapped unit according to Table A1.4, below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane et al., 2008).

Table A1.3: Components considered for the assessment of the ecological importance and sensitivity of a riparian system. An example of the scoring has also been provided.

Ecological Importance and Sensitivity assessment (Rivers)		
Determinants		Score (0-4)
BIOTA (RIPARIAN & INSTREAM)	Rare & endangered (range: 4=very high - 0 = none)	0,5
	Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	0,0
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	0,5
	Species/taxon richness (range: 4=very high - 1=low/marginal)	1,5
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	1,0
	Refugia (4=Very high - 1=marginal/low)	1,5
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	1,0
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	1,0
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1,0
	Importance of conservation & natural areas (range, 4=very high - 0=very low)	2
MEDIAN OF DETERMINANTS		1,00
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		LOW, EC=D

Table A1.4: The ratings associated with the assessment of the EIA for riparian areas

Rating	Explanation
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

APPENDIX 2- SPECIALIST CV

CURRICULUM VITAE

Debra Jane Fordham

Cell: 0724448243
Email: debrajanefordham@gmail.com
Date of birth: 26th August 1987
Country of origin: South Africa
ID Number: 8708260094081

Professional profile

Debbie is a registered ecologist (119102), with over 8 years of working experience, largely specialising in aquatic ecology. She has authored over 80 reports and applications and she constantly contributes to the scientific and local community. Most of her projects involve (as a minimum) in-depth wetland and river field delineation (including soil investigations via augering, vegetation identification, and classifying the hydrological characteristics), laboratory analysis (such as water quality and sediment analysis), classification, characterisation, ecological health and ecosystem functioning assessments (using the latest available tools), as well as impact rating, buffer determinations, mitigation recommendations and detailed rehabilitation plans. She is highly proficient using GIS software to incorporate accurate spatial analysis and visual aids (No Go Area maps etc.) into her reports.

Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by Prionium serratum in the Western Cape. She is a member of scientific organisations such as the Society of Wetland Scientists (SWS), the South African Wetland Society (SAWS), the Southern African Association of Geomorphologists (SAAG), and the International Association for Impact Assessment (IAIAsa). Debbie is registered with SACNASP in the field of Ecological Science (Reg Number: 119102).

Tertiary Education

- M.Sc. Environmental Science (Rhodes University):
  Master of Science thesis entitled: The geomorphic origin, evolution and collapse of a peatland dominated by Prionium serratum: a case study of the Tierkloof Wetland, Western Cape.
- BA Hons. Environmental Science (Rhodes University):
  Honours dissertation: The status and use of Aloe ferox. Mill in the Grahamstown commonage, South Africa.
  Courses: Wetland Ecology, Environmental Water Quality /Toxicology, Biodiversity, Non-Timber Forest Products (NTFPs) and Rural Livelihoods, Environmental Impact Assessment (EIA), Statistics
- BA - Environmental Science and Geography (Rhodes University)

Work Experience:

- Ecological specialist (2022/03/01 – present)
- Sharples Environmental Services cc (2016/08/10 – 2022/03/01)

Position: Aquatic Ecologist and WULA Manager

- KSEMS Environmental Consulting (2015/08/10 - 2016/07/31)

Position: Wetland specialist

- AGES EC (Pty) Ltd (2014/10/01 – 2015/08/10)

Position: Aquatic Ecologist and WULA Manager

- Environmental Impact Management Services (2014/02/04-2014/02/07)

Position: Environmental consultant

- Rhodes University Alumni Relations (2010/04/01 – 2010/12/17)

APPENDIX 3 - SITE SENSITIVITY VERIFICATION REPORT

Site verification report – Aquatic Ecology

Government Notice No. 645, dated 10 May 2019, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a project footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

- Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;
- Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;

Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This report has been produced specifically to consider the aquatic ecology theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the Scoping and EIA Reports produced for the projects.

Site sensitivity based on the aquatic biodiversity theme included in the Screening Tool and specialist assessment

Based on the DFFE Screening Tool, there are areas of Very High Aquatic Biodiversity sensitivity.

The site verification specialist findings were informed by a site visit undertaken in January 2023. The photographs within the Figures 1 to 4 below show the various aquatic features present on site. This information was then compared to current wetland inventories, 1: 50 000 topocadastral surveys mapping of the site. A baseline map was then developed (Figure 5).

Figure 1: A photograph of the open water caused by excavation to groundwater.

Figure 2: A photograph of the wetland habitat which has formed artificially within the quarry

Figure 3: A photograph of the wetland vegetation on the Droe River, east of the site

Figure 4: Photographs of soil augering during field assessment

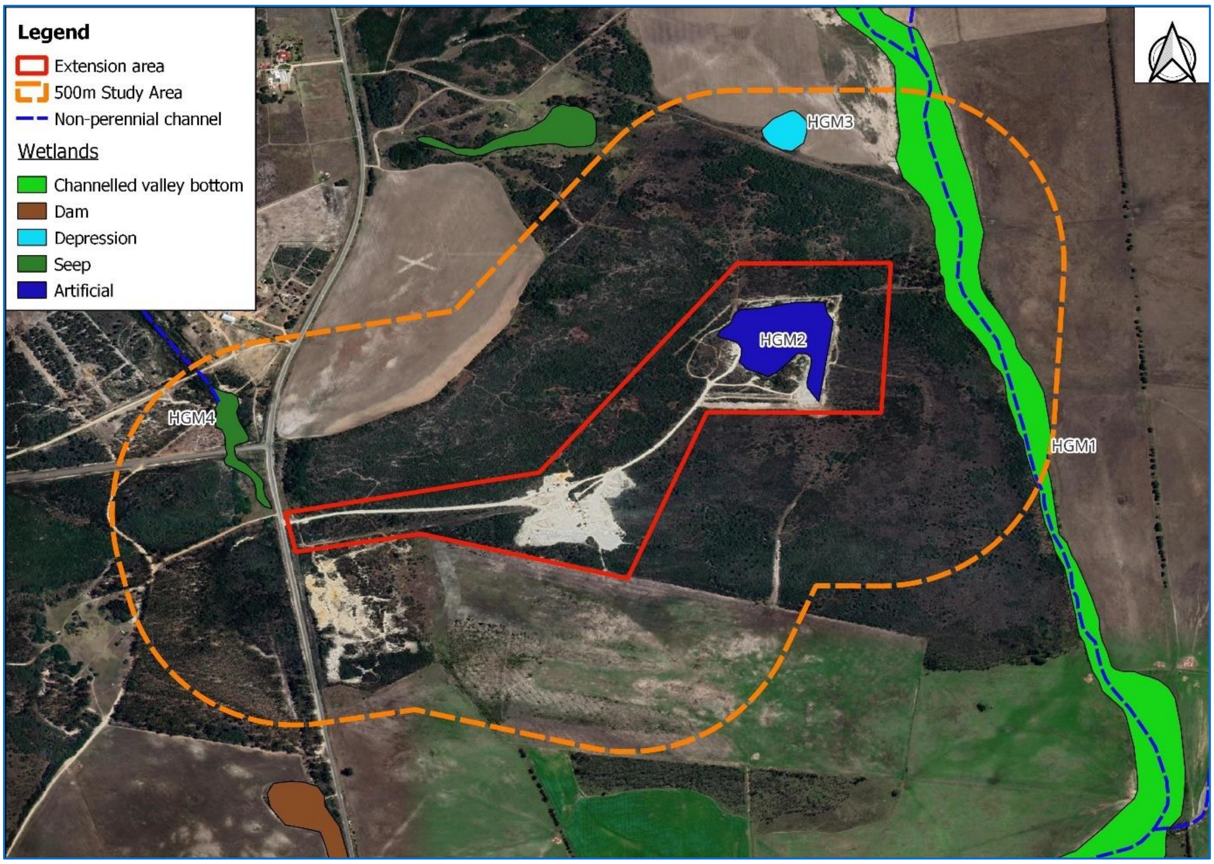

Figure 5: Delineated aquatic habitat within the study area

Motivation of the outcomes of the sensitivity map and key conclusions:

In conclusion, the DFFE Screening Tool resulted in Very High sensitivity ratings within the site footprint, and surrounding area, due to the drainage lines and Strategic Water Source Area. Following site verification, this Very High sensitivity rating is confirmed.

It is recommended that a full Aquatic Biodiversity Impact Assessment is undertaken for the project.

The environmental sensitivity input received from the aquatic ecology specialist will be taken forward and considered within the formal EA process and the impact to these areas assessed.