ENVIRONMENTAL IMPACT ASSESSMENT

FOR MINING OF BASE & RARE METALS, INDUSTRIAL MINERALS, PRECIOUS METALS AND SEMI-PRECIOUS STONES WITHIN MINING CLAIMS 75160, 75161 & 75162 - NEAR OTJIMUHAKA, EPUPA CONSTITUENCY, KUNENE REGION

SCOPING REPORT WITH ASSESMENT

(Submission to MEFT)

By Philip Hooks

February 2026

Project:	Environmental Impact Assessment for Mining of Base & Rare Metals, Industrial Minerals, Precious Metals and Semi-Precious Stones within Mining Claims 75160, 75161 & 75162 - Near Otjimuhaka, Epupa Constituency, Kunene Region
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EXECUTIVE SUMMARY

Nina Smit (hereafter referred to as the Proponent) is a Namibian citizen, who applied for mineral rights within Mining Claims (MCs) 75160, 75161 and 75162 for the following commodities, Base and Rare Metals, Industrial Minerals and Precious Metals. The mining claims are all located within the Exclusive Prospecting License (EPL) 5885, situated at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region. The proponent applied for the three MCs 75160, 75161 & 75162 on 22nd December 2023.

The Proponent appointed Philip Hooks, an independent Environmental Assessment Practitioner (EAP), to undertake the assessment and compile this scoping assessment report and Environmental Management Plan (EMP) in support of the application APP-6330. The curriculum vita of the EAP is provided in **Appendix A**. The Terms of Reference for the proposed project is based on the requirements set out by the Environmental Management Act (EMA) (2007) and its EA Regulations (2012).

The MCs lie approximately 130 km northwest from Opuwo and are located about 3.5 km southwest of the Namibian-Angolan border, marked by the river Kunene, and 6 km south-west of Otjimuhaka settlement (previously Swartbooisdrif). The MCs cover an area of about 53.5 hectares.

The proposed mining and processing activities focus on the specific resources of sodalite, iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the existing mining claims that the Proponent has applied for rights to. The product from the rare earth and iron mineralisation is envisaged in the form of mineral concentrates for the Southern African and international market. Sodalite is produced in the form of lumps of ornamental stones and as blocks of dimension stone. This is in line with the provisions of the Minerals (Mining and Prospecting) Act of 1993, where sodalite is categorised in the commodities of dimension stones (industrial minerals) and semi-precious stones. The mineralisation is unique in Namibia.

The mining and processing activities will be undertaken in phases as follows:

- The construction phase activities
- The operational phase activities
- Decommissioning phase activities

The MCs are situated in a remote rural area. The physical and biological environment is aesthetically beautiful. There are obvious signs of degradation by previous mining activities and the effects of the current drought exacerbate the difficulty that the communities experience in living off the land.

The mining operations take place on communal land. Due respect is given to the communities that use the area for subsistence living. The Ovahimba people are semi-nomadic and may come near the mining operations from time to time. Good community relations are imperative for the successful running of the mine. Public safety is of utmost importance.

Operations at the site use open cast mining methods. Mining techniques make use of modern equipment such as excavators, diamond wire saw, circular diamond cutting machines, compressor driven drill rigs, jack hammers and dump trucks. Such open cast mining operations will be established according to good practice procedure. The mining operations comprise of consecutive phases including site clearing, excavations – by means of drilling and blasting, digging, block cutting, removing and haulage of rock to processing plant and storage yard.

Multiple quarries (i.e., wedge, terrace or trench shaped) will be mined at various places within the mining claims. Quarry depth will also be to a maximum of about 50 m. Up to approximately 1,000 t of rock is expected to be removed from the ground and processed at a frequency yet to be determined. For all types of material from the ground the excavations are planned to a maximum stripping ratio of 1: 10. Overall the maximum or total estimate of waste rock produced will be up to 60 000 tons either annually or every two or three years. Mineral waste will be deposited in waste rock dumps and processing waste in a tailings' storage facility.

The greater Ondoto Mining project has already established a central processing facility for sodalite dimension stone blocks at the Oroutumba settlement and a mineral processing facility for rare earth minerals at an approved accessory works area northwest of the MCs. Both processing facilities are situated within ML40.

An estimated mining lifespan of up to 25 years is considered. The life of mine for the operations has been based on the expected demand and the size of the resource. However, this may vary significantly as the demand may fluctuate.

Decommissioning activities will include the removal of infrastructure, preparation of final landforms for closure and to rehabilitate roads where necessary. However, ongoing rehabilitation and landscaping should be conducted as the mining operations proceed. Shaping of the excavated area not only to accommodate rehabilitation efforts, but also in terms of safety, should be conducted according to a rehabilitation plan. In accordance with the Environmental Management Act, the proponent is required to make funds accessible which will specifically be available and allocated for rehabilitation efforts. This fund should continually be available during the life of mine yet also be sufficient to cover the decommissioning activities as required.

The potential impacts associated with all phases of the mining are outlined in the environmental impact assessment chapter and include the potential impacts on personnel working at the mine and the public who might reside near the MCs.

Public Participation

As part of the requirement to apply for environmental clearance public participation in the EIA process is required by law. The facilitator for the public participation process records the process in the report in **Appendix B**. The background information document used in the public participation process can be found in **Appendix C**. The key Public Consultation aspects are summarised in the following table.

Date / Action	Location / extent	Facilitator	Stakeholders	Confirmations, details, follow-ups
1st, 3rd and 9th of September 2025 Press Notices	Nation-wide	Die Republikein Allgemeine Zeitung The Sun newspaper	All interested parties	Advertisements in public newspapers – first, second and third notice. (See Public Participation Report)
From 1st September 2025 Public Notices	The Kunene Regional Council. The Okapereki supermarket in Otjimuhaka.	Mrs Charon Katjiuongua (Cultural Officer Education Ministry)	Public venues (school, shops, Opuwo Regional Office)	Photos of the site notices were taken. (See Public Participation Report)

Date / Action	Location / extent	Facilitator	Stakeholders	Confirmations, details, follow-ups
28th August – 4th September 2025 Email Notices	Email notices sent out	Philip Hooks & Lovisa Amwele	All pre-identified stakeholders in Opuwo and Otjimuhaka GRN offices and NGOs	Saved email messages (See Public Participation Report)
11th September 2025 Public Meeting	Otjimuhaka Primary School	Charon Katjiuongua (meeting interpreter) Lovisa Amwele (meeting facilitator)	Attendance list in the appendix of the minutes of the meeting.	Meeting minutes recorded and reported in the public participation report.
12th September 2025 Notices in person	Notices by hand		MEFT Offices (Opuwo) and Regional Government Offices (Opuwo)	Signed, stamped receipts (See Public Participation Report)
16th January 2026 Public Review	Start of public review	Philip Hooks	Send report out to registered IAPs; Printed copy of the public review document placed at the Regional Offices Opuwo and at the mine office in Oroutumba village.	Waited on feedback on the report and Draft EMP
6th February 2026 Public review	End of public review period	Philip Hooks	Work in all issues and responses from Public Review	Incorporated into the Executive Summary
23rd February 2026 Final Submission Proposed	MEFT Offices / Online Portal	Philip Hooks	DEA and MIME	Submission of the Final EIA Report and Draft EMP; Copy sent to MIME

The following table summarises the outcome and responses to the public consultation to date. Formal written responses from Interested and Affected Parties are yet to be received.

#	Theme	Summary of issues
1	Biodiversity	A researcher undertaking a freshwater fish study in the Ondoto River springs reported the presence of *Kneria maydelii* and a potentially undescribed fish species. Concerns were raised about the impact of water abstraction on these rare and possibly endemic species. The researcher strongly recommended that an EIA specifically assesses the risks of water abstraction on the spring ecosystems and their biodiversity. This will be taken into consideration and recommendations for assessment and monitoring have been incorporated into the Draft Environmental Management Plan (EMP) **Subsequent Public Review Additions:** The decision not to depend on the springs of the Ondoto River has been made. Alternative water sources for mineral processing are being investigated. The mitigations set out by the hydrologist and hydrogeologist regarding the tailing's facility were deemed sufficient to prevent the risk of contamination of any downstream receptors. The additional recommended aspect is to undertake a baseline of the downstream water quality conditions and to monitor the water quality at the required frequency during the construction and operational phases of the project. Monitoring reports are to be forwarded to the Department of Water Affairs.
2	EIA process	The community representatives felt that the notifications about the public meeting were too short notice. However, the notifications were carried out in accordance with the Environmental Management Act and Regulations. A central and easily accessible venue for the public meeting was arranged. Additional time has been given to the community to raise relevant environmental concerns and provide these in writing. Up to the point of drafting this Public Review EIA report, no written concerns from the community or the ministry stakeholders have been received. Should any such concerns be received by the end of the public review period then these will be incorporated and addressed in the EIA Report. **Subsequent Public Review Additions:** A non-technical summary of the EIA outcomes and project description has been submitted to the committee of the Kunene River Conservancy. The Kunene River Conservancy Committee have given their land-use consent.
3	Unrelated matters with an existing mining	Community representatives at the public meeting raised some concerns about other mining activities taking place in the area

	company / mining claims in the area	and requested a meeting with that company to discuss the matter. It is recommended that any concerns are raised with the mining companies or mining claim holders in question and hopefully the issues can be resolved amicably. **Subsequent Public Review Additions:** The historical matters raised by the community were resolved by the Ombudsman. The Ombudsman has communicated with the Regional Council and the Traditional Authority concerned, providing them with a full report of their investigation. The contents of that report are available on request from the Ombudsman. They are not the topic of this EIA process.
4	Environmental degradation	At the public meeting, concerns about environmental degradation were raised. Mining of mineral resources does change the environment in many ways. The expectations of the community need to be clarified, and the miners must communicate clearly prior to mining so that the environmental changes that are inevitable from mineral extraction and processing do not come as a surprise to the community. The presentation given at the public meeting and the electronic and printed material provided the initial communications of the planned project. It is suggested that mechanisms be put in place to mitigate frustrations among stakeholders that could arise in the future. The EMP Stakeholder programme highlights this commitment from the proponent to ensure stakeholder engagement is ongoing. **Subsequent Public Review Additions:** The Ombudsman made recommendations to the Regional Council and the regional and local development committees to be the normal conduit of information for the affected communities. It is these local community development committees that will be contacted with regards to existing and new developments initiated by the proponent. This aspect is now specifically stated in the Draft EMP which has been submitted for approval by the MEFT.

Project Screening

At the start of the Ondoto mining project, other proponents (KNL Namibia and MC holders) commissioned EIAs for their projects and it was confirmed through site visits and public participation, that aspects of the envisaged mining project needed to be evaluated for their need to conduct in-depth assessment. That screening determined the terms of reference for the impact assessments. Based on the screening, specialists were commissioned to undertake baseline studies and impact assessments. The outcomes of assessments were reported on and environmental clearances were issued.

The current application falls within the same area and under the same umbrella of activities. The issues related to water and biodiversity are mirrored in the current impact assessment. For this reason and for the purpose of transparency the same specialist reports are referred to and provided for the current assessment as follows.

1. Biodiversity studies (Fauna & Flora) by Mrs. Henriette Potgieter (**Appendices D & E**)
2. Water Studies by Namib Hydrosearch cc (**Appendix F**)

As part of the water study the hydrogeology component included geochemical analyses and element mobility assessments of the rock and soil as this is key to understanding potential pollutant flow. Water supply to the project and flood water management are also major components of the water studies.

Alternatives for the various aspects of the envisaged development were discussed with the individual specialists. Based on their input, with due consideration of the comments received by the public and stakeholders and also the proponent's development plan, the options were described. These options were weighed in the assessments phase.

The preferred project alternatives have been fixed and remain relevant for the current impact assessment are as follows:

- The abstraction of water from a site that constitutes Kunene River infiltrate (i.e. alluvial sediments or dwyke sedimentary rock) as the major water source for mineral processing.
- The abstraction of water from the Ondoto River as a minor source for mineral processing.
- The conveyance of electricity from the Swartboois (Otjimuhaka) substation.

A new specialist study was commissioned for this current impact assessment to cover the aspect of Heritage. Previously, only a survey of the homesteads was carried out. The Archaeological and Heritage Impact Assessment was carried out by Mr. Roland Mushi and is found in **Appendix G**.

Impact Assessment

The assessment of the identified potential impacts was undertaken after due consideration of all the physical, biological and socio-economic environment. The table below provides the expected outcomes of the assessment after mitigations are applied. The chapter on impact assessment more fully gives the reasons for these outcomes. The results have been incorporated into the environmental management plan and the programmes that will facilitate the implementation of the measures that are required. Here is the list of the aspects assessed. The biodiversity, water and heritage impact assessment outcomes are discussed in more detail hereafter.

- Air quality
- Noise
- Health & safety
- Visual
- Land use
- Waste
- Ecological & Biodiversity
- Water Resource
- Socio-economic
- Traffic
- Product Handling & Port Storage
- Heritage
- Post Mining Legacy

Mitigation Status	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Air Quality Impacts	Disturbances to soil, rock and ore resulting in excessive dust in the atmosphere					
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**
Noise Impacts	Disturbance of sense of place and the effect on tranquil ambient noise levels					
Mitigated	**L**	**M**	**M**	**L**	**L**	**L**
Health & Safety Impacts – Noise and Vibration Effects on Personnel	The effects of excessive noise and vibration on the health and safety of personnel.					
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Health & Safety Impacts – General Hazards and Potential Risk of Injury	Injury risks due to normal working conditions					
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Health Impact	Disease or normal health risk due to normal working conditions and in particular to exposure to radioactive particulates					
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Visual Impact	Changes to the aesthetic appeal of the area due to presence of people, vehicles and machinery. Visible changes to habitats due to human activities.					
Mitigated	**L**	**M**	**L**	**L**	**M**	**M**
Land Use Impact	**Herders could potentially experience restrictions to their grazing areas**					
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Waste Impact	Waste is generated during the construction, operational and decommissioning phases of the mine's life. Waste can be classified into mineralised and non-mineralised waste. Non-mineralised waste can be classified as non-hazardous and hazardous waste. Medical waste is an additional category.					
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Socio-economic Impact	Positive aspect of sustaining employment in the sector					
Mitigated	**M+**	**M+**	**M+**	**M+**	**H+**	**M+**

Mitigation Status	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Traffic Impact		Transporting bulk by trucks (PBS) along national roads				
Mitigated	**M**	**M**	**H**	**M**	**L**	**M**
Product Handling & Port Storage Impact		Bulk storage and handling of product at Walvis Bay Port				
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Post Mining Legacy Impact		Abandonment of the mining site potentially exposes public and wildlife to hazards				
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**

The outcomes of the specialist studies are summarised here.

Biodiversity studies

Three habitat types were identified in the vegetation and vertebrate studies for this project and were integrated in one combined floral and faunal classification: a) mopane scrub, b) rocky outcrops, and c) river/drainages.

The habitats were rated as to their sensitivity, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures.

A sensitivity rating was assigned based on properties of the habitat itself, including:

- nationally or regionally scarce habitats
- size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region.
- exceptionally high diversity and/or abundance of species
- high level of endemism
- support to species of conservation concern
- key ecological processes
- contribution to ecological functions (nutrient and energy flows)
- provision of critical resources
- restorability after disturbance

Human habitation, grazing and mining activities have resulted in modified areas, to the extent that some of them are rendered severely degraded such as the rocky ridge south of the ML and the quarry/MC sites. The village Oroutumba, located in Mopane scrub habitat adjacent to the Ondoto River, also constitutes an anthropologically modified area.

The assessment considered all project activities and how these could potentially impact the various habitats.

Flora

The largest part of the area consists of open **mopane scrubland**. The topography is gently undulating, bisected by drainage lines and ridges topped with rocky outcrops. The vegetation structure varies slightly from west to east, broadly corresponding to changes in topography with larger Mopane trees and some Commiphora species in the western parts of the study area. In the east and southeast *Colophospermum mopane* form a scrubby open woodland of homogenous height and structure, interspersed with *Catophractes alexandri*. The substrate consists of loose stones and gravel on compacted sand. The understorey is sparse, and grass was the only ground cover observable at the end of winter, but more annual plant species are expected to appear after rain. The accessory works areas will be established within this habitat.

The **rocky outcrops** generally occur at the top of ridges in the ML and MCs and closely follows fenitisation in the area. The vegetation structure is layered, providing resources for a variety of animal taxa. A ground cover of grass was observed and although no forbs were present at the time of the site visit, they will appear in summer and after rain. There is a sub storey of shrubs and a well-developed upper storey of trees. This habitat has both abundance and richness of plants that are much higher than those of the surrounding scrubland, thereby contributing to its ecological value. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals, further increases the sensitivity of the habitat. Sodalite and the rare earth minerals are located here; it is where mining will be done and where most of the irreversible impacts (drilling, blasting and open cast mining) will take place.

Lastly the **riverine** habitat. Although it crosses the study area for less than a kilometre, it is an important habitat in terms of both the study area and the region because of two reasons. Firstly, the **drainages** within ML and MCs flow into the river and from here it is only six kilometres from where it flows into the Kunene River. Secondly, it is an important source area of high diversity in an arid landscape and a resource during drought years. Any activity in the catchment could potentially affect the ecology of the Ondoto and Kunene rivers negatively. This stretch of the river and its tributaries contain sparsely distributed large trees, few shrubs and ground cover in the form of annual plants such as grasses and forbs are expected to appear in summer and after rain. The substrate is sandy, with scattered rocks and boulders and a shallow stream. The river is an important resource for the Oroutumba community, and it has been modified by historic and current human activities such as grazing and harvesting. Cattle and goats were observed in the river, as well as daily human household activities (water collection, laundry and playing children).

Four potential impacts were identified, two of which have a medium significance that becomes low after mitigation. Destruction of organisms and habitats and alteration of topography both have high unmitigated significance but potentially decrease to medium significance through the application of management measures if these are carried out effectively.

Mitigation Status	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Impact	**Habitat and plant destruction**					
Mitigated	**M**	**M**	**L**	**M**	**M**	**M**

Impact	**Alteration of topography**					
Mitigated	**M**	**M**	**L**	**M**	**M**	**M**
Impact	**Groundwater drawdown**					
Mitigated	**L**	**M**	**M**	**L**	**L**	**L**
Impact	**Contamination of soil and water**					
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

The following recommended mitigation measures have been incorporated into the Draft EMP:

- Keep the overall development footprint as small as possible.
- The extent and location of any construction site should be clearly marked out and signage used to restrict movement of vehicles and personnel outside this area.
- Roads, pipelines and power lines must be planned in order to minimise fragmentation or disturbance of the habitats.
- Anti-erosion measures must be taken where roads and tracks cross a wash or drainage line.
- Carefully plan the placement of stockpiling construction material, i.e. lay-down areas to avoid sensitive areas.
- Limit construction activities to daytime hours to reduce noise.
- Educate construction and permanent staff as to their environmental obligations. All contractors should be held responsible for transgressions and significant penalties should be enforced in order to ensure compliance.
- Position temporary construction infrastructure (e.g. accommodation) in areas that will be disturbed during operations in any case.
- Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks.
- Do not put water tanks, power pylons or any other large infrastructure in the river or washes.
- No sewerage overflow or French drain may be placed within 100 m of a drainage line.
- No illegal collection of plants should be allowed.
- No illegal collection of wood for fires (cooking or heating) should be allowed.
- A comprehensive restoration plan should be finalised during the first three years of initial clearance period. The Draft EMP includes a conceptual framework for habitat restoration or rehabilitation. Provision for monitoring and adaptive management as the project develops is imperative. Some rehabilitation actions should be implemented during operations in order to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later.
- Monitor groundwater levels to ensure sustained growth of trees.
- Monitor plant diversity downriver from the abstraction site at a minimum once a year.
- Abstract water from a site where infiltrate from the Kunene River is available.
- TSF containment measures should be strictly enforced to the highest existing standards.
- Regularly inspect structures related to the Tailings Storage Facility.
- Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater. No impact on the vegetation is permissible, especially downstream along the drainage lines.

Four impacts were identified, two of which have a medium significance that becomes low after mitigation. Impact 1 (destruction of organisms and habitats) and impact 2 (alteration of topography) both have high unmitigated significance, decreased to medium significance by the stringent application of management measures.

The cumulative nature of mining activities in the Kunene Region and in the Kaokoveld Centre of Endemism, the irreversible damage to the rocky ridges (sensitive, ecologically valuable habitat) and the persistence of excavations after the lifespan of the mine are three factors that lower the likelihood of impacts 1 and 2 being mitigated to the low significance rating. However, the strict implementation of mitigation measures and a professional restoration plan can improve the situation significantly for some habitats and aspects such as the accessory works, linear infrastructure, tailings facilities and waste rock dumps.

It is important to keep the overall project footprint to the absolute smallest size possible, and to keep it inside well-defined and clearly demarcated boundaries by putting up visible and effective signs, and fencing the operational area where possible, such as the accessory works and tailings facilities. The purpose of a fence and signs is to inform personnel and contractors of the exact boundaries of the operations area and to effectively control access to areas that will remain undeveloped. Fences and signage go hand in hand with appropriate environmental training and awareness raising of staff, and of contractors and their staff.

A key habitat is the rocky outcrops that support many species that would otherwise not be present. As mineral-bearing ore is located almost exclusively on the ridges and rocky outcrops, restoration of this habitat after mining operations will not be possible. To mitigate the loss of these outcrops, a botanical expedition is recommended to identify the most important sites and sacrifice the other less sensitive areas and to confirm the degree to which habitat destruction would affect the overall plant diversity of the greater area.

The Ondoto River is considered very sensitive and apart from the proposed borehole and water pipeline, no development should take place there. During operations the riverbed should be designated a no-go area, except for essential maintenance to the borehole and pipeline. The natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network, power line, water pipeline and any other linear development. Waste rock dumps and tailings facilities should be placed where least impact on diversity would occur, preferably in the mopane scrub towards the east if possible)

For a restoration programme to be effective, it is essential that it be implemented from the earliest possible time after the construction phase, and throughout the operational phase where possible. The protection of source areas from where seeds and organisms will originate to re-colonise the disturbed areas is a crucial aspect of restoration, and source areas need to be identified and protected from the planning phase, throughout operations and during decommissioning and closure. Accurate financial projections need to be made, and financial mechanisms for implementing restoration measures should be put in place before operations. The restoration plan should be developed by an expert in conjunction with the mine planners and engineers, and it should be fully integrated with the mine's EMP during the first three years of the environmental clearance period. In the light of the irreversible damage that will be done to the sensitive rocky outcrops and the cumulative nature of the impacts of mining in the Kunene Region, it is proposed that the NBRI conduct a full-scale botanical survey. Such an investigation is considered an essential part of mitigation and will inform the restoration planning and EMP amendments during the first three years of the clearance period.

The aims of the expedition will be:

- Record and assess the taxa that are likely to be affected by the development.
- Collect seeds and/or cuttings of vulnerable species and transplant valuable specimens if feasible.
- Make recommendations for the restoration plan and EMP in cooperation with other specialists and the mine planners.

It is recommended that the survey of the ML and MCs, in particular the rocky outcrops concerned with the planned mining operation, be conducted after the summer rains and that it be done in cooperation with the NBRI. Because of its remoteness, the region is botanically under-surveyed and under-collected and the participation of the NBRI will not only ensure a comprehensive baseline understanding of the existing environment but also provide a community service by making the data available to the public.

Fauna

A key habitat in the larger woodland mosaic is the rocky outcrops habitat. The physical diversity of the hills and rocky ridges leads to a higher and more specialised biodiversity than the surrounding Mopane woodland, and it supports many species that would otherwise not be present. Seeing as mineral-bearing ore is located almost exclusively in the rocky ridges, restoration of this habitat after mining operations will not be possible to any meaningful extent.

Riverine habitat has a high ecological value for all taxa; it plays a keystone role in nutrient transport and serves as important source areas for recolonisation after operations cease. In this project footprint, the Ondoto River is considered very sensitive and apart from the proposed linear infrastructure, no development should take place there. In addition, the natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network and any other linear development.

Destruction of organisms and habitats and alteration of topography both have high unmitigated significance but potentially decrease to medium significance through the application of management measures if those are carried out effectively. As mentioned above the cumulative nature of mining activities in the Kunene Region and in the Kaokoveld Centre of Endemism, the irreversible damage to the rocky outcrops (as the most sensitive, ecologically valuable habitat) and the persistence of the excavations after the lifespan of the mine, are three factors that lower the likelihood that these impacts can be mitigated to a low significance rating. Again, the strict implementation of mitigation measures and restoration plan can improve the situation significantly for other habitats and aspects such as the accessory works, linear infrastructure and any staff accommodation areas.

Seven impacts were identified. Five of these impacts are rated as having medium significance, mitigated to a low significance rating provided the suggested management measures are implemented.

Mitigation Status	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Impact 1	**Destruction of organisms and their habitats**					
Mitigated	**M**	**M**	**L**	**M**	**M**	**M**
Impact 2	**Disturbance of animals and interference with their behaviour**					
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Impact 3	**Light Pollutions**					
Mitigated	**L**	**M**	**L**	**L**	**M**	**L**
Impact 4	**Alteration of topography**					
Mitigated	**M**	**M**	**L**	**M**	**M**	**M**
Impact 5	**Groundwater drawdown**					
Mitigated	**L**	**M**	**M**	**L**	**L**	**L**

Impact 6	**Contamination of soil and water**					
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Impact 7	**Impacts associated with the accommodation of staff**					
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

The following recommended mitigation measures have been incorporated into the Draft EMP to minimise the potential impacts on fauna expected from the project:

- Keep the overall development footprint as small as possible.
- The extent and location of the construction site and operational areas should be clearly marked out and signage used to restrict movement of vehicles and personnel outside this area.
- Fencing is recommended for the processing plant and TSF where both fauna and public could be at risk.
- The location of roads, pipelines and power lines must be planned in order to minimise fragmentation or disturbance of habitats.
- Anti-erosion measures must be taken where roads and tracks cross a wash or drainage.
- Carefully plan the placement of stockpiling construction material, i.e. lay-down areas to avoid sensitive ground.
- Limit construction activities to daytime hours to reduce noise.
- Educate construction and permanent staff as to their environmental obligations. All contractors should be held responsible for transgressions and significant penalties should be levied in order to ensure compliance.
- Position temporary construction infrastructure (e.g. accommodation) in areas that will be disturbed during operations in any case.
- Areas surrounding the mine, processing plant and exploration sites that are not part of the demarcated development should be considered no-go zones for employees, visitors, vehicles or machinery.
- No off-road driving or driving next to established roads/tracks should be allowed.
- Limit activities to day-time hours to reduce noise.
- No fires outside a controlled area (eg. drum, braai area etc) should be allowed so that the natural vegetation does not burn in an uncontrolled way.
- Staff and contractors should be trained in sensitive human-wildlife interactions.
- Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks. Maintenance roads/tracks for linear structures should be built as close as possible to these structures and access should be limited to essential maintenance.
- Do not put water tanks, power pylons or any other large infrastructure within or in the vicinity of drainage lines.
- No sewerage overflow or French drain may be placed within 100 m of drainage lines.
- A vertebrate specialist is recommended for identifying nests, dens and other breeding locations and demarcate them before construction so that these sites can be avoided as part of the EMP.
- Reptiles and amphibians that are exposed during ground clearing should be captured for translocation by a qualified expert.
- A comprehensive restoration plan should be finalised during the first three years of initial clearance period. The Draft EMP includes a conceptual framework for habitat restoration or rehabilitation. Provision for monitoring and adaptive management as the project develops is imperative. Some rehabilitation actions should be implemented during operations in order to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later.
- Not much is known about the effect of artificial light on populations and ecosystems and the precautionary principle is applied here.

- Install motion detectors to limit light use to the minimum possible.
- Outdoor lights should be directed downwards and not up into the sky.
- Use yellow or amber outdoor lights because invertebrates don't detect yellow light as well as white.
- Install insect screens in doors and windows located in buildings that are used after sunset.
- Landscaping of waste rock dumps can become new rocky habitats for recolonisation of flora and fauna, and they should be made according to the provisions of the restoration plan and EMP.
- Monitor groundwater levels.
- Monitor plant and vertebrate diversity downriver from the abstraction site at a minimum of once a year.
- Using an alternative source of water like the Kunene River is expected to mitigate the impact on groundwater levels.
- Animals should not be able to enter the TSF area.
- Regularly inspect structures related to the Tailings Storage Facility.
- Containment of the discharge of TSF water will eliminate any possibility of dangerous chemicals entering the soil or groundwater.
- All inhabitants and visitors in the staff compound should receive environmental awareness training, including training on indiscriminate defecation.
- The staff accommodation area should be fenced in and the only access allowed outside the fence is along the entrance road.
- All cleaning and washing should take place inside a designated area (e.g. kitchen, laundry) and fat traps should be installed at the drain outlet from these areas.
- Gas cooking facilities should be provided instead of allowing wood or charcoal fires for cooking.
- Firefighting equipment should be placed in the compound. It should always be tested regularly and in working condition. All inhabitants of the compound should be trained in the use of this equipment and know where it is.
- Water saving measures should be put in place, e.g. low-pressure shower heads and taps; daily checks of pipes and tanks; immediate repair of leaks.
- Sewerage should be of sufficient capacity for the expected number of people.

Impact 1 (destruction of organisms and habitats) and impact 4 (alteration of topography) both have high unmitigated significance, decreased to medium significance by the stringent application of management measures. These impacts can be mitigated to a medium significance rating provided strict implementation of mitigation measures and the restoration plan occurs.

It is important to keep the overall project footprint to the absolute smallest size possible, and to keep it inside well-defined and clearly demarcated boundaries by fencing the operational area and putting up visible and effective signs. The purpose of a fence or at the least signs will inform personnel and contractors of the exact boundaries of the operations area and to effectively control access to areas that will remain undeveloped. Fences and signage go hand in hand with appropriate environmental training and awareness raising of staff, and of contractors and their staff.

A key habitat in the larger woodland mosaic is the rocky outcrops habitat. The physical diversity of the hills and rocky outcrops leads to a higher and more specialised biodiversity than the surrounding Mopane woodland, and it supports many species that would otherwise not be present. Seeing as mineral-bearing ore is located almost exclusively in the rocky outcrops, restoration of this habitat after mining operations will not be possible to any meaningful extent.

Riverine habitat has a high ecological value for all taxa, plays a keystone role in nutrient transport, and serves as important source areas for recolonisation after operations cease. In this project footprint, the Ondoto River is considered very sensitive and apart from the proposed linear infrastructure, no development should take place there. In addition, the natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network and any other linear development.

Of particular concern are the rare fish species found in the permanent springs of the Ondoto River. It has been subsequently recommended that the water levels of these springs be monitored by the community and mining companies that use the spring water for human consumption. Both users need to ensure the level of water does not drop to levels that prove destructive to the fish species. It is this recommended that the natural springs are not used for the mineral processing. The proponent has since confirmed that the natural springs are not used for this purpose.

For a restoration programme to be effective, it is essential that it be implemented from the earliest possible time after the construction phase, and throughout the operational phase where possible. The protection of source areas from where seeds and organisms will come to re-colonise the disturbed areas is a crucial aspect of restoration, and source areas need to be identified and protected from the beginning. Some mitigation measures need to be implemented during operations to be effective; potential examples include the removal and storage of topsoil, placement of roads, and the shape and placement of waste rock stockpiles. Accurate financial projections need to be made, and financial mechanisms for implementing restoration measures should be put in place before operations. These are some of the reasons why restoration, at least at conceptual level, should be part of the planning phase.

Because the project design has not been finalised, it is not possible to draft a complete restoration programme at this early stage. It is, however, possible to develop a conceptual plan that defines the most likely first implementation steps, as well as the structure of an adaptive management and monitoring plan. The restoration plan should be developed by an expert in conjunction with the mine planners and engineers, and it should be fully integrated with the mine's EMP.

Water Study

The hydrology and hydrogeology study provides valuable input into the project for water supply and flood water management where contamination is a risk. Details on rock and soil chemistry will be supplied in a second phase of the water study which is necessary in the design of the TSF for the new processing plant.

The mining area is topographically elevated and slopes northward towards the Kunene River. A large ephemeral river, the Ondoto, flows north to the Kunene through the project area and the mining area is in the Ondoto River catchment.

The current assessment primarily focusses on possible environmental impact from the planned REE mining activities on the Ondoto River and the alluvial aquifer, in terms of water quality and as a sustainable water source. Groundwater potential of the Ondoto alluvial aquifer is moderate and as the local community is dependent on this source for water, use of alternative water sources is recommended for the envisaged long-term mining and processing operations. Alternative water sources were identified, such as, direct intake from the Kunene River and development of the Dwyka Group sandstone aquifer along the banks of the Kunene River.

The assessment has identified the management of the tailings and waste rock from processing of REE ore as important environmental concerns as the ore processing activities are located upstream of the Ondoto and Kunene Rivers. Based on the hydrological study, measures for stormwater management and containing any effluent from the processing facility and waste are proposed. The potential for contamination through mobilisation of contaminants from the tailing and waste is considered low due predominance of carbonate minerals in the ore and resulting alkaline conditions of the waste rock and tailings. Possible contaminants such as thorium are being removed from site in the REE concentrate product.

The impact of sodalite mining to a maximum depth of 40 meter is limited as the groundwater level is deep, usually exceeding 100 m below ground level. However, recent exploration showed that groundwater may be situated from 30 m below ground level. Management of groundwater seepage and stormwater in the quarries and around the accessory work areas is recommended.

The following table provides the mitigated assessment significance for the water resource aspects.

Mitigation Status	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Impact	**Mining activities may affect water resources through over utilisation**					
Mitigated	**M**	**M**	**L**	**M**	**L**	**L**
Impact	**Mining activities may affect water resources through contamination**					
Mitigated	**M**	**L**	**L**	**M**	**L**	**L**

Water use sustainability will be achieved if the following mitigations are employed:

- Limit the use of the Ondoto River alluvium (ie. not the springs directly) to initial stages of the project only.
- If the Ondoto River alluvial aquifer shows signs of overexploitation (drop in groundwater level and increasing salinity) and is not replenished within a year of use by the mine, then use of the resource should be stopped, and the alternative sources used. The community affected by the disruption of supply should be supplied from the alternative source till supply from the Ondoto River is restored.
- Develop the alternative source of water (Kunene river or Dwyka aquifer) for sustainable long-term use.

Water Study Mitigation Measures for the soils, surface water and groundwater are as follows:

- Construction of a containment dam downstream of the processing plant, TSF, waste rock dump and other stockpiles. Thereby capture all water that is potentially contaminated.
- Evaporation of contained water that is not reused.
- Maintain water balance as a check on any significant water leakage from the operation.
- Regular inspection of TSF and WRDs.
- During the operation of the mine, the sediment material accumulated in the containment dam should be moved to the tailings at regular intervals so that the maximum capacity of the containment dam is retained and the risk of mobilising the material downstream is reduced.

For the management and mitigation of possible impacts from the mining pits the following measures are recommended:

- The pits to a maximum depth of 40 m bgl may below the groundwater level and groundwater inflow could expect when mining to this depth.
- Surface flow to the pits is also possible and the pits should be protected against inflow of surface runoff water and discharge from the pits should be avoided. Therefore, the pits should be cordoned off with berms (1 m high) to avoid surface inflow to the pit

Monitoring of water quality of the borehole water and the natural springs must be carried out in accordance with the Department of Water Affairs Abstraction Permits.

Heritage

Identification, mapping, classification and assessment of the significance of the archaeological, historical and cultural heritage resources in the area were conducted according to the National Heritage Guidelines of 2021. The site surveys were undertaken on the 1st September 2025 & 7th October 2025. Key findings of this AHIA assessment include:

- Weathered outcrops and Stone Artefacts: The mining claims area is dominated by prominent weathered outcrops, which were the most distinctive natural features observed during the survey. Apart from these, only surface scatters of stone artefacts were identified. No evidence of significant archaeological features or sites was found within the mining claim areas. Based on these findings, the archaeological potential of the area is assessed as low.
- Grave site: No visible graves or burial sites were identified within the boundaries of the mining claim. The nearest known grave is located approximately 4.3 km away, in Ondoto West village. Based on field observations, no significant impact on archaeological resources is anticipated as a result of the proposed mining activities
- Rock shelters: A very small rock shelter was recorded among weathered rock boulders within the project area. The shelter appears to be used by animals, and no cultural material or features of archaeological significance were observed.

The Archaeological and Heritage Impact Assessment (AHIA) has identified no significant impacts expected at the proposed mining site. The surface-level assessment has shown that the proposed mining claim areas are not archaeologically sensitive. Consequently, the overall impact significance of the proposed project has been assessed as **LOW**.

It is strongly recommended that project activities focus exclusively on the identified target sites. Strict compliance with the mitigation measures outlined in Section 16.2 is essential. Additionally, the adoption and implementation of Chance Find Procedures as part of the Environmental Management Plan (EMP) is required. The National Heritage Council of Namibia have issued the necessary consent permit.

Mitigation Status	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Impact	**Damage/destruction of archaeological sites or materials**					
Mitigated	**L**	**H**	**L**	**M**	**L**	**L**
Impact	**Damage/destruction of graves and burial grounds**					
Mitigated	**L**	**H**	**L**	**M**	**L**	**L**
Impact	**Damage to the rock shelters and caves**					
Mitigated	**L**	**H**	**L**	**M**	**L**	**L**

Management Plan

All the mitigation measures listed by the specialists have been considered for inclusion in the Draft Environmental Management Plan (EMP). Where a mitigation measure was deemed unrealistic and not necessary, justification for such decision is given. The Draft EMP also provides for the monitoring requirements as well as for the required rehabilitation activities. The Draft EMP can be found in **Appendix H**. The Radiation Management Plan, a supplement to the EMP can be found in **Appendix I**.

Fluctuations in market demand may affect the mine from time to time. Should the mining project have to be closed permanently then rehabilitation of the mining area would need to be undertaken. A mine closure plan should take into consideration the recommended rehabilitation measures highlighted in the EMP. Some restoration or rehabilitation work should take place at the end of construction phase where activities resulted in disturbances along the pipeline routes, new roads development along linear infrastructure routes.

For a restoration programme to be effective, it is essential that it be implemented from the earliest possible time after the construction phase, and throughout the operational phase where possible. The protection of source areas from where seeds and organisms will come to re-colonise the disturbed areas is a crucial aspect of restoration, and source areas need to be identified and protected from the onset. Some mitigation measures need to be implemented during operations to be effective; potential examples include the removal and storage of topsoil, planning and placement of roads, and the shape and placement of waste rock stockpiles. Accurate financial projections need to be made, and financial mechanisms for implementing restoration measures should be put in place before operations. These are some of the reasons why restoration, at least at conceptual level, should be part of the planning phase.

Concluding Remarks

The EAP deems the project to be acceptable considering the input of the specialists and the majority low significance of the potential impacts provided the necessary mitigation measures and ongoing rehabilitation measures are all implemented with monitoring. It is the author’s opinion that the environmental clearance be granted on condition that the Draft Environmental Management Plan be effectively implemented.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AMSL	Above Mean Sea-Level
BID	Background Information Document
bgl	Below ground level
CRO	Chief Regional Officer
DEA	Directorate of Environmental Affairs
DRWS	Directorate of Rural Water Supply
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EMA	Environmental Management Act No 7 of 2007
EMP	Environmental Management Plan
EMS	Environmental Management System
GRN	Government
HDPE	High-density polyethylene
IAPs	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
KAC	Kunene Anorthosite Complex
TS	Proponent Name (Nina Smit)
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MC	Mining Claim
MEFT	Ministry of Environment, Forestry and Tourism
ML	Mining Licence
MLR	Ministry of Land & Resettlement
MIME	Ministry of Industry, Mines & Energy
MoHSS	Ministry of Health & Social Services
NGO	Non-Government Organisation
NNW	North North West
PBS	Performance Base Standard
PPP	Public Participation Process
REE	Rare Earth Elements
SR	Scoping Report
TSF	Tailings Storage Facility
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
WNW	West North West
WRD	Waste Rock Dump

GLOSSARY OF TERMS

Competent Authority	A body or person empowered under the local authorities act or Environmental Management Act to enforce the rule of law.
Environment	As defined in the Environmental Assessment Policy and Environmental Management Act - "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, palaeontological or social values".
Environmental Assessment (EA)	Process of assessment of the effects of a development on the environment.
Environmental Management Plan (EMP)	A working document on environmental and socio-economic mitigation measures, which must be implemented by several responsible parties during all the phases of the proposed project.
Fenetization	A quartzo-feldspathic rock that has been altered by alkali metasomatism at the contact of a carbonatite intrusive complex.
Interested and Affected Party (IAP)	Any person, group of persons or organisation interested in, or affected by an activity; and any organ of state that may have jurisdiction over any aspect of the activity.
Kaokoveld Centre of Endemism	A term used to describe the special endemic nature of the Kaokoveld area.
Mitigate	The implementation of practical measures to reduce adverse impacts.
Proponent (Applicant)	Any person who has submitted or intends to submit an application for an authorisation, as legislated by the Environmental Management Act no. 7 of 2007, to undertake an activity or activities identified as a listed activity or listed activities; or in any other notice published by the Minister or Ministry of Environment & Tourism.
Scoping Process	Process of identifying: issues that will be relevant for consideration of the application; the potential environmental impacts of the proposed activity; and alternatives to the proposed activity that are feasible and reasonable.
Stakeholder Engagement	The process of engagement between stakeholders (the proponent, authorities and IAPs) during the planning, assessment, implementation and/or management of proposals or activities. The level of stakeholder engagement varies depending on the nature of the proposal or activity as well as the level of commitment by stakeholders to the process. Stakeholder engagement can therefore be described by a spectrum or continuum of increasing levels of engagement in the decision-making process. The term is considered to be more appropriate than the term "public participation".
Stakeholders	A sub-group of the public whose interests may be positively or negatively affected by a proposal or activity and/or who are concerned with a proposal or activity and its consequences. The term therefore includes the proponent, authorities (both the lead authority and other authorities) and all interested and affected parties (I&APs). The principle that environmental consultants and stakeholder engagement practitioners should be independent and unbiased excludes these groups from being considered stakeholders.

1 BACKGROUND AND INTRODUCTION

Nina Smit (hereafter referred to as the Proponent) is a Namibian citizen, who applied for mineral rights within MCs 75160, 75161 and 75162 for the following commodities, Base and Rare Metals, Industrial Minerals, Precious Metals and Semi-Precious Stones. The mining claims are all located within the Exclusive Prospecting License (EPL) 5885, situated at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region. The proponent applied for the three MCs 75160, 75161 & 75162 on 22nd December 2023.

Figure 1 renders a map of Otjimuhaka relative to Windhoek. **Figure 2** renders the location of Nina Smit's MCs, ML 40, and other granted MCs in the area.

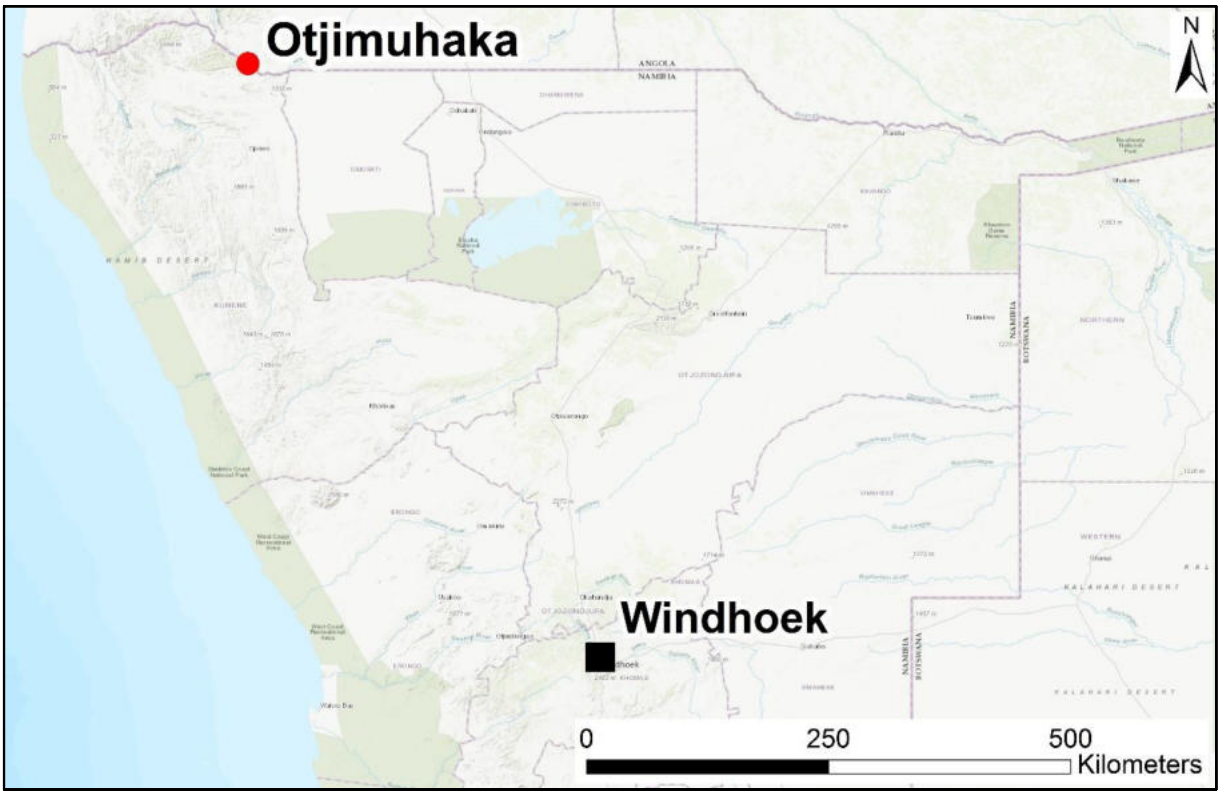


Figure 1. Location of Otjimuhaka relative to Windhoek.

1.1 MINE LEGACY

The Ondoto Mine Project includes other existing mineral licenses in the area - Exclusive Prospecting License (EPL) 5885 (held by Kunene Resources Namibia), ML 40 (held by KNL of Namibia), MCs 70783, 70784, 75206, 75207, 75212 (held by Timo Smit), MCs 68664, 70113, 70114 & 70119 (held by Jacobus Smit), MC 75211 (Morne du Toit) and MCs 66887, 66888, & 66921 (others held by Nina Smit) (See **Figure 2**). The current MC application (**75160, 75161 and 75162**) for Nina Smit are all located within EPL 5885 and are part of the greater Ondoto Mining Project. These are referred to herein as **Nina Smit's MCs**.

The Ondoto Mine Project area, particularly the ML40 ground and surrounding areas has undergone mining operations during the last 60 years. Small scale mining of lumps of sodalite and other ornamental stones is presently ongoing within ML40.

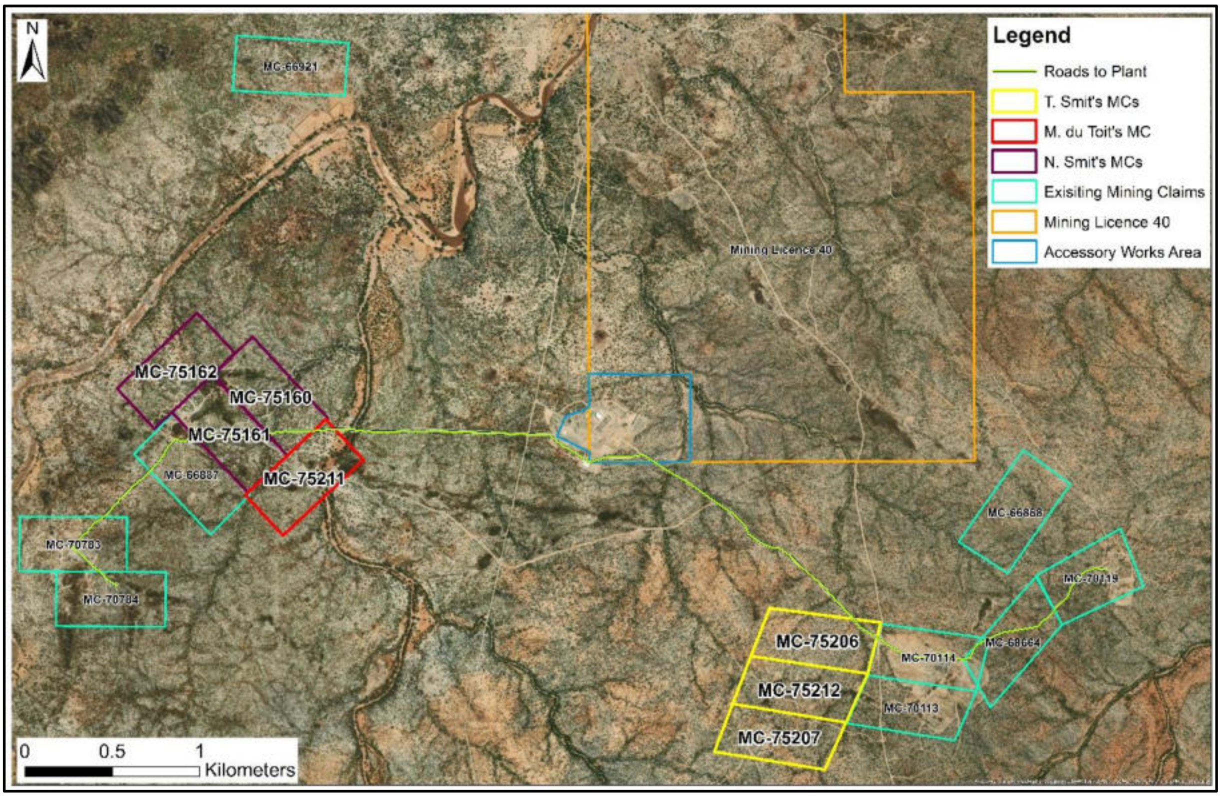


Figure 2. MCs locality map relative to ML 40 and other MCs in the area.

2 EIA TERMS OF REFERENCE

Nina Smit (hereafter referred to as the Proponent) appointed Philip Hooks, an independent Environmental Assessment Practitioner (EAP), to undertake the assessment and compile this scoping assessment report and Environmental Management Plan (EMP) in support of the application ECC-APP6330 to include MCs 75160, 75161 and 75162, for commodities Base and Rare Metals, Industrial Minerals, Precious Metals and Semi-Precious Stones. The curriculum vita of the EAP is provided in **Appendix A**.

The Terms of Reference for the proposed project is based on the requirements set out by the Environmental Management Act (EMA) (2007) and its EA Regulations (2012). The process covered the following steps, as divided into the sections below. Each section describes what was undertaken.

2.1 SCREENING, PLANNING, SITE VISITS & SCOPING

The current scope of study was finalised after correspondence and communication with the project promoters. Site visits and surveys by the biodiversity specialist, Hoens Potgieter during the 2020 EIA study for the Ondoto Mine Project, are referenced in this current study. The water study carried out in the 2020 EIA for the Ondoto Mine Project is also referenced in this current study. New Heritage Impact Assessments were commissioned for **Nina Smit's MCs.** The public consultation process included a new round of public meeting and focus group meetings.

2.2 LEGAL FRAMEWORK

All legislation, policies and guidelines that had reference to the proposed project were listed. The activities for which clearance is required for the project were extracted from the EMA Regulations. As per legal requirements, any mining activity requires the Environmental Commissioner within the Ministry of Environment & Tourism to render an Environmental Clearance Certificate (ECC) in terms of the Environmental Management Act, No 7 of 2007 (EMA).

2.3 PROJECT DESCRIPTION

The aim of this report is to provide details on the proposed operational, decommissioning and mine closure activities that will enable decision makers to make informed judgements regarding the **Nina Smit's MCs** from an environmental perspective. Stakeholders too, who must provide consent, must know and understand the project details. This section was based on the information provided by the proponent.

2.4 PUBLIC PARTICIPATION PROCESS

This chapter serves to inform Interested and Affected Parties (I&APs) and relevant authorities of the details of the proposed ECC application (APP-006330) and provide them with a reasonable opportunity to participate during the process.

The stakeholder engagement through the Public Consultation Process, is described in a later section of this report. The public meeting and focus group meetings were to provide comments and concerns regarding the potential impacts on the environment for the planned mining. Comments and concerns as obtained through discussions, written submissions and focus group meetings provided a community perspective towards the proposed development as well as generated information regarding the surrounding land use.

A public meeting with the local communities took place on the 11th September 2025.

2.5 ENVIRONMENT DESCRIPTION

The ‘environment’ is defined in the Environmental Assessment Policy and Environmental Management Act as “land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, paleontological or social values”.

Relevant environmental data was compiled by making use of primary information from site visits, primary data through surveys, specialist reports, secondary data and stakeholder consultation. The report identified existing environmental (both ecological and socio-economic) conditions of the receiving environment in order to determine environmental sensitivities. Information regarding the biophysical and socio-cultural environment was sourced from a number of studies previously done in and around the Opuwo and Otjimuhaka area. Fauna, flora, chemical and hydrological studies were carried out by specialists for adjacent mining claims and mining licence and these form the basis of the baseline. Current heritage studies cover this aspect of the baseline.

2.6 IMPACT ASSESSMENT

The scoping and assessment process aims to guide and promote sustainable and responsible development but not to discourage development. Project components which present unacceptable or very high impact ratings have been highlighted and possible alternatives or measures were suggested.

This section outlined and assessed the potential environmental impacts of the project. Potential environmental impacts and associated social impacts were identified and addressed in the report. The EAP has assessed all likely positive and negative impacts environmental and social impacts at the local and regional (Kunene Region) and national (Namibia) levels using an adaptation of the ‘Hacking Assessment Method’. Possible enhancement measures have been listed for those positive impacts while prevention, mitigation and rehabilitation measures have been provided for negative impacts. The environmental assessment was conducted to comply with Namibia’s Environmental Management Act other legal requirements applicable to the development and Namibia. The assessment process involved merging of various information streams into a description of the environment and the proposed project. If the environmental commissioner finds that the assessment of potential impacts and the proposed mitigation measures proposed in this report, are acceptable, an ECC may be awarded.

2.7 ENVIRONMENTAL MANAGEMENT PLANNING (EMP)

This task involved the drafting of a standalone document that outlined the management, monitoring and mitigation measures that will avoid, minimise and/or mitigate potentially negative impacts. In some case remediation and rehabilitation will be required. The ECC should refer to the EMP, and the conditions stipulated therein, thus rendering the EMP a legally binding document to which the proponent must adhere.

3 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

To protect the environment and achieve sustainable development, all projects, plans and programmes deemed to have adverse impacts on the environment require an ECC, as per the Namibian legislation which lists specific activities that need to apply for such clearance. The establishment and expansion of the sodalite mine and base and rare element operations with associated material processing falls within the range of these activities as mentioned above. The relevant project activities for which an ECC application must be made (listed as per Government Notice No 29 of 2012) are included in **Table 1** below:

Table 1. Applicable EMA listed activities

Activity No.	Activity	Applicability
2.1	The construction of facilities for waste sites, treatment of waste and disposal of waste.	Provision of ablutions on site for staff. Creation of a waste rock dump on site (topsoil stockpiles included) Wet mineral Tailings Storage Facility (TSF) included
2.2	Any activity entailing a scheduled process referred to in the Atmospheric Pollution Prevention Ordinance 1976	The site crushers, mills, will be used on site. A permit in terms of the Atmospheric Pollution Prevention Ordinance of 1976 is required
2.3	The import, processing, use, recycling, temporary storage, transit or export of waste	Provision of ablutions on site for staff Storage of waste oil for recycling
3.1	The construction of facilities for any process or activity which requires a licence, right or other form of authorisation, and the renewal of a licence, right or other form of authorisation in terms of the Mineral (Prospecting and Mining Act of 1992.	Establishment of a mine
3.2	Other forms of mining or extraction of any natural resources whether regulated by law or not.	Quarrying activities are a form of extraction of a natural resource.
4	The clearance of forest areas, deforestation, afforestation, timber harvesting or any other related activity that requires authorisation in term of the Forest Act, 2001 (Act No. 12 of 2001) or any other law.	The removal of trees will be done in association with the Directorate of Forestry who issue permits
8.1	The abstraction of ground or surface water for industrial or commercial purposes.	Water will be abstracted from:

		1. The Kunene River and conveyed to the mine site via a pipeline; and 2. A borehole / well in the Ondoto river.
9.1	The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance 1974	Storage of fuel on site and handling of explosives for blasting purposes.
9.4	The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum, gas or paraffin, in containers with a combined capacity of more than 30 cubic Meters at any one location	Petroleum Products Regulations No 2000: Section (3) (2) No person shall possess or store any fuel except under authority of a licence or a certificate

Additional pertinent legislation sets and policies which have (generally) informed the EA are listed in **Table 2**. Reference is made regarding the applicability of each law to this project.

Please note that permit application procedures required for hazardous waste materials handling are not available from any governmental department; therefore, MEFT is urged to indicate which ministry is to be contacted and which process must be followed for this.

Air pollution in Namibia was governed by the Atmospheric Pollution Prevention Ordinance (No. 11 of 1976) which mainly focused on the impact of air pollution emitted from point sources on occupational health and safety. It was limited in that it did not consider the impact of emissions from multiple air pollution sources on the surrounding environment, nor did it address ambient air quality issues. The Atmospheric Pollution Prevention Ordinance (No. 11 of 1976) was then replaced by the Pollution Control and Waste Management Bill which considers emissions from multiple air pollution sources and their impact on the surrounding environment. Although the bill makes provision for air quality standards, Namibia does not have any air quality standards that can be implemented at present. Therefore, according to Article 144 of the Namibian Constitution, international standards may be adopted.

Namibia's Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995) as well as the Draft Procedures and guidelines for EIA & EMP of 2008 requires the following steps in an Environmental Impact Assessment Procedure:

1. Project identification & conceptualisation
2. Appoint work to an environmental assessment practitioner
3. Development of proposal through consultation
4. Application with baseline scoping report and draft environmental management plan
5. Notification with baseline report and terms of reference for full EIA
6. Review of applications & registrations
7. Full investigation, EIA Report and draft environmental management
8. Mitigation plan(s)
9. Application with full EIA and draft environmental management plan
10. Conditions and approval
11. Record of Decisions
12. Appeal (if necessary)

13. Implementation of proposal
14. Monitoring, auditing and ongoing mitigations

The legal matrix of the project not only promotes sustainable development, but does so within the consideration of local, regional and national planning and development initiatives. It further serves to ensure that the health and safety of communities and workers are brought into the EMP. These procedures will be followed for the project described in the following section.

Table 2. Additional National and International Legislation

Legislation / Policy	Summary	Applicability to Assessment	Included in Report
National Legislation			
The Namibian Constitution	➢ Promote the welfare of people, ➢ Incorporates a high level of environmental protection, ➢ Incorporates international agreements as part of Namibian law.	All proposed development should aim at promoting the welfare of all people in a sustainable manner.	Principles of sustainable development and protection of the environment are enshrined in the objectives and goals of impact minimisation for adverse impacts.
Environmental Management Act Act No. 7 of 2007, Government Notice No. 232 of 2007	➢ Defines the environment, ➢ Promote sustainable management of the environment and the use of natural resources, ➢ Provide a process of assessment and control of activities with possible significant effects on the environment.	The proposed project is listed in the EMA regulations which require an application for an ECC.	The project has been registered with MEFT and the final EIA and EMP will be submitted in support of an ECC application. **Table 1** lists the activities requiring an ECC.

Legislation / Policy	Summary	Applicability to Assessment	Included in Report
National Legislation			
Soil Conservation Act (Act No. 76 of 1969)	➢ Law relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources Namibia. ➢ This Act covers the prevention and combating of soil erosion; the conservation, improvement and manner of use of the soil and vegetation; and the protection of water sources.	Infrastructure development of the proposed project will inevitably impact on the soils and further pose risks to soil contamination in the construction and operational phases.	Principles of soil conservation and pollution prevention have been included the EMP which will be submitted in support of an ECC.
The Water Act Act No. 54 of 1956	➢ Remains in force until the new Water Resources Management Act comes into force, ➢ Defines the interests of the state in protecting water resources, ➢ Controls the disposal of effluent, ➢ Draft regulations are being reviewed	Water will be used during the construction, operational and decommissioning phases. Ground water will be abstracted from a borehole; in such instance a water abstraction permit is required. A water registration / permit is also required for the disposal of wastewater into a French drain. Regulations about proximity to rivers are relevant.	Mitigation measures relating to water contamination are described in the EMP for the construction and operational phases.
Water Resources Management Act Act No. 11 of 2013	➢ Provide for management, protection, development, use and conservation of water resources, ➢ Prevention of water pollution and assignment of liability, ➢ Not in force yet.	Water will be used during the construction and operational phases for construction purposes as well as sewage management. No water will directly be sourced from a river or dam.	Mitigation measures relating to water contamination are described in the EMP for the construction and operational phases. Permits for abstraction are needed.

Local Authorities Act Act No. 23 of 1992, Government Notice No. 116 of 1992	➢ Define the powers, duties and functions of local authority councils, ➢ Regulates discharges into sewers.	EMA requires public participation inclusive of NGO's, local and regional government and IAPs.	Local and regional offices have been invited to participate in the application process.
Public Health Act Act No. 36 of 1919	➢ Provides for the protection of health of all people.	The proposed project may have health impacts on labourers and surrounding communities during the construction and operational phases.	Health and safety measures have been incorporated into the EMP of the proposed project
Labour Act Act No 11 of 2007, Government Notice No. 236 of 2007	➢ Provides for Labour Law and the protection and safety of employees, ➢ Labour Act, 1992: Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997).	The proposed project will require labour during the planning, construction, operational and decommissioning phases.	Measures to ensure that the requirements of the labour act are MEFT have been included in the EMP.
Electricity Act, 2007 (Act No. 4 of 2007)	➢ The Electricity Act aims to establish the Electricity Control Board and provide for its powers and functions; to provide for the requirements and conditions for obtaining licences for the provision of electricity; to provide for the powers and obligations of licensees; and to provide for incidental matters. Under section 17, no person may establish or carry on any undertaking for - ➢ (a) the generation of electricity; ➢ (b) the trading of electricity; ➢ (c) the transmission of electricity; ➢ (d) the supply of electricity; ➢ (e) the distribution of electricity; ➢ (f) the importation of electricity; or ➢ (g) the export of electricity,	The proposed project will obtain electricity produced from diesel generators on site.	Health and safety measures for the use and storage of fuel on site have been incorporated into the EMP of the proposed project

	➢ Unless such person holds a licence issued under this Act that authorises the particular activity.		
Road Traffic and Transport Act Act No. 52 of 1999 Government Notice No 282 of 1999	➢ Provides for the control of traffic on public roads and the regulations pertaining to road transport.	➢ Roadworthiness, ➢ Fitness for drivers, ➢ Loads on Vehicles, ➢ Transportation of Dangerous good, ➢ Road traffic signs, ➢ All construction vehicles to adhere to the provisions of the act.	As part of the Health and Safety mitigation measures in the EMP: Road traffic signs to be erected during the construction phases and maintained during the operational phase.
National Heritage Act Act No. 27 of 2004, Government Notice No. 287 of 2004	➢ Provides for protection and conservation of places and objects of heritage significance and the registration of such places and objects.	Although no sensitive archaeological or heritage features have been identified in the area, such artefacts may be discovered during excavation activities.	Chance find procedures of possible heritage / archaeological finds have been included as a condition to be conducted in the EMP.
Explosives Act Act 26 of 1956 (as amended in SA to April 1978)	➢ Regulations for safe storage and handling ➢ The magazines have to be licenced as required by Section 22. The quantity of explosives and the manner in which it is stored has to be approved by an inspector. The inspector has powers to enter the premises at any time to conduct inspections regarding the nature of explosive, quantity and the manner in which it is stored. All explosives and residues are to be removed or destroyed in accordance regulation.	In as much as the proponent will make use of explosives during mining, it will need to be aware of the provisions of this Act and its licensing requirements.	Reference is made to the regulations in the EMP.
Hazardous Substances Ordinance	➢ Applies to the manufacture, sale, use, disposal and dumping of hazardous substances as well as their import and export.	Various hazardous substances will be used during the construction, operational and decommissioning phases of the proposed project.	Handling, storage and disposal of such substances have been identified as per specific impacts as per the EIA and EMP which details

Ordinance No. 14 of 1974	➢ Aims to prevent hazardous substances from causing injury, ill-health, or the death of human beings.		management measures for hazardous substances throughout the project.
Pollution Control and Waste Management Bill (draft document)	➢ Not in force yet, ➢ Provides for prevention and control of pollution and waste, ➢ Provides for procedures to be followed for licence applications.	Various waste streams will be generated during the construction, operational and decommissioning phases. These include possible chemical and physical pollution.	Waste management measures have been highlighted in this report and management measures have been included in the EMP.

Legislation / Policy	Summary	Applicability to Assessment	Included in Report
International Law			
Stockholm Declaration on the Human Environment, Stockholm 1972.	➢ Recognizes the need for a common outlook and common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment.	The proposed development is situated in the Kunene Region amongst people with world heritage interest or status.	Identifying potential impacts of the project. The EMP has measures to mitigate negative impacts and enhance positive impacts
United Nations Framework Convention on Climate Change (UNFCCC)	➢ The Convention recognises that developing countries should be accorded appropriate assistance to enable them to fulfil the terms of the Convention.	Some emissions may be released during the construction and operational phase of the proposed development.	Emissions are planned to fall outside of the World Health Standards. Should such parameters be exceeded all necessary steps are to be taken to reduce emissions as mentioned in this report.
Convention on Biological Diversity, Rio de Janeiro, 1992	➢ Under article 14 of The Convention, EIAs must be conducted for projects that may negatively affect biological diversity.	Although the proposed project will be developed on previously disturbed areas (portion of claims mined already) the site still has sensitive features.	Aspects of the biodiversity has been included in this report and EMP.
United Nations Convention to Combat Desertification (UNCCD)	➢ Aims at land management and combating desertification/land degradation to contribute to the conservation and sustainable use of biodiversity and the mitigation of climate change.	Infrastructure development of the proposed project will impact on the soils and further pose risks to soil contamination in the construction and operational phases.	Principles of soil conservation and pollution prevention have been included the EMP which will be submitted in support of an ECC.

4 PROJECT DESCRIPTION

4.1 PROJECT RATIONALE / NEED AND DESIRABILITY

The proposed activity focuses on the specific resources of sodalite, iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the existing mining claims that the Proponent has applied for rights to. The product from the rare earth and iron mineralisation is envisaged in the form of mineral concentrates for the Southern African and international market. Sodalite is produced in the form of lumps of ornamental stones and as blocks of dimension stone. This is in line with the provisions of the Minerals (Mining and Prospecting) Act of 1993, where sodalite is categorised in the commodities of dimension stones (industrial minerals) and semi-precious stones. The mineralisation is unique in Namibia.

This project will contribute to the Kunene region's economy, and in doing so, will contribute to the socio-economic development in the area by providing jobs and providing opportunities for continued diversification of economic activities. The project is considered a small operation.

Potential direct benefits of the combined project include:

- Direct capital investment
- Stimulation of economic development (e.g. ongoing supply of materials and goods for construction purposes; new businesses, employment, housing, better markets and access to public services etc.).
- Skills development and employment (an average of 55 unskilled works will be employed during the operational phase.
- Foreign exchange earnings
- Value adding to Namibian raw materials

Potential indirect benefits of the project include:

- Expansion of trade and industrial activity in the town and region.
- Inducement of additional investments
- Diversification of the regional and national economy.

4.2 NATURE & SIZE OF THE PROJECT

Nina Smit's MCs lie approximately 130 km northwest from Opuwo and are located about 3.5 km southwest of the Namibian Angolan border, marked by the river Kunene, and 6 km south-west of Otjimuhaka settlement (previously Swartbooisdrif). The mining area is situated on the foothills of the NE-striking ridges of the Zebra Mountains in the north-west.

The sizes of the MCs are outlined in **Table 3** below:

Table 3. Areas of the Mining Claims

MINING CLAIMS	SIZE (ha)
Applications	
75160	17.9
75161	17.7
75162	18.0

The Proponent plans to produce sellable mineral product in the form of sodalite in the form of lumps of ornamental stone and blocks of dimension stone and as iron and rare earth element concentrates. The activities extend beyond the MCs and include the processing of the ores at a processing plant within ML40 and the transport of ore or product along routes to other processing plants and the storage and handling of the product at the Port of Walvis Bay.

4.3 Location Details

The MCs area is located within the Kunene Region and in the northern Epupa Constituency. The MCs is about 125km north of Opuwo travelling along the C43 and D3701 roads and about 80 kilometres west of Ruacana along the D3700 road. **Figure 3** below renders a map showing the location of the MCs in relation to the main towns, local town and village. **Figure 4** below renders a map showing the location of the MCs in relation to the local town, Otjimuhaka, and village, Oroutumba.

4.4 Accessibility

Access to **Nina Smit's MCs** from the district road is along existing single-track gravel roads that were constructed during the recent exploration activities or historically during the legacy mining activities. **Figure 5** renders a map of the MCs showing their detailed location with waypoints also showing the access road and tracks leading to and passing through the MCs. The nearby district roads are two-way gravel roads. From Opuwo or Ruacana to the port of Walvis Bay the road is mainly tarred with a few stretches of gravel from time to time. Some parts of the gravel road are prone to being washed away by floods during heavy rainfall season. These sections would need repair to make it possible for getting supplies to site and for large product haulage trucks to travel safely to the Walvis Bay harbour.

Table 4 in the product transport section below lists the preferred and alternative haul road from the mine site to the Port of Walvis Bay.

Figure 3. Map of Kunene Region showing Ruacana and Opuwo relative to the MCs' location.

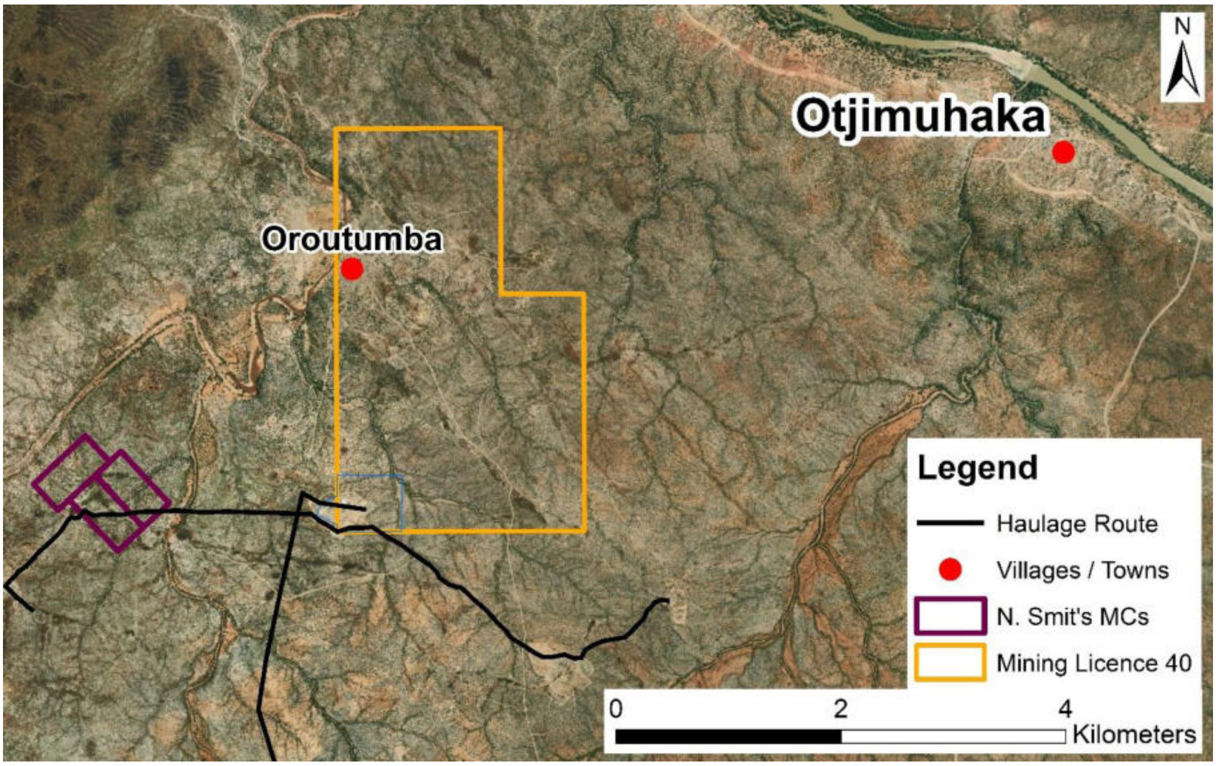
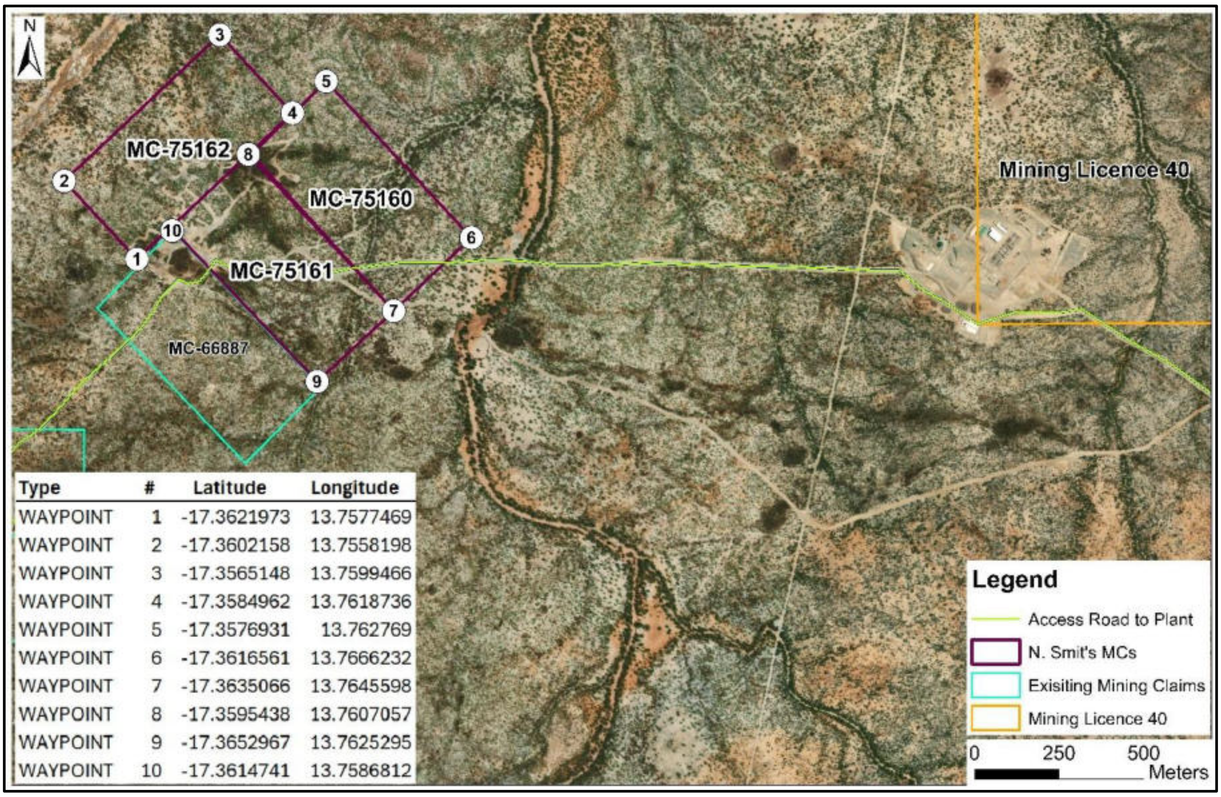


Figure 4. A map showing the MCs' location relative to the ML 40, Oroutumba village and Otjimuhaka Town.



Type	#	Latitude	Longitude
WAYPOINT	1	-17.3621973	13.7577469
WAYPOINT	2	-17.3602158	13.7558198
WAYPOINT	3	-17.3565148	13.7599466
WAYPOINT	4	-17.3584962	13.7618736
WAYPOINT	5	-17.3576931	13.762769
WAYPOINT	6	-17.3616561	13.7666232
WAYPOINT	7	-17.3635066	13.7645598
WAYPOINT	8	-17.3595438	13.7607057
WAYPOINT	9	-17.3652967	13.7625295
WAYPOINT	10	-17.3614741	13.7586812

Figure 5. Detailed (waypoints) location of the MCs showing the access road and tracks leading to and passing through the MCs.

4.5 PROPOSED PROJECT PLAN

The following is the summary of envisaged development with mining activities that are expected to be undertaken by the project proponent during different project development phases.

4.5.1 Construction Phase Activities

This will comprise of the construction of fuel storage and dispensing facilities, fencing, security and staff accommodation, sewerage, and waste handling facilities. The majority of these are already in place at the processing plant within the accessory works area of ML40.

Solid non-mineral waste will be removed off site and taken to the nearest rubbish dump either in Otjimuhaka or Ruacana depending on the nature of the waste. Ablution facilities will use sealed septic tanks or a wastewater treatment plant or French drains. The facilities at the processing plant can be used until the MCs own facilities need to be constructed. Sewerage sludge will be taken to the Ruacana sewerage plant periodically if the septic tank option is used.

The projects' electricity requirements will rely on diesel generators. Construction staff will be accommodated on site at a temporary camp. Security will be supplied on a 24-hour basis at the mine and construction sites. Support services and any facilities established during the construction phase will either be removed at the end of this phase or incorporated into the project's operational phase.

- It is anticipated that the proposed construction will commence immediately after receiving the ECC from the MEFT and once the relevant permits and licences have been issued by the different regulatory bodies

4.5.2 Operational Phase Activities

Operations at the site use open cast mining methods. Mining techniques make use of modern equipment such as excavators, diamond wire saw, circular diamond cutting machines, compressor driven drill rigs, jack hammers and dump trucks. Such open cast mining operations will be established according to good practice procedure. The mining operations comprise of consecutive phases including site clearing, excavations – by means of drilling and blasting, digging, block cutting, removing and haulage of rock to processing plant and storage yard.

Multiple quarries (i.e., wedge, terrace or trench shaped) will be mined at various places within the mining claims. Quarry depth will also be to a maximum of about 50 m. Up to approximately 1,000 t of rock is expected to be removed from the ground and processed monthly. For all types of material from the ground the excavations are planned to a maximum stripping ratio of 1: 10. Overall the maximum or total estimate of waste rock produced will be up to 60 000 tons annually. Mineral waste will be deposited in waste rock dumps and in a tailings' storage facility.

4.5.2.1 Mineral Processing

The Ondoto Mining project has already established a central processing facility for sodalite dimension stone blocks at the Oroutumba settlement and a mineral processing facility for rare earth minerals at an approved accessory works area northwest of the MCs. Both processing facilities are situated within ML40.

Blocks of sodalite dimension stone are trimmed by means of diamond rope machines and cut into slabs. Smaller blocks and boulders are also trimmed and cut into slabs and tiles. Lumps and boulders of sodalite rock are stockpiled and sold as ornamental stones.

Figure 6 renders a map showing the location of the processing plant area within ML40 showing the water pipeline extension from Oroutumba settlement and the hand-dug well.

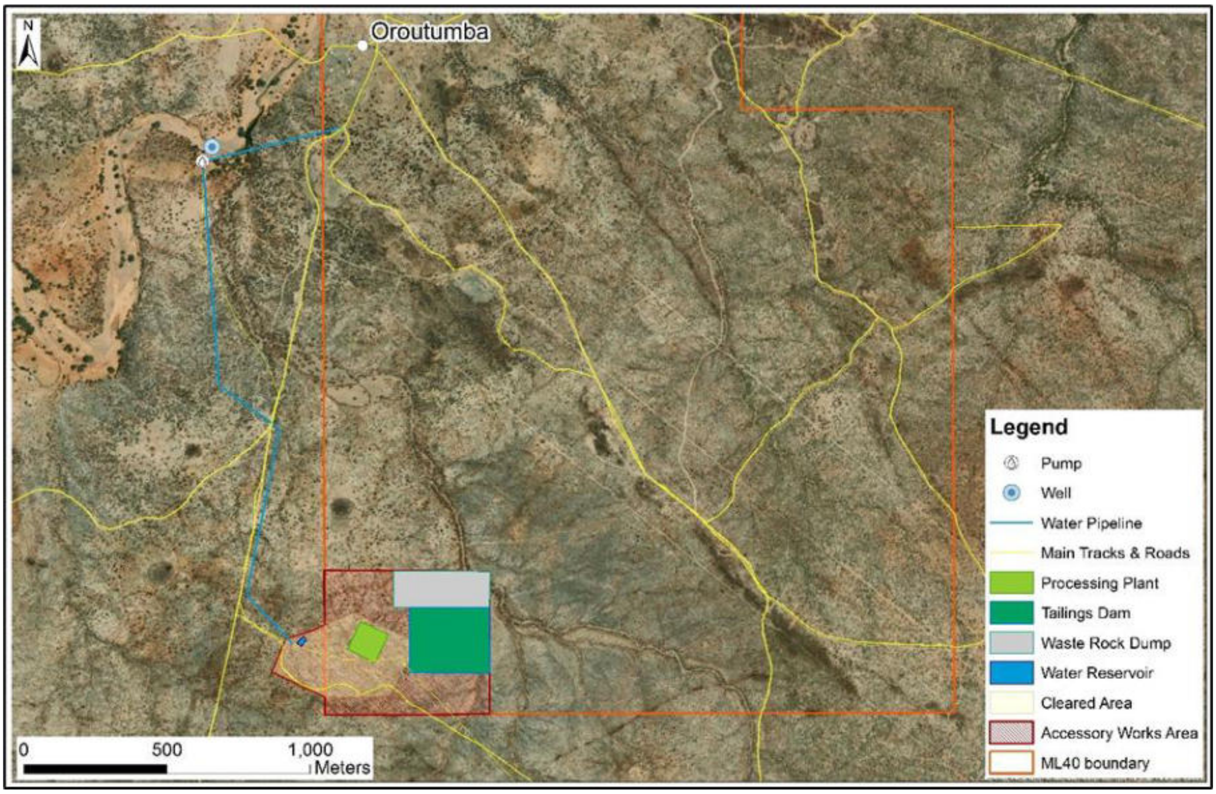


Figure 6. Processing plant area on ML 40 showing the water pipeline extension from Oroutumba village.

4.5.2.2 Product Transport

Blocks of dimension stone, lumps of ornamental stone or concentrates of base and rare earth element products are to be transported as bulk cargo as well as in bagged form. The viability of any mining operation, just like most industries, is particularly sensitive to the logistics concerned with getting the product to market. Different options are presently being investigated for the transport of the products to the harbour of Walvis Bay.

There are currently two options for the type of truck to be used for the haulage of products from all the MCs associated with the Ondoto Mining Project. Either the usual 36 tonne load or a specialised 67 tonne load is being considered. At a maximum monthly production of 5,000t (cumulative amount for whole Ondoto project) a total of 139 truckloads at 36t each (first option i.e. 36 tonne payloads) would transport product each month. That is 5 trucks each day leaving the processing plant each day. The product would be transported either along the gravel road to Ruacana or via Opuwo and thereafter along the tar and gravel roads to the port of Walvis Bay. The product would either be in bulk bags on low-bed trucks or in bulk trailers with covers.

A reduction in the number of trucks required for the transport could be achieved if a Performance Base Standard (PBS) trucking option is approved by the Roads Authority. The bridge study (Olivier, 2020) was undertaken to support the usage of 67 tonne payload trucks along the gravel road route from Opuwo to Walvis Bay. The bridge assessment along the preferred route was assessed for weight carrying capacity.

Geometrical information of bridges was verified on site, most importantly with respect to deck thicknesses and spans. Concrete strength estimates were established by means of Schmidt Hammer tests. Maximum Safe Yield design was compared to the modelled yield induced by the PBS Smart Truck configuration. From the work undertaken (Olivier, 2020) the bridges can accommodate the load imposed by the proposed high-tonnage vehicle with ample safety margins. The envisaged PBS option aims for an allowable unit load of 67 tons. This would almost half the number of haulage trucks on the road and or reduce the frequency with which the trucks must run.

The overall wear and tear on the road infrastructure would also be reduced when using the PBS trucks. See **Table 4** for the preferred and alternative routes and associated distances for each leg of the routes. The preferred route would be the shortest but includes gravel sections amounting to half the journey. The preferred route is shorter by 426 km for the round trip. Although the preferred route includes gravel road sections it is not as congested as some legs of the alternative route. **Figure 7** renders a map of the planned haulage route.

Table 4. Preferred and alternative road routes for haulage trucks.

Preferred route	**Distance**	**Units**	**Road**	**Surface**
Mine Site to Ruacana	80	km	Via D3700	gravel
Ruacana to Kamanjab	287	km	via C35	bitumen
Kamanjab to Fransfontein	84	km	via C35	gravel
Fransfontein to Uis	135	km	via C35	gravel
Uis to Hentiesbay	124	km	via C35	gravel
Hentiesbay to c28 (Swakop)	74	km	via C34	bitumen
Swakop junction to Namport	45	km	Via D1984	bitumen
Total	**829**	**km**		
Full cycle	**1658**	**km**		
Alternative route				
Mine Site to Opuwo	130	km	via D3701	gravel
Opuwo to Kamanjab	262	km	via C35	bitumen
Kamanjab to Outjo	157	km	via C40	bitumen
Outjo to Otjiwarongo	72	km	via B1	bitumen
Otjiwarongo to Omaruru	140	km	via C33	bitumen
Omaruru to Karibib	65	km	via C33	bitumen
Karibib to Usakos	33	km	via B2	bitumen
Usakos to Swakopmund	138	km	via B2	bitumen
Swakopmund to Namport	45	km	via D1984	bitumen
Total	**1042**	**km**		
Full cycle	**2084**	**km**		

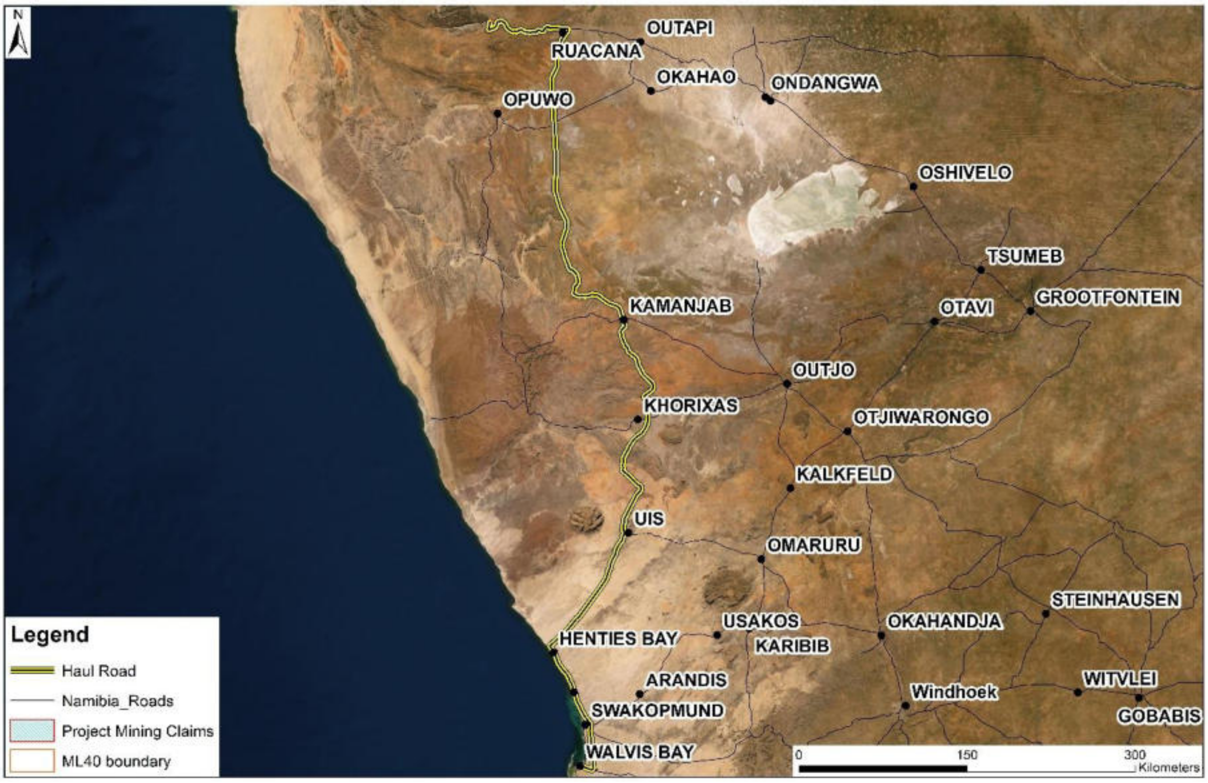


Figure 7. The preferred haulage route for transporting the various products to the Walvis Bay port.

4.5.2.3 Walvis Bay Port Storage & Export

Four bulk storage location options are available for the proponent at the Walvis Bay Harbour. **Figure 8** renders a map of the layout of the storage areas at the Walvis Bay Port. For the options made available there are restrictions on how the material must be stored. Traditionally, the bulk storage area for commodities were allocated opposite berths 5, 6 and 7. Due to the proximity to the Etosha Fish Factory Bulk Plot 10 would require the product to be contained in bulk bags. This mitigation would potential apply to Bulk Plot 37 as well. Bulk Plot 17 provides for the option of undercover break bulk material and all the precautions about handling exposed product inside a potentially unventilated space must be in place. Bulk Plot 20 may also allow break bulk storage in the open. Due to the heavy nature of the product, only minor barriers may be necessary to prevent Aeolian drift of any particulates. Specific requirements by the port will be applied. A lease application will be submitted for the option that best suits the Proponent.

Figure 8. Layout of Walvis Bay Port and Locations of Bulk Storage Options (Bulk Plot No. 10, 17, 20, 37)

Water supply

Water supply is currently from a well in the Ondoto River. **Figure 6** renders a map showing the location of the source of the water for the village and processing plant within ML40. The alternative plan is to source water underground by drilling a borehole in the Dwyka sediments near the Kunene River. The estimated water demand for the whole Ondoto Mining Project will be 100,000 m^3/year (or 12 m^3/hour over every 24 hours).

4.5.2.4 Power Supply

Infrastructure to get electricity from the national grid may be required for the future processing operations of the Ondoto Mining project. A powerline extending from the Otjimuhaka (Swartbooisdrift) substation to the mine site is a potential plan by the Proponent. The route for the powerline would be overhead electricity lines. The design and construction of the powerline will be in such a way that it mitigates for limiting bird collisions. This plan is not being considered under the current application.

Currently, electricity for the machinery at the existing sodalite quarries is supplied by diesel generator equipment. Diesel will be stored at the mine site.

An array of photovoltaic panels will be considered as addition or as alternative form of power generation. This would make use of mine buildings and structures and also of land which is already impacted on, where suitable for the construction of the panels. Such PV installation, with an overall reduction of the mine’s footprint, would constitute an environmentally feasible alternative to both diesel generated power and a new transmission line. Water heating would use solar energy as well to maximise the use of the sun as a renewable source of energy.

For this application, power generation by diesel generators is to be assessed.

4.5.2.5 On-Site Fuel and Lubricant Storage

Diesel storage at the mine site will consist of a bunded fuel tank system, conveniently placed and accessible for the frequent deliveries. In addition to this it is feasible for a few bunded mobile facilities to be placed conveniently for use by the mining equipment at the various active mining areas. These facilities will be of modern construction, either double-skinned or bunded to ensure spills are prevented.

Delivery systems will use sealed fittings to prevent spillage. The fuel facilities should be actively manned. Lubricants will be stored in a double bunded facility which is designed for this purpose. Lubricants will be transferred to machines via reticulated network within the heavy vehicles workshop or mobile lubrication trucks.

Standardised spill kits and reporting systems will be in place to deal with hydrocarbon spills. Contaminated soils will be transferred to a remediation section on site specifically designed for soil remediation.

4.5.2.6 Explosives Magazine and Use of Explosives

In terms of the proper use and storage of explosive material on site, the Explosives Act of 1956 states that the proponent can only keep, store or possess explosives in such a manner and in such quantities as have been approved in writing by an inspector and shall only be stored on premises where there is an explosives factory or explosives magazine. The proponent should obtain a permit issued by an inspector of the explosive police unit and the explosives need to be kept in quantities not exceeding 500 kilograms and be stored in an isolated place. Every 120 days the proponent should furnish the Chief Explosive Inspector with information in writing as from the said date regarding the quantity of explosives in the company’s possession or custody. The proponent should bear in mind that the inspector may enter any explosives facility or explosives magazine at any hour of the day or night for the purpose of inspection and for making inquiries relative to the compliance with the provisions of this Act and its regulations, or relative to the means used therein for preserving the safety of the public or employees or for purposes of analysis or test, ask for samples of explosives or ingredients of explosives from the proponent.

4.5.2.7 Security of the Mine and Accessory Works Area

Various locations and infrastructure may need to be fenced in order to control access to the various hazardous or potentially unsafe facilities to prevent unauthorised persons and vehicles from entering these areas, and to keep out animals from the surrounding communal farming area. Public safety is the guiding principle behind this aspect. Security personnel may be needed from time to time.

4.5.3 Decommissioning Phase

The life of the Ondoto Mine project is set at 25 years currently. After this time, if all mineral resources are spent then it will be required to close the mine. This decommissioning phase includes the following activities:

- removal of processing plant infrastructure,
- potential sale of any permanent office and ablution infrastructure for residential use
- Rehabilitation of waste rock dumps and the tailings storage facility to encourage natural revegetation
- Secure the quarry areas for long term public safety (i.e. by fencing, revegetation or physically changing the angle of quarry sides.
- Rehabilitate roads where necessary.

- Re-assign electrical and water infrastructure for use by the residents.

These and other aspects will be comprehensively addressed in a mine closure plan which will be developed during the first cycle of the environmental clearance certificate. This is necessary so that rehabilitation and landscaping can be conducted as the quarries, trenches and pits are created during the life of mine. This saves money in the long term so that the rehabilitation works do not get left to the time of closure when costs might be more. The life of mine for the operations has been based on the expected demand and the size of the resource. However, this may vary significantly as the demand may fluctuate.

In accordance with the EMA, the proponent is required to make funds accessible, which will specifically be available and allocated for rehabilitation efforts. This fund should continually be available during the life of mine and yet also be sufficient to cover all decommissioning activities at decommissioning. The rehabilitation of the various mine landforms is to encouraging vegetation growth to reduce the effects of soil erosion and to re-establish normal ecosystem functionality after the mine closes.

4.5.4 No Go Project Option

The mining activities on the other MCs granted to the proponent and these current MCs can keep the mining viable, maintain the employment of current staff and to add more opportunities for the community. The activities will continue the much-needed stimulus to the country’s economy.

From the environmental specialist work conducted, the proposed amendment will only have minimal negative impact on the environment if the mitigation methods prescribed with the EMP are effectively implemented. However, if the outcome of the assessment would have identified a fatal flaw or if the decision of the MEFT was to not grant environmental clearance, then the ‘no go’ option would result. The operations on Nina Smit MCs would need to cease should this occur. This will not only deprive the proponent an opportunity to enhance economic wealth but will also deny other key stakeholders an opportunity to earn much needed income. Furthermore, the local authority and central government agencies would not earn revenue through rates and taxes.

5 PUBLIC CONSULTATION

The Environmental Management Act (Act No 7 of 2007) (EMA) and the Environmental Assessment Regulations (MEFT, 2012) require that the proponent provide the public with details of the project during a public participation process. Consultation with the public forms an integral component of an EA and enables Interested and Affected Parties (IAPs) e.g. neighbouring landowners, local authorities, environmental groups, civic associations and communities, to comment on the potential environmental impacts associated with the proposed operations and to identify additional issues which they feel should be addressed in the scoping phase. Consultation was initiated and facilitated through notification letters, site and press notices, public meetings and focus group meetings. **Table 5** outlines the important dates and associated actions and meetings related to the Public Participation Process.

Table 5. Important Dates and Actions Related to the Public Participation Process

Date	Venue	Facilitator	Stakeholders	Confirmations, details, follow-ups
1st, 3rd and 9th of September 2025	Nation-wide	Die Republikein Allgemeine Zeitung The Sun newspaper	All interested parties	Advertisements in public newspapers – first, second and third notice. (See Public Participation Report)
From 1st September 2025	The Kunene Regional Council. The Okapereki supermarket in Otjimuhaka.	Mrs Charon Katjiuongua (Cultural Officer Education Ministry)	Public venues (school, shops, Opuwo Regional Office)	Photos of the site notices were taken. (See Public Participation Report)
28th August – 4th September 2025	Email notices sent out	Philip Hooks & Lovisa Amwele	All pre-identified stakeholders in Opuwo and Otjimuhaka GRN offices and NGOs	Saved email messages (See Public Participation Report)
11th September 2025	Otjimuhaka Primary School	Charon Katjiuongua (meeting interpreter) Lovisa Amwele (meeting facilitator)	Attendance list in the appendix of the minutes of the meeting.	Meeting minutes recorded and reported in the public participation report.
12th September 2025	Notices by hand		MEFT Offices (Opuwo) and Regional	Signed, stamped receipts (See Public Participation Report)

Date	Venue	Facilitator	Stakeholders	Confirmations, details, follow-ups
			Government Offices (Opuwo)	
16th January 2026	Start of public review	Philip Hooks	Send report out to registered IAPs; Printed copy of the public review document placed at the Regional Offices Opuwo and at the mine office in Oroutumba village.	Waited on feedback on the report and Draft EMP
6th February 2026	End of public review period	Philip Hooks	Work in all issues and responses from Public Review	Incorporated into the Executive Summary
23rd February 2026	MEFT Offices / Online Portal	Philip Hooks	DEA and MIME	Submission of the Final EIA Report and Draft EMP; Copy sent to MIME

5.1 Site Notices

Site notices for this application were erected conspicuously to inform the public:

- At the Okapereki supermarket in Otjimuhaka (Swartbooisdrif)
- Kunene Regional Offices, Opuwo

These notices were still present at the time of the public meeting on the 11th September 2025. Photographs of the site notices can be found in the public participation report in **Appendix B.**

5.2 Press Notices

Press notices were placed in two widely distributed newspapers for two consecutive weeks providing details of the project whilst giving the public an opportunity to register as IAPs. Notices appeared in Die Republikein, Allgemeine Zeitung and The Sun newspapers on the 1st , 3rd and 9th of September 2025. Scanned copies of the newspaper notices can be found in the public participation report in **Appendix B.**

5.3 Background Information Document

A Background Information Document (BID) was provided to the various IAPs throughout the initial public participation process. This document provides an overview and a non-technical summary of the proposed development and acts as an easy reference to the proposed project. The BID is included in **Appendix C.** It was distributed in hard copy format during the public meetings.

5.4 Public Meetings & Focus Group Meetings

The Public meeting was held on 11th September 2025, at Otjimuhaka Primary School. Furthermore, a meeting with MEFT staff at their offices in Opuwo took place after the public meeting on the 12th September 2025. The public participation report summarises their comments and concerns and the document is included with **Appendix B**. The power point presentation is given in **Appendix B**. The comments and requests made at these meetings were minuted and these can be found in **Appendix B**. For the stakeholders and I&APs who attended the meetings the attendance list can be found in the public participation report in **Appendix B**.

5.5 Stakeholder Notification

The full list of stakeholders is included in the public participation report **Appendix B**. All the I&APs were all contacted by email and invited to the public meeting. Lovisa Amwele facilitated the public participation process and wrote up the public participation report and the minutes of the public meeting.

5.6 Public Consultation Outcomes

A summary of the main points of concern are presented in **Table 6** below. The responses to the concerns raised during the public consultation are also provided in the Executive Summary but with additional points included subsequent to the public review period. The comments and concerns have been considered, and mitigation measures have been incorporated into the Draft EMP prior to the public review period.

Table 6. The main points of concern received from people who attended the public meetings.

	Theme	Summary of issues
1	Biodiversity	A researcher undertaking a freshwater fish study in the Ondoto River springs reported the presence of *Kneria maydelii* and a potentially undescribed fish species. Concerns were raised about the impact of water abstraction on these rare and possibly endemic species. The researcher strongly recommended that an EIA specifically assesses the risks of water abstraction on the spring ecosystems and their biodiversity. This has been taken into consideration and recommendations for assessment and monitoring have been incorporated into the Draft Environmental Management Plan (EMP). **Subsequent Public Review Additions:** The decision not to depend on the springs of the Ondoto River has been made. Alternative water sources for mineral processing are being investigated. The mitigations set out by the hydrologist and hydrogeologist regarding the tailing's facility were deemed sufficient to prevent the risk of contamination of any downstream receptors. The additional recommended aspect is to undertake a baseline of the downstream water quality conditions and to monitor the water quality at the required frequency during the construction and operational phases of the project. Monitoring reports are to be forwarded to the Department of Water Affairs.
2	EIA process	The community representatives felt that the notifications about the public meeting were too short notice. However, the notifications were carried out in accordance with the

		Environmental Management Act and Regulations. A central and easily accessible venue for the public meeting was arranged. Additional time has been given to the community to raise relevant environmental concerns and provide these in writing. Up to the point of drafting this Public Review EIA report, no written concerns from the community or the ministry stakeholders have been received. Should any such concerns be received by the end of the public review period then there will be incorporated and addressed in the EIA Report. **Subsequent Public Review Additions:** A non-technical summary of the EIA outcomes and project description has been submitted to the committee of the Kunene River Conservancy. The Kunene River Conservancy Committee have given their land-use consent.
3	Unrelated matters with an existing mining company / mining claims in the area	Community representatives at the public meeting raised some concerns about other mining activities taking place in the area and requested a meeting with that company to discuss the matter. It is recommended that any concerns are raised with the mining companies or mining claim holders in question and hopefully the issues can be resolved amicably. **Subsequent Public Review Additions:** The historical matters raised by the community were resolved by the Ombudsman. The Ombudsman has communicated with the Regional Council and the Traditional Authority concerned, providing them with a full report of their investigation. The contents of that report are available on request from the Ombudsman. They are not the topic of this EIA process.
4	Environmental degradation	At the public meeting, concerns about environmental degradation were raised. Mining of mineral resources does change the environment in many ways. The expectations of the community need to be clarified, and the miners must communicate clearly prior to mining so that the environmental changes that are inevitable from mineral extraction and processing do not come as a surprise to the community. The presentation given at the public meeting and the electronic and printed material provided the initial communications of the planned project. It is suggested that mechanisms be put in place to mitigate frustrations among stakeholders that could arise in the future. The EMP Stakeholder programme highlights this commitment from the proponent to ensure stakeholder engagement is ongoing. **Subsequent Public Review Additions:** The Ombudsman made recommendations to the Regional Council and the regional and local development committees to be the normal conduit of information for the affected communities. It is these local community development committees that will be contacted with regards to existing and new developments initiated by the proponent. This aspect is now specifically stated in the Draft EMP which has been submitted for approval by the MEFT.

5.7 PUBLIC REVIEW & REPORT FINDINGS FEEDBACK

The public review period for the Draft Scoping Report with Assessment and Draft EMP will take place between 16th January and 6th February 2026. Two registered IAPs contacted the EAP during this time. Subsequent changes to the EIA report were made. Some additional recommendations were made which are included in the Table above.

6 DESCRIPTION OF THE ENVIRONMENT

This section lists the most important properties and environmental characteristics of the study area.

6.1 GEOLOGY

6.1.1 Regional Geology

MCs 75160, 75161 and 75162 and surrounding area is in the Eastern Kaoko Zone (EKZ) of the Kaoko Belt, in the Kunene Region, of northwestern Namibia. The northern part of the EKZ is dominated by the Kunene Anorthosite Complex (KAC). The KAC is the largest anorthosite complex in the world, with only about 10% of the KAC in Namibia, and 90% in the south-western part of Angola.

The KAC in Namibia can be divided into northwestern and southeastern bodies. The northwestern body is made up of a white massive anorthosite. The southeastern part, called the Zebra Mountain lobe, is an interlayered body, subdivided into white and green anorthosite, dark leucotroctolite, and olive-bearing anorthosite. The white and green colour of the anorthosite is due to sericitisation and saussuritisation of plagioclase and the white anorthosites are older than the dark leucotroctolites.

Post-dating and bordering the KAC are several, mostly mafic to ultramafic intrusions (Maier et al., 2013). These intrusions form the so-called 'Satellite Intrusions' of the KAC. The magmatic rocks of this group span from dunite, peridotite, pyroxenite, gabbro, troctolite, norites, anorthosites, to syenites and alkaline granites.

The eastern to southern part of the KAC in Namibia, is transected by numerous regional shear zones, striking WNW and NNW. These mylonitised shear zones are intruded by syenite, quartz syenite, calcitic and ankeritic carbonatite dykes. The volatile-rich intrusives caused intense fenitisation of the older magmatic rocks. The country rocks of the Epupa basement are heavily altered by the alkaline intrusives

6.1.2 Local Geology

The project area is underlain by massive anorthosite and layered anorthosite - troctolite of the Kunene Complex. The Proterozoic age large, layered intrusion is emplaced in the Archean to early Proterozoic age Epupa Complex. The anorthosite intrusion is associated with peripheral ultramafic and mafic intrusives.

The economic geology of the main magmatic phase of the Kunene Igneous Complex (KIC) is dominated by magmatic cumulates such as titano-magnetite. Titano-magnetite occurs as several meter wide and up to 100m long lenses within the anorthosites. Variable amounts of sodalite occur as lenses, layers and breccias in several of the larger carbonatite dykes, but also at the direct contact of carbonatite with anorthosite. These Sodalite-ankerite ferro carbonatite dykes intrude into the anorthosite in the project area. The dykes are emplaced along earlier syenite or lamprophyre dykes in the anorthosite country rock (Miller, 2008). Three main rock types are present in the dyke a) massive carbonatite (dolomite, ankerite and sodalite), b) the main body of ankerite with albite, titaniferous magnetite, analcite and sodalite, and c) layered carbonatite containing sodalite, ankerite, analcite, albite and magnetite. **Figure 9** renders the map of the various types of carbonatite dykes.

The Otjitanga REE deposit is a new discovery. The carbonatites of the area contain locally rare elements like niobium (Niobec-type), rare earth elements (Mountain Pass type) and copper-nickel-sulphide mineralisation (Phalabora-type). Most REE mineralised dykes occur over an area of about 6 km in East-West direction and 2-3 km N-S direction in the southern foreland of the Zebra Mountains. Many significant mineralized carbonatite dykes are concentrated in 4 structural zones in an E-W striking corridor of 4.7 km x 1.3 km. Dyke widths range from as little as 1cm to 10 m, with most dykes between 10-50 cm widths. The carbonatite dykes attain true widths close to 10m at the cusps of two dykes.

In the KAC, and restricted to the white altered anorthosites, are ellipsoidal oxide concentrations consisting predominantly of titanomagnetite and ilmenite, with minor silicates and sulphides.

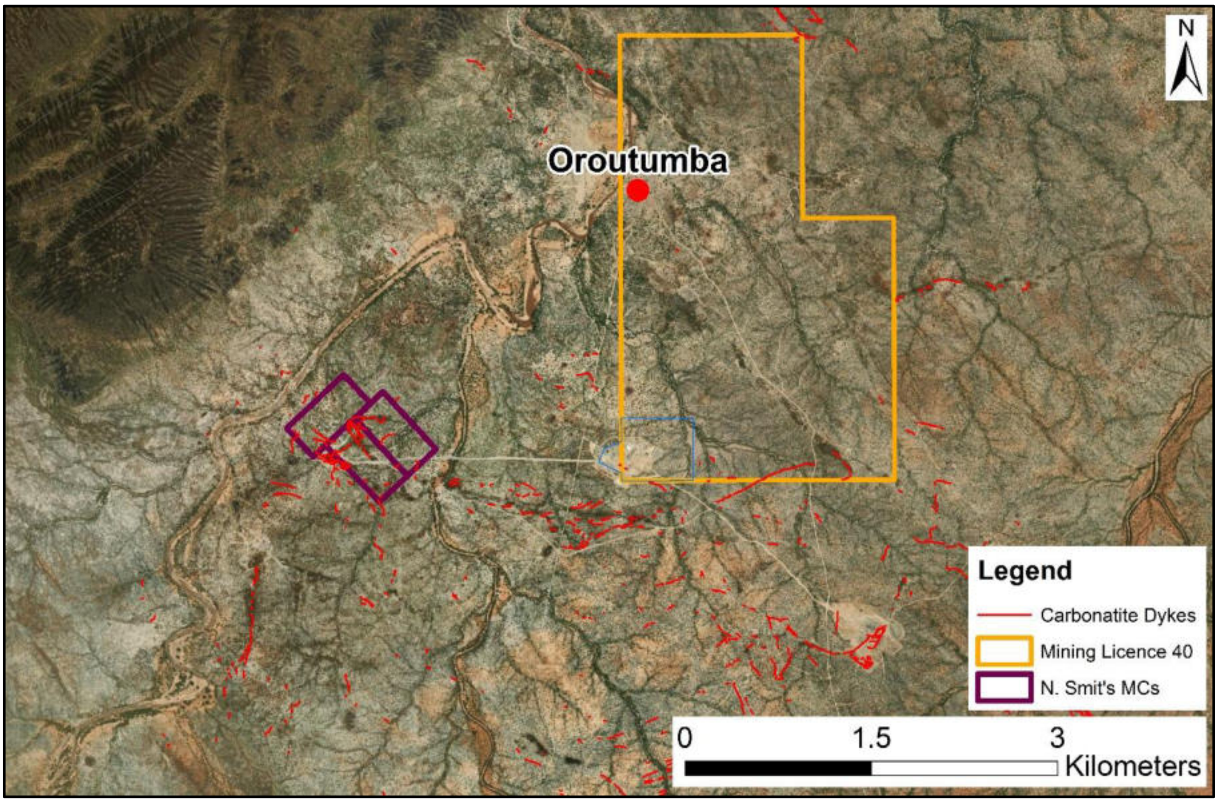


Figure 9. A map of the carbonatite dykes discovered in and around the ML and MCs.

6.2 SOILS

The soils in this area are either Chromi-Leptic Cambisols or Petric Calcisols. The suitability of the soils for crop production ranges from low to moderate. The rocky and Calcisols areas have a low crop production potential. The other soil type renders a moderate crop production potential. The soils have limitations such as low cation exchange capacity, a cemented calcareous layer within 100cm or continuous rock within 100 cm from the soil surface. The project area shows overutilization by livestock, and gully erosion.

6.3 HYDROLOGY

The Nina Smit MCs located at an elevation of about 800 m amsl on the eastern side of the Kunene Complex anorthosite intrusives (Zebra Mountains). Topographically the area slopes north towards the Kunene River and the Namibian border with Angola. There are two main supply options available, the first is the Ondoto River System and the second the Kunene River located approximately 4km north of the project. The Ondoto River, a north flowing tributary of the Kunene River, drains the areas. The ephemeral Ondoto River channel has saturated alluvium that discharges as a perennial waterhole close to the project area, which is the main water source for the local community. This section 6.3 is taken from the specialist study by Namib Hydrosearch (Sarma, 2021).

6.3.1 Ondoto River System

The Ondoto River runs along the Western boundary of the project, i.e. the Mining Licence area and would be the obvious choice when considering a water supply. The immediate concern is firstly sustainability and secondly the social impact on the surrounding community if the water source is over exploited.

The specialist hydrologist stated that to cover all possible water supply options, use of surface water could be considered. This could be in the form of a reservoir (dam) constructed within the Ondoto River or sub-river large enough to capture adequate volumes to sustainably supply the mine and surrounding communities. The hydrologist stated that the construction of a dam within the Ondoto River would require an in-depth catchment study to determine the estimated mean annual runoff and peak flows. This option was not considered as a solution for sourcing water for the project as reasoned below.

According to the 1992 study by the Department of Water Affairs, the Ondoto sub-catchment has the characteristics listed below in **Table 7** and **Figure 10**.

Table 7. Details of the Ondoto Sub-Catchment (Abstracted form Table 45 – Unit Runoff Map of Namibia)

Main River Name	Catchment Site Name	Area (km^2)	Stream Length (km)	Vegetation Type	Soil Type	Predominant Underlying Rock Formation
ONDOTO	Ondoto	1640	56	Mopane Savannah	Acid (Granite)	Granitic/Volcanic Rocks
		River Slope	**MAP (mm)**	**Altitude (m AMSL) MAX-MIN**	**MAR (Mm^3)**	**UR (MAR/A – mm)**
		0.00714	325	1858-852	13.200	8.049

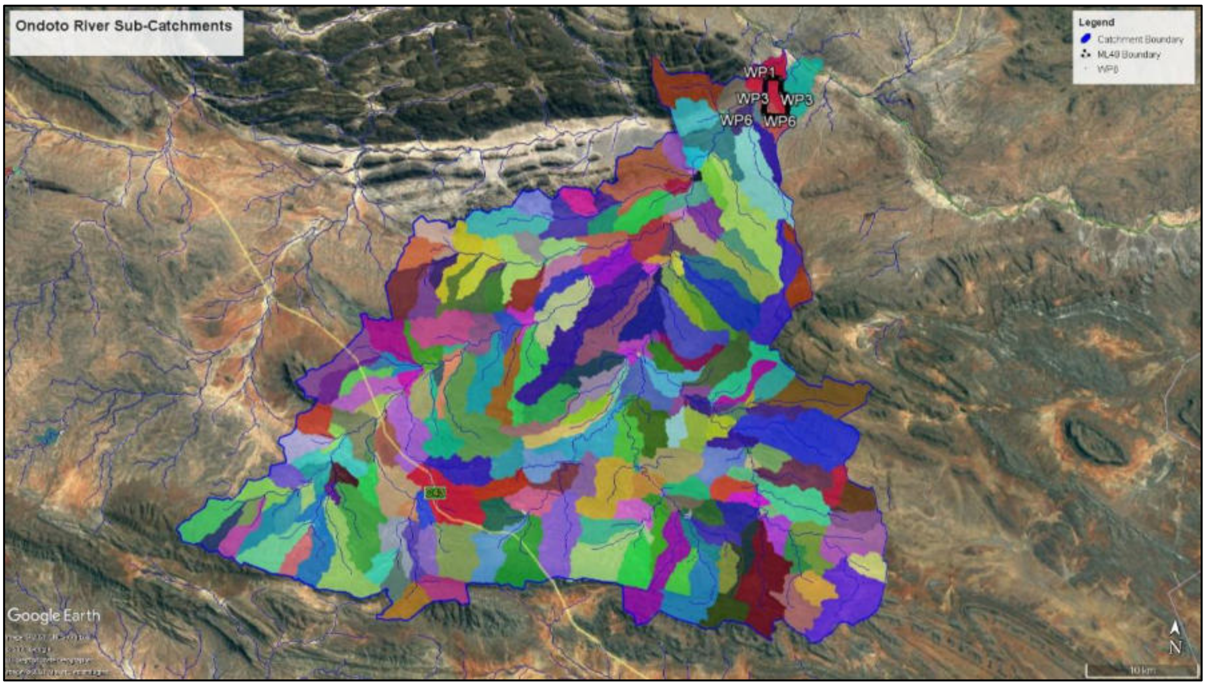


Figure 10. Ondoto Sub Catchments.

As can be seen in **Table 7** and **Figure 10** the Ondoto catchment spans over a relatively large area totalling 1,640 km^2 and has the potential to yield a MAR of 13.2 Million cubic meter of water. The Mean Annual Precipitation (MAP) of the Ondoto catchment is 325mm per year.

The Ondoto catchment is however located in an area with high rainfall variance. The relatively high MAP is therefore misleading. Generally speaking, the area will receive below average rainfall for long periods followed by periods of high to extreme rainfall seasons. Using this data to determine the long-term sustainability for a water supply can be risky and would require a long period of actual onsite flow monitoring.

In light of the above, to sustainably utilize surface water, a reservoir (dam) large enough to hold at least three to five years' worth of water requirements (including evaporation and infiltration losses) would have to be constructed. The evaporation in this area is approximately 3,000mm per year resulting in extremely large annual losses to evaporation alone.

In addition to this the Ondoto River System will generate extremely high peak flows resulting in the need for costly in-river and spillway infrastructure.

Flow measurement infrastructure would also have to be constructed in the Ondoto River in order to get a more comprehensive idea of the actual onsite flow characteristics. To utilise the Ondoto River as a sustainable supply high capital intensive in-river infrastructure, i.e. a dam wall, would be required therefore rendering this option uneconomical.

6.3.2 Kunene River

The Kunene River is a westward flowing perineal river located approximately 4km north of ML40. The catchment area is 107,000 km^2 with an average MAR of 5,200 Million m^3/year (**Figure 11** and **Figure 12**).

The river level is dependent on the discharge from the hydropower station located upstream at Ruacana but subject to seasonal flooding as can be seen on **Figure 13**. The minimum flow is mostly experienced in November, but the low flow is still approximately 20 m^3/sec (72,000 m^3/hr). The required approximately 15 m^3/hr abstraction to supply the mine and surrounding communities would therefore have negligible effect on the river flow.

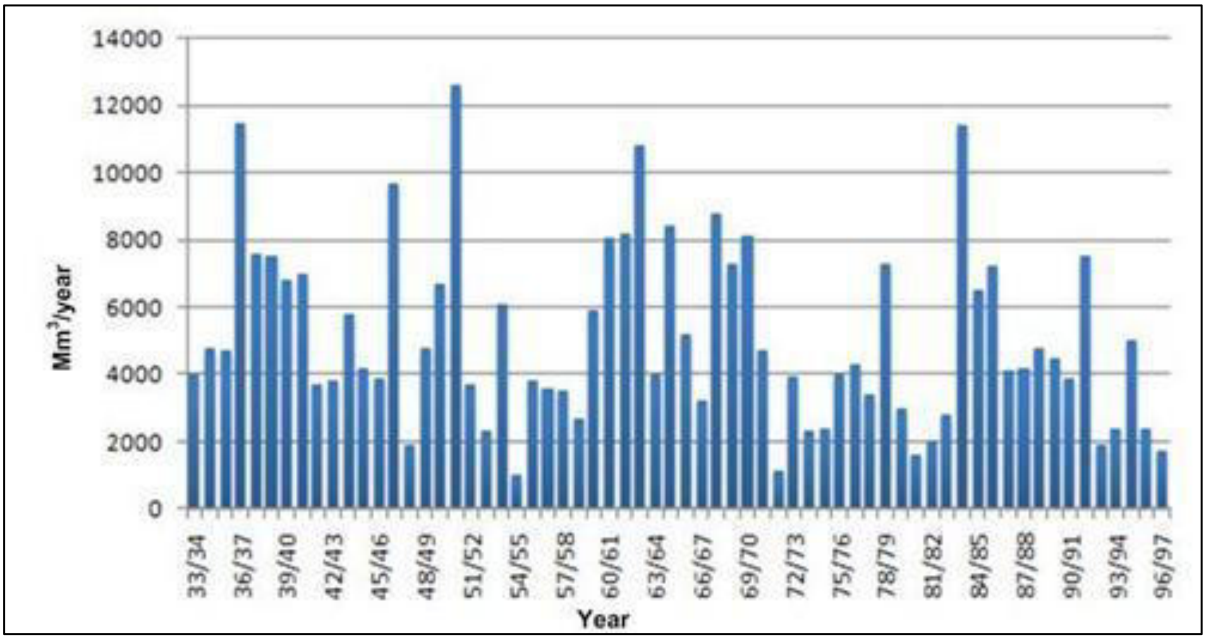


Figure 11. Kunene River Annual Runoff at Ruacana

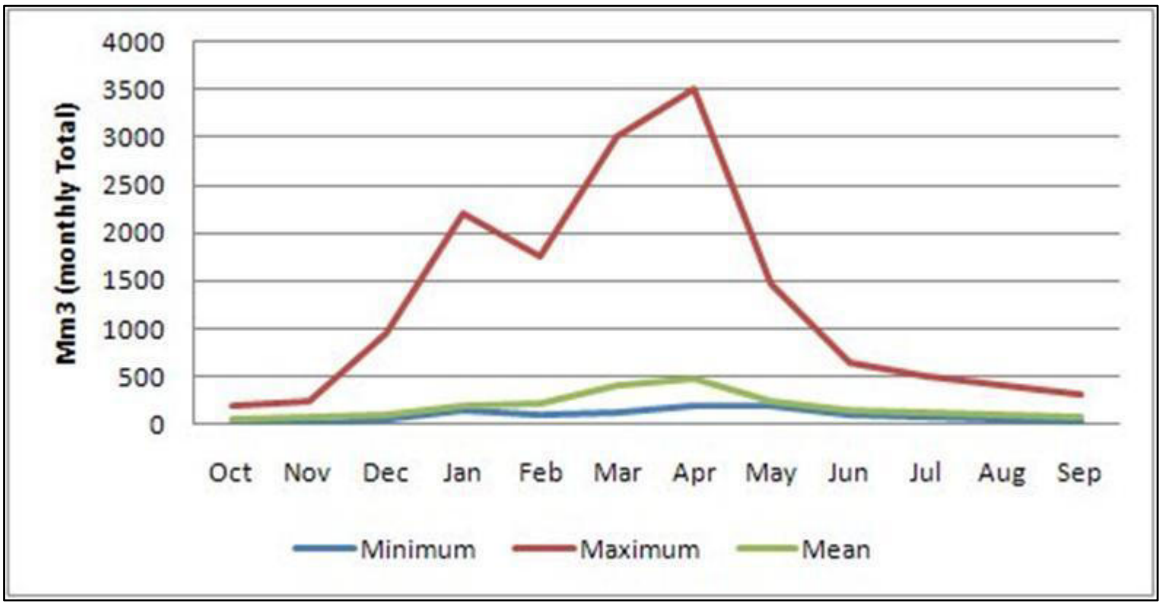


Figure 12. Kunene River Hydrograph, Ruacana.

The Kunene River has an extremely high variation in flow (and river level) making river abstraction infrastructure costly and also subject to flood damage. A few options are available ranging from a floating system to wet wells. In-river infrastructure is generally extremely costly and construction timing during low water season is essential.

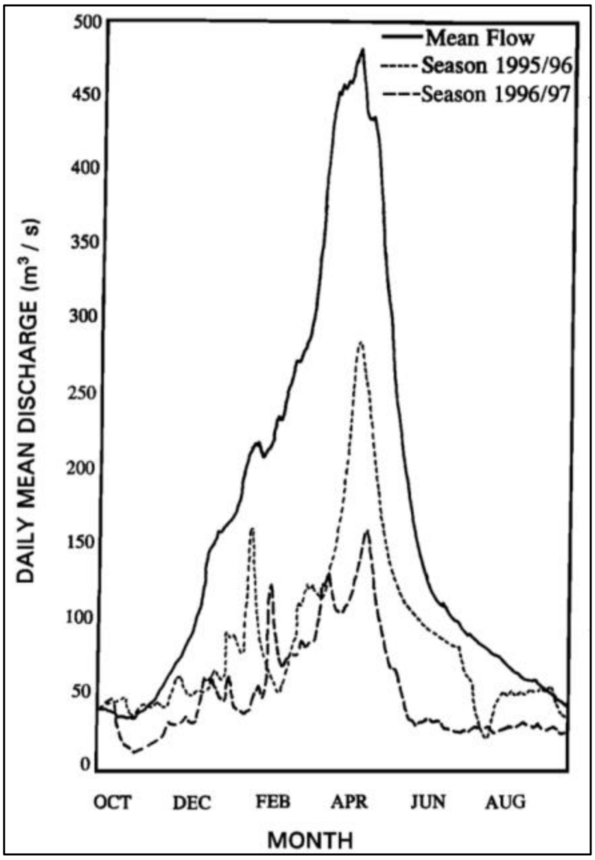


Figure 13. Daily Mean Discharge - Kunene River at Ruacana

Considering the relatively low quantities of water required, the abstraction infrastructure would not have to accommodate large pumps but would need to be constructed large enough to handle flooding and still maintain adequate supply during the low flow periods.

A floating raft type of system would therefore be ideal but would be susceptible to damage during high flows. A sump would also have to be built to accommodate the low flow periods as the pump intakes would still need to have adequate depth to avoid vortexes and cavitation.

According to the Directorate of Rural Water Supply (DRWS), the Kunene River is relatively unpolluted with a low concentration of phosphorus as well as other nutrients. The river does however have a high sediment load making the water turbid and would therefore require filtration before use.

6.3.3 Storm Water Management Plan: Canals, Diversions & Contamination Containment

The project area falls within the lower section of the Ondoto catchment approximately 3 km before reaching the Kunene River. The area receives relatively high rainfall (MAP 325mm per annum) and has a high runoff potential.

A comprehensive storm water management plan is therefore imperative to prevent any dirty water runoff from processing areas, drainage from tailing storage facilities or stockpiles entering the Ondoto River System and ultimately the Kunene River.

The Storm Water Management Plan will therefore focus on the preliminary infrastructure required in order to:

- Effectively prevent, where possible, any surface water runoff entering the area and coming in contact with any mining or processing activities, rock or material stockpiles or workings that have the potential of contaminating such water. This includes run of mine stockpile (ROM), waste rock dumps, tailings storage facility, chemical and reagents safe storage in the designated area in the southwest corner of ML40, nearby the location of Nina Smit MCs.
- Divert, store and evaporate any surface runoff generated from any processing and workings within the project area.
- Identify any area where additional mitigation measures will be required

6.4 GROUNDWATER

The groundwater study by Namib Hydrosearch (Sarma, 2021) is referenced throughout the discussion that follows. The current water supply source is an infiltration gallery on the Ondoto River alluvium. The sustainability of this scheme is dependent of the stored volume and regularity of recharge. Recharge is dependent on rainfall that is known to be erratic in the semi-arid Kunene Region. The abstracted water from the hand dug alluvium well is utilised by the local community and so any abstraction exceeding the inflow rate into the alluvium may cause a lowering of the water table and render the hand-dug well dry, therefore putting the supply at risk.

Three potential groundwater sources were evaluated, and the findings are summarised here.

6.4.1 Ondoto River alluvium

The main commercial activities in the project area are dimension stone mining, artisanal scale mining of sodalite from various claims and livestock farming by the community. The only source of perennial water in the project area and immediate surroundings is groundwater in the Ondoto River alluvium. A hand dug well is operated by the proponent for supply to the camp and community. Therefore, a submersible pump has been placed in the hand-dug well and water is pumped to a filter system before supply (**Figure 14**). The current water consumption from the well in the Ondoto River is estimated as less than 5m³/day for domestic use by the community and the company. During the hydrocensus conducted no other borehole or well was found. Livestock are watered directly at springs in the Ondoto River in places of outflow from the alluvium where the bedrock is close to surface. The community and government offices in Otjimuhaka (Swartbooisdrift) at the bank of the Kunene source water from the Kunene River.

The reach of the river that includes the well forms an alluvial compartment bounded upstream and downstream by bedrock outcrops. The compartment has a length of 5,700 m and covers an area of 375,600 m². It is digitised from a Google Earth image and is shown in **Figure 15**. The groundwater level measured in the well is 3.9 m bgl.

Assessment of the Ondoto River alluvium for water supply for the future mining and processing activities could only be done in a cursory manner from the data available. The stored resource in the alluvium compartment with assumed saturated thickness of 4m and a porosity value of 20% is 300,500m³. Further assuming that 50% of the stored volume is abstractable and the aquifer is replenished every 5 years the volume of water available is 30,000 m³/year (or about 80m³/day). The time intervals in which groundwater recharge occur is the critical factor in the sustainability of this supply. Recharge to alluvial aquifers generally occurs by vertical leakage during river flow as known from the better studied ephemeral systems of Namibia (e.g. Kuiseb, Omaruru, and Oanob). The Ondoto River is known to have highly variable flow from year to year as discussed above but actual flow monitoring data is not available for analysis.

A detailed evaluation of the sustainability of the source would require measurement of the alluvium thickness over the length of the compartment, estimation of aquifer properties and flow gaging information. Notwithstanding the above constraints in the evaluation of the aquifer, the variability of river flow and recharge suggests that the overall long-term sustainability of the resource is doubtful when subjected to regular abstraction at the required rate.

Figure 14. Hand-dug well in the Ondoto River alluvium used to supply the mining camp and local community

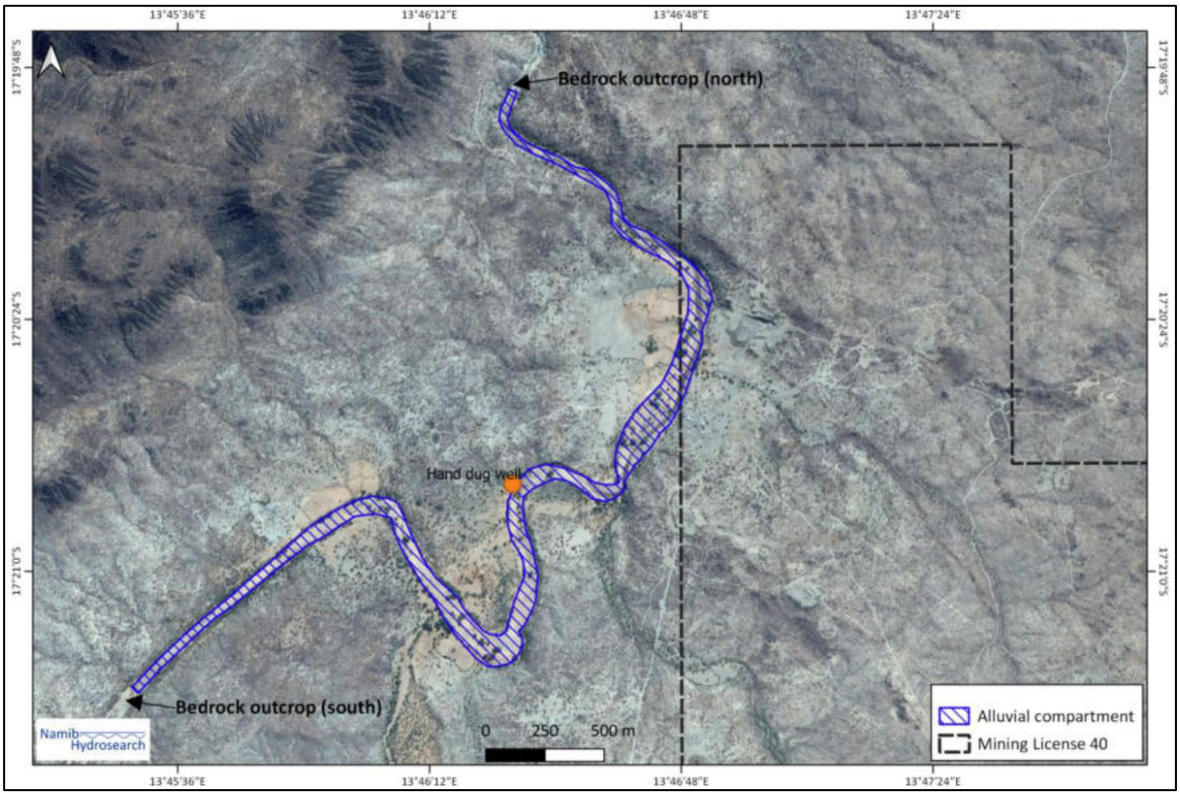


Figure 15. Ondoto River alluvial deposit between bedrock outcrops close to Mining License 40.

6.4.2 Quality of groundwater in the project area and surroundings

Groundwater sampled in the Ondoto hand-dug well is already used to supply for domestic use to the local community and exploration camp site, and for livestock watering. The overall quality of the water is categorised as Group B, Good quality water according to the water quality guidelines (MAWF, 1988). The water has temporary hardness, sodium and chloride levels exceeding Group-A level. Higher sodium and chloride (and consequently the total dissolved solids) usually result from evaporative concentration of water over time in semi-arid areas. Mixing of older water with recent recharge water of Ca-Mg–bicarbonate type and lower salinity determine the overall chemistry of the water.

Iron and manganese content of the sample taken from the hand-dug well is slightly higher when compared to the supplied water at the community water point. Aeration during pumping and transfer possibly causes iron to precipitate as oxide/hydroxides and is removed during filtration before supply. Equilibrium calculations show that the well water is supersaturated in terms of calcite, dolomite, goethite, and hematite. Precipitation of carbonate and iron oxide/hydroxide phases is therefore expected.

Additional physico-chemical parameters were analysed of the hand-dug well water and all analysed parameters are within maximum recommended limits (General standard limits of Article 21 permits, effluents, regulation R553, 1962).

Analysed minor and trace elements are within acceptable limits. The compared limits are Cu 2 mg/l, Zn 10 mg/l, B 4 mg/l, Co 1 mg/l, Pb 0.2 mg/l (Water Quality Guidelines of Namibia, MAWF 1988) and Cu 2 mg/l, B 2.4 mg/L, and Pb 0.01mg/l WHO (2011).

The above parameter values are indicative of the level to be expected naturally and should form the baseline levels for the monitoring of water quality in the future. The sodium, chloride and sulphate levels in the Ondoto River alluvium may decrease or increase depending on frequency of recharge and rate of abstraction.

6.4.3 Dwyka Group sediments

To the north of the MCs between the east-west road to Otjimuhaka and the Kunene River, exposures of Dwyka Group sediments are present. The lithologies include tillite, mudstone and some sandstone units. The sediments and the contact with the underlying Kunene Complex anorthosite are visible in the Ondoto River cutting, immediately south of the road to Otjimuhaka. From the outcrop the Dwyka strata dips northwards towards the Kunene River.

The groundwater potential of the Dwyka Group sediments is usually considered poor (e.g., central and south Namibia). The potential of sandstone units (**Figure 16**) within the Group and the contact zone between the Dwyka and the underlying anorthosite is however considered high as direct leakage from the Kunene River is possible. The extent of the exposed Dwyka Group is about 700m till the Kunene River channel. There currently no boreholes within this formation.

Figure 16. Arenaceous unit within Dwyka Group sediments in the southern bank of the Kunene River

Abstraction from a single or a series of boreholes drilled within a safe distance from the river edge but still supplied by the river via lateral infiltration would alleviate the need for any in-river infrastructure and if placed correctly would not be susceptible to flood damage. Low water periods would also not be an issue as the riverbed level will still be much higher than the pump intake level with adequate hydraulic gradient to ensure adequate supply.

Water quality would be vastly improved especially when considering the low pollutant but high sediment load of the river water. Therefore, water supply boreholes in the Dwyka may have the benefit of requiring little treatment and being free of suspended solids and microbiological pollution.

High efficiency submersible pumps can be used so the borehole can be drilled to any depth allowing for an adequate sump to accommodate this type of pump.

The exact location and potential yield would however have to be investigated further before a final decision can be made.

6.4.4 Supply Infrastructure for the Ondoto Mine Project

A main supply pipeline will be required to convey water from the river / borehole abstraction infrastructure at the Kunene River. to an elevated storage reservoir. The pipeline will be approximately 3.36km with an elevation difference of 110m. **Figure 17** shows the site of the borehole infrastructure, the pipeline route and elevated reservoir. The route is kept reasonably straight to reduce length and therefore friction loss. A detailed pipeline design with costing will have to be conducted. However, a preliminary sizing analysis has been complied in order to get a better understanding of the required infrastructure. There are two sizing options, namely using HDPE pipe material of 110mm and or 90mm nominal diameter. As can be seen, the 110mm option results in a flow speed of 0.66 and 0.61 m/s and a total required head (elevation + friction losses) of 131.12m from the river level. Option 2 is a 90mm HDPE pipe with a higher total required head of 160.51m.

HDPE Pipe class up CL16 (can safely operate under pressure of up to 160m) is relatively common and therefore less expensive than any custom manufacture higher classes. The 110mm HDPE option (with a single lift pressure requirement of 131.12m) is therefore advisable. The lower section of pipeline installed with a standard class 16 pipe will eliminate the need for a booster pump station and water can safely be conveyed with a single lift from the river level.

6.4.5 Discussion on water supply options

In light of the above information, the most viable option for sustainable water supply is a borehole or series of boreholes drilled close to the Kunene River into the Dwyka sandstone target lithologies. This option is not totally immune to flood damage but will also ensure adequate supply during the low flow periods with potential benefits as listed below.

- Water quality will be greatly improved alleviating the need for water treatment infrastructure.
- Efficient high pressure multistage submersible pumps can easily be installed without the need for expensive in-river infrastructure.
- A detailed pipeline design will have to be drawn up but from the preliminary pipe sizing, standard 110mm HDPE pipe can be installed with standard off the shelf fittings.
- Water storage can be located within the ML40 Mining area with a potential pressure of 20m (2 bar) over a large portion of the area. Final location would however be dependent on the mining activities.
- A second reservoir near the new processing plant could be supplied by both the Kunene and the borehole/well in the Ondoto River (**Figure 17**).
- Nina’s MCs would use the utilities that are discussed here.

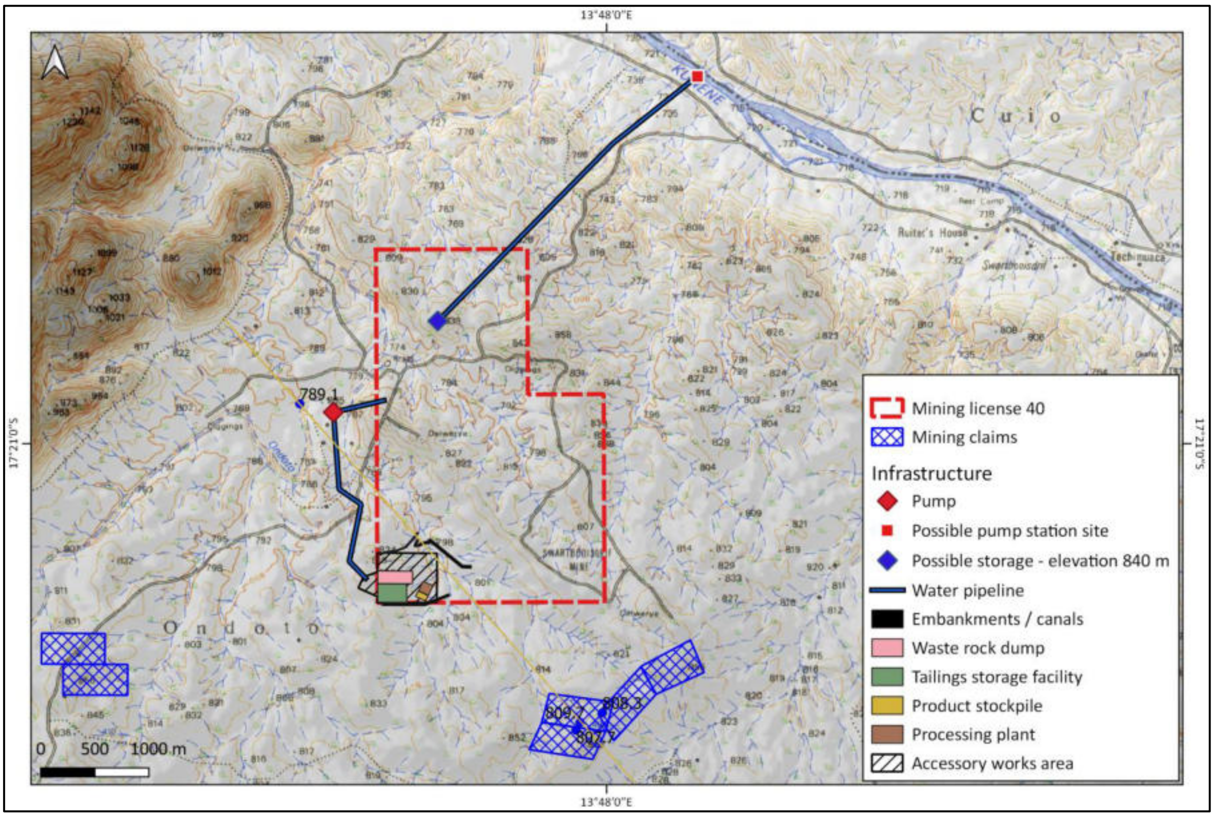


Figure 17. Map showing the source of the water supply options, pipeline routes and reservoirs.

6.5 CLIMATE

Climate data described below comprises the temperatures, wind and rainfall typical for the area. The importance of this data is for assessing the potential impacts of dust emanating from the mining process and predicting directions and intensity of emission plumes. The direction and distance that plume travels can assist in planning the locations of mining infrastructure and the degree to which receptors might be affected.

6.5.1 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume can rise), and determining the development of the mixing and inversion layers (Liebenberg-Enslin 2019).

Maximum, minimum and mean temperatures for a study area 50 km east of the mining claim are given as 34°C, 7°C and 21°C respectively (**Figure 18**), based on modelled data for the period 2016-2018. Average daily maximum temperatures range from 34°C in November to 25°C in July, with daily minima ranging from 14°C in March to 7°C in July. (Liebenberg-Enslin 2019)

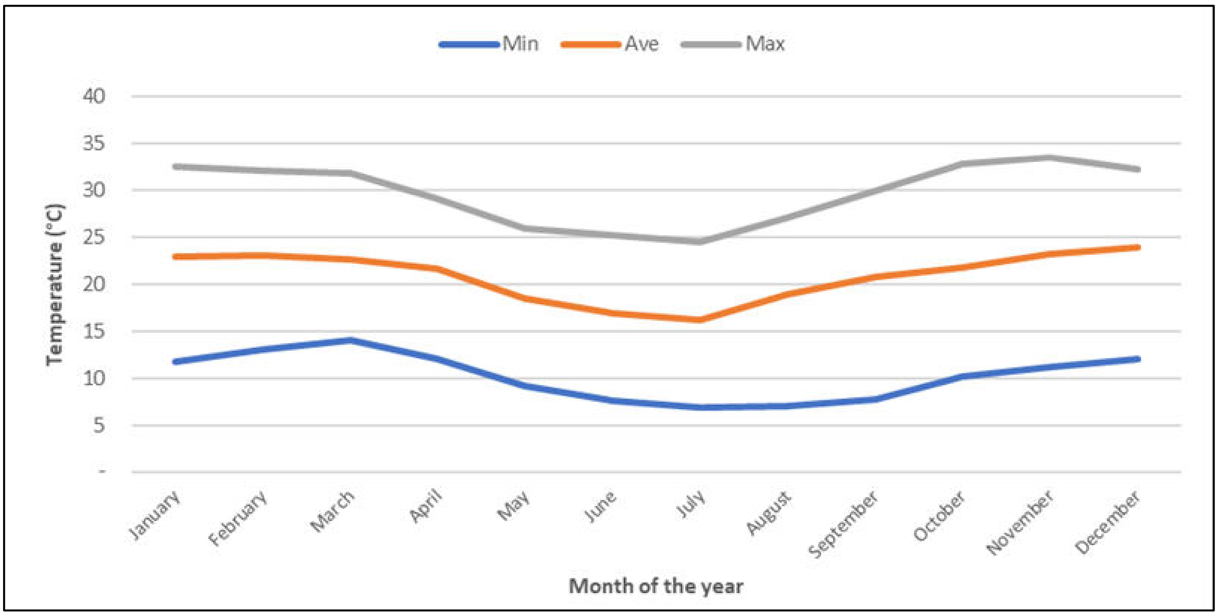


Figure 18. Modelled average, minimum and maximum temperatures for each month of the year for the period 2016 to 2018 for Opuwo (Liebenberg-Enslin 2019)

6.5.2 Wind

The wind direction, and the variability in wind direction, determines the general path air pollutants will follow, and the extent of crosswind spreading. Wind roses comprise 16 spokes, which represent the directions from which winds blew during the period. The colours used in the wind roses below, reflect the different categories of wind speeds; the red area, for example, representing winds between higher than 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred refers to periods during which the wind speed was below 1 m/s. (Liebenberg-Enslin 2019)

Seasonal variation in the wind field is shown in **Figure 19** with predominantly southwesterly and west-southwesterly winds during the summer months (Nov – Feb). During the autumn months (Mar – May), the westerly flow subsided with more frequent winds from the east and east-northeast. The winter months reflected predominant east-northeasterly and easterly winds with almost no flow from the westerly sector. During springtime (Aug – Oct) the easterly flow started to subside with more frequent flow again from the west-southwest. (Liebenberg-Enslin 2019)

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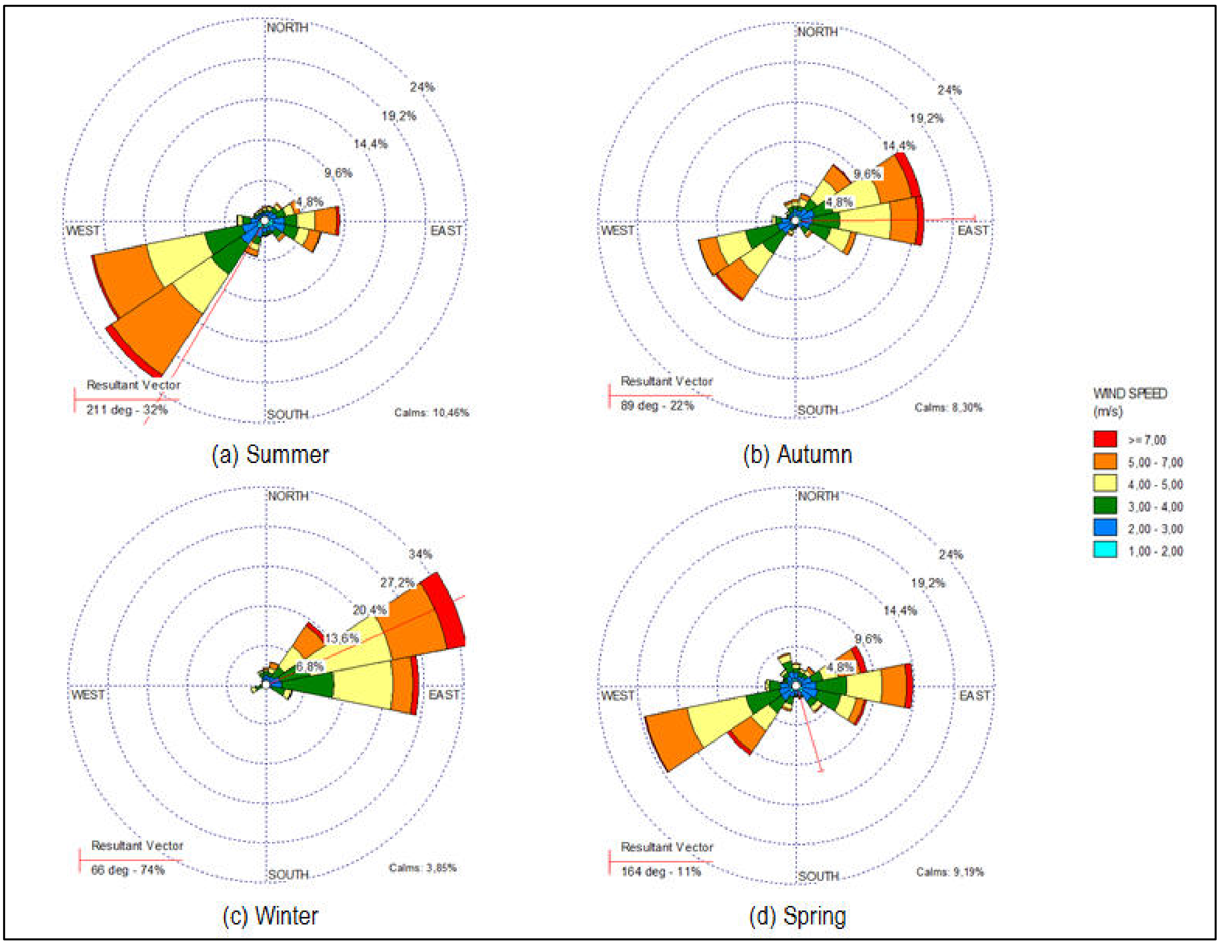

Figure 19. Modelled wind data for the seasons from 2016 to 2021 for Opuwo (Liebenberg-Enslin 2019)

6.5.3 Rainfall

Precipitation is important to air pollution studies since it represents an effective removal mechanism for atmospheric pollutants and inhibits dust generation potentials. Monthly average rainfall figures obtained from worldweatheronline.com are illustrated in **Figure 20**. (Liebenberg-Enslin 2019)

Based on long-term rainfall data for Opuwo (1940 – 2001), the area receives between 62 mm and 837 mm. The rainy season is between December and March, with the dry season from May to September. (Liebenberg-Enslin 2019)

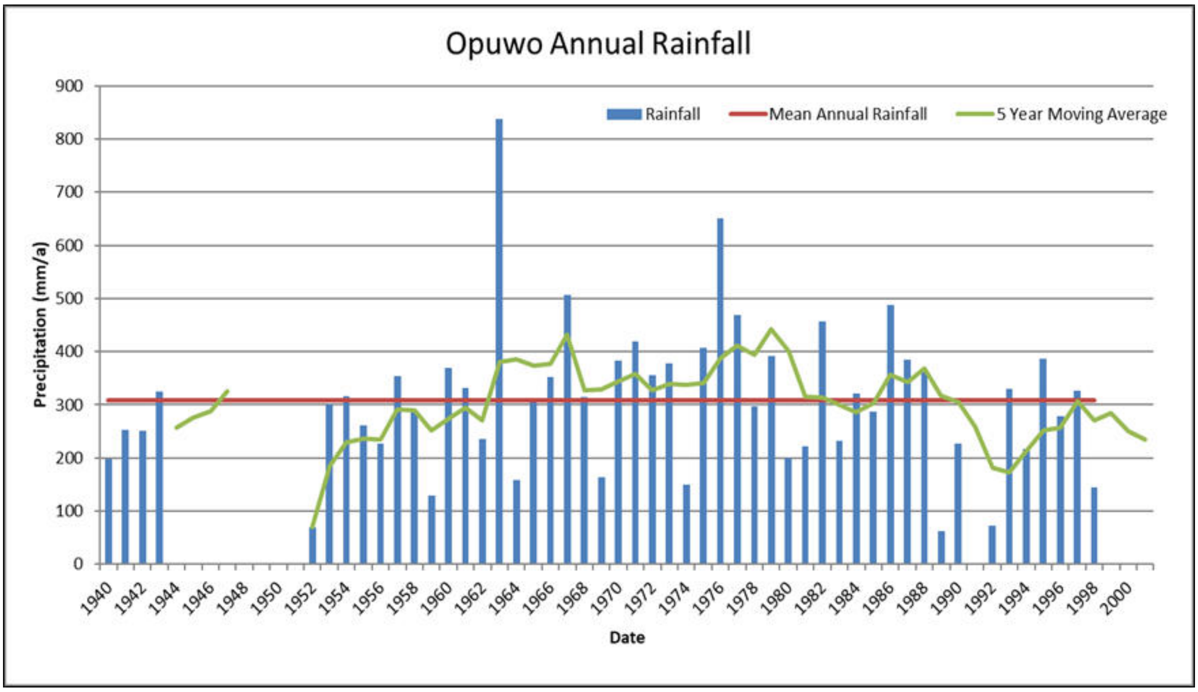

Figure 20. Opuwo annual rainfall data from 1940 to 1998 (Liebenberg-Enslin 2019).

6.6 BIOLOGICAL ENVIRONMENT

At the African scale the project site falls in the Savanna biome, in the stable savanna zone where the ratio between woody and grass plants is determined by climate, particularly annual rainfall below 560 mm. At the Namibian scale the site is in the Western Highlands biome, which is characterised by an Acacia Tree-and-Shrub Savanna vegetation type and a dominant vegetation structure of grassland and scattered trees (Mendelssohn, et al., 2002).

The region's biodiversity patterns are variable according to Mendelssohn et al (2002), whose ranking for plant diversity (the number of species present in an area) is given here as medium-high.

On the landscape scale, the scale on which biodiversity conservation needs are addressed, endemism levels are high for many taxa because of ranges that extend from Angola south across the Kunene River (Mendelssohn, et al., 2002).

At a global scale the project site falls in the Afrotropical Region for all vertebrate taxa. Anthropomorphic modification and the low density of vegetation result in a low density of large mammals.

The project site falls within the Kaokoveld centre of endemism, a biogeographical region rich in endemic and range-restricted plants and animals. Because of the remoteness of the region there is a dearth of data on biodiversity, but recent discoveries of plant species underline the conservation importance of the region. The cumulative impact of mining and other development in the arid zones of Namibia and Angola means that development in such areas should be planned responsibly, and management measures implemented and monitored diligently.

6.6.1 Habitat Classification (Potgieter, 2020a)

Basing a biodiversity study for impact assessment on habitats has been found to result in units that are easier to address in environmental management plans and they can also be managed more easily by mine staff during the operational phase of the project. Another advantage is that in arid zones many species of plants and vertebrates are restricted to certain habitats and are not observed during the site visit, but information on expected species of conservation concern can be extrapolated from knowledge of the habitats.

Three habitat types were identified in the vegetation and vertebrate studies for this project and were integrated in one combined floral and faunal classification (See images in **Figure 21**):

- Mopane scrub,
- rocky outcrops and
- river/drainages.

It should be noted that this categorisation describes macrohabitats on ML40. It is possible that microhabitats may be discernible within any or all of these and that they could potentially require additional mitigation measures.

Aspects that were considered when assigning habitat categories:

- Topography
- Substrate
- Vegetation structure, in terms of layers: a well-structured vegetation assemblage is represented by the presence of a high canopy, trees and shrubs of varying heights, a forb layer and a bottom layer with ground cover such as grass.

The three habitat types were given sensitivity ratings, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures.

The sensitivity rating was assigned based on properties of each habitat itself, including:

- nationally or regionally scarce habitats
- size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region
- exceptionally high diversity and/or abundance of species
- high level of endemism
- species of conservation concern are supported
- key ecological processes
- contributes disproportionately to ecological function (nutrient and energy flows)
- provides critical resources
- restorability after disturbance

Human habitation, grazing and mining activities have resulted in modified areas, some of them severely degraded such as the rocky ridge south of ML40 and the quarry/mine sites (The village Oroutumba, located in Mopane scrub habitat adjacent to the Ondoto River, is also an anthropologically modified area.

6.6.1.1 Mopane Scrubland

The largest part of ML40 and the mining claims under assessment consist of open Mopane scrubland. The topography is gently undulating, bisected by drainages and ridges topped with rocky outcrops. In the east and southeast of the study area the profile is flatter than in the west and northwest, where there are more and steeper rocky ridges.

The vegetation structure varies slightly from west to east, broadly corresponding to changes in topography with larger Mopane trees and some Commiphora species in the western parts of the study area. In the east and southeast *Colophospermum mopane* form a scrubby open woodland of homogenous height and structure, interspersed with *Catophractes alexandri*. The substrate consists of loose stones and gravel on packed sand.

Mopane trees are interspersed with *Terminalia prunioides*, *Boscia microphylla, Commiphora multijuga* and other *Commiphora* species, as well as *Ceraria pedunculata* and *Gymnosporia senegalensis*. The vegetation understorey is sparse, and grass was the only ground cover observable at the end of winter, but more annual plant species are expected to appear after rain.

This habitat has been modified by human activities such as harvesting and livestock grazing. Both these activities are current and ongoing, and the village Oroutumba is located in a degraded area in Mopane scrub abutting the Ondoto River. Roads and accessory works will be located in this habitat.

It is considered the least sensitive habitat, but care should be taken to maintain the natural flow patterns of surface water in all drainage lines.

6.6.1.2 Rocky Outcrops

This habitat occurs at the top of ridges in ML40 and Nina's MCs and the surrounding area, and closely follows fenitisation, i.e. rock alteration features.

The vegetation structure is layered, providing resources for a variety of animal taxa. A ground cover of grass was observed from the flora specialist work and, although no forbs were present, these will appear in summer and after rain. There is a sub storey of shrubs and a well-developed upper storey of trees, dominated by *Colophospermum mopane* and including *Terminalia prunioides, Commiphora mutlijuga*, several other *Commiphora* species, *Sterculia quinqueloba, Sterculia africana, Moringa ovalifolia, Rhigozum virgatum, Boscia albitrunca, Boscia microphylla, Boscia foetida and Ceraria longipedunculata*.

It is highly likely that three recently described plant species of conservation concern could occur in the rocky outcrops: *Maerua sebrabergensis*, *Erythrococca kaokoensis* and *Ocimum sebrabergensis*, since the rocky ridges contain black and grey anorthosite rocks similar to the locations in the Zebra Mountains where these three species were first found.

The rocky outcrops present both abundance and richness of plants that are much higher than those of the surrounding scrubland, contributing to the ecological value of this habitat. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals, further increases the sensitivity of the rocky ridges.

Sodalite and the rare earth minerals are in this habitat; it is where mining will be done and where most of the irreversible impacts (drilling, blasting and open cast mining) will take place.

6.6.1.3 Rivers & Drainage Lines

The Ondoto River crosses the study area for less than a kilometre, but it is an important habitat in terms of both the study area and the region because of two reasons. Firstly, the drainages on ML40 and within Nina's MCs empty into the river and from here it is only six km from where it flows into the Kunene River. Secondly, it is an important source area of high diversity in an arid landscape and a resource during drought years. Any activity in the catchment of the mine site will affect the ecology of the Ondoto and Kunene rivers.

At this point the river is wide with a rock face on its east bank and a flood plain to the west. This stretch of the river and its banks contain sparsely distributed large trees, few shrubs and ground cover in the form of annual plants such as grasses and forbs are expected to appear in summer and after rain. The substrate is sandy, with scattered rocks and boulders and a shallow stream.

The river is an important resource for the Oroutumba community, and it has been modified by historic and current human activities such as grazing and harvesting. Cattle and goats were observed in the river, as well as daily human household activities (water collection, laundry and playing children).

After rainfall events, surface water runs via ephemeral drainages from the ridges and outcrops to two large washes and eventually into the Ondoto River. The washes are expected to have surface water after rain and likely contain groundwater that sustains assemblages of perennial vegetation that are more diverse (both floristically and structurally) than the vegetation in the surrounding landscape. The substrate in this habitat consists of sand, gravel and rocks, providing habitat for burrowing reptiles and for small mammals and reptiles that rely on rocks for shelter.

Plant species in the riverbed and on its banks include Faidherbia albida, Acacia erioloba, Ficus cordata, Ficus petersii, Combretum imberbe, Ziziphus mucronata, Aloe littoralis, Acacia reficiens, Hyphaene petersiana, Boscia albitrunca, Combretum apiculatum, Gymnosporia senegalensis.

In the smaller drainages, vegetation is dominated by Colophospermum mopane and also present are Acacia nilotica, Acacia reficiens, Terminalia prunioides, Commiphora multijuga and Combretum apiculatum.

Riverine and drainage habitats present a high ecological value for most taxa and are considered very sensitive. Blocking of surface and/or groundwater flow will result in loss of perennial plant species and a reduction in the resources, such as food, shelter and soil stabilisation for burrows that they represent to other trophic groups.

Development that is planned in this habitat includes linear structures such as roads, pipeline and power line that will cross drainages. In the Ondoto River, a new well and pump to provide water to the accessory works area are planned developments.

6.6.2 Flora (Potgieter, 2020a)

The following terms of reference for the flora study were used:

1. Describe and map the existing terrestrial flora and identify their occurrence, relative abundance and distribution
2. Identify any species that are of conservation concern.
3. Provide up to date information and data on the flora and fauna within the project area (based on existing literature, expert opinion and moderate-effort fieldwork).
4. Identify key critical factors concerning the impact on biodiversity.
5. Prepare a report about the findings from the work.

The mine site was visited for four days and information on the taxa included in this report is based largely on existing literature.

The site visit took place in the middle of winter and there were many plant species without leaves, fruits or seeds. Most annual and some perennial plants were either absent or present but not presenting identifying characteristics, such as the Corkwoods (*Commiphora spp*), of which there are several species in the study area. It is possible that some factors that could affect the composition of plant assemblages or populations may have been overlooked during the site visit.

Vegetation structure in the region is a shrubland-woodland mosaic, the upper storey dominated by Colophospermum mopane, Terminalia prunioides and Commiphora species. Acacia species are present in drainages and streams, and grass cover is sparse.

6.6.2.1 Habitat delineation and categorization

This is described above, and the photographs of each habitat type are rendered in the specialist flora report found in **Appendix D**.

6.6.2.2 Species of Conservation Concern

Species are potentially of conservation concern when they are endemic or near endemic to Namibia, have a threatened Namibian or IUCN status, or are legally protected in Namibia.

Three species, the Maerua sebrabergensis, Erythrococca kaokoensis and Ocimum sebrabergensis are known only from a few specimens collected in the Zebra Mountains but they are likely to be found on the ridges and rocky outcrops in the project area as well.

The fact that they were found and described as recently as 2015 and 2019 illustrates both the importance of the Kaokoveld Centre of endemism and how under-collected it is in terms of herbarium specimens. This is largely a result of the remoteness and inaccessibility of much of the region and of the Zebra Mountains specifically.

6.6.2.3 Landuse and resource utilisation

Livestock carrying capacity is regarded as relatively low and so the risk of farming in this area is medium (Mendelsohn *et al* 2002).

The life stock shepherds are currently utilising the Ondoto Mine project mining licence and surrounding mining claims on an intermittent basis for feeding their herds, keeping their livestock safe overnight and travelling through the mining licence en route to other browsing areas or a daily water source near the mine village of Oroutumba.

The subsistence farming has had some impact on the habitat functioning in terms of the availability of resources higher up the food chain. This is anecdotally or qualitatively evidenced by the intensively browsed vegetation and the absence of herbaceous vegetation in the three habitats. To what extent climate, i.e the persisting drought, has played a contributing role in diminishing the potential for re-establishment of grasses and herbaceous plants is unknown.

The community subsists from the various habitats in multiple ways through the harvesting of wild fruits and or seeds and even bulbs. The veld is also a source of natural medicinal remedies and even cosmetic products. The expansion of the mine and infrastructure may have an impact on these elements. It is important that the proponent works with the community to identify the areas within the mining footprint that provide such resources and provide some means of access or compensation for loss of access to such resources if at all necessary.

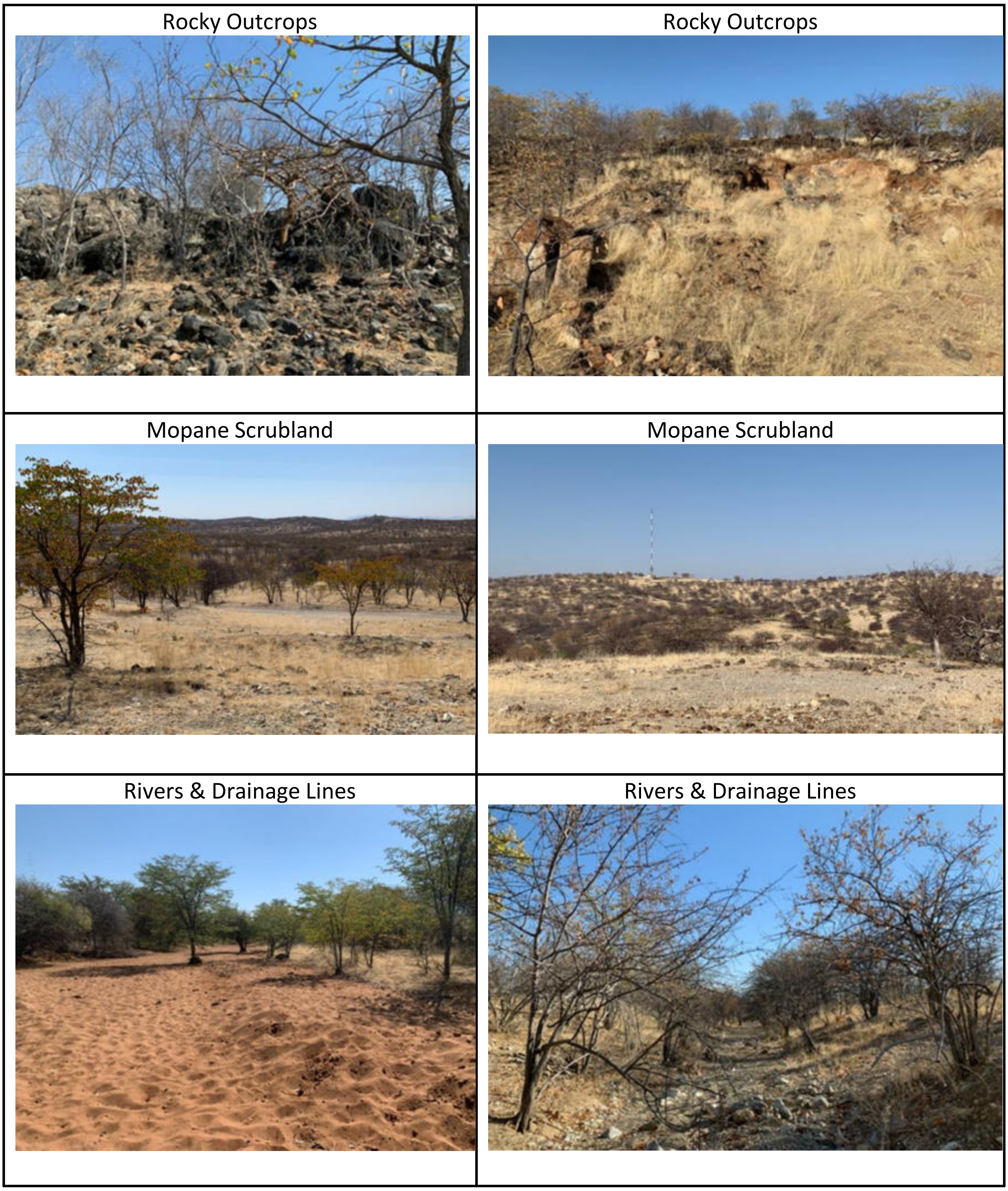

Figure 21. Images of the three habitat types categorised for the area

6.6.3 Fauna

The area in close proximity to the mining claims was visited for four days by the Specialist in 2020, which limited the field work to visual observations. Therefore, information on the taxa included in this report is based largely on existing literature. It is possible that some factors that could affect the persistence of species and/or composition of populations may have been overlooked during the site visit. A greater confidence is attributed to the assessment outcome for those areas the specialist observed firsthand. The fauna specialist categorised and delineated the landscape into three habitats.

The habitats were rated as to their sensitivity, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures.

A sensitivity rating was assigned based on properties of the habitat itself, including:

- nationally or regionally scarce habitats
- size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region.
- exceptionally high diversity and/or abundance of species
- high level of endemism
- species of conservation concern are supported
- key ecological processes
- contributes disproportionately to ecological function (nutrient and energy flows)
- provides critical resources
- restorability after disturbance

6.6.3.1 Rocky Outcrops

This habitat comprises rocky outcrops at the top of rocky ridges and closely follows fenitisation in the area.

The vegetation structure is layered, providing resources for a variety of taxa. A ground cover of grass was observed and although no forbs were present, they will appear in summer and after rain. There is a sub-storey of shrubs and a well-developed upper storey of trees, dominated by *Colophospermum mopane* and including *Terminalia prunioides, Commiphora mutlijuga*, several other *Commiphora* species, *Sterculia quinqueloba, Sterculia africana, Moringa ovalifolia, Rhigozum virgatum, Boscia albitrunca, Boscia microphylla, Boscia foetida,* and *Ceraria longipedunculata*.

Structured habitats potentially support a large diversity of birds, especially insectivores, and are possibly essential for many invertebrate taxa. Large boulders and rocks, shrubs, annual plants and detritus combine to offer high niche diversity that sustains high species diversity, particularly for invertebrates, reptiles and habitat-specific small mammals.

It is highly likely that three recently described plant species of conservation concern would occur in this habitat: *Maerua sebrabergensis, Erythrococca kaokoensis* and *Ocimum sebrabergensis*, since the rocky ridges contain black and grey anorthosite rocks similar to the locations in the Zebra Mountains where these three species were first found.

The rocky ridges present both abundance and richness of plant species that are much higher than those of the surrounding woodland, contributing to the ecological value of this habitat. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals (Swanepoel, 2015), further increases the sensitivity of the rocky ridges.

Rare earth minerals are in this habitat; it is where mining will be done and where most of the irreversible impacts (drilling, blasting, open cast mining) will take place.

6.6.3.2 River & Drainage Lines

The Ondoto River and its tributaries are proximal to the mining claims, but it is an important habitat in terms of both the greater study area and the region because of two reasons. Firstly, the drainages within the mining claims empty into the river and from here it is only about seven kilometres from where it flows into the Kunene River. Secondly, it is an important source area of high diversity in an arid landscape and a resource centre during drought years. Any activity in the catchment will potentially affect the ecology of the Ondoto and Kunene Rivers.

The main tributary of the river and its banks contain sparsely distributed large trees, few shrubs and ground cover in the form of annual plants such as grasses and forbs are expected to appear in summer and after rain. The substrate is sandy, with scattered rocks and boulders and a shallow stream.

Plant species in the riverbed and on its banks include *Faidherbia albida*, *Acacia erioloba, Ficus cordata, Ficus petersii, Combretum imberbe, Ziziphus mucronata, Aloe littoralis, Acacia reficiens, Hyphaene petersiana, Boscia albitrunca, Combretum apiculatum, Gymnosporia senegalensis*.

This habitat has been modified by historic and current human activities such as grazing and harvesting. Cattle and goats were observed in the river, as well as daily human household activities (water collection, laundry and playing children). There is a new well and pump to provide water to the accessory works area located in the main tributary of the Ondoto river.

Riverine habitats present a high ecological value for most taxa and are generally considered very sensitive.

After rain, surface water runs via ephemeral drainages from the ridges and outcrops to two large washes and eventually into the Ondoto River. The washes are expected to have surface water after rainfall events and likely contain groundwater that sustains assemblages of perennial vegetation that are more diverse (both floristically and structurally) than the vegetation in the surrounding landscape. The substrate in this habitat consists of sand, gravel and rocks, providing habitat for burrowing reptiles and for small mammals and reptiles that rely on rocks for shelter.

Vegetation is dominated by *Colophospermum mopane* and also present are *Acacia nilotica*, *Acacia reficiens*, *Terminalia prunioides, Commiphora multijuga* and *Combretum apiculatum*.

Blocking of surface and/or groundwater flow will result in loss of perennial species and a reduction in the resources, such as food, shelter and soil stabilisation for burrows that they represent to other trophic groups. Washes and drainages play the same important role in arid zones as rivers and are considered very sensitive.

Development that is planned in this habitat includes linear structures such as roads, pipeline and power line. There is no main or subsidiary tributary of the Ondoto river within the mining claims.

6.6.3.3 Mopane Scrubland

Open Mopane woodland covers most of the mining claims. The topography of this habitat is gently undulating, bisected by ridges topped with rocky outcrops and drainages. In the east and southeast of the study area, the topographic profile is flatter with fewer and lower rocky ridges than in the west and northwest, where there are more and steeper rocky ridges. The substrate consists of loose stones and gravel on compact sand.

The vegetation structure varies slightly from west to east, broadly corresponding to changes in topography with larger Mopane trees and some Commiphora species in the western parts of the study area. In the east and southeast *Colophospermum mopane* form a scrubby open woodland of homogenous height and structure, interspersed with *Catophractes alexandri*.

Mopane trees are interspersed with *Terminalia prunioides, Boscia microphylla, Commiphora multijuga* and other *Commiphora* species, as well as *Ceraria pedunculata*. The understorey is sparse, and grass was the only ground cover observable at the end of winter, but more annual plant species are expected to appear after rain.

The low density and diversity of plant species, combined with the relative homogeneity of this habitat, result in a relatively low ecological value for vertebrates.

This habitat has been modified by human activities such as harvesting and livestock grazing. Both these activities are current and ongoing, and the village Oroutumba is in a degraded area in Mopane woodland abutting the Ondoto River. Roads and quarries will be developed within the mining claims which will be impact this habitat.

It is considered the least sensitive habitat, but care should be taken to maintain the natural flow patterns of surface water in all drainage lines.

6.6.3.4 Species description

The taxa that were investigated are listed in the **Appendix E**. Species were included in the lists if they:

- are expected to occur or have been previously recorded in the study area, and
- are compatible with the habitats in the study area

Species that are range-restricted endemics, have Threatened status, or which are legally protected in Namibia, are potentially of concern.

6.6.3.4.1 Mammals

An estimated 85 species of mammals have distribution ranges that overlap with the study area and 64 of these are expected to be found in the habitat types in the study area. This is a relatively high species richness but the habitat characteristics on the site are limiting for mammal density. In addition, disturbance caused by farming and harvesting has contributed to low densities of large mammals and no signs of large mammals were observed during the site visit.

The Damara Rock Squirrel and Pygmy Rock Mouse are Namibian endemics that are highly likely to occur in the study area. Of the 64 species for which habitat suitability is high or medium, five are listed in the IUCN's Vulnerable or Near-threatened categories and nine are Vulnerable, Rare or Near-threatened in Namibia (pangolin, aardwolf, brown hyena, cape grey mongoose, Damara woolly bat, elephant, African wild cat, bat-eared fox and Cape fox). Bat-eared fox, Cape fox, aardwolf and brown hyena are particularly vulnerable to death by vehicle collision, exacerbated by increased traffic on the D3701. D3700 could be alternative route and travelling by day will mitigate this risk.

6.6.3.4.2 Birds

The Southern African Bird Atlas Project 2 (SABAP2, 2020) records 254 species in the region, and the habitats of the study area are highly suitable for 187. This is a high species richness for such an arid environment, representing 37% of the 687 species recorded for Namibia (Simmons, et al., 2015).

Eight of the expected species are threatened in Namibia, including the Martial Eagle and Tawny Eagle that are also globally threatened. The other six species are Angola Cave-chat (near threatened), Verreaux's Eagle (near threatened), Yellow-bellied Eremomela (endangered), Rüppel's Parrot (near threatened), Wood Sandpiper (vulnerable) and Cinderella Waxbill (endangered). Carp's Tit, Hartlaub's Spurfowl, White-tailed Shrike, Rüppel's Parrot, Damara Hornbill, Monteiro's Hornbill and Bare-cheeked Babbler are near-endemic to Namibia, defined as more than 90% of the world population occurring in the country.

Raptors, bustards and all migrating species are vulnerable in varying degrees to impacts caused by power lines, e.g. collision, electrocution, disturbance and habitat destruction. The location of the power line to service the accessory works area was not finalised at the time of writing, preventing a thorough assessment of this impact. This is addressed in the recommendations in chapter 4 of the fauna report.

6.6.3.4.3 Reptiles

The study area is located in a high diversity zone for reptiles, ranked second-highest in Namibia by Mendelssohn et al, 2002 and the distribution ranges of 66 reptile species overlap with the project site, with habitat suitability considered high or medium for 56 of these species.

Only one of the 56 species, Hellmich's Wolf Snake, is on the IUCN list where it is categorised as Data Deficient. Nationally it is considered Rare. In addition, seven other species are considered Vulnerable, Rare or Endangered in Namibia. It is important to note that 19 species are endemic (100% of breeding population in Namibia) or near-endemic (>75% of breeding population in Namibia), representing 34% of the potentially occurring reptile species in the area and making the project site an area of high concern for reptiles.

The national and international assessment of this taxon is almost 15 years old and it is likely that the situation, specifically regarding threatened species, has changed significantly.

6.6.3.4.4 Amphibians

Distribution ranges (Du Preez & Carruthers, 2009) indicate that 20 frog species could potentially occur here and 17 of these species have a medium or high probability of being found on the project site. This is a much higher species richness than the ranking Mendelssohn et al (2002) gives for the region due to data that became available after 2002. The Kunene River and its riparian vegetation contribute to the unexpectedly high potential diversity of amphibians in this arid area.

The Damara Pygmy Toad is endemic and the Marbled Rubber Frog near-endemic to Namibia. A third species of conservation concern is the Giant Bullfrog: near threatened in Namibia and numbers decreasing globally.

The Ondoto River had water in the middle of winter at the point where it intersects ML40, leading to the assumption that standing or slow-moving water is present year-round, providing habitats that may be suitable for the expected species. This increases the likelihood of the study area supporting more frog species than would be expected in such a low rainfall area.

It is essential for frog diversity to keep washes and drainages unobstructed and to maintain the natural runoff patterns of water from the hills to the Ondoto River.

6.6.3.4.5 Fish

Dr Ben van Zyl is currently engaged in a private research project focused on freshwater fish inhabiting the springs within the tributaries of the Kunene River. This work is being conducted with the approval of the former Ministry of Fisheries and Marine Resources, in collaboration with Ministry staff. Over the past few years, the springs of the Ondoto River and its tributaries have been sampled multiple times, revealing the presence of two rare fish species: Kneria maydelii and one yet-to-be-identified species. His research is ongoing, with a recent field survey scheduled for December 2025, was aimed at collecting genetic data to finally confirm that the unidentified species is indeed undescribed. These findings will help determine its taxonomic classification—potentially as a new genus or even a new family. Additionally, early genetic data indicates that the Kneria maydelii specimens sampled may represent a distinct species within the Kneriidae family. Further sampling and analysis are essential to verify these findings.

Preliminary results suggest that this specie may be endemic to the spring environment, raising concerns about the impact of nearby mining activities, particularly freshwater abstraction, on the integrity of the springs and the survival of both species. Dr. van Zyl strongly proposed to conduct an EIA to establish the impact of water abstraction on the livelihoods of the springs in the Ondoto River. An Environmental Impact Assessment (EIA) is needed to evaluate how water abstraction may affect the springs and the biodiversity supported by these spring ecosystems. This recommendation needs to be included in the EMP as means to finalise the best way forward for sourcing water and reducing the impact on the fish species.

6.6.3.5 Impact assessment and summary

The fauna specialist identified the following 7 key potential impacts:

- Potential destruction of organisms and habitats
- Potential disturbance of animals and interference with their behaviour
- Light pollution
- Alteration of topography
- Groundwater drawn down
- Contamination to soils and water
- Impacts linked to accommodation of staff

Three of these were rated as having medium unmitigated significance, all three declining to low significance with the implementation of mitigation and management measures. Impact one, the direct destruction of organisms and habitat, has a high unmitigated significance, but the application of a restoration plan and strict implementation of management measures mitigate it to a low significance. The significance of impacts on birds and mammals is limited to some extent by the low densities at which these taxa occur in the area.

The alteration of topography by quarries and waste heaps, may not be mitigated to any meaningful level. Nevertheless, the significance of the impact drops to low, provided an effective restoration plan is budgeted for and implemented appropriately and efficiently.

It is important to keep the project footprint to the absolute smallest size possible, and to keep it inside well-defined and clearly demarcated boundaries by fencing the operational area and putting up visible and effective signs. The purpose of a fence and signs is to inform personnel and contractors of the exact boundaries of the operations area and to effectively control access to areas that will remain undeveloped. Fences and signage go hand in hand with appropriate environmental training, raising awareness of staff, and contractors and their staff.

The riverine habitat has a high ecological value for all taxa, plays a keystone role in nutrient transport, and serves as important source areas for recolonisation. In the project footprint, the two rivers and large eastern ravine are considered very sensitive and apart from the proposed linear infrastructure, no development should take place there. In addition, the natural flow patterns in washes, ravines and other drainage lines should be maintained.

A restoration plan, if implemented efficiently, could potentially contribute positively to conservation. The protection of source areas from where seeds and organisms will come to re-colonise the disturbed areas is a crucial aspect of restoration. For a restoration programme to be effective, it is essential that it be implemented from the earliest possible time after the construction phase of the project, and throughout the operational phase where possible, so as to ensure that source areas are identified and protected from the beginning. Restoration should, where possible, not be left until the end of mining.

6.7 SOCIO-CULTURAL ENVIRONMENT

6.7.1 Introduction

Ashby (2019) quotes the Kunene Regional Council’s Development Profile of 2015 in stating that it supports mining of mineral resources as it will contribute to economic growth of the region. More specifically, it suggests that investors within the mining sector are encouraged to engage in Public Private Partnerships (PPPs) with local communities, thereby addressing the inequitable distribution of mineral resources in the region.

6.7.2 Demography

According to the Namibian Statistics Agency reporting of 2023 and 2024, the regional population is 120,762. The Epupa Constituency has a population of over 26,000 inhabitants while the town of Opuwo’s population is 12,335. The devastating drought years since 2013 have caused many farmers to lose their livelihoods and have increased migration to Opuwo to be in easier reach of drought-relief food from the government (Ashby 2019). This has put considerable strain on the Opuwo Town Council to provide basic services such as water, ablution and refuse removal in the informal settlements which have expanded rapidly.

This has little bearing on the mine operations itself but provides an indication of the current pressures experienced by the authorities to meet the needs of the people in the region.

6.7.3 Regional Economics

According to the National Planning Commission 2023 reporting (NPC, 2023), Kunene is one of the regions that has the highest proportion of the poor and deprived in basic need indicators such as cooking and lighting energy (63.0%), transportation assets (61.3%), sanitation (59.3%) and housing (52.6%). Kunene Region has an average household size of 3.8.

6.7.4 Education

The Kunene Region has the highest levels of education deprivation of all the regions. According to the National Statistics Agency 2023 Census Report (NSA, 2023), Kunene Region has the lowest early childhood development attendance rate at 11.0%. The region has the lowest literacy rate amongst other regions 63.9% and the lowest school enrolment rate (54.3%).

6.7.5 Land Use

Agriculture is the most important employment sector in the region but as the region is very arid, farming was the main source of income for only 31% of households in 2011 (Ashby 2019). In theory communal grazing of livestock benefits from rangeland management practises which protect and enhance the grazing resource. This fits very well with Namibia's Community Based Resource Management programme of conservancies which has enabled communities to manage the natural resources in their areas and use them for community benefits and improvement of individual livelihoods. The high number of conservancies and community forests in northern Kunene is largely a reflection of the remoteness of many areas and the divisions within communities, often along ethnic lines. The mine site falls within the border of a conservancy, namely Kunene River Conservancy.

renders a map of the conservancy relative to the project area. In principle the community gain benefits from the conservation of the biodiversity through eco-tourism and potential hunting tourists during permitted periods of the year. It is not expected that the mine will have a direct impact on these conservancy endeavours.

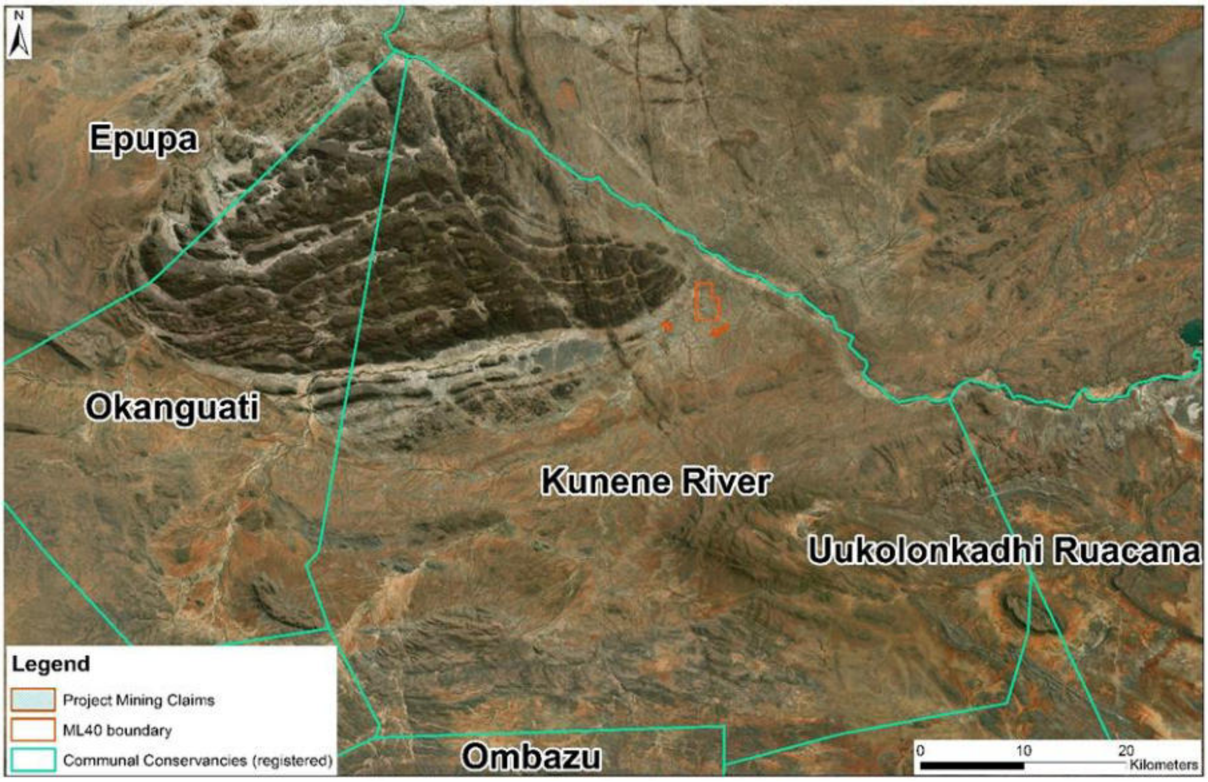

Figure 22. Map showing the extent of the Kunene River Conservancy

According to the National Planning Commission, the Epupa Constituency is famous for its Ovahimba pastoralists, and 83% of households in the constituency are involved in livestock farming and many settlements have grown up around natural springs and 65% of the constituency's household's practised crop farming as documented during the 2011 census (Ashby 2019). According to national statisitics reporting of 2014 (Ashby 2019) the reliance on agriculture as the main source of income to 78% of households in the constituency highlights their vulnerability to drought. The Kunene Regional Development Profile Report states that the percentage of households receiving an income from pensions is 8% and from wages and salaries is 6%, the rest it is assumed mainly from agriculture (Ashby 2019).

6.7.6 Residence Survey

A baseline residence survey of the surrounding area was carried out in the first two weeks of August 2020. During the survey, many dwellings up to 5km away from the Ondoto Mine site were surveyed. **Figure 23** renders a map of the locations of the residences in the areas of the two major communities. A member of each dwelling near the mine completed a questionnaire to document information about the families staying there. Intermittent residency of the some of the residences was confirmed by the survey. Near the planned new processing plant 3 clusters (homestead) of residences were surveyed. 26 people live in these residences permanently. Should the processing plant, waste rock dumps or tailings facility create conditions that are potentially dangerous for residents who will live permanently less than a kilometre from these sources, then the proponent will need to consider some form of compensation in whatever form is required. It is not known at the drafting of this report if any of these residents have relocated to another area.

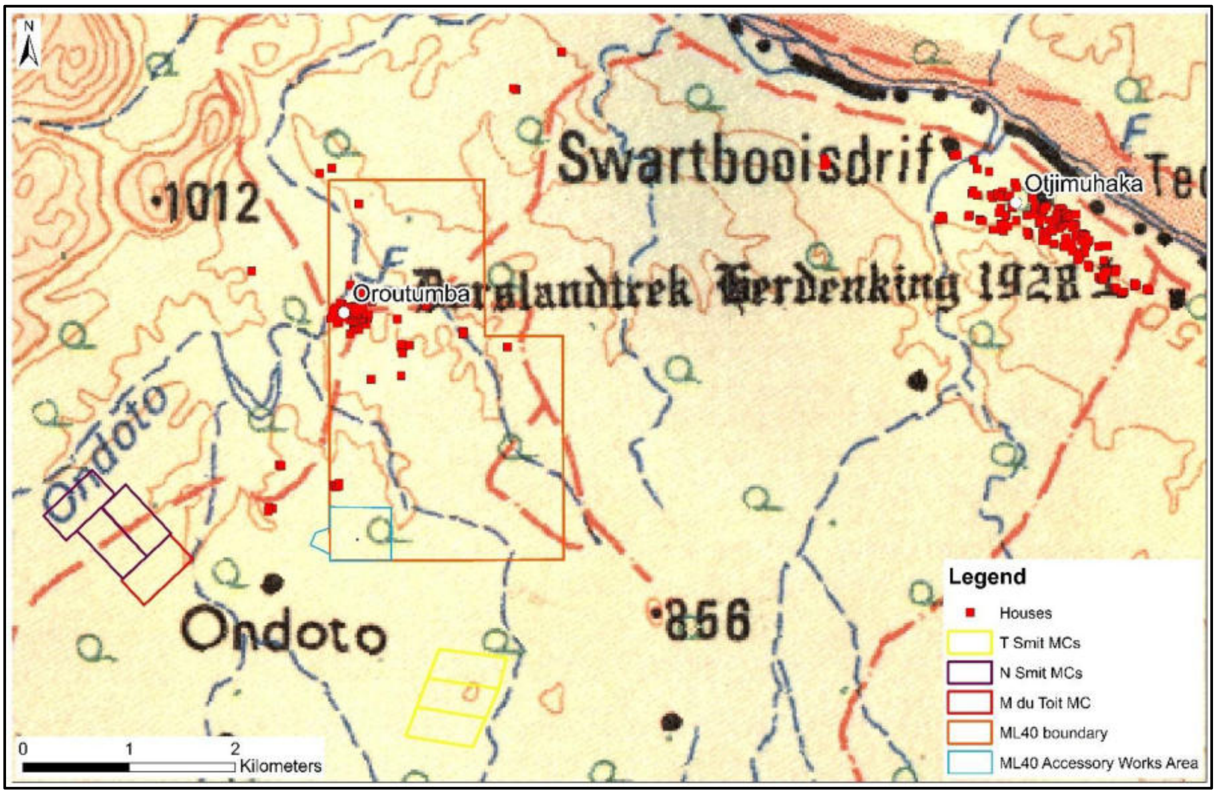

Figure 23. Locations of the potential homesteads surveyed relative to the mineral licences.

6.7.7 Infrastructure and Services

The Nina Smit MCs project makes use of infrastructure and services associated with the Ondoto Mine project. The following infrastructure existed prior to starting this environmental scoping with assessment:

- Mining offices and storage buildings
- Diesel generators and internal powerlines for quarry equipment, offices and other mine buildings
- Pump and water pipeline (using water from the hand dug well in the Ondoto river)
- Access roads

Exploration tracks traverse the ML40 area which have existed for decades. Larger tracks access the the quarries from the south and north. Nampower and Northern Electricity Distributor currently have electrical infrastructure supplying the Otjimuhaka (previously Swartboois Drift) settlement some 7km from the main quarry site. No electricity lines convey electricity to the mining area. It is assumed that the sewerage facilities for the residences at Oroutumba consist of French drains.

6.7.8 Cultural Heritage

TARO Archaeological & Heritage Consultants (TARO AHC) was appointed by Phillip Hooks on behalf of Nina Smit to conduct an Archaeological and Heritage Impact Assessment (AHIA) (**Appendix G**) for the proposed mining project located at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region. The combined total footprint areas of the proposed mining and quarrying project is about 51,6428 (ha), topographically, the claim is situated on mountains and hills. Archaeologically, the findings from the surface survey conducted are of LOW significance

Identification, mapping, classification and assessment of the significance of the archaeological, historical and cultural heritage resources in the area were conducted accordingly to the National

Heritage Guidelines of 2021. The site surveys were undertaken on the 1st of September 2025 & 7th of October 2025. Key findings of this AHIA assessment include the following.

6.7.8.1 Weathered outcrops and Stone Artefacts

The mining claims area is dominated by prominent weathered outcrops, which were the most distinctive natural features observed during the survey. Apart from these, only surface scatters of stone artefacts were identified. No evidence of significant archaeological features or sites was found within the mining claim areas. Based on these findings, the archaeological potential of the area is assessed as low.

6.7.8.2 Grave site

No visible graves or burial sites were identified within the boundaries of the mining claim. The nearest known grave is located approximately 2 km away, in Oroutumba. Based on field observations, no significant impact on archaeological resources is anticipated because of the proposed mining activities.

6.7.8.3 Rock shelters

A very small rock shelter was recorded among weathered rock boulders within the project area. The shelter appears to be used by animals, and no cultural material or features of archaeological significance were observed.

6.7.8.4 Conclusion and Recommendations

The Archaeological and Heritage Impact Assessment (AHIA) has identified no significant impacts expected at the proposed mining site. The surface-level assessment has shown that the proposed mining claim areas are not archaeologically sensitive. Consequently, the overall impact significance of the proposed project has been assessed as LOW. **Figure 24** renders a map of the landscape archaeological map in relation to the mining claims showing that the current significant records are for sites considerable distances from the project location.

It is strongly recommended that project activities focus exclusively on the identified target sites. Strict compliance with the mitigation measures outlined in Section 16.2 of the AHIA is essential. Additionally, the adoption and implementation of Chance Find Procedures as part of the Environmental Management Plan (EMP) is required, pending approval from the relevant authority.

While the recommended mitigations pertain specifically to archaeological and heritage considerations, it is important to note that project authorization is still subject to approval. The proposed exploration activities may only proceed upon review and approval by the National Heritage Council of Namibia. The proponent awaits the receipt of the consent permits.

6.7.9 Potential Impacts

This small-scale mining project will bring some opportunities for employment during construction and operations. It will have a small positive socio-economic impact both in the immediate project area and at the nearest larger towns of Opuwo and Ruacana.

Potential impacts which will be assessed in include:

- Economic impact at national, regional and local levels
- Jobs and skills development
- Minor negative livelihood changes in the immediate project area: e.g. loss of grazing
- Benefits to livelihoods in the immediate project area: e.g. improved infrastructure such as road and potential for local SMEs such as a shop or security company.
- Positive and negative impacts on Otjimuhaka, Opuwo and Ruacana: infrastructure and services developments e.g. housing and service industries.

- Negative impacts of in-migration e.g. unsuccessful jobseekers, sexually transmitted diseases

No fatal flaws have been identified for the envisaged project development and operations.

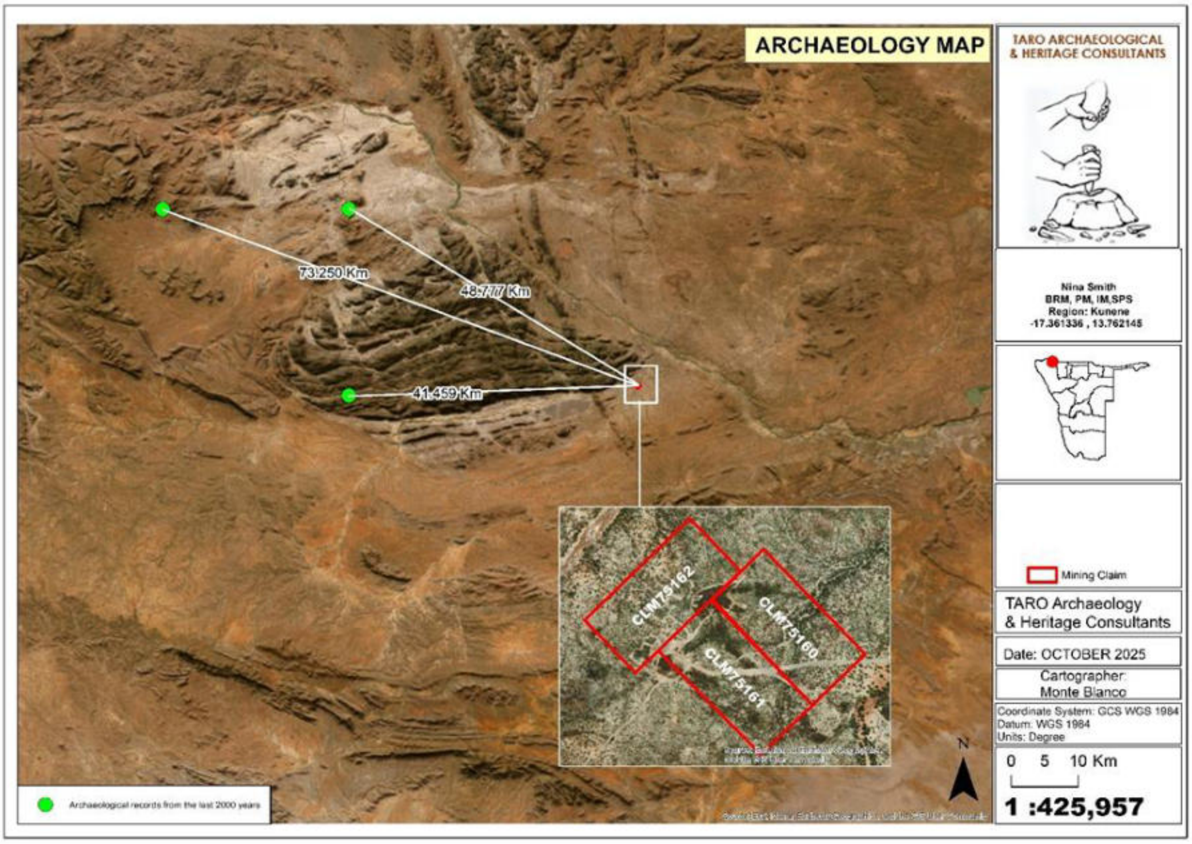

Figure 24. Landscape archaeological map in relation to the mining claims.

7 IMPACT ASSESSMENT

The impact assessment of all the listed aspects was carried out using an adaptation of the Hacking Method. Both, the criteria used to assess the impacts and the Method of determining the significance of the impacts, is outlined in **Table 8** below: (This procedure complies with the method provided in the Namibian EIA Policy document and EIA regulations)

- *Part A* provides the approach for determining impact consequence (combining severity, spatial scale and duration) and impact significance (the overall rating of the impact).
- Impact consequence and significance are determined from *Part B and C*.
- The interpretation of the impact significance is given in Part D. Both mitigated and unmitigated scenarios are considered for each impact.

The purpose of this section is to assess and identify the most relevant environmental impacts by describing certain quantifiable aspects of these and to provide possible mitigation measures to minimise the magnitude of the impacts that would be expected from the gravel mining activities.

The following potential impacts on the environment for the mining activities were identified and assessed:

- Air quality
- Noise
- Health & safety
- Visual
- Land use
- Waste
- Ecological &Biodiversity
- Water Resource
- Socio-economic
- Traffic
- Product Handling & Port Storage
- Heritage
- Post Mining Legacy

These identified potential impacts were evaluated. A **mitigation hierarchy** was considered as follows. Firstly, one tries to **prevent** the impact. If this is not possible then **mitigation measures** are applied to each aspect. Should the mitigation measures not reduce the impact, then an **alternative site** or **method** is considered. If an alternative is not possible then **rehabilitation** is considered as the last on-site resort. Usually, a combination of mitigation measures, alternative methods and rehabilitation is carried out to lower the impacts. If none of the above can be achieved to reduce the impact in the long term, then an **offset** can be considered where an improvement to the environment at another project site is actioned or a considerable contribution is given to a biodiversity conservation cause elsewhere is made.

Table 9 to
Table 24 describe and assess the potential impacts of the project.

Table 8. Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE					
			SEVERITY = L		
DURATION	Long term	**H**	Medium	Medium	Medium
	Medium term	**M**	**Low**	**Low**	Medium
	Short term	**L**	**Low**	**Low**	Medium
			SEVERITY = M		
DURATION	Long term	**H**	Medium	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	**Low**	Medium	Medium
			SEVERITY = H		
DURATION	Long term	**H**	High	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	Medium	Medium	High
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	Medium	Medium	High
	Possible/ frequent	**M**	Medium	Medium	High
	Unlikely/ seldom	**L**	**Low**	**Low**	Medium
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

Table 9. Air Quality Impacts

Impact Event	**Disturbances to soil, rock and ore resulting in excessive dust in the atmosphere**
Description	Dusty atmospheric conditions do prevail in the arid northwest of Namibia particularly during the winter months when dry easterly winds blow and during early summer months and when south westerly winds blow. Mining activities will generate dust as follows: ➢ Movement of vehicles along road network hauling ore to the plant on site are likely to lift dust into the air ➢ Trucks transporting product mainly along the dirt roads travelling south through to Henties Bay after which the road surface is bitumen tar. ➢ Drilling and blasting will most definitely cause dusty conditions. ➢ Crusher, sifting screens and conveyor functioning will result in dusty conditions. ➢ The TSF and waste rock dump (WRD). ➢ Product handling & storage areas The surrounding habitats receive the dust that emanates from the mining activities and may potentially be affected. Fauna and flora alike could be impacted as ecosystem functioning is possibly affected. Negative effects of dust on personnel working at the quarry site are likely to occur if dust suppression techniques are not employed and personal protection equipment is not used to safeguard the health of personnel. It is not known how many people lived at Oroutumba before the existing sodalite quarry work started decades ago but currently there are at least 50 residences within 500m of the main quarry site. At the new processing site there are only 26 people living in 10 residences at 250m to 750m away from the boundary of the new accessory works area. Nearby residents may be affected by these dust sources. Within the mining claims and adjacent to the mining claims there are no residences.
Nature	Negative
Phases	Phases during which sources of dust apply are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term risk.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Crushers & screens	Crushers & screens	Dismantling crushers & screens	Background levels will most likely resume soon after closure.
Conveyor construction	Conveyor functioning	Dismantling conveyors	
Road network establishment	Road use and maintenance	Demolishing buildings	
Building construction	Drilling & blasting	Rehabilitation of slopes	
	Ore haulage from quarry pit	Constructing fences	
	Product handling & storage		

Severity	Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated.
Duration	Reversible over time. Life of the project. Medium term
Spatial Scale	Fairly widespread – Beyond the site boundary. Localised at best. Though this does depend on mobility of particles and prevailing weather conditions. The only place outside the local area is along the gravel road between the mine and Opuwo or Ruacana and then again between Kamanjab and Henties Bay via Khorixas.
Probability	Definite and continuous

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**M**	**M**	**H**	**M**

Significance of Consequence	Unless it is mitigated the generation of dust should have an influence on the decision to carry out the activity or not. Natural weather conditions can create very dusty atmospheric conditions regardless of the existence of the mine. However, mining and processing activities on site will contribute significantly to local atmospheric dust levels and could potentially affect the ecosystem functioning. Company personnel could be affected depending on the content of the atmospheric dust and how great the exposure is.					
Prevention	Dust creation cannot be prevented completely. Water is normally used to suppress dust on the roads. However, this scarce resource cannot be applied continuously and indiscriminately without impacting the groundwater resource.					
Mitigation Action	Dust suppression techniques will be necessary when dust becomes an issue during the dry winter months. The following can be done to reduce exposure of the environment and personnel to continuous and excessive dust plumes: ➢ Avoid dust generating activities that create excessive dust during windy conditions. ➢ The new and refurbished roads should have a hard surface whose integrity will not be easily compromised. ➢ Personnel are required to wear personal protection equipment if excessive dust should be created. ➢ All vehicles transporting product material off site should be covered with a tarpaulin when travelling on the national road network of tar and gravel roads. ➢ Windbreaks and covers can be used to reduce lifting of dust from crushers, screens and conveyors. ➢ Water spays at the various plant components will effectively keep dust from blowing into the atmosphere (only if water sources are sustainably used) ➢ The road network within the mine site can be sprayed with water and other dust suppressants during dry dusty conditions (only if water sources are sustainably used) ➢ Waste rock dumps (WRDs) and the TSF should be landscaped and compacted where necessary to supress erosion of soil and dust emission on windy days. ➢ Natural revegetation of the WRDs and the TSF side walls would mitigate the amount of dust that these sources could generate. ➢ To mitigate gaseous pollutants released from the combustion of hydrocarbons, use of high-quality fuels will ensure quantities released per unit weight of product are at levels within environmental limits. ➢ In order to know whether the dusty conditions created by mining activities will exceed the limits or standards set for the southern African context it is necessary to set up a monitoring network of dust fallout buckets. The results of the monitoring will confirm the ambient air quality during baseline pre-construction conditions, and this will provide a gauge by which the site-specific conditions compare to the industry standards used.					

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Significance of Consequence	The dust suppression techniques if applied diligently and consistently will result in a low significance impact for both the biophysical and social environment.
Confidence Level	High, provided management implements the mitigation action and the company provides the necessary financial support to implement the measures required

Table 10. Noise Impacts

Impact Event	**Disturbance of sense of place and the effect on tranquil ambient noise levels**
Description	Potential noise sources during the mining and processing activities could originate from vehicles, earthmoving equipment like excavators and graders, generators, drilling and blasting, crushers, screens, and conveyors. The irritation issue of these noise sources will depend on the closeness of the mining activities to various receptors. The nearest residences are between 250m (from processing plant) and 2km from any mining activity. It is not known how many people lived at Oroutumba before the existing sodalite quarry work started decades ago but currently there are at least 50 residences within 500m of the main quarry site. At the planned new processing site there are 26 people living in 10 residences from 250m to 750m away from the boundary of the new accessory works area.

	For rural districts the day-time ambient noise level requirement outlined in SANS 10103 (2008) between 6am and 10pm is 45dBA (**A-weighted decibel**). This is in line with the guidelines published by the World Health Organisation (WHO). The noise levels should not exceed the ambient noise levels for rural settings. The residences mentioned above would fall into the rural category.
Nature	Negative
Phases	Phases during which sources of noise will apply are highlighted below; Significance assessment was carried out for the operational phase which presents the long-term risk.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Crushers & screens	Rock Cutters, crushers & screens	Dismantling crushers & screens	Background or baseline levels will most likely become prevalent again immediately after closure.
Conveyor construction	Conveyor functioning	Dismantling conveyors	
Vehicles on road network	Vehicles on road network	Demolishing buildings	
Building construction	Drilling & blasting	Rehabilitation of slopes	
	Ore haulage from quarry pit	Constructing fences	

Severity	Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
Duration	Reversible over time. Life of the project. Medium term
Spatial Scale	Fairly widespread – Beyond the site boundary. Localised at best. Though this does depend on prevailing wind conditions proximity of residents.
Probability	Definite and continuous

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**M**	**M**	**H**	**M**
Significance of Consequence		Mitigations to reduce noise levels measured at receptors will be necessary.				
Prevention		Noise creation cannot be prevented and will occur and should be mitigated. Additional traffic planned for the road for hauling product cannot be avoided.				
Mitigation Action		There are industrial standards to which the noise sources (i.e. machinery) must comply. Regular maintenance of machinery should ensure the acceptable noise levels for operators working with the machines. It is not clear whether this will produce the accepted rural standard at the homesteads. It is recommended that any complaints regarding noise be recorded and included in the environmental reports. Should complaints persist then a survey by a suitably qualified and independent occupational hygienist will be required. Shields which deflect the noise away from receptors may reduce the decibels to within the rural standards. The placement of stockpiles and buildings will also play a role to ensure sources of noise are not directly in line with the farm homestead. Transportation routes should be planned for trucks such that they pass noise sensitive receivers at appropriate times. A restriction of the hours of movement, e.g. not allowing the transport of material during the noise sensitive hours of the night can mitigate noise impacts. The frequency (distance between trucks can also be planned to fall within a limited period.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**M**	**L**	**L**	**L**
Significance of Consequence		The normal maintenance may reduce the probability of noise marginally. Should the shielding of noise sources keep the noise measured at the receptors to within the limits then the significance could drop to low.				

Confidence Level	The EAP is confident that the mitigations will result in the impact significance. A good monitoring system will enable the mine to document the facts and respond accordingly by enhancing any noise reduction strategies.

Table 11. Health & Safety Impacts – Noise and Vibration Effects on Personnel

Impact Event	**The effects of excessive noise and vibration on the health and safety of personnel.**
Description	Noise: ➢ Long term exposure to high levels of noise can cause permanent hearing loss. Neither surgery nor a hearing aid can help correct this type of hearing loss. ➢ Short term exposure to loud noise can also cause a temporary change in hearing (your ears may feel stuffed-up) or ringing in your ears (tinnitus). These short-term problems may go away within a few minutes or hours after leaving the noisy area. Vibration: Different vibration types are defined as: ➢ Hand-Arm Vibration is defined as mechanical vibration that, when transmitted to the human hand-arm system, entails risks to the health and safety of workers, vascular, bone or joint, neurological or muscular disorders. Whole-Body Vibration is defined as the mechanical vibration that, when transmitted to the whole body, entails risks to the health and safety of workers lower back morbidity and trauma to the spine.
Nature	Negative
Phases	Phases during which sources of noise and vibration could apply are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term risk.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Crushers & screens	Rock Cutters, Crushers & screens	Dismantling crushers & screens	Background or baseline levels will most likely become prevalent again immediately after closure. Personnel no longer on site.
Conveyor construction	Conveyor functioning	Dismantling conveyors	
Vehicles on road network	Vehicles on road network	Demolishing buildings	
Building construction	Drilling & blasting	Rehabilitation of slopes	
	Ore haulage from quarry pit	Constructing fences	

Severity	Substantial deterioration (permanent damage to spine from vibration or hearing). Recommended level will often be violated. Personnel potentially unable to work any longer.
Duration	Permanent. Beyond closure. Long term.
Spatial Scale	Localised - Within the site boundary.
Probability	Definite and continuous

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**L**	**M**	**M**	**M**

Significance of Consequence	Mitigations to reduce noise levels and exposure to vibrations for personnel are imperative.
Prevention	Engineering controls that reduce sound exposure levels are available and technologically feasible for most noise sources. Engineering controls involve modifying or replacing equipment or making related physical changes at the noise source or along the transmission path to reduce the noise level at the worker's ear. The same goes for vibration. The following should be considered: ➢ Choose low-noise tools and machinery. ➢ Maintain and lubricate machinery and equipment (e.g. oil bearings). ➢ Enclose or isolate the noise source.

Mitigation Action		**Noise:** The **Occupational Safety and Health Administration** (OSHA) guidelines set legal limits on noise exposure in the workplace. These limits are based on a worker's time weighted average over an 8 hour day. With noise, OSHA's **permissible exposure limit** (PEL) is 90dBA for all workers for an 8 hour day. The OSHA standard uses a 5dBA exchange rate. This means that when the noise level is increased by 5dBA, the amount of time a person can be exposed to a certain noise level to receive the same dose is cut in half. The WHO guideline on maximum noise levels to prevent hearing impairment set noise level limits at an average of 70 da over a 24-hour period with maximum noise levels not exceeding 110 dBA during the period. These limits would apply if the day-time shift is prolonged beyond the 8-hour day. **Mitigation actions include:** ➢ Limiting the amount of time, a person spends at a noise source. ➢ Providing quiet areas where workers can gain relief from noise sources. ➢ Where possible, restricting worker presence to a suitable distance away from noisy equipment. (Controlling noise exposure through distance is often an effective, yet simple and inexpensive administrative control.) ➢ In open space, the further the distance from the source of noise, the worker may experience a decrease in noise levels to be about 6dBA less for every doubling of the distance (nonlinear relationship). ➢ Hearing protection devices, specifically earmuffs for long periods of exposure near sources and at all times use plugs for all places outside offices within the claims not near noise sources for extended periods ➢ PPE is considered an acceptable mitigation, but a less desirable option to control exposures to noise. ➢ Entrance and exit medicals to test hearing should be carried out as a minimum requirement. **Vibration:** Meet industry vibration regulations; set daily exposure limit values and action values for both hand-arm and whole-body vibration for eight-hour shifts. Personnel can work shorter shifts where excessive vibration conditions exist.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Significance of Consequence		If all the mitigations listed are used then the significance of the impact will be maintained at low.				
Confidence Level		The EAP is confident that the mitigations will result in low significance. A good monitoring system will enable the mine to document the facts and respond accordingly by enhancing any noise and vibration reduction strategies. Continuous training of personnel is imperative				

Table 12. Health & Safety Impacts – General Hazards and Potential Risk of Injury

Impact Event	**Injury risks due to normal working conditions**
Description	The potential impacts on human health and safety resulting from activities in any phase could include occupational accidents and injuries, vehicle accidents, exposure to weather extremes, trips and fall on uneven terrain, adverse health effects from dust generation and emissions, and contact with hazardous materials. The potential for these impacts to occur would be low because of the limited range of activities and number of workers required during operations. Gecko follows a set of industry-specific safety and health policies in the workplace. Typical operational procedures that pose risks to operational personnel are: ➢ Operating heavy machinery such as, front-end loaders, excavators, and stationary processing equipment. ➢ Operating haulage trucks

<table>
<tr><td>Nature</td><td colspan="3">Negative</td></tr>
<tr><td>Phases</td><td colspan="3">Phases and specific activities or equipment during which personnel are exposed to health and safety risks will apply are highlighted below; Significance assessment was carried out on the operational phase which presents a long-term exposure risk.</td></tr>
<tr><td>Construction Phase</td><td>Operational Phase</td><td>Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td>Processing plant construction site</td><td>Processing plant operations</td><td>Dismantling processing plant</td><td rowspan="5">Personnel no longer on site. Public safety ensured through restricted access though quarry pit will remain.</td></tr>
<tr><td>Rock falls from steep and high cliff faces of quarry pit</td><td>Rock falls from steep and high cliff faces of quarry pit</td><td>Rehabilitation of slopes</td></tr>
<tr><td>Large mobile plant equipment</td><td>Large mobile plant equipment and product haulage</td><td>Demolishing buildings</td></tr>
<tr><td rowspan="2">Working at heights</td><td>Drilling & blasting</td><td rowspan="2">Constructing fences</td></tr>
<tr><td>Fire and explosion hazards</td></tr>
<tr><td>Severity</td><td colspan="3">Substantial deterioration. Should industry standards be exceeded personnel may potentially be unable to work any longer.</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent. Beyond closure. Long term.</td></tr>
<tr><td>Spatial Scale</td><td colspan="3">Localised - Within the site boundary.</td></tr>
<tr><td>Probability</td><td colspan="3">Definite and continuous</td></tr>
</table>

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**H**	**H**	**L**	**H**	**H**	**H**

<table>
<tr><td>Significance of Consequence</td><td>Mitigations to reduce exposure to health and safety risks for personnel are imperative.</td></tr>
<tr><td>Prevention</td><td>The removal of hazards or risks will possibly prevent accidents from occurring. However, it is not possible to remove all risks.</td></tr>
<tr><td>Mitigation Action</td><td>It is not possible to prevent all incidents from occurring completely. An accident is an unplanned incident though it could have been foreseen if the necessary precautions had been taken. Not all hazards can be removed but the risk it presents can be lowered. An integrated health and safety management system acts as a monitoring tool and mitigating tool to reduce the risks. Typical mitigating measures within the health and safety management systems are:-
➢ Draw up operational procedure manuals
➢ Provide health and safety awareness training
➢ Establish practical standard housekeeping rules
➢ Colour code certain areas, equipment and substances to thereby classifying the risks.
➢ Provide signage for personal protective equipment (e.g. protective clothing like safety boots and hard hats)
➢ Institute safe working procedures and require permits to work
➢ Devise and implement emergency response plans
➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained
➢ Provide easy access to Material Safety Data Sheets (MSDS)
➢ Provide first aid treatment and training
➢ Devise emergency medical procedures for all eventualities
➢ Undertake daily safety reminders and/or drills</td></tr>
</table>

	➢ Establish regulations for handling fuel The MSDS gives health related medical responses for personnel assisting staff who are exposed to the fuels. Procedures for dealing with injuries or accidents must be in place and all contact details for emergency personnel must be available. This list is not comprehensive and could be supplemented substantially by the Health & Safety Manager					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence	If all the mitigations listed are implemented, then the significance will be maintained at low.					
Confidence Level	The EAP is quite confident that the mitigations will result in low significance. Continuous training of personnel is imperative.					

Table 13. Health Impact due to exposure to radioactive particulates + normal working conditions.

Impact Event	**Disease or normal health risks due to normal working conditions and in particular to exposure to radioactive particulates**		
Description	The potential impacts on human health and safety resulting from activities in any phase could include occupational accidents and injuries, vehicle accidents, exposure to weather extremes, trips and fall on uneven terrain, adverse health effects from dust generation and emissions, and contact with hazardous materials. The potential for these impacts to occur would be low because of the limited range of activities and number of workers required during operations. The proponent and his operational mining company follows a set of industry-specific safety and health policies in the workplace. Typical operational procedures that pose risks to operational personnel are: ➢ Operating heavy machinery such as, front-end loaders, excavators, conveyors, crushers and sieves ➢ Operating haulage trucks ➢ Prolonged proximity to and exposure to radioactive particulates The REE ore and REE product concentrate is potentially hazardous because of the radioactive nature of the thorium at higher concentrations. Through the processing of the REE ore the thorium element is expected to concentrate and as a result increase the risk of radioactive emissions. Working at the mine's quarries and processing plant could increase the exposure to this risk. The risks associated with exposure to radioactive materials is increased by three factors. Namely, the proximity to the source, the period of time spent on any one occasion near to the source and thirdly the frequency with which you are exposed over a long period of time. These factors affect the potential with which the radiation can cause sickness and or death. Radioactive exposure can be through inhalation, oral, dermal contact or close to the source without contact. The effects can be carcinogenic in nature and can eventually lead to death.		
Nature	Negative		
Phases	Phases and specific activities or equipment during which personnel are exposed to health and safety risks will apply are highlighted below; Significance assessment was carried out on the operational phase which represents the period personnel are exposed to the hazard.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Processing plant construction site	Processing plant operations, product storage and handling, and transport of concentrate	Dismantling processing plant and handling 'radioactive contaminated materials'	Personnel no longer on site. Public safety ensured through restricted access though quarry pit will remain.
Rock falls from steep and high cliff faces of quarry pit	Rock falls from steep and high cliff faces of quarry pit	Rehabilitation of slopes	

Large mobile plant equipment		Large mobile plant equipment and product haulage		Demolishing buildings		
Working at heights		Drilling & blasting		Constructing fences		
		Fire and explosion hazards				
Severity		Substantial deterioration. Recommended level will often be violated. Personnel potentially unable to work because the maximum exposures for the month or year have been met. Some personnel may need to work at less risky sites at the mine for the remainder of the period (a month or a year)				
Duration		Permanent. Beyond closure. Long term.				
Spatial Scale		Localised - Within the site boundary. During transportation (lowest risk to public) and temporary storage at Walvis Bay Harbour				
Probability		Definite and continuous				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**H**	**H**	**L**	**H**	**H**	**H**
Significance of Consequence		Mitigations to reduce exposure to health and safety risks for personnel are imperative.				
Prevention		The removal of all hazards or risks will not be possible.				
Mitigation Action		It is not possible to prevent all incidents from occurring completely. An accident is an unplanned incident though it could have been foreseen if the necessary precautions had been taken. Not all hazards can be removed but the risk it presents can be lowered. An integrated health and safety management system acts as a monitoring tool and mitigating tool to reduce the risks. Typical mitigating measures within the health and safety management systems are:- ➢ Draw up operational procedure manuals based on the Radiation Management Plan ➢ Provide health and safety awareness and radiation training ➢ Establish practical standard housekeeping rules ➢ Colour code certain areas, equipment and substances to thereby classifying the risks. ➢ Provide signage for personal protective equipment (e.g. protective clothing like safety boots and hard hats) ➢ Institute safe working procedures and require permits to work ➢ Devise and implement emergency response plans ➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained ➢ Provide easy access to Material Safety Data Sheets (MSDS) ➢ Provide first aid treatment and training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling fuel The Fuel storage and handling MSDS gives health related medical responses for personnel assisting staff who are exposed to the fuels. Procedures for dealing with injuries or accidents must be in place and all contact details for emergency personnel must be available. This list is not comprehensive and could be supplemented substantially by the Health & Safety Manager With respect to radiation exposure the following mitigations and monitoring are either mandatory by law or recommended:				

	➢ Annual medical assessment – apart from the normal checks, employees' white blood cell count could be tested to assess the potential effect of radiation exposure. Refer to **Appendix I** for the full radiation management plan for the greater Ondoto Mine Project. ➢ Personnel working in the higher risk area should wear a passive sensor that can be analysed at the laboratory to provide monthly records of radiation exposure; ➢ PPE – dust masks are worn by all employees exposed to dust. The type used is FFP3; ➢ Ideally the higher risk ground surfaces should be watered or chemically bound to supress dust billowing; ➢ Ideally at transfer points on conveyor belts and at crusher bins mist sprays should be installed; ➢ The networks of dust fall-out sampling points should be in place and monitoring results direct further decisions for planning mitigation depending on the spatial extent of any high levels of atmospheric radioactive particulates. ➢ Devices for monitoring the radiation emitted from all potential sources must be purchased and a regular monitoring programme be carried out and records kept for reporting purposes. A procedure manual must be drafted that is based on the industry standards and laws and regulations that are implemented by the MME and Ministry of Labour.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence	If all the mitigations listed are implemented, then the significance will be maintained at low.					
Confidence Level	The EAP is quite confident that the mitigations will result in low significance. It is imperative that continuous training and medical monitoring of personnel at the regionally (SADC region) recommended frequency. The regionally (SADC region) accepted levels of radiation exposure must be monitored and maintained. The only point where mitigation may be insufficient is with dust suppression due to the measures in place for limiting water use					

Table 14. Visual Impacts

Impact Event	**Changes to the aesthetic appeal of the area due to presence of people, vehicles and machinery. Visible changes to habitats due to human activities.**		
Description	The experience of enjoying the landscape free of human activities is considered highly desirable. Intrusions into the current scenery may be unwelcomed. The mine site is remote and no main tourism routes pass through this valley. Residents within a 5 km radius are few. Impact on visual resources would be considered unfavourable if the landscape was significantly degraded or modified. The presence of mine personnel, vehicles and other equipment may reduce the aesthetic appeal of the area. The position of WRDs and a processing plant are key issues with regards this impact. The initial location and extent of the accessory works area have been amended so that the new site is not visible to the people staying in Oroutumba. The new quarries will not be visible to residents or tourists.		
Nature	Negative		
Phases	Phases during which traffic, infrastructure and dust plumes which potentially play a role in visual nuisances are highlighted below; Significance assessment was carried out on the operational phase which presents the long-term risk.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Dust plumes caused by mobile equipment operating at the mine	Ore haulage and blasting creating dust plumes	Demolishing buildings causing dust plumes	Barren mountain slopes and quarry scarring

<table>
<tr><td colspan="2">Additional traffic on the district road and mine access roads</td><td colspan="2">Bare slopes, waste rock dumps, topsoil stockpiles</td><td colspan="2">Denuded mountain slopes and open quarry not revegetated</td><td></td></tr>
<tr><td colspan="2">Severity</td><td colspan="5">Moderate / measurable deterioration. Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.

It is a remote area off the main tourism route. Only 26 residents stay within 500m of the new processing area.</td></tr>
<tr><td colspan="2">Duration</td><td colspan="5">Reversible over time. Life of the project. Medium term

(Except for the quarries which will remain visible for the long term.</td></tr>
<tr><td colspan="2">Spatial Scale</td><td colspan="5">Fairly widespread – Beyond the site boundary. Localised at best. Though this does depend on mobility of particles and prevailing weather conditions. The setting is rural and the only receptors currently are a few residents (26 at the time of the social survey).</td></tr>
<tr><td colspan="2">Probability</td><td colspan="5">Definite (in terms of dust plume creation from blasting) and continuous (in terms of the barren mountain slopes until revegetated during post closure)</td></tr>
<tr><th>Mitigation</th><th>Severity</th><th>Duration</th><th>Spatial Scale</th><th>Consequence</th><th>Probability of Occurrence</th><th>Significance</th></tr>
<tr><td>Unmitigated</td><td>M</td><td>M</td><td>M</td><td>M</td><td>M</td><td>M</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="5">The two aspects for visual impact are under consideration:

1. Unless it is mitigated, the generation of dust should have a moderate influence on the decision to carry out the activity or not. However, natural weather conditions can also create very dusty atmospheric conditions. The mining and processing activities on site will contribute to local atmospheric dust levels and will potentially affect the visual experience of the people staying nearby. Those communities staying along the transport route are affected by other road users too, so this aspect is a cumulative impact. This latter aspect is considered a minor aspect and temporary in nature. The nearby residents (26) could be relocated to a more favourable location.
2. The aesthetic changes to the landscape can be mitigated for all phases of the mining project. Alternatives have been considered which will reduce the visual impact of the mine on any who pass through the area.</td></tr>
<tr><td colspan="2">Prevention</td><td colspan="5">1. Dust creation cannot be prevented completely. Water is normally used to suppress dust on the roads. Blasting will be intermittent, and the plume will dissipate rapidly.
2. The bare slopes cannot be avoided in the medium term, and the quarries will be a permanent feature of the mining area.

For operations to continue, personnel, vehicles and machinery will operate within the area for the duration of the project. It is not possible to operate and have no visual presence.</td></tr>
<tr><td colspan="2">Mitigation Action</td><td colspan="5">Best practice Methodologies for operations will be employed. These may include the following:
➢ Existing roads and tracks are used to access the mine site.
➢ Dust suppression using water will most likely not be practical due to the non-sustainability of ground water usage.
➢ Product transport should either be containerised or at least installed with covers.
➢ Careful planning to avoid disturbing significant floral and faunal habitats when accessing the mining site
➢ Training personnel regarding the visible signs of faunal and floral biodiversity and the avoidance of habitat disturbance.
➢ Minimise the footprint of personnel, vehicles and machinery
➢ Rehabilitate habitats through the removal of obvious signs of human presence.
➢ Regular removal of waste (daily/weekly/monthly) and disposal of waste in the appropriate manner.
➢ Removal of machinery from the mining sites if periods of inactivity are prolonged.</td></tr>
</table>

		➢ If lighting is required at night, lights need to be strictly controlled, and fixtures should be low-glare lighting with downward facing directed beams (except for quarry walls) ➢ Constructed structures should have natural colours so that they can blend in with the surrounding environment. Often, the sites that are disturbed and rehabilitated at least from an aesthetic perspective will in time be recolonized by both plants and animals. The aim is to minimise the footprint to achieve the least impact due to anthropogenic influence. With respect to this the following has been considered: ➢ A reduction in the size or number of the WRDs. ➢ Location and design of WRDs to make them inobtrusive. ➢ Landscaping of quarry sites to reduce visual impact.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Significance of Consequence		The dust suppression techniques if applied diligently and consistently will result in a medium significance visual impact for the residents in the immediate vicinity because dust from heavy traffic on the main dirt road will not be mitigated except by reducing travelling speeds. Additionally, the visual alteration of the mountain slopes cannot be mitigated until mine closure when at that time the quarry will remain a visual reminder of the once active mine.				
Confidence Level		High, provided management implements the mitigation action and the company provides the necessary financial support to implement the changes required. A commitment to rehabilitating the denuded slopes and waste rock dump with the stockpiled topsoil will need to be done where practical and necessary.				

Table 15. Land Use Impact

Impact Event	**Herders could potentially experience restrictions to their grazing areas**
Description	The mining area is situated on land belonging to the government of Namibia granted to rural people in the form of communal land. The mining areas fall within the Kunene River Conservancy. The mining area falls within the Epupa Constituency but falls under the stewardship of Okangwati's rural constituency councilor. The community has grazing rights to the area. The leaders of the community request that the area is kept safe for shepherd boys and their livestock. The pits may need to be fenced off to maintain public safety. The community has many needs, and request was made that the proponent consider social responsibility projects to uplift the community. Initially, the well in the Ondoto river will be shared as it has been since the sodalite mining began decades ago. The Kunene River Conservancy has consented to allow the proponent to mine within their mining claims. The Ombudsman has recommended that the Regional Council work together with the regional and local community development committees to disseminate information about projects in their areas.
Nature	Negative
Phases	Phases during which potential conflicts may apply are highlighted below; Significance assessment was carried out for the operational phase. However, the long-term presence of quarries pose a safety risk. This is also included in the assessment.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Access to site	Access to site	Access to site	Access to site
Access to groundwater resources / boreholes	Access to groundwater resources / boreholes	Access to groundwater resources / boreholes	Public safety
Public safety	Public safety	Public safety	Alternative uses for pit
Asset security	Asset security	Asset security	
Waste management	Waste management	Waste management	

Severity	Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources. Herders' area for grazing will be reduced marginally. Public safety must prevail and access must be temporarily prohibited if and when blasting is carried out.
Duration	Reversible over time. Life of the project. Medium term (except quarry which is long term)
Spatial Scale	Localised. Within accessory works area and 500m boundaries around the quarries.
Probability	Definite / continuous

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**L**	**M**	**H**	**M**

Significance of Consequence	Mitigations to ensure no conflicts with landowners occur will be necessary.
Prevention	It is not possible to prevent all conflicts. Any unforeseen issues will be mitigated through the various mechanisms stipulated in the EMP
Mitigation Action	The EMA requires that permission be provided by the competent authorities for the listed activity. The EIA has facilitated a transparent process by which concerns were raised. The PPP has ensured that all stakeholders have been informed. The proponent is subservient to the conditions laid down by the guidelines / conditions and the law that upholds it. The implementation of the mining programme will be in accordance with the approved Environmental Management Plan (EMP). The draft EMP can be found in **Appendix K.**

	The following mechanisms should be included in the environmental management system: ➢ Correspondence and agreements - document filing system ➢ Review memoranda of understanding annually ➢ Keep complaints register up to date ➢ Update stakeholder register regularly ➢ Engage land users regularly to maintain open channels of communication ➢ Fence off mining areas to increase public safety where necessary The Life of Mine is predicted to be 25 years. This represents a medium period compared to other larger mining operations at other mine sites. Depending on the management approach and decisions to allow access to grazing during no blasting periods and land markers or fences restricting access for safety and security the footprint and impact on normal usage of the area could be kept to a minimum thereby keeping the spatial extent localised.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**M**	**L**	**L**	**L**	**L**
Significance of Consequence	Maintaining good relationships with landowners is imperative so that the severity and duration of disputes can be kept low. This will ensure the probability is low.					
Confidence Level	I am confident that a well-designed and well implemented stakeholder engagement programme will cover the land use conflicts that could potentially arise.					

Table 16. Waste Impact

Impact Event	**Waste Production**		
Description	Waste is generated during the construction, operational and decommissioning phases of the mine's life. Waste can be classified into mineralised and non-mineralised waste. Non-mineralised waste can be classified as non-hazardous and hazardous waste. Medical waste is an additional category. 1. **Non-Hazardous non-Mineralised includes:** Metal cut offs, rubber, wood, product packaging, organic materials, glass, plastics, food scraps, cardboard/paper, used PPE, etc. 2. **Hazardous non-mineralised:** Printer cartridges, sewerage, batteries, hydrocarbons (oils, grease), fluorescent, etc. 3. **Medical waste:** Syringes, material with blood stains, bandages, etc. 4. **Mineral waste includes:** waste rock, tailings from mineral processing, rejects from beneficiation or concentration of other minerals, refinery or processing discards and sludges, smelter and other furnace slags, ashes, etc. (not all apply to this site but provided as examples)		
Nature	Negative		
Phases	Phases during which waste will be produced are highlighted below; Significance assessment was carried out for the operational phase which presents a long-term risk. Receptors potentially affected by waste are listed.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Company personnel health	Company personnel health	Company personnel health	General public health
General public health	General public health	General public health	Groundwater
Groundwater	Groundwater	Groundwater	Biodiversity
Biodiversity	Biodiversity	Biodiversity	Soil
Soil	Soil	Soil	Atmosphere - dust and other volatiles emitted from waste are covered under air quality impacts but there is some overlap with waste management risks
Atmosphere	Atmosphere	Atmosphere	

<table>
<tr><td>Severity</td><td colspan="6">Moderate / measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.</td></tr>
<tr><td>Duration</td><td colspan="6">Reversible over time. Life of the project. Medium term</td></tr>
<tr><td>Spatial Scale</td><td colspan="6">Fairly widespread – Beyond the site boundary. Localised at best.</td></tr>
<tr><td>Probability</td><td colspan="6">Definite / continuous</td></tr>
<tr><td>Mitigation</td><td>Severity</td><td>Duration</td><td>Spatial Scale</td><td>Consequence</td><td>Probability of Occurrence</td><td>Significance</td></tr>
<tr><td>Unmitigated</td><td>M</td><td>M</td><td>M</td><td>M</td><td>H</td><td>M</td></tr>
<tr><td>Significance of Consequence</td><td colspan="6">The mining activities will generate waste. Preventative and mitigating mechanisms are imperative.</td></tr>
<tr><td>Prevention</td><td colspan="6">Some waste products of categories 1-3 that can potentially impact the listed receptors can be managed to prevent impacts. Actions and company commitments that can prevent the impacts include the following:
➢ A waste management procedure should cover recycling, re-use, storage, handling, transportation, and disposal
➢ Collection and disposal of waste must be effective enough to not impact any of the receptors
➢ If waste must be stored and separated on site then the activities must take place on sealed surfaces, within bunds and fenced areas, and made ready for transport off-site by packaging the waste in sealed containers</td></tr>
<tr><td>Mitigation Action</td><td colspan="6">Where waste product impacts on the receptors cannot be prevented the preventative measures above should still be employed to mitigate or reduce the impacts. Mitigations for the various receptors include the following:
➢ Personal protection equipment (PPE) can protect personnel from exposure to disease or toxic chemicals
➢ Awareness training for company personnel and the public will inform them of those wastes that may cause harm, pollute the soil, groundwater or air (if particulate)
➢ Some wastes are dangerous to fauna and flora; Animals should not be able to access the waste management area; waste must be contained so that it cannot enter the naturally vegetated areas beyond the accessory works area.
➢ Containerisation of highly volatile wastes should be actioned to reduce emissions but not so effectively that creates explosive risks if pressures build up. The latter may occur if the containers are stored outside in the heat of the sun.

A waste management programme as outlined in the EMP should keep records in the form of an inventory of waste products collected, sorted, stored, recycled, reused or disposed. Certificates for disposal of hazardous waste should be filed.

The mineral waste (category 4 above) will most likely only be waste rock and process tailings that cannot be processed for product. This waste rock will be dumped or stockpiled on site or alongside the new processing plant and could be used in the rehabilitation during decommissioning phase. The health risks associated with the process tailings is discussed under the health impacts above.

Sewerage created at the camp or management offices either needs to be deposited directly into approved and permitted French drains or removed offsite. If the latter is to be done, then sealed sewerage tanks are required. The regulations under the Water Resource Management Act need to be consulted with regards to the erection of French drains near water courses. They cannot to be constructed within 100m of the banks of a water course.

Storage of hazardous liquid waste must by law follow industry standards. These standards will be communicated in fuller details by the fuel supplier. Ideally, self-bunded containers should be brought to site and placed upon sealed surfaces with waste collection sumps. Fuel collection should be carried out upon the same sealed surface with slopes for runoff into the sumps. At the mining claim itself a similar bunded surface must be constructed where fuel from a bowser can be transferred to the mobile plant.

An oil water separator and wash bay are constructed in conjunction with fuel dispensing to reduce costs and the concretised footprint at the Ondoto Mine project (i.e. within the accessory works area within ML40). The oil water separator is a requirement to ensure</td></tr>
</table>

<table>
<tr><td colspan="2"></td><td colspan="5">hydrocarbons do not enter the environment indiscriminately. The mobile plant workshop of the Ondoto Mine also needs to be constructed on a sealed surface and have liquid waste sumps so that spills can be collected and removed from site on a regular basis. A sealed waste oil contain should be constructed at the vehicle workshop. Regular removal of oil to recyclers is advised. All hazardous liquid waste should be stored on sealed surfaces. Refuelling of the mining claim mobile equipment will not take place within the mining claims. If they must be refuelled within the mining claims then drip trays must be used.</td></tr>
<tr><td colspan="2">Rehabilitation</td><td colspan="5">If the mitigation hierarchy is followed, rehabilitation may or may not be required. Should an accident occur during the process of collection, storage or disposal of waste and no mitigation be actioned then one of the receptors may be impacted. Consequently, the following examples of rehabilitation may be required:
➢ A person who is exposed to disease (bacteria from organic waste) or toxic waste (mineral or non-mineral), which results in harm, will need medical attention
➢ Soil which is contaminated by used hydrocarbons needs to be relocated to a remediation cell where the material after treatment, i.e. the addition of fertiliser, air and water will within a year be suitable for re-use.
➢ In the event of groundwater contamination by chemicals or hydrocarbons, the sinking of a borehole or the excavation of a pit in the vicinity of the contaminate source will allow the pumping of the groundwater into a holding dam. Through the continued pumping a cone of depression will draw the contaminated water towards the pump. The collected contaminated water can be discarded at a registered hazardous waste site or if separable the contaminant can be removed from the water before disposal. The reclaimed water could be pumped back into the pit or borehole.</td></tr>
<tr><td>Mitigation</td><td>Severity</td><td>Duration</td><td>Spatial Scale</td><td>Consequence</td><td>Probability of Occurrence</td><td>Significance</td></tr>
<tr><td>Mitigated</td><td>L</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="5">If the mitigation hierarchy is followed through to rehabilitation, then the resultant consequence could be insignificant.</td></tr>
<tr><td colspan="2">Confidence Level</td><td colspan="5">A well designed and well implemented waste management programme will provide the necessary confidence that the risks to receptors will be of low significance.</td></tr>
</table>

Table 17. Ecological & Biodiversity Impacts

<table>
<tr><td>Impact Event</td><td>Mining activities may affect biodiversity of fauna and flora directly or through habitat alteration.</td></tr>
<tr><td>Description</td><td>Through mining in general there is potential for impacting the diversity of species within the various habitats by reducing population numbers of certain species. Pressures on the population numbers can potentially lead to a reduction of a population within an area causing the species to no longer exist within that area. Should a species be endemic to that same area then the risk of extinction is high. Habitats can be severely altered potentially changing the type of habitat or leading to the removal of micro habitats.

Specialist fauna and flora studies were commissioned for the larger Ondoto Mining project accessory works area and the activities therein. Site visits, species lists for the area and reference to other studies carried out nearby and elsewhere reveal that the habitats, fauna and flora present in the area are not endemic to claim and accessory works area specifically but are either common or potentially rare throughout the Kunene Region. Refer to the chapter on the fauna and flora above and to the specialist study reports in the Appendix D & E.

Three habitat types were identified in the vegetation and vertebrate studies for this project and were integrated in one combined floral and faunal classification: Mopane scrub, rocky outcrops and river/drainages.

The habitats were rated as to their sensitivity, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures.

A sensitivity rating was assigned based on properties of the habitat itself, including:
➢ nationally or regionally scarce habitats
➢ size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region.
➢ exceptionally high diversity and/or abundance of species
➢ high level of endemism</td></tr>
</table>

	➢ support to species of conservation concern ➢ key ecological processes ➢ contribution to ecological functions (nutrient and energy flows) ➢ provision of critical resources ➢ restorability after disturbance Human habitation, grazing and mining activities have resulted in modified areas, some of them get severely degraded such as the rocky ridge south of ML40 and the quarry/mine sites on the two other existing Nina Smit MCs. The village Oroutumba, located downstream in Mopane scrub habitat adjacent to the Ondoto River, also constitutes an anthropologically modified area. The assessment considered all project activities and how these could potentially impact the various habitats. **Fauna:** A key habitat in the larger woodland mosaic is the rocky outcrops habitat. The physical diversity of the hills and rocky ridges leads to a higher and more specialised biodiversity than the surrounding Mopane woodland, and it supports many species that would otherwise not be present. Seeing as mineral-bearing ore is located almost exclusively in the rocky ridges, restoration of this habitat after mining operations will not be possible to any meaningful extent. Riverine habitat has a high ecological value for all taxa; it plays a keystone role in nutrient transport and serves as important source areas for recolonisation after operations cease. In this project footprint, the Ondoto River is considered very sensitive and apart from the proposed linear infrastructure, no development should take place there. In addition, the natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network and any other linear development. Destruction of organisms and habitats and alteration of topography both have high unmitigated significance but potentially decrease to medium significance through the application of management measures if those are carried out effectively. The cumulative nature of mining activities in the Kunene Region and in the Kaokoveld Centre of Endemism, the irreversible damage to the rocky outcrops (as the most sensitive, ecologically valuable habitat) and the persistence of the excavations after the lifespan of the mine, are three factors that decrease the likelihood of these impacts being mitigated to low significance. However, the strict implementation of mitigation measures and restoration plan can improve the situation significantly for other habitats and aspects such as the accessory works, linear infrastructure and any staff accommodation areas. **A. Potential destruction of habitats and organisms** could take place during construction and operations, construction and use of roads by vehicles and machinery, clearing of land, building of infrastructure, within laydown areas, around water tanks, at accommodation, around human activities, during blasting and earthmoving, around vehicle movements, and the operation of machinery. A ccumulative impact of mining in the Kunene Region, especially on ecologically valuable rocky ridges and outcrops as follows: ➢ Death of animals that are struck by earthmoving equipment, vehicles and machinery. Protected and at-risk species such as bat-eared fox, Cape fox, aardwolf and brown hyena are vulnerable to roadkill. ➢ Death of animals due to poaching. ➢ Raptors, bustards and migrating birds are vulnerable to power line impacts such as collision and electrocution. ➢ Bird nests, nesting habitats and feeding habitats are destroyed, affecting the viability of bird populations. ➢ Mammal and reptile burrows, burrow habitats and feeding habitats are destroyed, affecting the viability of the populations of these taxa. ➢ Potential loss of biodiversity in the form of fish species found within the springs of the Ondoto river. ➢ Parts of territories and home ranges are destroyed. ➢ Loss of plants and decline in habitat quality. ➢ Dust causes a decline in air quality and creates conditions for health decline in plants and animals. ➢ Noise disturbs animals and causes increase in stress.

B. **Potential disturbance of animals and interference with their behaviour** during operations, when infrastructure and roads form obstacles to the directional movement of animals, when an increase in human and vehicle presence and movement results from mining activities, as a result of loud noises caused by blasting and the operation of heavy machinery. The potential impact could be as follows:

- Larger mammals and birds are the taxa most likely to be affected.
- The loss of migration corridors causes stress and an increased risk of death to various taxa.
- Birds and eggs could be poached.
- Animals, particularly birds, are disturbed while going about their daily activities, such as feeding, roosting and breeding.
- Dust creates conditions for health decline in plants and animals, and an increase in stress for animals.
- Noise disturbs the normal behaviour of animals, specifically mammals.

C. **Potential light pollution as result of light sources** that are visible outdoors in the accessory works area and in the mining area. This can impact in the following ways:

- Invertebrates that are attracted to the light provide an unnatural food source for taxa such as bats, geckos, nightjars and frogs. These insectivores are attracted to the food and then face conditions where they are more likely to die from causes such as collisions and predation.
- Invertebrates could die every night from exhaustion or predation, potentially disrupting their population numbers and causing disturbances in ecological processes.

D. **Alteration of topography** during construction and operational phases can occur because of excavation of the ore bodies leaving a deep, open pit or several smaller quarries on the mountain. The processing plant and waste stockpiles will create large heaps of material on the surface of the landscape. This cumulative (for mining in the Kunene Region) impact acts on the level of ecosystems and could result in the following:

- Irreversible alteration of the ecologically valuable rocky outcrops.
- This impact may affect ecosystem functioning.
- Direct destruction of habitat and organisms (see A above).
- Fragmentation of habitat, leading to the loss of migration corridors for various taxa, in turn resulting in the loss of individual organisms and potentially populations.

E. **Groundwater drawdown** - Abstraction of water from the Ondoto River and Kunene for drilling, mining, ore processing and human consumption:

- River vegetation is dependent on groundwater to some extent. Of particular concern are woody species in the Ondoto River, e.g. *Acacia erioloba, Faidherbia albida and Ficus spp.*
- Deterioration of the river habitat has negative impact on biodiversity outside the boundaries of the project site, specifically the Kunene River.
- Removal of all water from the Ondoto river springs could result in the significant reduction in populations of 2 rare fish species.

F. **Contamination of soil and water** - Chemicals used in the processing of ore, e.g. radioactive thorium, escape containment and contaminate the soil, surface and groundwater

- Chemicals leach into soil, causing contamination of soil and eventually groundwater.
- Effects of chemicals are cumulative and build up in groundwater over time.
- Once in the groundwater, there is the potential for contamination to spread beyond site boundaries. The Kunene River is an internationally important ecological feature that could potentially be directly affected.
- Birds, mammals and reptiles are attracted by an unnatural source of water (open water body) and either drown or ingest contaminated water.

G. **Impacts associated with accommodation of staff** – During construction, operational and closure phases, vehicles can cause death of organisms, staff could be involved in poaching and plant collection, cooking and lighting practices cause fires, water use in an arid zone with few resources, poor sewerage practices and from cooking and cleaning cause oil spillage.

- Direct destruction of organisms and habitat.
- Oil spills and sewerage contaminate soil and water.
- Fires destroy habitats and cause death of animals.

Flora:

The habitats and flora are either common throughout the Kaokoland and if restricted in distribution or to micro habitats, they do occur outside the planned mining areas.

Riverine and drainage habitats present a high ecological value for most taxa and are considered very sensitive. Blocking of surface and/or groundwater flow will result in loss of perennial plant species and a reduction in the resources, such as food, shelter and soil stabilisation for burrows that they represent to other trophic groups.

The rocky outcrops present both abundance and richness of plants that are much higher than those of the surrounding scrubland, contributing to the ecological value of this habitat. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals, further increases the sensitivity of the rocky ridges. The rare earth minerals are located in this habitat; it is where mining will be done and where most of the irreversible impacts (drilling, blasting and open cast mining) will take place.

The largest part of the mining claims consists of open Mopane scrubland. The topography is gently undulating, bisected by drainages and ridges topped with rocky outcrops. In the east and southeast of the study area the profile is flatter than in the west and northwest, where there are more and steeper rocky ridges. This habitat has been modified by human activities such as harvesting and livestock grazing. Both these activities are current and ongoing, and the village Oroutumba is in a degraded area in Mopane scrub abutting the Ondoto River. Pipelines, powerlines, roads, and the accessory work area will all be in this habitat.

Species are potentially of conservation concern when they are endemic or near endemic to Namibia, have a threatened Namibian or IUCN status, or are legally protected in Namibia. Three recently described species, *Maerua sebrabergensis*, *Erythrococca kaokoensis* and *Ocimum sebrabergensis* are known only from a few specimens collected in the Zebra Mountains but they are likely to be found on the ridges and rocky outcrops in ML40 as well. The fact that they were found and described as recently as 2015 and 2019 illustrates both the importance of the Kaokoveld Centre of endemism and how under-collected it is in terms of herbarium specimens. This is largely a result of the remoteness and inaccessibility of much of the region and of the Zebra Mountains specifically.

The following potential aspects were assessed:

A. Mining activities may affect the ecology of the flora directly through **habitat alteration or destruction** within the planned mining claim and accessory works area:
   - Cumulative impact: mining in Kunene Region, especially on ecologically valuable rocky ridges and outcrops.
   - Loss of plants and decline in habitat quality.
   - Dust causes a decline in air quality and creates conditions for health decline in plants and animals.

B. **Alteration of topography –** the sources of the impact during the construction and operational phases are from excavation of the orebodies that leave deep open pits caused by drilling, blasting and open cast mining and the use of equipment such as excavators, compressor driven drill rigs and cutting machines. The processing plant and mineral waste is deposited on the cleared ground.
   - This is a cumulative impact of mining in the Kunene Region.
   - Irreversible alteration of the ecologically valuable rocky ridges.
   - This impact may affect ecosystems.
   - Direct destruction of plants and habitat.
   - Fragmentation of habitat, leading to the disruption or loss of colonisation pathways for seed dispersal, in turn resulting in the loss of individual organisms and potentially populations.

C. **Groundwater drawdown** - Abstraction of water from the Ondoto River for drilling, mining, ore processing and human consumption.
   - River vegetation is dependent on groundwater to some extent. Of particular concern are woody species in the Ondoto River and drainages, e.g. *Acacia erioloba, Faidherbia albida and Ficus spp.*
   - Deterioration of the drainage and river habitat has negative impact on biodiversity outside the boundaries of the project site, specifically the Kunene River.

D. **Contamination of soil and water -** Chemicals used in the processing of ore, e.g. radioactive thorium, escape containment and contaminate the soil, surface and groundwater.
   - Chemicals leach into soil, causing contamination of soil and eventually groundwater.
   - Effects of chemicals are cumulative and build up in groundwater over time.

	➢ Once in the groundwater, there is the potential for contamination to spread beyond site boundaries. The Kunene River is an internationally important ecological feature that could potentially be directly affected.
Nature	Negative
Phases	Phases during which mining activities may impact the ecology and biodiversity through habitat alteration or destruction are highlighted below; The significance assessment was carried out on both the construction and operational phases.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Flora	Flora	Flora	Flora
Fauna	Fauna	Fauna	Fauna
Habitat	Habitat	Habitat	Habitat
Species diversity	Species diversity	Species diversity	Species diversity

Severity	Moderate / measurable deterioration. Noticeable loss of resources.
Duration	Permanent, beyond closure, long term.
Spatial Scale	Localised - Within the site boundary for flora but beyond the site boundary for fauna
Probability	Possible/frequent

Unmitigated	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Fauna - A. Potential destruction of habitats and organisms						
Fauna A.	**M**	**H**	**M**	**H**	**M**	**H**
Fauna – B. Potential disturbance of animals and interference with their behaviour						
Fauna B.	**M**	**M**	**L**	**M**	**H**	**M**
Fauna – C. Potential light pollution as result of light sources						
Fauna C.	**M**	**M**	**L**	**M**	**H**	**M**
Fauna - D. Alteration of topography						
Fauna D.	**M**	**H**	**M**	**H**	**H**	**H**
Fauna - E. Groundwater drawdown						
Fauna E.	**M**	**M**	**M**	**M**	**M**	**M**
Fauna - F. Contamination of soil and water						
Fauna F.	**M**	**H**	**M**	**H**	**M**	**M**
Fauna - G. Impacts associated with the accommodation of staff						
Fauna G.	**M**	**M**	**M**	**M**	**M**	**M**
Flora – A. Destruction of plant and habitats						
Flora A.	**H**	**H**	**L**	**H**	**H**	**H**
Flora – B. Alteration of Topography						
Flora B.	**M**	**H**	**M**	**H**	**H**	**H**
Flora – C. Groundwater Drawdown						
Flora C.	**M**	**M**	**M**	**M**	**M**	**M**
Flora – D. Contamination of soil and water						
Flora D.	**M**	**H**	**M**	**H**	**M**	**M**

Significance of Consequence	The mining activities will alter the habitats that previously existed. Soil and flora will be removed. Some fauna will relocate and compete for resources in adjacent habitats, but many

	will be destroyed and/or affected negatively. Dust and lighting will also impact ecosystem. Mitigating & rehabilitation mechanisms are imperative.
Prevention	Not possible as at least many specimens of the most common flora taxa found in the district will be removed during construction activities and quarry creation.
Mitigation Action	*Suggested by fauna specialist:* **A. Destruction of organisms and their habitats:** ➢ Keep the overall development footprint as small as possible. ➢ The extent and location of the construction site should be fenced and all construction activities should take place within the fence. Adherence should be strictly enforced. ➢ The location of roads, pipelines and power lines must be planned to minimise fragmentation or disturbance of habitats. ➢ Anti-erosion measures must be taken where roads and tracks cross a wash or drainage. ➢ Carefully plan the placement of stockpiling construction material so as to avoid sensitive areas. ➢ Limit construction activities to daytime hours to reduce noise. ➢ Educate construction and permanent staff as to their environmental obligations. All contractors should be held responsible for transgressions and significant penalties should be levied in order to ensure compliance. ➢ Position temporary construction infrastructure (e.g. accommodation) in areas that will definitely be disturbed during operations. ➢ Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks. Maintenance roads/tracks for linear structures should be built as close as possible to the structure and access should be limited to essential maintenance. ➢ Do not put water tanks, power pylons or any other large infrastructure in the river or washes. ➢ No sewerage overflow or French drain may be placed within 100 m of a wash or river. ➢ A vertebrate specialist should identify nests, dens and other breeding locations and demarcate them before construction so that these sites can be avoided as part of the EMP. ➢ Reptiles and amphibians that are exposed during ground clearing should be captured for translocation by a qualified expert. ➢ No collection of plants should be allowed. No fires should be allowed. ➢ A comprehensive restoration plan should be drawn up by an expert BEFORE construction commences, at least at conceptual level, and should make provision for monitoring and adaptive management as the project develops. Some rehabilitation actions should be implemented during operations to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later; road and pipeline locations. **B. Disturbance of animals and interference with their behaviour**: ➢ The extent of the operation should be clearly demarcated on site layout plans and fenced in. The nature of a fence would be informative rather than restrictive – it is to make the boundaries of the area of operations clear to staff, visitors and contractors, and to effectively control access to undeveloped areas. ➢ Areas surrounding the mine and accessory works that are not part of the demarcated development should be considered a no-development zone. ➢ No employees, visitors or machinery should be allowed in such a zone. ➢ No off-road driving should be allowed. ➢ Limit activities to day-time hours so as to reduce noise. ➢ Only controlled and contained fires should be allowed for cooking and heating purposes. Only wood collected during the clearing of areas during the construction phase should be used for firewood. ➢ The significance of this impact is somewhat decreased by the fact that human presence and human-caused disturbance in the region is already interfering with the presence and movement of many taxa, particularly large mammals. ➢ Staff and contractors should be trained in sensitive human-wildlife interaction. **C. Light Pollution**: Not much is known about the effect of light on populations and ecosystems and the precautionary principle is applied here. ➢ Install motion detectors to limit light use to the minimum possible. ➢ Outdoor lights should be directed downwards and not up into the sky.

	➢ Use yellow or amber outdoor lights because invertebrates don't detect yellow light as well as white. ➢ Install insect screens in doors and windows located in buildings that are used at night. **D. Alteration of Topography**: ➢ It may not be possible to rehabilitate the site significantly, but a comprehensive restoration plan would mitigate impacts to some extent. ➢ A comprehensive restoration plan with financial mechanisms for implementation should be drawn up by an expert during the construction phase. It is possible that some mitigation measures and rehabilitation actions should be implemented during operations to be effective; therefore, a restoration plan should be in place at the start of operations. ➢ Implement the restoration programme as soon as possible after the impact has ceased. **E. Groundwater drawdown:** ➢ Monitor groundwater levels. ➢ Monitor plant and vertebrate diversity downriver from the abstraction site at a minimum of once a year. **F. Contamination of Soil and Water**: ➢ Containment measures should be strictly enforced to the highest existing standards. Open water structures should be sealed and provide no opportunity for either leakage or entry by animals. ➢ Constant monitoring of open bodies of water and their associated pipes, lining and covers is essential to ensure that there is no malfunction, tear or opening. ➢ Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater. **G. Impacts linked to accommodation of staff** ➢ All inhabitants and visitors in the staff compound should receive environmental awareness training, including training on indiscriminate defecation. ➢ The staff compound should be fenced in and the only access allowed outside the fence is on the entrance road. ➢ All cleaning and washing should take place inside a designated area (e.g. kitchen, laundry) and fat traps should be installed at the drain outlet from these areas. ➢ No collection of plants or plant material should be allowed. ➢ No open fires or flames should be allowed in the staff compound. ➢ Gas cooking facilities should be provided. ➢ Lights should be solar, or generator powered - no candles or paraffin lamps. ➢ Firefighting equipment should be placed in the compound. Equipment should always be tested regularly and be in working condition. All inhabitants of the compound should be trained in the use of this equipment and know where it is. ➢ Water saving measures should be put in place, e.g. low-pressure shower heads and taps; daily checks of pipes and tanks; immediate repair of leaks. ➢ Sewerage should be of sufficient capacity for the number of people, and should be a sealed breakdown system. ➢ No sewerage overflow structure or French drain may be placed within 100 m of a wash, drainage line or river. *Suggested by flora specialist:* **A. Habitat alteration and destruction** - The spatial extent of the infrastructure should be planned to keep it as small as possible. Then when clearing areas, where possible, do not fell the larger and older trees as they act as seed (genetic stock) sources. By changing the location of the new processing plant and WRD and area of lower diversity will be impacted. However, it is not possible to reduce the impact of the quarries on the rocky habitat that harbours several protected tree species. It is recommended that a the NBRI be supported in doing a comprehensive survey of the area during the MEFT EIA review period. Roads, pipelines and power lines must be planned to minimise fragmentation or disturbance of habitats The following most important mitigations should be implemented: ➢ Do not put water tanks, power pylons or any other large infrastructure in the river or washes. ➢ Position temporary construction infrastructure (e.g. accommodation) in areas that will be disturbed during operations. ➢ Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks.

<table>
<tr><td colspan="2"></td><td colspan="5">➢ Carefully plan the placement of stockpiling construction material to avoid sensitive areas.
Awareness training for management & other personnel must focus on:
➢ Training of all personnel to limit the habitat alteration during the construction and operational phases of the mine
➢ Teach knowledge and understanding of the flora and its ecology
The following basic rules must be adhered too:
➢ No littering
➢ Driving only on existing roads (roads created by the mine inside the mining areas.
➢ Firewood should come from trees that were felled within the cleared areas and no additional clearing for firewood should occur.
A restoration plan should be drawn up by an expert BEFORE operations commences, at least at conceptual level before construction starts, and should make provision for monitoring and adaptive management as the project develops. Some rehabilitation actions should be implemented during operations to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later; road and pipeline locations.
B. Alteration of Topography
➢ It may not be possible to rehabilitate the mining sites significantly, but a comprehensive restoration plan would mitigate impacts to some extent.
➢ A restoration plan should be drawn up by an expert BEFORE operation commences.
➢ Implement the restoration programme as soon as possible after the impact has ceased.
C. Groundwater drawdown
➢ Conduct a specialist hydrogeological study for the project.
➢ Monitor groundwater levels.
➢ Monitor plant and vertebrate diversity downriver from the abstraction site at a minimum once a year.
➢ Ensure sustainable water supply to the project based on the findings of the hydrogeological study.
D. Contamination of soil and water
➢ Conduct specialist work on element mobilisation from the different types of ore and waste rocks.
➢ Containment measures should be strictly enforced to the highest existing standards in the mining industry.
➢ Constant monitoring of open bodies of water and their associated pipes, lining and covers is essential to ensure that there is no malfunction, tear or opening.
➢ Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater.</td></tr>
<tr><td colspan="2">Rehabilitation</td><td colspan="5">Rehabilitation at mine closure should be applied to the accessory works areas as defined in the project description in this flora assessment. The waste rock dump should be constructed in such a way that fits in with the surrounding physical features and so that water infiltration is maximised, and erosion minimised. These latter points will allow for natural regrowth of the vegetation on the waste rock dump. The following aspects should be considered when finalising the mine closure plan:
➢ The infrastructure removal and landscaping of the accessory works area to match as far as possible the baseline conditions.
➢ Funds for rehabilitation should be set aside from the start of the operational phase. A mechanism for securing these funds should be in place during the construction phase.
➢ Reasonable and acceptable ways of rehabilitation should be implemented on an ongoing basis as well as at the time of site closure.
➢ Where the ground has been affected by spillages such hydrocarbons, these soils should be stockpiled and appropriately treated to regulate the contamination levels prior to being used for rehabilitation purposes.</td></tr>
<tr><td>Mitigated</td><td>Severity</td><td>Duration</td><td>Spatial Scale</td><td>Consequence</td><td>Probability of Occurrence</td><td>Significance</td></tr>
<tr><td>Fauna A.</td><td>M</td><td>M</td><td>L</td><td>M</td><td>M</td><td>M</td></tr>
<tr><td>Fauna B.</td><td>L</td><td>L</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td>Fauna C.</td><td>L</td><td>M</td><td>L</td><td>L</td><td>M</td><td>L</td></tr>
<tr><td>Fauna D.</td><td>M</td><td>M</td><td>L</td><td>M</td><td>M</td><td>M</td></tr>
</table>

Fauna E.	**L**	**M**	**M**	**L**	**L**	**L**
Fauna F.	**L**	**L**	**L**	**L**	**L**	**L**
Fauna G.	**L**	**L**	**L**	**L**	**L**	**L**
Flora A.	**M**	**M**	**L**	**M**	**M**	**M**
Flora B.	**M**	**M**	**L**	**M**	**M**	**M**
Flora C.	**L**	**M**	**M**	**L**	**L**	**L**
Flora D.	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence		If the mitigation hierarchy is followed through to rehabilitation, then the resultant consequence could be insignificant overall.				
Confidence Level		A well designed and well implemented rehabilitation programme will provide the necessary confidence that the altered habitats could be rehabilitated at mine closure to a degree that the final footprint of the mine will be acceptable. Provided the waste rock dump is covered with the stockpiled topsoil at mine closure, natural revegetation of this area could occur in the long term.				

Table 18. Water Resource Impact – Over Utilisation

Impact Event	**Mining activities may affect water resources through over utilisation**					
Description	Water demand for mining, processing and domestic use is estimated as 100,000 m³/year for the overall Ondoto project (ML40 and all surrounding mining claims). During the construction phase and first year of operation, water will be sourced from the Ondoto River hand dug well, close to Mining License 40 boundary. The sustainable yield of the Ondoto River is low mainly due to irregular river flow and recharge. The mine area is underlain by anorthosite that generally has poor groundwater potential. See **Appendix F**.					
Nature	Negative					
Phases	Phases during which mining activities may impact the water resources are highlighted below.					
Construction Phase	**Operational Phase**		**Decommissioning Phase**		**Post Closure**	
Alluvial hand dug well of the Ondoto River	Hand dug well of the Ondoto River & the pipeline from the Kunene River		Hand dug well of the Ondoto River & the pipeline from the Kunene River		With ceasing of abstraction, water level in the aquifer will be restored with time.	
Groundwater (via borehole abstraction)	Groundwater (via borehole abstraction)		Groundwater (via borehole abstraction)			
Severity	Recommended water level could often be violated. Interruption of supply to mine and community.					
Duration	Reversible over time.					
Spatial Scale	Fairly widespread, at the mine site and neighbouring Oroutumba village.					
Probability	Definite / continuous					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**H**	**M**	**M**	**M**	**H**	**H**
Significance of Consequence	A high significance is expected if no mitigation measures are implemented.					
Prevention	Alternative water sources to be developed such as direct intake from the Kunene River or aquifer in the bank of the Kunene River are sustainable sources. Monitoring of groundwater level and water quality should serve as early warning of overexploitation of groundwater.					
Mitigation Action	Limit the use of the Ondoto River alluvium to initial stages of the project. Water levels must not drop to levels that results in the destruction of the fish species that survive ephemerally in the springs.					

	If the Ondoto River alluvial aquifer shows signs of overexploitation (drop in groundwater level and increasing salinity), the use of the resource should be stopped, and alternative sources used. The community affected by the disruption of supply should be supplied from the alternative source till supply from the Ondoto River is restored. Develop the alternative source of water (Kunene river or Dwyka aquifer) for long term use.					
Decommissioning & Rehabilitation	Upon decommissioning of the mine the water levels in the hand dug well of the Onodoto river will resume to the levels that existed prior to use by the mine. The pipeline bringing water to the mine from the Kunene River borehole could be handed over to the community to maintain s and future use o that a more sustainable source of water could supply the community.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**M**	**L**	**M**	**L**	**L**
Significance of Consequence	Provided the development of the alternative Kunene River borehole source goes ahead the impact would be low as the abstraction from the Ondoto River alluvial aquifer for mine process water could be stopped. The groundwater level will be restored with natural recharge over time.					
Confidence Level	The restoration of any impact of abstraction of groundwater is dependent on groundwater replenishment by river flow. Arid region river flow and recharge is episodic and not often predictable. Continuous monitoring will provide feedback on the restoration of conditions of the water resource.					

Table 19. Water Resource Impact – Potential Contamination

Impact Event	**Mining activities may affect water resources through contamination**		
Description	The containment of effluent and runoff from the tailings and waste rock dump, particularly in the rainy season is of concern. Water diversion structures and a containment dam for the run-off and seepage need to be constructed with design capacity of the diversion and containment dam adequate for handling large rainfall events as experienced in this area. Potential impacts are as follows: ➢ Leaching of contaminants and erosion of material from the TSF and waste rock dumps into surface water channels by discarded process water and rain events are of high intensity. The leachate from the TSF and mine waste is however likely to be alkaline thus limiting the mobility of metals. ➢ Erosion of material and mobilisation of precipitates and fines is possible. ➢ Wastewater disposal reaching natural drainage		
Nature	Negative		
Phases	Phases during which mining activities may impact the water resources are highlighted below.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Hand dug well of the Ondoto River	Hand dug well of the Ondoto River & the pipeline from the Kunene River	Hand dug well of the Ondoto River & the pipeline from the Kunene River	The waste rock dump and TSF will remain exposed to risk of erosion and mobilisation into surface water channels. Wastewater disposal will cease.
Eroded material and fines reaching the alluvial aquifer during severe rainfall events.	Eroded material and fines reaching the alluvial aquifer during severe rainfall events.	Eroded material and fines reaching the alluvial aquifer during severe rainfall events.	
Severity	The mobilisation of material from the TSF and waste rock dump into natural water channels and eventually to the Ondoto River is possible. The area experiences high intensity rainfall following extended dry periods that can mobilise sediments and material. See **Appendix F**.		
Duration	The duration of the impact will continue through the development, operational and after closure of the mine.		

Spatial Scale	Fairly widespread, in the mine site and neighbouring village.					
Probability	Possible / continuous					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**H**	**M**	**H**	**M**	**H**
Significance of Consequence	A high significance is expected if no mitigation measures are implemented.					
Prevention	Reclaim of process water and reuse to limit the amount of water used. Design, construction and maintenance of TSF and waste rock dumps to prevent erosion.					
Mitigation Action	Measures to mitigate contamination of the soils, surface water and groundwater are as follows: ➢ Evaporation of contained water that is not reused. ➢ Maintain water balance as a check on any significant water leakage from the operation. ➢ Regular inspection of TSF and WRDs. ➢ During the operation of the mine, the sediment material accumulated in the containment dam should be moved to the tailings at regular intervals so that the maximum capacity of the dam is retained and the risk of mobilising the material downstream is reduced. For the management and mitigation of possible impacts from the mining pits the following measures are recommended. ➢ The pits to a maximum depth of 40 m below ground level will be above the groundwater level and no groundwater inflow is expected. ➢ Surface flow to the pits is possible and the pits should be protected against inflow of surface runoff water and discharge from the pits should be avoided. Therefore, the pits should be cordoned off with berms (1 m high) to avoid surface inflow to the pit					
Decommissioning & Rehabilitation	Upon closure of the mine, the surface of the TSF should be graded to avoid ponding and encourage surface runoff thus limiting infiltration. Placement of a low permeability seal on the TSF is the preferred measure to avoid infiltration and salt accumulation in accordance with best practice measures proposed by the British Columbia Acid Mine Drainage Task Force (1989). For establishing such top seal, a large quantity of clay rich material would be required which may not be available locally. Alternatively, other material of good compatibility or low permeability such as compacted calcrete can be used. On closure the pits should be cordoned off with berms to avoid and prevent access to the sites by animals and humans.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**L**	**L**	**M**	**L**	**L**
Significance of Consequence	The possibility of wastewater, leachate and eroded material reaching the natural river channels is significantly reduced by the construction of a containment dam. The overall risk of leaching of metals will be low due to the alkaline nature of the tailings.					
Confidence Level	Continuous monitoring and implementation of mitigation measures will significantly reduce the probability of waste material reaching the downstream natural drainage channels.					

Table 20. Socio-Economic Impact

Impact Event	**Positive aspect of sustaining employment in the sector.**
Description	The operations to be carried out on the MCs forms part of the greater Ondoto project and is included in the expected staff compliment of 50 (including haulage truck drivers) personnel. These personnel are contracted to manage the excavation, crushing, milling, screening and transportation processes for the processing plant and quarrying. A security team of up to 3 personnel can also be employed for the project. Herders use the area for grazing their livestock. The negative social impact is deemed negligible and the positive aspects of the mine on the economic benefits outweigh any negative aspects.

		The Kunene River Conservancy has consented to allow the proponent to mine within their mining claims. The Ombudsman has recommended that the Regional Council work together with the regional and local community development committees to disseminate information about projects in their areas.				
Nature		Positive				
Phases		Phases during which mining activities may contribute to the local economy are highlighted below; The significance assessment was carried out on the operational phase which represents the longest term when benefits are greater.				
Construction Phase		**Operational Phase**		**Decommissioning Phase**		**Post Closure**
Construction personnel		Operational personnel		Demolition personnel		No employment
Security personnel		Security personnel		Security personnel		
Support services		Support services		Support services		
Severity		Substantial improvement. Will be within or better than the recommended level. Favourable publicity.				
Duration		Reversible over time. Life of the project. Medium term				
Spatial Scale		Fairly widespread – Beyond the site boundary. Local				
Probability		Possible/ frequent				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M+**	**M+**	**M+**	**M+**	**M+**	**M+**
Significance of Consequence		A medium positive significance is expected.				
Prevention		Economic benefits could be prevented locally if no residents are employed and all materials and equipment is imported from other towns in the region and beyond. Actions that will prevent the positive impact of employment creation for this project would be the no go alternative due to either a fatal flaw from socio-economic or biodiversity impacts being of high significance. Retrenchment of permanently employed can be avoided by diversifying the business options in the construction industry.				
Mitigation Action		Where possible personnel should be hired from the local resident pool. At least this should apply to the unskilled vacancies. The proponent continues social responsibility projects to uplift the areas health and educational needs.				
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M+**	**M+**	**M+**	**M+**	**H+**	**M+**
Significance of Consequence		A medium positive significance is expected.				
Confidence Level		Provided as many nearby residents are hired as is practically possible then one can be more confident in achieving the medium significance. Through meaningful permanent employment economic development can be secured for all concerned.				

Table 21. Traffic Impacts

Impact Event	**Transporting bulk mineral concentrates by trucks (PBS) along national roads**
Description	The potential impacts of the haulage of bulk product can be categorised in terms of public safety and capacity of the road to handle 67 tonne vehicles.

<table>
<tr><td colspan="2"></td><td colspan="5">For public safety the proponent or contractor must abide by the rules and regulations that are enforced by the Roads Authority. The vehicles need to be routinely checked for road worthiness, and the containment of the goods needs to be such that no harm may come to the public and other road users during the transit from the mine to the port of Walvis Bay. No product may be strewn along the roadside as part of the normal transit. Covers over bulk transporters must always be adequate. Drivers must always follow the rules of the road. Additionally, the route provides for adequate visibility on hills and turns and that the road will always be safe for two-way traffic except where single traffic bridges exist.

The capacity of the whole road should be such that the surface is not damaged because of the load beyond the normal wear and that the bridges to be crossed have the integrity to handle multiple crossings at the frequency expected. A route might need to be altered should a bridge not be sufficiently strong to handle the 67-tonne laden vehicle. Additionally, the frequency of trucks per day is such that it does not exceed the threshold that was originally designed for the route.

A maximum of 1 truck per day is expected to travel from the two Mining Claims along either of the possible routes. The preferred shorter route is less frequented by traffic but currently has long stretches of gravel road. The PBS option will mean slower travel and less impact on the road surface. Thus the gravel road sections are expected to be less dusty due to slower travelling speeds and will not be negatively impacted by the 67-tonne laden vehicles.</td></tr>
<tr><td colspan="2">Nature</td><td colspan="5">Negative</td></tr>
<tr><td colspan="2">Phases</td><td colspan="5">Significance assessment was carried out on the operational phase which represents the period the road, road users and the public are exposed to the hazard.</td></tr>
<tr><td colspan="2">Construction Phase</td><td colspan="2">Operational Phase</td><td colspan="2">Decommissioning Phase</td><td>Post Closure</td></tr>
<tr><td colspan="2" rowspan="3"></td><td colspan="2">Public safety – pedestrians and road users</td><td colspan="2" rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td colspan="2">Road design – surface integrity and bridge strength</td></tr>
<tr><td colspan="2">Regulations – mass of vehicles when fully laden and permits</td></tr>
<tr><td colspan="2">Severity</td><td colspan="5">Moderate / measurable deterioration. Noticeable loss of resources.</td></tr>
<tr><td colspan="2">Duration</td><td colspan="5">Medium term. Life of Mine.</td></tr>
<tr><td colspan="2">Spatial Scale</td><td colspan="5">Widespread – Far beyond site boundary. National</td></tr>
<tr><td colspan="2">Probability</td><td colspan="5">Possible/ frequent</td></tr>
<tr><td>Mitigation</td><td>Severity</td><td>Duration</td><td>Spatial Scale</td><td>Consequence</td><td>Probability of Occurrence</td><td>Significance</td></tr>
<tr><td>Unmitigated</td><td>M</td><td>M</td><td>H</td><td>H</td><td>M</td><td>H</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="5">Mitigations to reduce risks to Public Safety are imperative.</td></tr>
<tr><td colspan="2">Prevention</td><td colspan="5">The removal of all hazards will not be possible.</td></tr>
<tr><td colspan="2">Mitigation Action</td><td colspan="5">As far as public safety is concerned it is not possible to prevent all incidents from occurring completely, but the probability can be reduced if the following aspects are considered: -
➢ Draw up operational procedure manual
➢ Provide road safety awareness training
➢ Establish specific rules for driving including travelling speed and rest times.
➢ Devise and implement emergency response plans
➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained
➢ Provide easy access to Material Safety Data Sheets (MSDS) for drivers</td></tr>
</table>

	➢ Provide first aid training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling fuel ➢ Establish and implement measures to exclude discharge of product particulates during travel As far as capacity is concerned the frequency and of trucks must be maintained at the stated daily rate and there should be at least 2 km travelling distance between trucks. Only one truck should travel over a bridge at any one time. Avoidance of travelling during peak times on busy sections of road should be practiced. The capacity of the road to handle the additional 5 trucks per day is within the road design.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**M**	**H**	**M**	**L**	**M**
Significance of Consequence	If all the mitigations listed are implemented, then the significance will be maintained at medium.					
Confidence Level	The significance would be lower had the spatial extent not been over such a long stretch of road.					

Table 22. Product Handling & Storage Impacts

Impact Event	**Bulk storage and handling of product at Walvis Bay Port**		
Description	The management of the product at the Port of Walvis Bay involves various hazards that can have an impact on the Port functioning, on third parties and on the proponent. The potential impacts on human health and safety resulting from activities at the port could include occupational accidents and injuries, vehicle accidents, exposure to weather extremes, trips and fall on uneven terrain, adverse health effects from dust generation and emissions Failure to store and handle the product safely at any point between the storage facility and the stowage on board the ship could have negative impacts on the other users of the port and areas they are responsible for. The proponent and contractors must follow a set of industry-specific safety and health policies at the Port. Typical operational procedures that pose risks to operational personnel are: ➢ Operating heavy machinery such as, front-end loaders, conveyors, forklifts, articulated trucks and trains during handling and transfer to ships ➢ Operating haulage trucks during offloading ➢ Prolonged proximity to and exposure to radioactive particulates either inside a warehouse or around exposed stockpiles.		
Nature	Negative		
Phases	The significance assessment was carried out on the operations at the port. No construction phase is expected.		
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
	Receiving product from the mine in bulk or bulk bags Storage and containment of bulk bags or bulk product at the port Transfer of the product to the vessel		.
Severity	Moderate / measurable deterioration. Noticeable loss of resources.		
Duration	Medium term. Life of Mine.		

Spatial Scale	Localised - Within the site boundary. Temporary storage at Walvis Bay Harbour					
Probability	Definite and continuous					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**M**	**L**	**M**	**M**	**M**
Significance of Consequence	Mitigations to reduce exposure to health and safety risks for personnel are imperative.					
Prevention	The removal of hazards or risks will possibly prevent accidents from occurring. However, it is not possible to remove all risks.					
Mitigation Action	It is not possible to prevent all incidents from occurring completely. An accident is an unplanned incident though it could have been foreseen if the necessary precautions had been taken. Not all hazards can be removed but the risk it presents can be lowered. An integrated health and safety management system acts as a monitoring tool and mitigating tool to reduce the risks. Typical mitigating measures within the health and safety management systems are:- ➢ Draw up operational procedure manuals ➢ Provide health and safety awareness training ➢ Establish practical standard housekeeping rules ➢ Colour code certain areas, equipment and substances to thereby classifying the risks. ➢ Provide signage for personal protective equipment (e.g. protective clothing like safety boots and hard hats) ➢ Institute safe working procedures and require permits to work ➢ Devise and implement emergency response plans ➢ Close coordination with the traffic authorities to ensure road safety signs are strategically placed and ensure all employee drivers are well trained ➢ Provide easy access to Material Safety Data Sheets (MSDS) ➢ Provide first aid treatment and training ➢ Devise emergency medical procedures for all eventualities ➢ Undertake daily safety reminders and/or drills ➢ Establish regulations for handling the product ➢ Establish monitoring points for particulate contamination around the storage facility. Procedures for dealing with injuries or accidents must be in place and all contact details for emergency personnel must be available. This list is not comprehensive and could be supplemented substantially by the Health & Safety Manager With respect radiation exposure the following mitigations and monitoring are either mandatory by law or recommended: ➢ Annual medical assessment ➢ PPE – dust masks are worn by all employees exposed to dust. The type used is FFP3; ➢ Rules applicable to the Port Authority must be applied. ➢ Equipment for measuring radiation emissions need to be purchased and personnel trained to use them.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**
Significance of Consequence	If all the mitigations listed are implemented, then the significance will be maintained at low.					
Confidence Level	The EAP is quite confident that the mitigations will result in low significance. Continuous training and medical monitoring of personnel and the regionally (SADC region) recommended					

	frequency is imperative. The regionally (SADC region) accepted levels of radiation exposure in employees must be monitored and maintained. The port authority will place the onus on the proponent to provide proof that the source of pollutants is not from the site of proponent.

Table 23. Heritage Impacts

Impact Event	**Heritage related impacts.**
Description	Kaokoland is a special place, and it is recognised for its world heritage and for the people who continue to live off the land there. It is expected that the area has important sites of national importance from a historical and pre-historic perspective. The siting of graves, ritual sites, middens and other such important heritage aspects within the mining area could mean that specific areas within the mining claims need to be kept pristine for further study If any unknown sites were damaged in any way it would be considered a heritage impact and depending on the importance of the site result in a great loss, were it damaged by mining.
Nature	Negative
Phases	Phases during which the significance assessment was carried out is highlighted in green. It is the various personnel who could potential come across yet to be documented find.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Construction personnel	Operational personnel		
Security personnel	Security personnel		
Residents	Residents		

Severity	undetermined as yet
Duration	Not reversible over time. long term
Spatial Scale	Localised to within the mining licences.
Probability	Possible because no records known to proponent

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**L**	**H**	**L**	**M**	**L**	**L**

Significance of Consequence	A low significance is expected.
Prevention	Well trained staff who know what to look for during the construction and operational phases could prevent any destruction of important sites.
Mitigation Action	A heritage survey of the area was conducted in August 2025, and the assessment report was submitted to the Heritage council in November 2025. The assessment carried out was to identify any place of importance before any construction starts. See the full report in **Appendix G.** Should anything come up during construction or operations then work should stop and the local police should be informed. A member of the heritage council would need to assess the importance of the chance find and provide the necessary permission to continue with works at that specific site.

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**L**	**H**	**L**	**M**	**L**	**L**

Significance of Consequence	A low significance is expected.
Confidence Level	Provided all personnel are trained in the procedure of chance finds the destruction of anything important could be prevented.

Table 24. Post Mining Legacy Impact

<table>
<tr><th colspan="2">Impact Event</th><th colspan="7">Abandonment of the mining site potentially exposes public and wildlife to hazards</th></tr>
<tr><td colspan="2">Description</td><td colspan="7">When a mining area is abandoned the infrastructure and altered landscape can affect the safe access of wildlife and public if not rehabilitated. The altered habitat may or may not promote the re-establishment of organisms once found there. Visual rehabilitation to the original state like the filling up of quarries for example as it is not always practical for economic factors.</td></tr>
<tr><td colspan="2">Nature</td><td colspan="7">Negative</td></tr>
<tr><td colspan="2">Phases</td><td colspan="7">The decommissioning and mine closure may impact public safety, future ecosystem functioning for domestic livestock and wildlife, economic stability and social health, and asset security. The significance assessment is carried out for the post closure phase.</td></tr>
<tr><td colspan="2">Construction Phase</td><td colspan="3">Operational Phase</td><td colspan="2">Decommissioning Phase</td><td colspan="2">Post Closure</td></tr>
<tr><td colspan="2" rowspan="4">Not applicable</td><td colspan="3" rowspan="4">Not applicable</td><td colspan="2">Ecosystem functioning</td><td colspan="2">Ecosystem functioning</td></tr>
<tr><td colspan="2">Public safety</td><td colspan="2">Public safety</td></tr>
<tr><td colspan="2">Economic uncertainty</td><td colspan="2" rowspan="2">Social challenges of unemployment</td></tr>
<tr><td colspan="2">Asset security</td></tr>
<tr><td colspan="2">Severity</td><td colspan="7">Substantial deterioration after mine closure with respect to aspects listed above.</td></tr>
<tr><td colspan="2">Duration</td><td colspan="7">Permanent. Beyond closure. Long term.</td></tr>
<tr><td colspan="2">Spatial Scale</td><td colspan="7">Fairly widespread – Beyond the site boundary. Local</td></tr>
<tr><td colspan="2">Probability</td><td colspan="7">Definite / continuous</td></tr>
<tr><td>Mitigation</td><td>Severity</td><td>Duration</td><td>Spatial Scale</td><td colspan="2">Consequence</td><td colspan="2">Probability of Occurrence</td><td>Significance</td></tr>
<tr><td>Unmitigated</td><td>H</td><td>H</td><td>M</td><td colspan="2">H</td><td colspan="2">H</td><td>H</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="7">A high significance is expected if no mitigation mechanisms are implemented. This is a worst-case scenario where no alternative uses of the altered habitat is considered.

In terms of economic benefits lost, it is important to note that the longer the mine stays open the longer the benefit to the community which if the mine did not start up would not have been realised in the first place.</td></tr>
<tr><td colspan="2">Prevention</td><td colspan="7">The resources are finite and so decommissioning is inevitable at some point. The degree to which the impact of closure will have will depends on the mitigations that can be considered.

Ecosystem functioning of the whole area cannot return to baseline conditions unless the excavated quarry is refilled and the area revegetated to baseline conditions. This is not practically possible.

Public harm can be prevented provided the area is secured and the very risky hazards are inaccessible to the public, livestock and wild animals.

Jobs within this sector will be lost. This cannot be prevented unless the employees move with the company to the next site.

Theft and damage to equipment can be prevented during the decommissioning phase provided good security prevents any form of criminal behaviour by disgruntled employees.</td></tr>
<tr><td colspan="2">Mitigation Action</td><td colspan="7">Visual impacts can be mitigated through a thorough removal of all infrastructure.

The reduction in the size of the mine footprint during operations and decommissioning increases the probability that more habitat would have become fully functional when the mine closes.

Secure fencing or other physical objects (rock piles) around any hazardous quarry pits (i.e. height risks) could prevent accidents from occurring but the permanent and visually acceptable barrier to humans and wildlife would be required to prevent injuries due to falling from heights. Access down into the pit could be allowed provided there is no risk from falling rocks.</td></tr>
</table>

<table>
<tr><td colspan="2"></td><td colspan="5"> The access road leading to the pit, waste rock dumps areas should be closed off to the public except to those that need access to the facilities for inspection after closure. Wherever there are safe access roads that are useable by the neighbours, these should be left. Some infrastructure could remain if alternative uses for buildings could be found. When the mine closes the losses of employment will have a negative economic effect on the livelihoods of the workers and the region. To mitigate this impact all stakeholders should be notified about the mine closure in good time. </td></tr>
<tr><td colspan="2">Rehabilitation</td><td colspan="5"> Reasonable rehabilitation of the mine site should take place. The proponent will be responsible to put aside funds for rehabilitation. The mine closure plan with the mine rehabilitation or restoration plan should be written up during the first three years of the first environmental clearance. Rehabilitation of the abandoned mining area will amongst other things include the following: All movable assets to be removed off site
All waste to be removed from site to prevent later potential excavation by people trying to recover any sort of usable scrap / materials
All immovable machinery to be dismantled and removed from site
Possibly create shallow sloped sides of quarried areas
WRD material is used in landscaping
All stockpiled topsoil will be re-laid on the landscaped areas.
Designed landscaped areas to be revegetated with plants from the nursery
Finally, erect fencing or barriers to prevent access by public or animals to cliff faces of the quarried pits</td></tr>
<tr><th>Mitigation</th><th>Severity</th><th>Duration</th><th>Spatial Scale</th><th>Consequence</th><th>Probability of Occurrence</th><th>Significance</th></tr>
<tr><td>Mitigated</td><td>L</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td colspan="2">Significance of Consequence</td><td colspan="5">If the mitigation hierarchy is followed through to rehabilitation, then the resultant consequence could be insignificant or at worst a low significance.</td></tr>
<tr><td colspan="2">Confidence Level</td><td colspan="5">A well designed and well implemented mine closure plan should provide for a low significance upon mine closure.</td></tr>
</table>

8 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) provides management options to ensure impacts of the quarry are minimised. An EMP is a tool used to take pro-active action by addressing potential problems before they occur. This should limit the corrective measures needed, although additional mitigation measures might be included if necessary. The draft EMP is found in **Appendix H**. The Radiation Management Plan for the greater Ondoto Mine Project, a supplement to the EMP can be found in **Appendix I**.

The objectives of the EMP are:

- to include all components of the operations of the project;
- to prescribe the best practicable control methods to lessen the environmental impacts associated with the operations of the project;
- to monitor and audit the performance of operational personnel in applying such controls; and
- to ensure that appropriate environmental training is provided to responsible operational personnel.

The EMP acts as a stand-alone document, which can be used during the various phases (construction, operational and decommissioning) of the facility. All personnel taking part in the extraction operations should be made aware of the contents of the EMP, to plan the relevant operations accordingly and in an environmentally sound manner. The EMP outlines 9 environmental management programmes which are to be used for all phases of the mining activities. Monitoring recommendations are included in the EMP.

The programmes listed and described in the EMP are:

1. Air quality Management Programme (Radiation Management Included)
2. Noise Management Programme
3. Health & safety Management Programme (includes Security)
4. Visual Management Programme
5. Stakeholder Communication Management Programme (include socio-economic and heritage aspects)
6. Waste Management Programme (Radiation Management included)
7. Ecology Management Programme
8. Water Resource Management Programme
9. Mine Closure & Rehabilitation Management Programme

The proponent could implement an Environmental Management System (EMS) to manage these 9 programmes. However, a good EMS goes beyond mere implementation of the EMP. An EMS is internationally recognized as best practice that will ensure ongoing incorporation of environmental constraints. At the heart of an EMS is the concept of continual improvement of environmental performance with resulting increases in operational efficiency, financial savings and reduction in environmental, health and safety risks. An effective EMS would need to include the following elements:

- A stated environmental policy which sets the desired level of environmental performance;
- An environmental legal register;
- An institutional structure which sets out the responsibility, authority, lines of communication and resources needed to implement the EMS;
- Identification of environmental, safety and health training needs;
- Implementation of the EMP's Environmental programmes;

- Stipulated environmental objectives and targets to be MEFT, and work instructions and controls to be applied in order to achieve compliance with the environmental policy;
- Periodic (internal and external) audits and reviews of environmental performance and the effectiveness of the EMP and EMS;
- Complete development of a Mine Closure Plan submitted and approved by MEFT and MIME.

9 CONCLUSIONS & RECOMMENDATIONS

The proponent will contribute locally to employment opportunities for both locals and contractors. Skills transfer and training would develop the local workforce during both the construction and operational phases. Social responsibility projects need to be identified by the proponent to help the rural communities develop their skills or provide for their health of education.

The EMP should be used as an on-site reference document for the design, construction, operations and decommissioning of the mine and associated works. Parties responsible for transgressing the EMP should be held responsible for any rehabilitation that may need to be undertaken. The proponent could use an in-house Health, Safety, Security and Environment Management System in conjunction with the EMP and its management programmes. Personnel must be taught and understand the contents of the EMP as a minimum requirement. Best practice would be the hiring of a suitably qualified and experienced environmental control officer to implement the environmental management programmes. Alternatively, the implementing of the programmes should be delegated amongst the management personnel on and off site. The EMP requires minimum and realistic monitoring of the environmental aspects explicitly listed for each of the management programmes.

Based on the information provided in this report, the EAP is confident that the identified potential impacts associated with the project can be reduced to acceptable levels. This is conditional on the implementation of all the measures (i.e. preventions, mitigations, remediations, monitoring etc.) described in the EMP.

10 REFERENCES

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11 APPENDIX A: CURRICULUM VITAE EAP

12 APPENDIX B: PUBLIC CONSULTATION REPORT

13 APPENDIX C: BACKGROUND INFORMATION DOCUMENT

14 APPENDIX D: FLORA STUDY

15 APPENDIX E: FAUNA STUDY

16 APPENDIX F: WATER STUDY

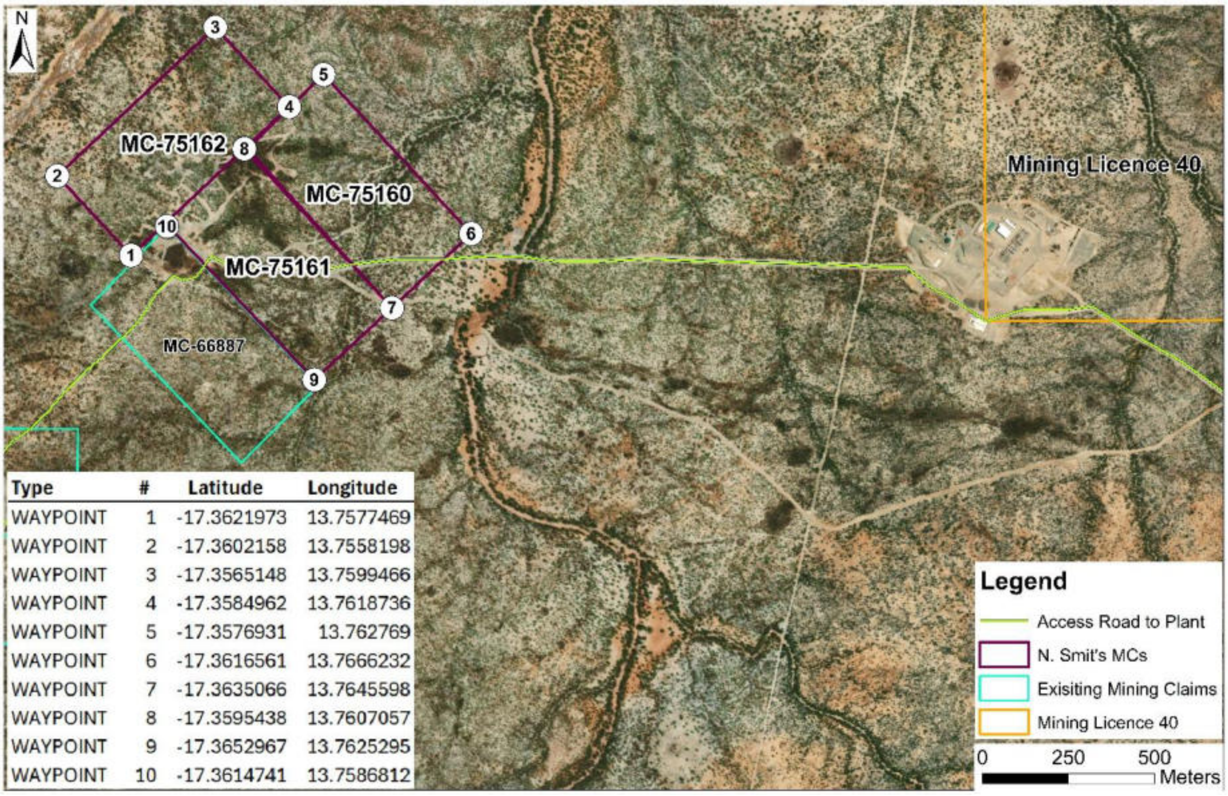
17 APPENDIX G: HERITAGE STUDY

18 APPENDIX H: DRAFT ENVIRONMENTAL MANAGEMENT PLAN

19 APPENDIX I: RADIATION MANAGEMENT PLAN

BACKGROUND INFORMATION DOCUMENT

ENVIRONMENTAL SCOPING WITH IMPACT ASSESSMENT FOR MINING WITHIN MINING CLAIMS 75160, 75161 &75162, NEAR OTJIMUHAKA, EPUPA CONSTITUENCY, KUNENE REGION



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WAYPOINT	2	-17.3602158	13.7558198
WAYPOINT	3	-17.3565148	13.7599466
WAYPOINT	4	-17.3584962	13.7618736
WAYPOINT	5	-17.3576931	13.762769
WAYPOINT	6	-17.3616561	13.7666232
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WAYPOINT	8	-17.3595438	13.7607057
WAYPOINT	9	-17.3652967	13.7625295
WAYPOINT	10	-17.3614741	13.7586812

Prepared by Philip Hooks

August 2025

TABLE OF CONTENTS

1 INTRODUCTION

Ms. Nina Smit (hereafter referred to as the Proponent) pegged Mining Claims 75160, 75161 & 75162 and will be granted mining rights by the Ministry of Mines and Energy upon receipt of an Environmental Clearance certificate (ECC). The proponent will start mining of Rare Earth Element (REE) ore other mineral ores (i.e. in accordance with the registration with MME) within the mining claim once the mineral license is granted. The processing of the ore will be carried out within the accessory works area of Mining Licence (ML) 40 which has already been granted rights to mine and process and has received an ECC for operations. The mining claim is located at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region.

From 1997 to 2006, KNL Namibia (Pty) Ltd developed dimension stone quarries within ML40 together with the related mining and processing infrastructure at the accessory works area of the ML. Since 2017 no blocks of dimension stone have been extracted. Expansion of the mining to iron-titanium ore and rare earth element minerals have been undertaken. The accessory works area was expanded to accommodate the processing of these additional ores. It is at this new accessory works area that the ore from the Mining Claims 75160, 75161 & 75162 will be processed.

The Proponent has commissioned an Environmental Impact Assessment (EIA) process based on the requirements of the Environmental Management Act (Act. No. 7 of 2007) and associated EIA regulations Government Notice (GN) No. 29 and 30. An Environmental Clearance Certificate (ECC) for the construction and operation of the proposed mining and processing activities is required and thus an EIA application with associated support documents need to be drawn up for submission to the Ministry of Mines and Energy (MME) and to the Ministry of Environment, Forestry and Tourism (MEFT) for review.

The EIA report, including an Environmental Management Plan (EMP), will enable MME and MEFT to make an informed decision regarding the proposed development from an environmental perspective. An assessment of the potential impacts will be undertaken to determine the significance of the activities associated with the construction, operational and decommissioning phases of the proposed project on the environment.

The aim of this background information document (BID) is to:

- Inform I&APs about the proposed mining within Mining Claims 75160, 75161 & 75162;
- Provide Interested and Affected Parties (I&APs) the opportunity to register for the public participation process;
- Explain the EIA process being followed;
- Explain how IA&Ps can share any comments, issues or concerns related to the proposed development. This will provide the consultant with additional information which should be taken into account for the identification of environmental aspects and the assessment of potential impacts.

2 LOCATION

The Mining Claims 75160, 75161 & 75162 lie approximately 130 km northwest from Opuwo and is located about 3.5 km south of the Namibian-Angolan border, which is marked by the river Kunene, and 6 km south-west of the settlement Otjimuhaka (previously Swartbooisdrif) (see Figure 1 below for location in the country). Mining Claims 75160, 75161 & 75162 comprise a total area of about 54 hectares and are covered by a section of the topographic map 1:50,000 Swartbooisdrif (sheet 1713BD). The mining area is situated on the foothills of the NE-striking ridges of the Zebra Mountains in the north-west. A tributary of the ephemeral Ondoto River flows for about 500m through the claims. Figure 2 renders a map of the mining claims relative to other mineral licences in the area. See Figure 3 below for a focussed image of the mining claims relative to the accessory works area of ML40.

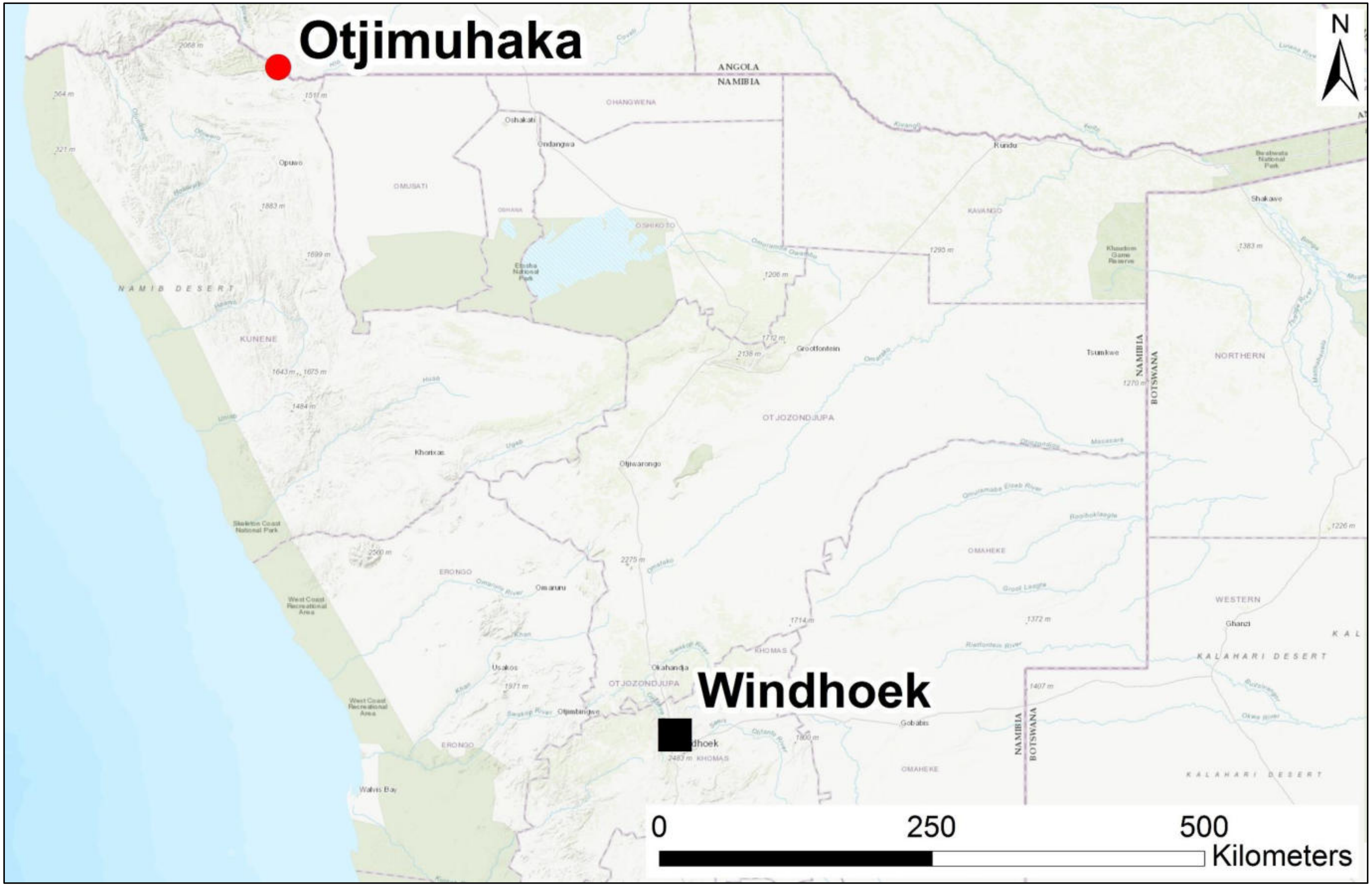


Figure 1. Location of the nearest town, namely Otjimuhaka (previously Swartboois Drift), to the mining claim within the country. .

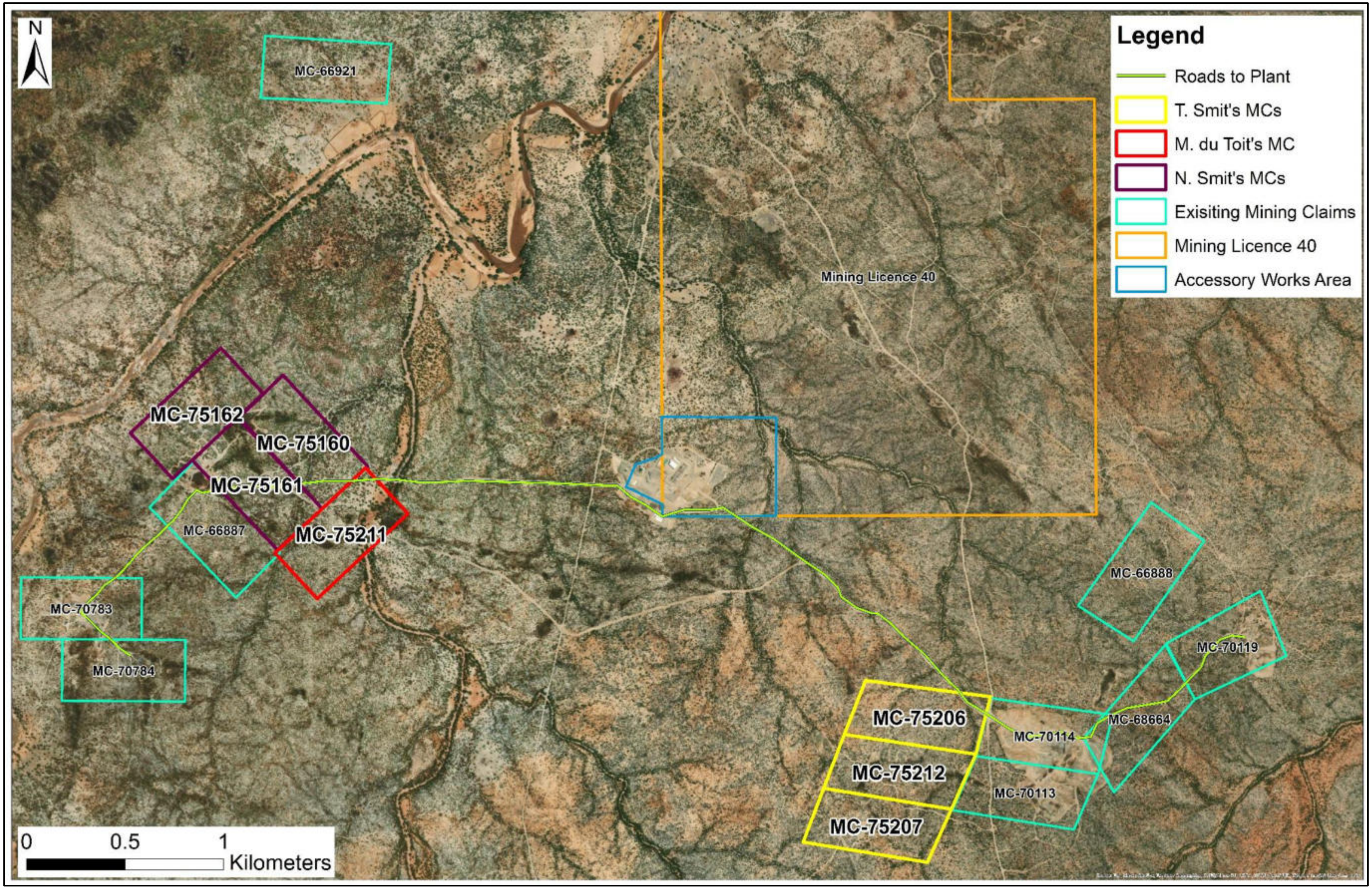
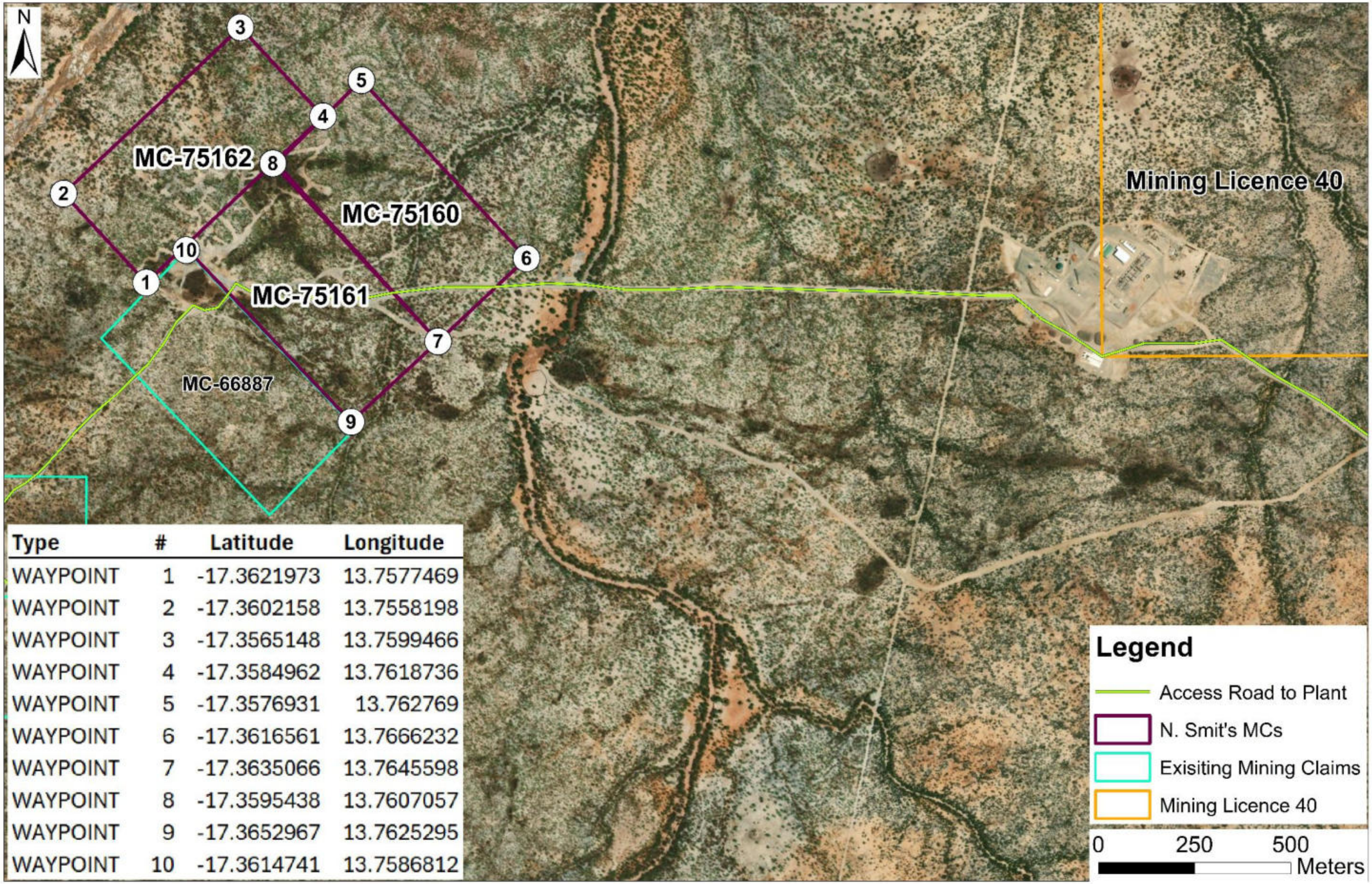


Figure 2. Mineral Licences surrounding Mining Claims 75160, 75161 & 75162



Type	#	Latitude	Longitude
WAYPOINT	1	-17.3621973	13.7577469
WAYPOINT	2	-17.3602158	13.7558198
WAYPOINT	3	-17.3565148	13.7599466
WAYPOINT	4	-17.3584962	13.7618736
WAYPOINT	5	-17.3576931	13.762769
WAYPOINT	6	-17.3616561	13.7666232
WAYPOINT	7	-17.3635066	13.7645598
WAYPOINT	8	-17.3595438	13.7607057
WAYPOINT	9	-17.3652967	13.7625295
WAYPOINT	10	-17.3614741	13.7586812

Figure 3. Location of the mining claims and their proximity to the accessory works area of ML40 area.

3 GEOLOGY

The mining claims are underlain by anorthosite rocks and associated mafic intrusions of the Kunene Intrusive Complex which is 1.3 billion years old and which comprises of rocks that intruded the intensely metamorphosed and deformed rocks of the Epupa Metamorphic Complex, with rock ages of up to 1810 million years.

Mineralization within the licence areas is comprised of intrusions and zones of alteration that are made up of the mineral sodalite, as pods of iron ore and dykes of rare earth mineralisation within the anorthosite country rock. The mining in the area has expanded to mining iron ore (i.e. as magnetite with elevated titanium and vanadium content in lenses and plugs) and rare earth mineral-bearing dykes (i.e. up to 200m long, very narrow (decimetre-scale) dyke).

4 PROJECT MOTIVATION

Although the envisaged operation might be considered a medium-scale project, this project has the potential to contribute to the Kunene region's socio-economic development through local job creation and increased delivery of support services to the proposed mine from Ruacana or Opuwo.

Additional employment opportunities will result from the project. Up until 2017, general unskilled workers were sourced from the nearest communities. It is hoped that when the mine resumes full operation levels the staff compliment could return to work. Additional unskilled workers would be needed when the expansion of the mine was complete. Skilled labour based in the region and further afield may be utilised. Skills development would result from the employment of both unskilled and skilled workers.

Indirectly, the expansion of trade and industrial activity in the region and country did result from the sodalite mining activity in the past. It is hoped this will resume as the market becomes favourable again. The operations did directly contribute to the government budget by payments of taxes and royalties on the sale of manganese products. The expansion of the mine to incorporate iron-titanium and rare earth element ore will add to these economic benefits.

Once all operational activities commence for all the mining claims in the area, approximately 50 personnel would be employed on a permanent basis. Security staff are included in that number. This excludes the labour for transporting the products to the port in Walvis Bay. It is estimated that 10 truck drivers would be employed for this purpose as and when haulage is required. Approximately 20 staff would reside on site on an intermittent basis.

5 PROJECT DESCRIPTION

The proposed activity focuses on the specific resources of iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the Mining Claims 75160, 75161 & 75162.

Narrow, dykes and veins, up to 1 metre wide and with lengths of up to approximately 200m constitute zones of rare earth mineralisation. Both these types of mineralisation, iron and rare earth, belong to the class of base and rare metals.

Looking at the available rock material within the Mining Claims 75160, 75161 & 75162 and other claims in the area, the estimated mining lifespan could be more than 50 years. However, for this assignment an estimated mining lifespan of up to 25 years is considered.

The following is the summary of envisaged development with mining and processing activities that are expected to be undertaken by the project Proponent during different project development phases.

CONSTRUCTION PHASE ACTIVITIES

This will comprise of the following:

1. Construction of roads (internal within the Mining Claims) (an access road from the claim to the main road to the north and the processing plant in ML40 already exist)
2. Construction of new quarries within Mining Claims 75160, 75161 & 75162

All other infrastructure for mining and processing of the ore has all been covered by the ECC for the ML40. Due to the presence of trace amounts of radioactive thorium within the REE ore the processing plant is located remotely from the local communities. The existence of one operational processing plant within the adjacent mining licence for all the associated mining claims reduces the cumulative impact or potentially danger to humans.

Solid non-mineral waste will be removed off site and taken to the nearest rubbish dump either in Otjimuhaka or Ruacana depending on the nature of the waste. Ablution facilities will use sealed septic tanks or a sewage treatment plant. Sewerage sludge will be taken to the Ruacana sewerage plant periodically. Prior to the construction of a new power line, the projects' electricity requirements will rely on diesel generators. Construction staff will be accommodated on site at a temporary camp. Security will be supplied on a 24-hour basis at the mine and construction sites. Support services and any facilities established during the construction phase will either be removed at the end of this phase or incorporated into the project's operational phase.

It is anticipated that the proposed construction will commence immediately after receiving the ECC from the MEFT and the relevant permits and licences have been issued by the different regulatory bodies.

OPERATIONAL PHASE ACTIVITIES

Mining

Operation will entail mining, i.e. drilling and blasting of rock outcrops and open cast mining. Mining techniques will make use of modern equipment such as excavators, compressor driven drill rigs, jack hammers and dump trucks. Open cast mining will be established according to good practice procedure.

Multiple quarries (i.e. wedge, terrace or trench shaped) will be mined within Mining Claims 75160, 75161 & 75162. Quarry depth will be to about 40 m. Approximately 8,000 t of ore is expected to be removed cumulatively from multiple mining claims and processed on a monthly basis. For all types of mineral ore the excavations are planned to a maximum stripping ratio of 1 : 15. Overall the maximum or total estimate of waste rock produced will be 1.5 million tons annually for all the associated mining claims in the area. Mineral waste will be deposited in waste rock dumps and a tailings storage facility within ML40.

Mineral Processing

A central processing facility for iron ore and for rare earth mineralisation, all of which will occur within ML40 and to some extent the primary crushing within the associated mining claims. For iron and rare earth mineralisation the ore is drilled and blasted and removed from the ground in opencast quarries. To concentrate the valuable mineral content the following process is envisaged.

The iron ore processing from the Run-of-Mine ore:

I. Run-of-Mine ore crushed to <25 mm

II. screen for size classification

a) fraction 40 to 25 mm: scan / sorting separation
b) fraction less 25: magnetic separation

After mining of the rare earth containing rock processing will occur as follows:

I. Run-of-Mine ore crushed to <25 mm

II. screen for size classification

a) fraction 40 to 25 mm: scan / optical sorting separation
b) fraction 25 to 6 mm: magnetic sorting
c) fraction less 6 mm: gravity separation process using limited amounts of water

III. Milling of concentrate

a) Flotation, using limited amounts of water
b) leaching of gangue carbonate, using limited amounts of water

Up to 90 ha of footprint size are envisaged for the accessory works area to accommodate the processing, tailings disposal, product storage, loading facilities, offices, security and workshop facilities all within the adjacent ML40 area.

At a maximum monthly production of 5,000 t a total of 139 truckloads at 36 t would transport product each month. That is 5 trucks each day. The product would be transported along the gravel road to Opuwo and thereafter along the tar roads to the port of Walvis Bay.

Infrastructure Development

ML40 presently abstracts ground water from a soft sediment water compartment in the Ondoto river. Gensets are used for power generation. Development of linear infrastructure for pumping water from the Kunene river as well as establishing a new conductor path transmission line from Nampower's Swartbooisdrift substation to the accessory works area were part of the scope for the Environmental Scoping Study carried out for ML40. The mining claims' proponent will make use of ML40's infrastructure for its water needs. ML40 has taken into consideration the incorporation of multiple mining claims making use of this utility.

The tailings storage facility was assessed as part of ML40's EIA and does not form part of the mining claim's assessment.

Waste rock dumps will be located alongside quarries, pits and trenches and where least impact on flora and fauna is expected. They could be potentially used in landscaping during rehabilitation during decommissioning of the same quarries, pits or trenches.

Other infrastructure required and foreseen for the project development are offices and accommodation for a small portion of the work force. Much overlap with other mining claims and the ML40 is expected with respect to these developments.

Product Transport

Concentrates of base and rare earth metal products are to be transported as bulk cargo as well as in bagged form. The viability of any mining operation, just like most industries, is particularly sensitive to the logistics concerned with getting the product to market. Different options are presently being investigated for the transport of the products to the harbour of Walvis Bay.

Bulk bags on low-bed trucks or bulk road transport with loads up to 67 tons are envisaged to take the products on the public road infrastructure from the mine site to the harbour of Walvis Bay. Various studies have been undertaken to support the usage of such trucks including road wear analyses, modelling of a tractor-trailer design, bridge assessments.

An alternative plan that is also being considered is the transport of partially processed ore to Okorusu Mine. From that Okorusu mine site and processing plant, the product would be transported to Walvis Bay harbour.

DECOMMISSIONING PHASE ACTIVITIES

The estimated life of the mine is set at 25 years currently.

Decommissioning activities will include the removal of infrastructure, preparation of final landforms for closure and to rehabilitate roads and other linear infrastructure where necessary.

6 EIA PROCESS

The EIA will be carried out as follows:

Stakeholders and Interested and Affected Parties (IAPs) have been notified regarding the project through the national press, radio announcements and by site and public notices. A public meeting has been arranged to provide an opportunity for stakeholders and IAPs to receive information about the project and to give input into the EIA process. This public participation at a public meeting and via written correspondence is required under the laws that govern environmental protection. After the initial public consultation, the Scoping Report with Assessment and Draft Environmental Management Plan (EMP) will be written. Focus group meetings with stakeholders will also be held during the week of the public meeting.

Several specialists provided assessment studies or statements for the Scoping Report of ML40 and associated mining claims. These documents together with other environmental baseline information will be used to assess the potential impacts of the current development under consideration. Measures to offset, mitigate or prevent any potential impacts will be recommended.

Monitoring of activities throughout the phases of the project will be proposed so that the compliance to the recommended measures can be assessed. A Scoping Report with Assessment and Draft EMP will be submitted to the public for review. Thereafter, the documents will be submitted to the Environmental Commissioner, who will weigh up the impact assessment, recommended measures and monitoring suggestions and approve or reject the environmental clearance. If approved, the EMP (supported by the Scoping Report with Assessment and specialist studies/statements) becomes the legally binding plan to which the company must comply.

POSSIBLE ENVIRONMENTAL, SOCIAL AND CULTURAL IMPACTS OF THE PROJECT

Impacts that could potentially arise from the proposed project include but are not limited to:

- Biodiversity impacts
  - Alteration of habitat
  - Physical destruction and general disturbance of biodiversity
- Alteration of landscape
- Air Quality
- Noise
- Surface water and groundwater bodies
- Radiation
- Heritage impacts
- Increased traffic volumes on public roads and road safety
- Employment opportunities (permanent / temporary)
- Growth of both local and regional economy

Where the environmental impact assessment practitioner deems it necessary, additional specialist studies or statements will be provided for as part of the Scoping Report with Assessment.

PUBLIC PARTICIPATION

The Environmental Impact Assessment process involves interaction with individuals, stakeholders and organisations who are interested in, or who could be affected by, the proposed development. IAPs are invited to register and receive communication concerning the project. The public meeting, focus group meetings and email correspondence provides you with an opportunity to comment and make further inquiries.

We invite all IAPs to provide in writing, any issues and suggestions regarding the proposed development. This correspondence must include:

1. Name & surname;
2. Organization represented;
3. Position in the organization;
4. Contact details and;
5. Any direct business, financial, personal or other interest which you may have in the approval or refusal of the application.

All initial contributions, comments and concerns must be submitted by **11th October 2025**. After the issuing of the Scoping Report with Assessment, all stakeholders and IAPs will be requested to review the document and provide comments. A 21 working day review period will be granted for this aspect of the public participation. After the review period, the Scoping Report with Assessment will be submitted to the Environmental Commissioner to apply for an ECC.

For further information, or to register as an Interested or Affected Party, please contact:

Mr. Philip Hooks (Lead Environmental Assessment Practitioner - EAP/Consultant) or Miss Lovisa Amwele (EAP – Public Consultation Facilitator)

E-Mail: philip.nigel.hooks@gmail.com / enviro.aec@gmail.com

VEGETATION STUDY AND IMPACT ASSESSMENT

Sodalite and rare earth minerals on ML40, Kunene Region

Prepared for:

Philip Hooks

December 2020

PROJECT	Vegetation baseline study and impact assessment: ML40 Sodalite and rare earth minerals mine
CLIENT	Philip Hooks
DOCUMENT NAME	Report
DOCUMENT #	3
DATE	13 January 2021
AUTHOR	Henriette Potgieter Potgieter Consultancy CC PO Box 11867 Klein Windhoek

DISCLAIMER

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ACKNOWLEDGEMENT

The National Botanical Research Institute (NBRI) provided plant species lists for specimens collected or sighted within two coordinate squares which encompass the study area.

ABBREVIATIONS

CITES	Convention on International Trade in Endangered Species
CRIT	Critically Endangered
DD	Data Deficient
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
End	Endemic
EPL	Exclusive Prospecting Licence
FA	Forestry Act 12 of 2001
IUCN	International Union for Conservation of Nature
KNL	KNL of Namibia (Pty) Ltd
MEFT	Ministry of Environment, Forestry and Tourism
ML40	Mining Licence 40
NBRI	National Botanical Research Institute
NCO	Nature Conservation Ordinance 4 of 1975
Near End	Near Endemic
NT	Near Threatened
VUL	Vulnerable

Table of contents

Table of figures

List of tables

1 INTRODUCTION

1.1 Background

KNL of Namibia (Pty) Ltd (KNL) was granted Mining Licence 40 (ML40) in 1997. The company proposes to continue mining sodalite dimension stone, and to start the mining and processing of iron-titanium ore and rare earth minerals on ML40.

The project is located 130 km northwest of Opuwo and is accessed from the D3701. It is 2.5 km south of the Kunene River and 4 km southwest of Otjimuhaka in the foothills of the Zebra Mountains.

KNL commissioned Philip Hooks to do an Environmental Impact Assessment (EIA) according to the Environmental Management Act (Act. No. 7 of 2007) and its regulations. Philip Hooks requested Potgieter Consultancy CC to do a vegetation study for the EIA, namely of the plants that might possibly occur on or near the project site. This document consists of a baseline vegetation diversity report, followed by an impact assessment with suggested management/mitigation measures.

The project site falls within the Kaokoveld centre of endemism, a biogeographical region rich in endemic and range-restricted plants and animals (Craven, 2009), (Swanepoel, 2015) and (Swanepoel, 2019). Because of the remoteness of the region there is a dearth of data on biodiversity, but recent discoveries of plant species (Swanepoel 2015 and 2019) underline the conservation importance of the region. The cumulative impact of mining and other development in the arid zones of Namibia and Angola means that development in such areas should be planned responsibly, and management measures implemented and monitored diligently.

1.2 Terms of reference

The terms of reference for this study were obtained from Philip Hooks, in Appendix C of his "Proposal: Environmental Scoping Study with assessment" dated June 2020.

1. Describe and map the existing terrestrial fauna and flora and identify their occurrence, relative abundance and distribution
2. Identify any species that are of conservation concern.
3. Provide up to date information and data on the flora and fauna within the project area (based on existing literature, expert opinion and moderate-effort fieldwork).
4. Identify key critical factors concerning the impact on biodiversity.
5. Prepare a report about the findings from the work.

1.3 Assumptions and limitations

The site was visited for four days and information on the taxa included in this report is based largely on existing literature.

The site visit took place in the middle of winter and there were many plant species without leaves, fruits or seeds. Most annual and some perennial plants were either absent or present but not presenting identifying characteristics, such as the Corkwoods (*Commiphora spp*), of which there are several species in the study area. It is possible that some factors that could affect the composition of plant assemblages or populations may have been overlooked during the site visit.

1.4 Methodology

1.4.1 Sources used

The species list was compiled from specialist sources:

- Brahms database (National Herbarium of Namibia, 2020)
- Field Guide to the trees and shrubs of Namibia (Mannheimer & Curtis, 2018)
- Tree Atlas of Namibia (Curtis & Mannheimer, 2018)

The Namibia Biodiversity Database (Irish, 2020) and the Red Data Book of Namibian Plants (Loots, 2005) were consulted for the Namibian conservation status of plant species.

The IUCN Red list (IUCN, 2016) was consulted for the international conservation status of plant species.

1.4.2 Site visit

A site visit was conducted for four days, 4 - 7 August 2020, to examine the nature of the habitats within and adjacent to the project area, and also to look at any ecological factors that might affect plant communities and the presence of vertebrates.

Notes were made of general vegetation structure and the potential role that vegetation could play in sustaining animal taxa. Trees and shrubs were identified as far as possible, but the timing (middle of winter) meant that many plants did not have leaves or other identifying characteristics.

Accessibility was good and the project site was comprehensively covered by vehicle and on foot, focusing on the fenitisation ridges and mining sites as pointed out by the geologist on site. Visibility was clear for tens of kilometres.

1.4.3 Habitat categorisation

Potential habitat types were initially identified by inspecting the project site and the surrounding landscape on Google Earth Pro, and they were then reviewed during the site visit.

Habitat descriptions were based mainly on topography, substrate and vegetation structure.

1.5 Study area

Figure 1 shows the study area (purple) for this report. It extends south beyond the border of ML40 (red) to include a magnetite/sodalite outcrop that is a potential mining site for rare earth element mineralisation.

Maps and descriptions of the accessory works area and other infrastructure layout were not available at the time of the site visit, resulting in an assessment of these aspects with lower confidence levels.

Any study area in a biodiversity survey is affected by ecological features, processes and functions from the surrounding area. In this case the Kunene River (via the Ondoto River) is an essential ecological feature that will be directly affected by development, and in turn affects the biodiversity characteristics of the study area. This is particularly true of birds and amphibians that occur only along the Kunene River, but will utilise resources on ML40 in a seasonal cycle or opportunistically, since the study area is less than 2.3 km from the river. The hydrology supports the plants which in turn support the birds.

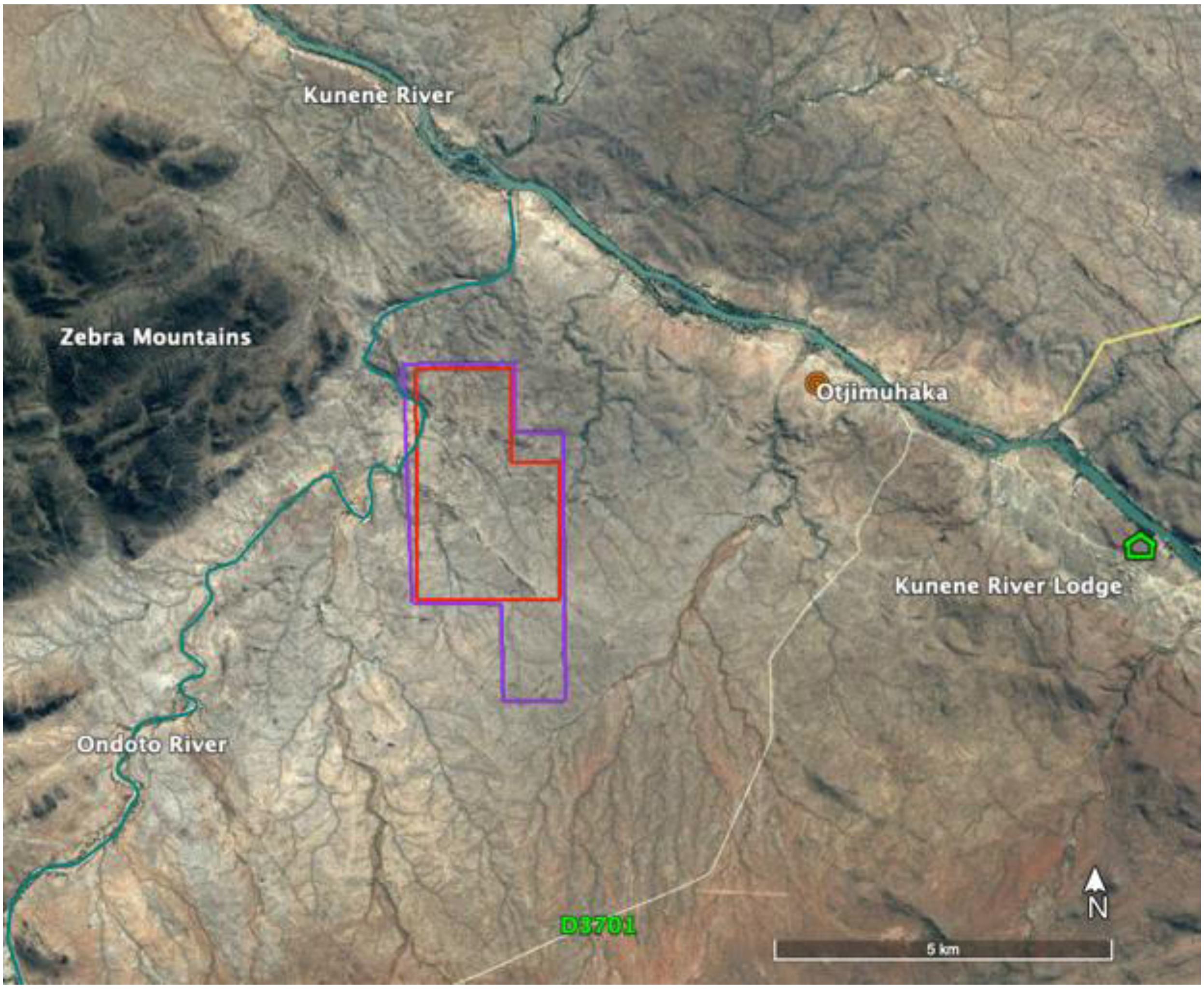

Figure 1. Location of the study area (purple outline) and ML40 (red outline).

2 DESCRIPTION OF RECEIVING ENVIRONMENT

2.1 Landscape description

At the African scale the project site falls in the Savanna biome, in the stable savanna zone where the ratio between woody and grass plants is determined by climate, particularly annual rainfall below 560 mm (Sankaran, et al., 2005). At the Namibian scale the site is located in the Western Highlands biome, which is characterised by an Acacia Tree-and-Shrub Savanna vegetation type and a dominant vegetation structure of grassland and scattered trees (Mendelssohn, et al., 2002).

The region is in a hot, arid climate zone according to the Köppen-Geiger system (Kottek, et al., 2006) with hot summers (average maximum of 34 – 36 °C), mild, dry winters (average minimum of 6 – 8 °C) and no frost (Mendelssohn, et al., 2002). Median annual rainfall is 300-350 mm and the variation in annual rainfall is relatively low at 40%.

The region's biodiversity patterns are variable according to Mendelssohn et al (2002), whose ranking for plant diversity (the number of species present in an area) is given here as medium-high.

On the landscape scale, the scale on which biodiversity conservation needs are addressed, endemism levels are high for many taxa because of ranges that extend from Angola south across the Kunene River (Mendelssohn, et al., 2002). The study area falls within the Kaokoveld centre of endemism and supports many range-restricted plants and animals (Craven, 2009), (Swanepoel, 2019).

Vegetation structure in the region is a shrubland-woodland mosaic, the upper storey dominated by *Colophospermum mopane*, *Terminalia prunioides and Commiphora* species. *Acacia* species are present in drainages and streams, and grass cover is sparse.

At a global scale the project site falls in the Afrotropical Region for all vertebrate taxa (Proches & Ramdhani, 2012). Anthropomorphic modification and the low density of vegetation result in a low density of large mammals.

2.2 Habitat types

Basing a biodiversity study for impact assessment on habitats has been found to result in units that are easier to address in environmental management plans and they can also be managed more easily by mine staff during the operational phase of the project. Another advantage is that in arid zones many species of plants and vertebrates are restricted to certain habitats and are not observed during the site visit, but information on expected species of conservation concern can be extrapolated from knowledge of the habitats.

Three habitat types were identified in the vegetation and vertebrate studies for this project and were integrated in one combined floral and faunal classification: Mopane scrub, rocky outcrops and river/drainages.

It should be noted that this categorisation describes macrohabitats on ML40. It is possible that microhabitats may be discernible within any or all of these and that they could potentially require additional mitigation measures.

Aspects that were considered when assigning habitat categories:

- Topography
- Substrate
- Vegetation structure, in terms of layers: a well-structured vegetation assemblage is represented by the presence of a high canopy, trees and shrubs of varying heights, a forb layer and a bottom layer with ground cover such as grass.

The three habitat types were given sensitivity ratings, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures.
The sensitivity rating was assigned based on properties of each habitat itself, including:

- nationally or regionally scarce habitats
- size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region
- exceptionally high diversity and/or abundance of species
- high level of endemism
- species of conservation concern are supported
- key ecological processes
- contributes disproportionately to ecological function (nutrient and energy flows)
- provides critical resources
- restorability after disturbance

Human habitation, grazing and mining activities have resulted in modified areas, some of them severely degraded such as the rocky ridge south of ML40 (Figure 3) and the quarry/mine sites (yellow in Figure 2). The village Oroutumba, located in Mopane scrub habitat adjacent to the Ondoto River (Figure 2), is also an anthropologically modified area.

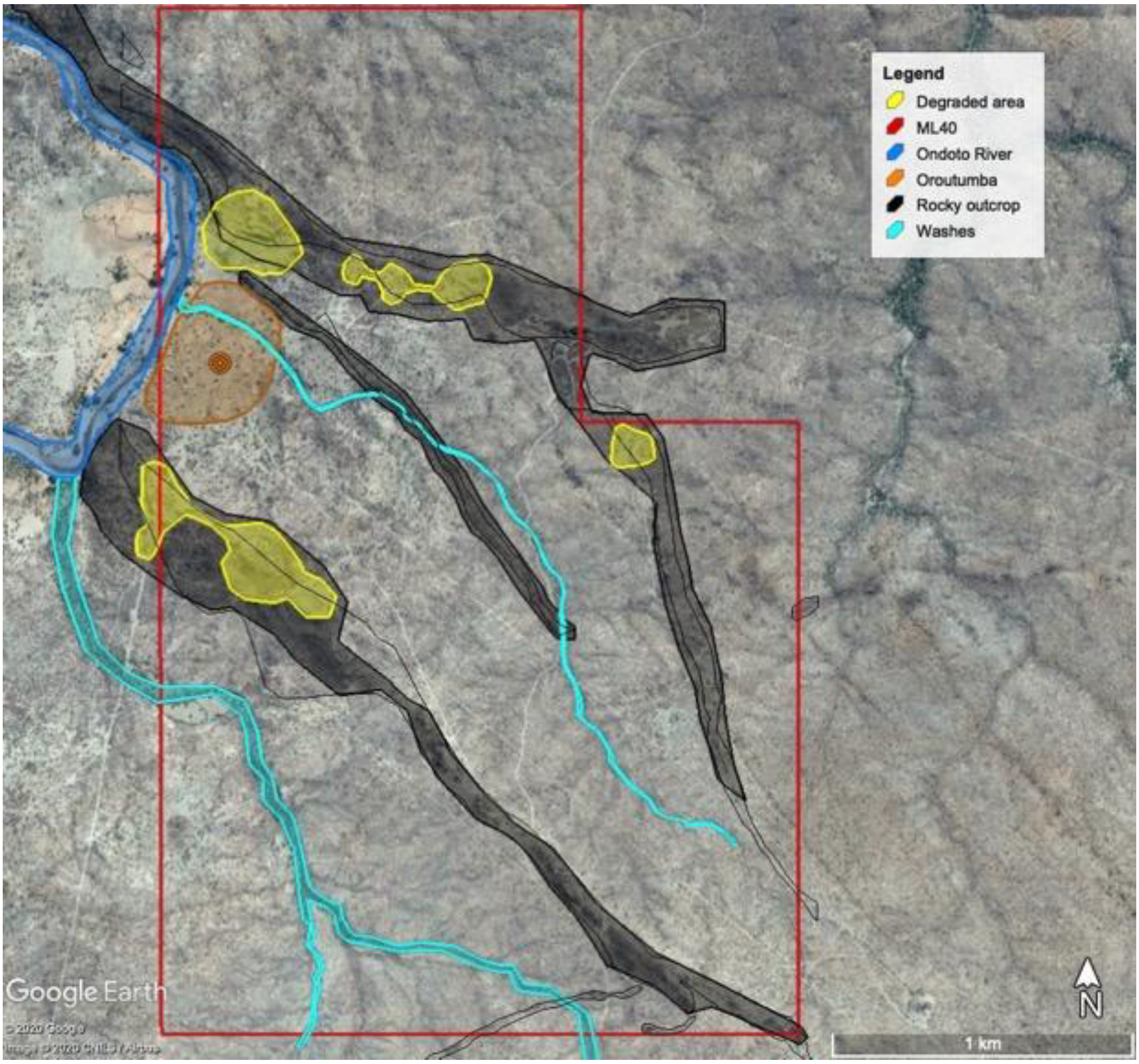

Figure 2. Map of habitats in the study area.
The yellow areas represent mine/quarry sites that are considered irreversibly disturbed.

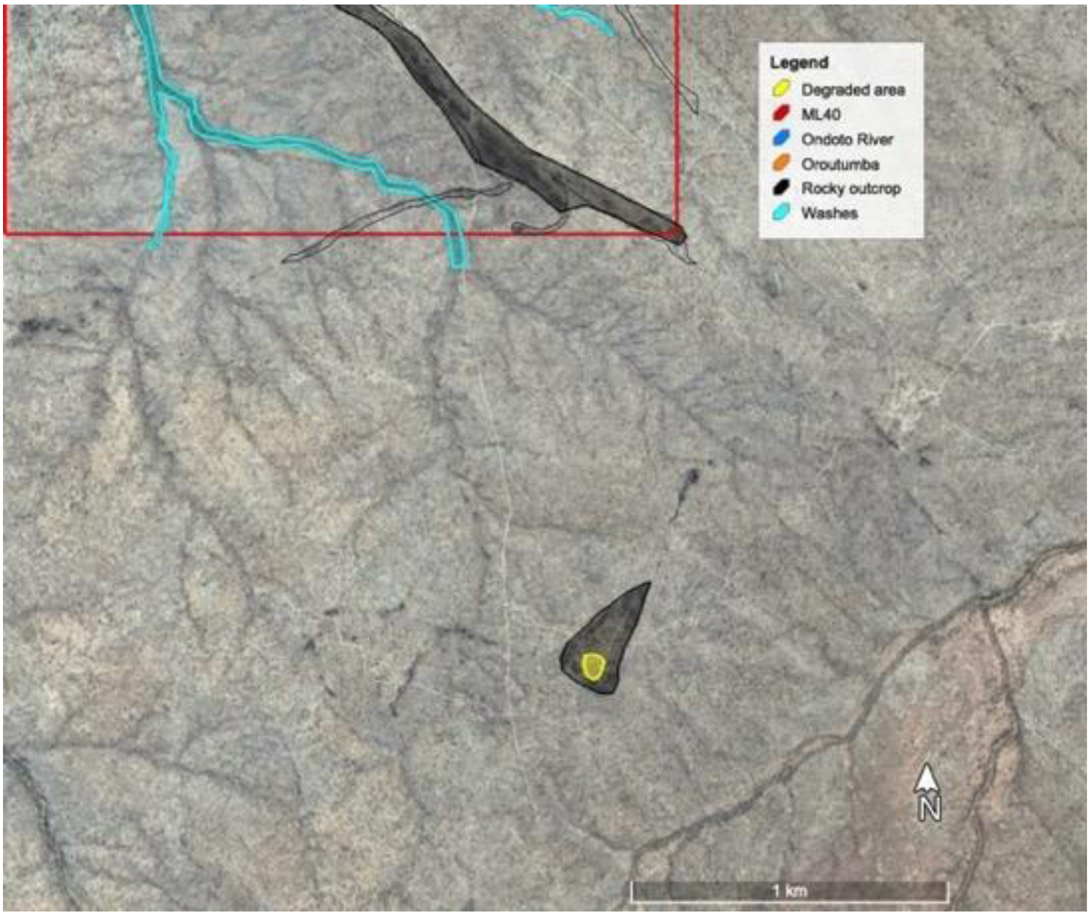

Figure 3. Rocky ridge with quarry south of ML40.
At the request of the client the ridge was included for assessment in this report.

2.2.1 Mopane scrub

The largest part of ML40 consists of open Mopane scrubland. The topography is gently undulating, bisected by drainages and ridges topped with rocky outcrops. In the east and southeast of the study area the profile is flatter (Figure 4 and Figure 5) than in the west and northwest, where there are more and steeper rocky ridges (Figure 6).

The vegetation structure varies slightly from west to east, broadly corresponding to changes in topography with larger Mopane trees and some Commiphora species in the western parts of the study area (Figure 6). In the east and southeast *Colophospermum mopane* form a scrubby open woodland of homogenous height and structure, interspersed with *Catophractes alexandri*. The substrate consists of loose stones and gravel on packed sand.

Mopane trees are interspersed with *Terminalia prunioides*, *Boscia microphylla, Commiphora multijuga* and other *Commiphora* species, as well as *Ceraria pedunculata* and *Gymnosporia senegalensis*. The understorey is sparse, and grass was the only ground cover observable at the end of winter, but more annual plant species are expected to appear after rain.

This habitat has been modified by human activities such as harvesting and livestock grazing. Both these activities are current and ongoing, and the village Oroutumba is located in a degraded area in Mopane scrub abutting the Ondoto River. Roads and accessory works will be located in this habitat.

It is considered the least sensitive habitat, but care should be taken to maintain the natural flow patterns of surface water in all drainage lines.

Figure 4. Mopane scrub in the southeast part of ML40.

Figure 5. Mopane scrub in the western part of ML40. Telecommunication tower on hill crest.

Figure 6. *Commiphora multijuga* in Mopane scrub.

2.2.2 Rocky outcrops

This habitat occurs at the top of ridges in ML40 (black in Figure 2 and Figure 3), and closely follows fenitisation in the area.

The vegetation structure is layered, providing resources for a variety of animal taxa. A ground cover of grass was observed and although no forbs were present, they will appear in summer and after rain (Figure 8, Figure 9 and Figure 11). There is a sub storey of shrubs and a well-developed upper storey of trees, dominated by *Colophospermum mopane* and including *Terminalia prunioides, Commiphora mutlijuga*, several other *Commiphora* species, *Sterculia quinqueloba, Sterculia africana, Moringa ovalifolia, Rhigozum virgatum, Boscia albitrunca, Boscia microphylla, Boscia foetida and Ceraria longipedunculata*.

It is highly likely that three recently described plant species of conservation concern could occur in the rocky outcrops: *Maerua sebrabergensis*, *Erythrococca kaokoensis* and *Ocimum sebrabergensis*, since the rocky ridges contain black and grey anorthosite rocks similar to the locations in the Zebra Mountains where these three species were first found.

The rocky outcrops present both abundance and richness of plants that are much higher than those of the surrounding scrubland, contributing to the ecological value of this habitat. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals (Swanepoel, 2015), further increases the sensitivity of the rocky ridges.

Sodalite and the rare earth minerals are located in this habitat; it is where mining will be done and where most of the irreversible impacts (drilling, blasting and open cast mining) will take place.

Figure 7. Mopane scrub in the foreground rising to a rocky outcrop.

Figure 8. Rocky outcrop habitat.

Figure 9. The near-endemic Moringa ovalifolia on a rocky outcrop in the western half of ML40.

Figure 10. Boulders, rocks, shrubs and detritus.

Figure 11. Hillside leading up to a rocky ridge, showing a layered variety of vegetation and substrates.

The ridge south of ML40 (Figure 3) was included for assessment in the site visit and this report. It represents a valuable habitat for various taxa surrounded by heavily grazed Mopane scrub, but earthmoving equipment has left the top of the ridge denuded (Figure 13).

Figure 12. Commiphora spp and Rhigozum brevispinosum
This is an undisturbed part of the hill south of ML40 (Figure 3), showing a well-structured plant assemblage with a diversity of species and providing habitat for invertebrate and vertebrate taxa. Compare this with the denuded hilltop where mining has taken place (Figure 13).

Figure 13. Peak of the hill south of ML40.
Topsoil and vegetation were removed en masse by earthmoving equipment.

2.2.3 River/drainages

The Ondoto River crosses the study area for less than a kilometre, but it is an important habitat in terms of both the study area and the region because of two reasons. Firstly, the drainages on ML40 empty into the river and from here it is only six km from where it flows into the Kunene River. Secondly, it is an important source area of high diversity in an arid landscape and a resource during drought years. Any activity in the catchment (i.e. ML40) will affect the ecology of the Ondoto and Kunene rivers.

At this point the river is wide with a rock face on its east bank and a flood plain to the west (Figure 15 and Figure 16). This stretch of the river and its banks contain sparsely distributed large trees, few shrubs and ground cover in the form of annual plants such as grasses and forbs are expected to appear in summer and after rain. The substrate is sandy, with scattered rocks and boulders and a shallow stream (Figure 14).

The river is an important resource for the Oroutumba community, and it has been modified by historic and current human activities such as grazing and harvesting. Cattle and goats were observed in the river, as well as daily human household activities (water collection, laundry and playing children).

As part of the Environmental Assessment for the project, a specialist hydrology-hydrogeological study is being conducted on ML40 and associated mining and processing components.

Figure 14. View northwest across the Ondoto River.

Figure 15. Mature trees in the riverbed, including Hyphaena petersiana, Faidherbia albida and Ficus sycomorus.
Heavily utilised west bank in the foreground.

Figure 16. Steep, rocky east bank of the river with *Aloe littoralis*.

After rainfall events, surface water runs via ephemeral drainages from the ridges and outcrops to two large washes and eventually into the Ondoto River. The washes are expected to have surface water after rain and likely contain groundwater that sustains assemblages of perennial vegetation that are more diverse (both floristically and structurally) than the vegetation in the surrounding landscape (Figure 17, Figure 18 and Figure 19). The substrate in this habitat consists of sand, gravel and rocks, providing habitat for burrowing reptiles and for small mammals and reptiles that rely on rocks for shelter.

Plant species in the riverbed and on its banks include Faidherbia albida, Acacia erioloba, Ficus cordata, Ficus petersii, Combretum imberbe, Ziziphus mucronata, Aloe littoralis, Acacia reficiens, Hyphaene petersiana, Boscia albitrunca, Combretum apiculatum, Gymnosporia senegalensis.

In the smaller drainages, vegetation is dominated by Colophospermum mopane and also present are Acacia nilotica, Acacia reficiens, Terminalia prunioides, Commiphora multijuga and Combretum apiculatum.

Riverine and drainage habitats present a high ecological value for most taxa and are considered very sensitive. Blocking of surface and/or groundwater flow will result in loss of perennial plant species and a reduction in the resources, such as food, shelter and soil stabilisation for burrows that they represent to other trophic groups.

Development that is planned in this habitat includes linear structures such as roads, pipeline and power line that will cross drainages. In the Ondoto River, a new well and pump to provide water to the accessory works area (Figure 20) are planned developments.

Figure 17. Large drainage southeast of ML40.
This drainage contains dense stands of large Mopane trees, as well as mature *Acacia nilotica* and *Acacia tortilis*.

Figure 18. Small drainage near Oroutumba.
It shows a sandy-gravel substrate and higher canopy than surrounding Mopane scrub.

Figure 19. Small drainage in the east of ML40.
Here is a gravel and rocky substrate, and the vegetation is somewhat denser and more diverse than the surrounding scrubland.

2.3 Species of conservation concern

Species are potentially of conservation concern when they are endemic or near endemic to Namibia, have a threatened Namibian or IUCN status, or are legally protected in Namibia.

The plants species that have been recorded in or that are expected to occur in and around ML40 are listed in APPENDIX II. The species list was drawn up mainly from data provided by the National Botanical Research Institute (National Herbarium of Namibia, 2020) for quarter degree squares 1713 BC and 1713 BD (which include ML40), as well as from observations made during the site visit and from perusing distribution maps and habitat descriptions in the sources listed in section 1.4.1.

The results of the vegetation study are summarised in Table 1. The table contains the following headings and abbreviations:
Endemism: End = endemic, Near End = near endemic.
Namibia Legal: species that are legally protected by Namibian laws or regulations. FA = Forestry Act 12 of 2001, NCO = Nature Conservation Ordinance 4 of 1975.
Red Data: Red Data Book of Namibian Plants (Loots, 2005) as updated by Sonja Loots in personal communication (November 2020). DD = Data Deficient, VUL = vulnerable, NT = near threatened, CRIT = critically endangered
CITES: Convention on International Trade in Endangered Species of wild fauna and flora. Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.
IUCN: International Union for Conservation of Nature. DD = Data Deficient, VUL = vulnerable, NT = near threatened, CRIT = critically endangered.

Table 1. Plant species of conservation concern

SPECIES NAME	ENDEMISM	NAMIBIA LEGAL	RED DATA	CITES	IUCN
Abrus kaokoensis	End				
Adenium boehmianum		FA			
Aeollanthus namibiensis	End				
Aloe littoralis		NCO		Appendix II	
Aloe zebrina		NCO		Appendix II	
Berchemia discolor		FA			
Boscia albitrunca		FA			
Bridelia tenuifolia			DD		
Cassia abbreviata			DD		
Ceraria longipedunculata	End			Appendix II	
Cleome laburnifolia	End				
Combretum collinum			DD		
Combretum imberbe		FA			
Combretum oxystachyum			DD		
Commiphora crenato-serrata	Near End				
Commiphora glaucescens	Near End				
Commiphora multijuga	Near End				
Commiphora oblanceolata	Near End	FA			
Diospyros mespiliformis		FA			
Entandrophragma spicatum		FA			
Erythrococca kaokoensis	End		VUL		
Euphorbia monteiroi				Appendix II	
Euphorbia subsalsa				Appendix II	
Ficus sycomorus		FA			
Gossypium anomalum					NT
Kohautia azurea	End				
Kohautia cynanchica		NCO			
Maerua sebrabergensis	End		CRIT		
Moringa ovalifolia		NCO, FA			
Ocimum sebrabergensis	End		VUL		
Pachypodium lealii	Near End	NCO, FA		Appendix II	
Sclerocarya birrea		FA			
Sterculia africana		FA			
Sterculia quinqueloba		FA			
Ziziphus mucronata		FA			
TOTALS	13	17	7	6	1

Three recently described species, *Maerua sebrabergensis*, *Erythrococca kaokoensis* and *Ocimum sebrabergensis* are known only from a few specimens collected in the Zebra Mountains but they are likely to be found on the ridges and rocky outcrops in ML40 as well.

The fact that they were found and described as recently as 2015 and 2019 illustrates both the importance of the Kaokoveld Centre of endemism and how under-collected it is in terms of herbarium specimens. This is largely a result of the remoteness and inaccessibility of much of the region and of the Zebra Mountains specifically.

3 IMPACT ASSESSMENT

The criteria that were used to assess possible impacts and to determine their significance follow the adapted Hacking method and are given in Table 2.

Table 2. Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		Significance = consequence x probability
Definition of CONSEQUENCE		Consequence is a function of severity, spatial extent and duration
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M +	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H +	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE					
			SEVERITY = L		
DURATION	Long term	H	Medium	Medium	Medium
	Medium term	M	Low	Low	Medium
	Short term	L	Low	Low	Medium
			SEVERITY = M		
DURATION	Long term	H	Medium	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Low	Medium	Medium
			SEVERITY = H		
DURATION	Long term	H	High	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Medium	Medium	High
			L	M	H
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	H	Medium	Medium	High
	Possible/ frequent	M	Medium	Medium	High
	Unlikely/ seldom	L	Low	Low	Medium
			L	M	H
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	Decision guideline
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

The location and layout of the planned support infrastructure are given in Figure 20. The map also shows the water pipeline option drawing water from the Ondoto River. This information was not available at the time of the site visit and the impact assessment of infrastructure could not be verified on the ground.

The planned electricity powerline and water pipeline option drawing water from the Kunene River are shown in Figure 21 and are included in the impact assessment in this section.

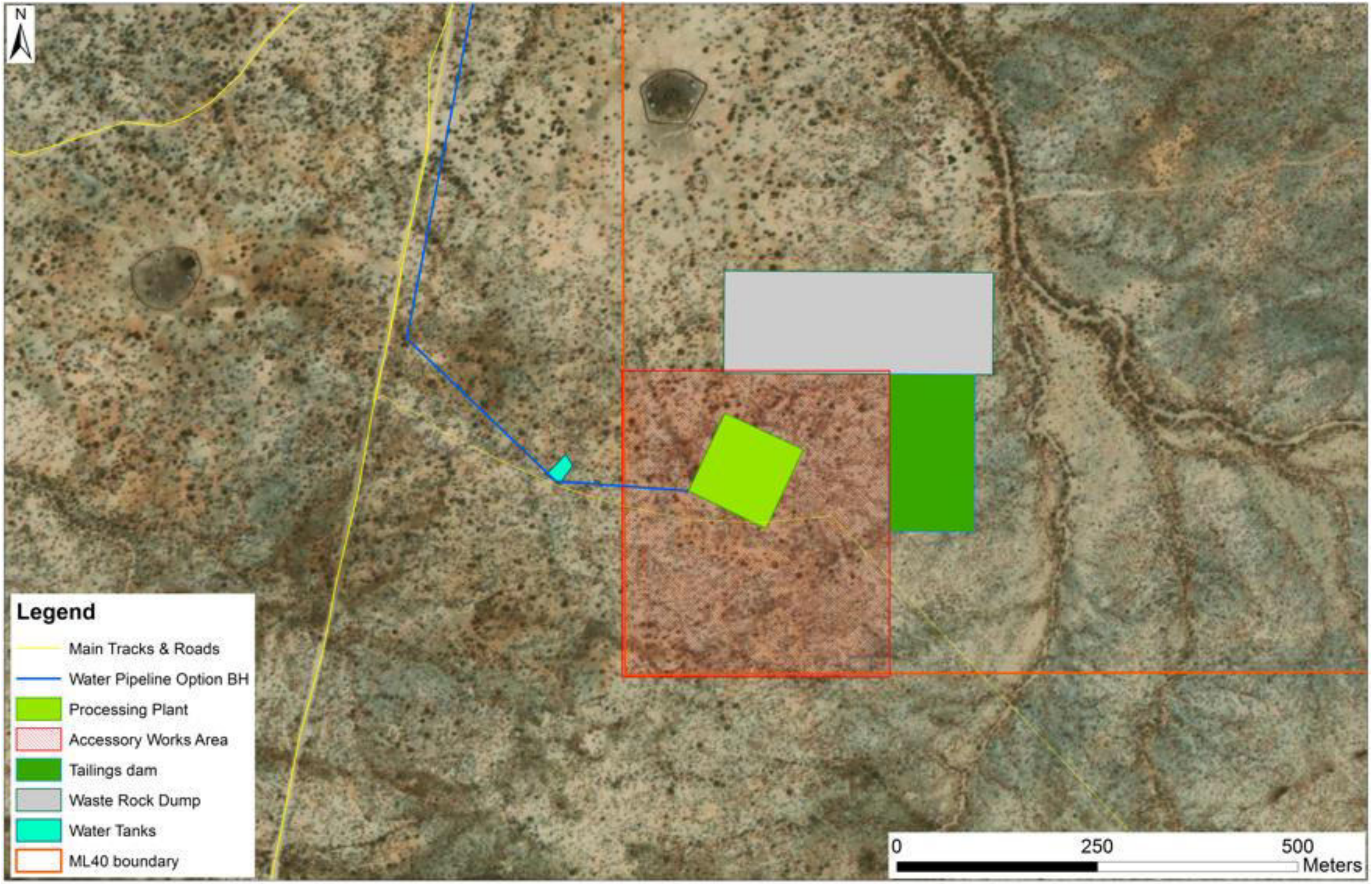

Figure 20. Proposed layout of infrastructure.

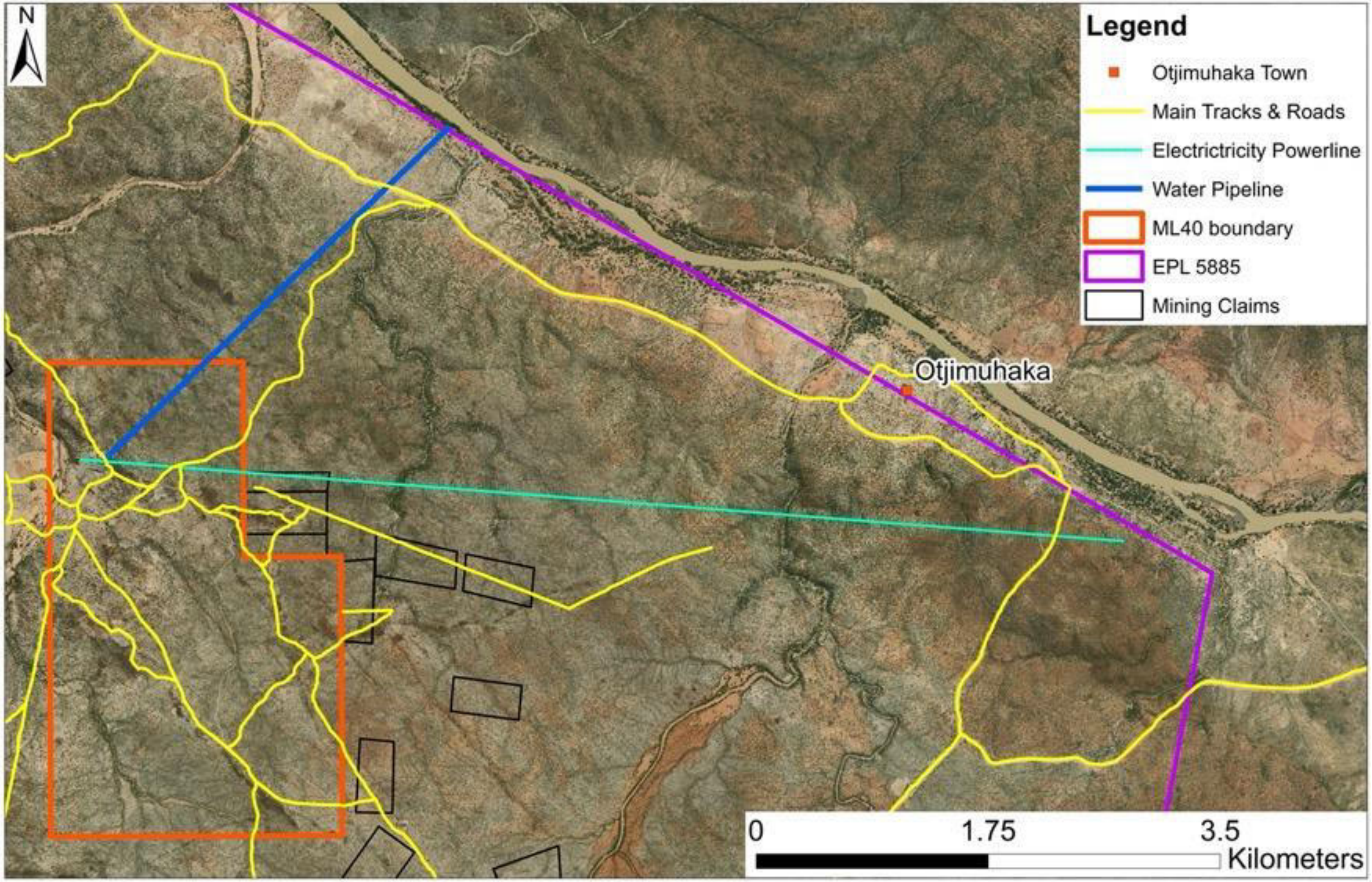

Figure 21. Proposed linear infrastructure.

IMPACT 1 DESTRUCTION OF PLANTS AND HABITATS
SOURCE OF IMPACT During construction: Construction and use of roads by vehicles and machinery. Clearing of land; laydown areas; water tanks. Construction of infrastructure and accessory works area (waste rock dumps and tailings storage facility). Water pipeline and power line construction and maintenance. Accommodation for construction staff. Human activities and vehicle movements.
During operations: Use of roads by vehicles and machinery. Excavation of earth by heavy machinery, drilling and blasting. Dumping of waste rock. Human activities and vehicle movements.
RESULT OF IMPACT Cumulative impact: mining in Kunene Region, especially on ecologically valuable rocky ridges and outcrops. Loss of plants and decline in habitat quality. Dust causes a decline in air quality and creates conditions for health decline in plants and animals.
MANAGEMENT/MITIGATION MEASURES Keep the overall development footprint as small as possible. The extent and location of the construction site should be fenced, and all construction activities should take place within the fence. Adherence should be strictly enforced. Roads, pipelines and power lines must be planned in order to minimise fragmentation or disturbance of habitats. Anti-erosion measures must be taken where roads and tracks cross a wash or drainage. Carefully plan the placement of stockpiling construction material so as to avoid sensitive areas. Limit construction activities to daytime hours to reduce noise. Educate construction and permanent staff as to their environmental obligations. All contractors should be held responsible for transgressions and significant penalties should be levied in order to ensure compliance. Position temporary construction infrastructure (e.g. accommodation) in areas that will definitely be disturbed during operations. Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks. Do not put water tanks, power pylons or any other large infrastructure in the river or washes. No sewerage overflow or French drain may be placed within 100 m of a wash or river. Reptiles and amphibians that are exposed during ground clearing should be captured for translocation by a qualified expert. No collection of plants should be allowed. No fires should be allowed. A comprehensive restoration plan should be drawn up by an expert BEFORE construction commences, at least at conceptual level, and should make provision for monitoring and adaptive management as the project develops. Some rehabilitation actions should be

IMPACT 1 DESTRUCTION OF PLANTS AND HABITATS
implemented during operations in order to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later; road and pipeline locations.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Medium
SPATIAL SCALE	Medium	Low
DURATION	High	Medium
CONSEQUENCE	High	Medium
PROBABILITY	Medium	Medium
SIGNIFICANCE	High	Medium

IMPACT 2 ALTERATION OF TOPOGRAPHY

SOURCE OF IMPACT

Construction and operational phases.

Excavation of the ore bodies leaves deep, open pits, caused by drilling, blasting and open cast mining and the use of equipment such as excavators, compressor driven drill rigs and cutting machines.

The processing plant and waste stockpiles result in large heaps of material deposited on the ground.

RESULT OF IMPACT

This is a cumulative impact of mining in the Kunene Region.

Irreversible alteration of the ecologically valuable rocky ridges.

This impact may affect ecosystems.

Direct destruction of plants and habitat (see Impact 1).

Fragmentation of habitat, leading to the disruption or loss of colonisation pathways for seed dispersal, in turn resulting in the loss of individual organisms and potentially populations.

MANAGEMENT/MITIGATION MEASURES

It may not be possible to rehabilitate the mining sites significantly, but a comprehensive restoration plan would mitigate impacts to some extent.

A comprehensive restoration plan should be drawn up by an expert BEFORE operation commences. See impact 1.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Medium
SPATIAL SCALE	Medium	Low
DURATION	High	Medium
CONSEQUENCE	High	Medium
PROBABILITY	High	Medium
SIGNIFICANCE	High	Medium

IMPACT 3 GROUNDWATER DRAWDOWN
SOURCE OF IMPACT Abstraction of water from the Ondoto River for drilling, mining, ore processing and human consumption.
RESULT OF IMPACT River vegetation is dependent on groundwater to some extent. Of particular concern are woody species in the Ondoto River and drainages, e.g. *Acacia erioloba, Faidherbia albida and Ficus spp.* Deterioration of the drainage and river habitat has negative impact on biodiversity outside the boundaries of the project site, specifically the Kunene River.
MANAGEMENT/MITIGATION MEASURES Conduct a specialist hydrogeological study for the project. Monitor groundwater levels. Monitor plant and vertebrate diversity downriver from the abstraction site at a minimum once a year. Ensure sustainable water supply to the project based on the findings of the hydrogeological study.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Medium	Medium
DURATION	Medium	Medium
CONSEQUENCE	Medium	Low
PROBABILITY	Medium	Low
SIGNIFICANCE	Medium	Low

IMPACT 4 CONTAMINATION OF SOIL AND WATER
SOURCE OF IMPACT Chemicals used in the processing of ore, e.g. radioactive thorium, escape containment and contaminate the soil, surface and groundwater.
RESULT OF IMPACT Chemicals leach into soil, causing contamination of soil and eventually groundwater. Effects of chemicals are cumulative and build up in groundwater over time. Once in the groundwater, there is the potential for contamination to spread beyond site boundaries. The Kunene River is an internationally important ecological feature that could potentially be directly affected.
MANAGEMENT/MITIGATION MEASURES Conduct specialist work on element mobilisation from the different types of ore and waste rocks. Containment measures should be strictly enforced to the highest existing standards in the mining industry. Constant monitoring of open bodies of water and their associated pipes, lining and covers is essential to ensure that there is no malfunction, tear or opening. Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Medium	Low
DURATION	High	Low
CONSEQUENCE	High	Low
PROBABILITY	Medium	Low
SIGNIFICANCE	Medium	Low

4 SUMMARY AND RECOMMENDATIONS

Four impacts were identified, two of which have a medium significance that becomes low after mitigation. Impact 1 (destruction of organisms and habitats) and impact 2 (alteration of topography) both have high unmitigated significance, decreased to medium significance by the stringent application of management measures.

The cumulative nature of mining activities in the Kunene Region and in the Kaokoveld Centre of Endemism, the irreversible damage to the rocky ridges (sensitive, ecologically valuable habitat) and the persistence of excavations after the lifespan of the mine are three factors that decrease the likelihood of impacts 1 and 2 to be mitigated to low significance. However, the strict implementation of mitigation measures and a professional restoration plan can improve the situation significantly for some habitats and aspects such as the accessory works, linear infrastructure, tailings facilities and waste rock dumps.

It is important to keep the overall project footprint to the absolute smallest size possible, and to keep it inside well-defined and clearly demarcated boundaries by putting up visible and effective signs, and fencing the operational area where possible, such as the accessory works and tailings facilities. The purpose of a fence and signs is to inform personnel and contractors of the exact boundaries of the operations area and to effectively control access to areas that will remain undeveloped. Fences and signage go hand in hand with appropriate environmental training and awareness raising of staff, and of contractors and their staff.

A key habitat is the rocky outcrops that support many species that would otherwise not be present. As mineral-bearing ore is located almost exclusively on the ridges and rocky outcrops, restoration of this habitat after mining operations will not be possible. To mitigate the loss of these outcrops, a botanical expedition is recommended in section 4.1. to identify the most important sites and sacrifice the other less sensitive areas and to confirm the degree to which habitat destruction would affect the overall plant diversity of the greater area.

The Ondoto River is considered very sensitive and apart from the proposed borehole and water pipeline, no development should take place there. During operations it should be designated a no-go area, except essential maintenance to the borehole and pipeline. The natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network, power line, water pipeline and any other linear development. Waste rock dumps and tailings facilities should be placed where least impact on diversity would occur, preferably in the mopane scrub towards the east if possible)

For a restoration programme to be effective, it is essential that it be implemented from the earliest possible time after the construction phase, and throughout the operational phase where possible. The protection of source areas from where seeds and organisms will originate to re-colonise the disturbed areas is a crucial aspect of restoration, and source areas need to be identified and protected from the planning phase, throughout operations and during decommissioning and closure. Accurate financial projections need to be made, and financial mechanisms for implementing restoration measures should be put in place before operations. The restoration plan should be developed by an expert in conjunction with the mine planners and engineers, and it should be fully integrated with the mine’s EMP during the first three years of the clearance period.

4.1 Botanical survey

In the light of the irreversible damage that will be done to the sensitive rocky outcrops and the cumulative nature of the impacts of mining in the Kunene Region, it is proposed that the NBRI conduct a full-scale botanical survey. Such an investigation is considered an essential part of mitigation and will inform the restoration planning and EMP amendments during the first three years of the clearance period.

The aims of the expedition will be:

- Record and assess the taxa that are likely to be affected by the development.
- Collect seeds and/or cuttings of vulnerable species and transplant valuable specimens if feasible.
- Make recommendations for the restoration plan and EMP in cooperation with other specialists and the mine planners.

It is recommended that the survey of ML40, in particular the rocky outcrops, be conducted in summer and that it be done in cooperation with the NBRI. Because of its remoteness, the region is under-surveyed and under-collected and the participation of the NBRI will not only ensure a comprehensive baseline understanding of the existing environment, but also provide a community service by making the data available to the public.

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APPENDIX I. PROJECT DESCRIPTION

The proposed activity focuses on the specific resources of sodalite, iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the ML40 and any claims that the Proponent currently has rights to.

By the Minerals (Mining and Prospecting) Act of 1993 sodalite is categorised in the commodities of dimension stones and semi-precious stones. The mineralisation is unique in Namibia. Sodalite occurs in bright colours (mostly blue), making it a sought-after mineral and that is well known in the dimension stone and also in the semi-precious stone trade for carvings and jewellery. Worldwide, significant deposits are restricted to only a few localities in Canada and the US, Brazil and Bolivia in South America and in Burma and Russia.

Besides the sodalite, lenses and plugs of iron-titanium-oxides occur within ML40. Additionally, narrow, dykes and veins, up to 1 metre wide and with lengths of up to approximately 200m constitute zones of rare earth mineralisation. Both these types of mineralisation, iron and rare earth, belong to the class of base and rare metals.

If purely looking at the available rock material within the mining licence, the estimated mining lifespan could be more than 50 years. However, for this assignment an estimated mining lifespan of up to 25 years is considered.

The following is the summary of envisaged development with mining and processing activities that are expected to be undertaken by the project Proponent during different project development phases.

Construction Phase Activities

This will comprise of the following:

1. Construction of roads (internal within the Mining Licence) and upgrading an access road from the mine to the main road to the north
2. Construction of a new processing facility for iron and rare earth ore
3. Construction of a tailings storage facility
4. Construction of a water pipeline from the Kunene river to the processing plant
5. Construction of a powerline from Otjimuhaka sub-station to the processing plant
6. Construction of fencing as required

The potential route of the water pipeline and electrical powerline can be found in Figure 4. This EIA will review these routes and other potential alternatives for the Proponent to consider as better options from an environmental perspective. The new processing plant, tailings and rock dumps may need to be located at another site and not the existing sodalite processing area due to its close proximity to the Ondoto community. The reason for this is the presence of trace amounts of radioactive thorium which after processing of the ore would become concentrated and potentially dangerous to humans.

Solid non-mineral waste will be removed off site and taken to the nearest rubbish dump either in Otjimuhaka or Ruacana depending on the nature of the waste. Ablution facilities will use sealed septic tanks or a sewage treatment plant. Sewerage sludge will be taken to the Ruacana sewerage plant periodically. Prior to the construction of a new power line, the projects’ electricity requirements will rely on diesel generators. Construction staff will be accommodated on site at a temporary camp.

Security will be supplied on a 24-hour basis at the mine and construction sites. Support services and any facilities established during the construction phase will either be removed at the end of this phase or incorporated into the project's operational phase.
It is anticipated that the proposed construction will commence immediately after receiving the ECC from the MEFT and the relevant permits and licences have been issued by the different regulatory bodies.

Operational Phase Activities

Mining
Operation will entail mining, i.e. drilling and blasting of rock outcrops and open cast mining with diamond cutting equipment to extract industrial size blocks of dimension stone. Mining techniques will make use of modern equipment such as excavators, diamond wire saw, circular diamond cutting machines, compressor driven drill rigs, jack hammers and dump trucks. Open cast mining will be established according to good practice procedure. Photo 2 below shows two examples of these types of mine machinery. The mining operations comprise of the phases including site clearing, excavations – by means of drilling and blasting, digging, block cutting, removing and haulage of rock to processing plant and storage yard.

Multiple quarries (i.e. wedge, terrace or trench shaped) will be mined at various places within ML40. Quarry depth will be to about 40 m. Approximately 8,000 t of ore is expected to be removed from the ground and processed on a monthly basis. For all types of mineral ore the excavations are planned to a maximum stripping ratio of 1 : 15. Overall the maximum or total estimate of waste rock produced will be 1.5 million tons annually. Mineral waste will be deposited in waste rock dumps and a tailings storage facility.

Mineral Processing
KNL wants to establish central processing facilities for dimension stone, iron ore and for rare earth mineralisation, all of which occur within the Mining Licences and to some extend also on other surrounding mineral licences.

For dimension stone, in particular for the processing of sodalite mineralisation, blocks are trimmed with a diamond rope machines and cut into slabs. Smaller blocks and boulders are trimmed and cut in slabs and tiles; Smaller lumps and boulders of sodalite rock are stockpiled and sold as ornamental stones.

For iron and rare earth mineralisation the ore is drilled and blasted and removed from the ground in opencast quarries. To concentrate the valuable mineral content the following process is envisaged.
The iron ore processing from the Run-of-Mine ore:

I. Run-of-Mine ore crushed to <25 mm
II. screen for size classification
    a) fraction 40 to 25 mm: scan / sorting separation
    b) fraction less 25: magnetic separation

After mining of the rare earth containing rock processing will occur as follows:

I. Run-of-Mine ore crushed to <25 mm

II. screen for size classification
   a) fraction 40 to 25 mm: scan / optical sorting separation
   b) fraction 25 to 6 mm: magnetic sorting
   c) fraction less 6 mm: gravity separation process using limited amounts of water
III. Milling of concentrate
   a) Flotation, using limited amounts of water
   b) leaching of gangue carbonate, using limited amounts of water

Mining has taken place in a number of small quarry areas within ML40. Up to 90 ha of footprint size are envisaged for the accessory works area to accommodate the processing, tailings disposal, product storage, loading facilities, offices, security and workshop facilities within the mining licence area.

At a maximum monthly production of 5,000 t a total of 139 truckloads at 36 t would transport product each month. That is 5 trucks each day. The product would be transported along the gravel road to Ruacana and thereafter along the tar roads to the port of Walvis Bay.

As mentioned already, the EIA will make suggestions as to the location and layout of the accessory works areas based on the findings of the various specialist studies.

Infrastructure Development

KNL presently abstracts ground water from a soft sediment water compartment in the Ondoto river. Gensets are used for power generation. Development of linear infrastructure for pumping water from the Kunene river as well as establishing a new conductor path transmission line from Nampower's Swartbooisdrift substation to the accessory works area are envisaged and therefore form part of the scope for the Environmental Scoping Study.

The new tailings storage facility (including the design) will be located in accord with the recommendations of the EIA.

Waste rock dumps will be located alongside quarries, pits and trenches and where least impact on flora and fauna is expected. They could be potentially used in landscaping during rehabilitation during decommissioning of the same quarries, pits or trenches.

Other infrastructure required and foreseen for the project development are offices and accommodation for a small portion of the work force.

Product Transport

Blocks of dimension stone, lumps of ornamental stone or concentrates of base and rare earth metal products are to be transported as bulk cargo as well as in bagged form. The viability of any mining operation, just like most industries, is particularly sensitive to the logistics concerned with getting the product to market. Different options are presently being investigated for the transport of the products to the harbour of Walvis Bay.

Bulk bags on low-bed trucks or bulk road transport with loads up to 67 tons are envisaged to take the products on the public road infrastructure from the mine site to the harbour of Walvis Bay. Various studies have been undertaken to support the usage of such trucks including road wear analyses, modelling of a tractor-trailer design, bridge assessments.

Decommissioning Phase Activities

The estimated life of the mine is set at 25 years currently. Decommissioning activities will include the removal of infrastructure, preparation of final landforms for closure and to rehabilitate roads and other linear infrastructure where necessary

APPENDIX II. LIST OF PLANT SPECIES

The list was compiled from data supplied by the NBRI on Quarter degree squares 1713 BC and 1713 BD, as well as from personal observation during the site visit.

Endemism: End = endemic, Near End = near endemic.
Legal: species that are legally protected by Namibian laws or regulations. FA = Forestry Act 12 of 2001, NCO = Nature Conservation Ordinance 4 of 1975.
Red Data: Red Data Book of Namibian Plants (Loots, 2005) and augmented by personal communication with Sonja Loots (November 2020). DD = Data Deficient, VUL = vulnerable, NT = near threatened, CRIT = critically endangered
CITES: Convention on International Trade in Endangered Species of wild fauna and flora. Appendix II includes "species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilisation incompatible with their survival".
IUCN: International Union for Conservation of Nature. DD = Data Deficient, VUL = vulnerable, NT = near threatened, CRIT = critically endangered.

		Conservation Status			
SPECIES NAME	ENDEMISM	NAMIBIA LEGAL	RED DATA	CITES	IUCN
Abrus kaokoensis	End				
Acacia mellifera					
Acacia senegal					
Acacia sieberiana					
Acalypha ciliata					
Acrachne racemosa					
Adenium boehmianum		FA			
Aeollanthus namibiensis	End				
Albizia tanganyicensis					
Alectra orobanchoides					
Aloe littoralis		NCO		Appendix II	
Aloe zebrina		NCO		Appendix II	
Ammannia auriculata					
Ammannia baccifera					
Amphiasma benguellense					
Anticharis senegalensis					
Argemone ochroleuca					
Astripomoea lachnosperma					
Balanites angolensis					
Barleria elegans					
Barleria mackenii					
Barleria prionitis					
Barleria sp.					

		Conservation Status			
SPECIES NAME	ENDEMISM	NAMIBIA LEGAL	RED DATA	CITES	IUCN
Bauhinia petersiana					
Berchemia discolor		FA			
Bergia polyantha					
Boscia albitrunca		FA			
Boscia microphylla					
Boscia mossambicensis					
Bridelia tenuifolia			DD		
Cassia abbreviata			DD		
Catophractes alexandri					
Cenchrus ciliaris					
Ceraria longipedunculata	End			Appendix II	
Chlorophytum galpinii					
Chrysopogon nigritanus					
Cienfuegosia digitata					
Cleome foliosa					
Cleome gynandra					
Cleome laburnifolia	End				
Clerodendrum glabrum					
Cocculus hirsutus					
Combretum apiculatum					
Combretum celastroides					
Combretum collinum			DD		
Combretum imberbe		FA			
Combretum oxystachyum			DD		
Commelina forskaolii					
Commiphora crenato-serrata	Near End				
Commiphora glaucescens	Near End				
Commiphora mollis					
Commiphora multijuga	Near End				
Commiphora oblanceolata	Near End	FA			
Commiphora tenuipetiolata					
Corchorus tridens					
Cordia monoica					
Crotalaria barnabassii					
Crotalaria heidmannii					
Crotalaria podocarpa					
Croton gratissimus					
Cryptolepis decidua					
Cyathula cylindrica					
Cyperus imbricatus					
Cyperus marginatus					
Cyphostemma ruacanense					

		Conservation Status			
SPECIES NAME	ENDEMISM	NAMIBIA LEGAL	RED DATA	CITES	IUCN
Diclis petiolaris					
Digitaria milanjiana					
Diospyros lycioides					
Diospyros mespiliformis		FA			
Diplorhynchus condylocarpon					
Elaeodendron transvaalense					
Eleusine indica					
Entandrophragma spicatum		FA			
Eragrostis lehmanniana					
Erythrococca kaokoensis	End		VUL		
Ethulia conyzoides					
Euclea divinorum					
Euphorbia guerichiana					
Euphorbia monteiroi				Appendix II	
Euphorbia subsalsa				Appendix II	
Euphorbia transvaalensis					
Ficus capreifolia					
Ficus petersii					
Ficus sycomorus		FA			
Fimbristylis squarrosa					
Gardenia volkensii					
Geigeria ornativa					
Gisekia africana					
Gossypium anomalum					NT
Grewia schinzii					
Grewia villosa					
Gymnema sylvestre					
Gymnosporia senegalensis					
Helichrysum candolleanum					
Heliotropium zeylanicum					
Hermannia modesta					
Hexalobus monopetalus					
Hibiscus rhabdotospermus					
Hiernia angolensis					
Hippocratea parvifolia					
Hydrostachys polymorpha					
Indigofera astragalina					
Indigofera flavicans					
Jamesbrittenia concinna					
Jasminum fluminense					
Kohautia azurea	End				
Kohautia cynanchica		NCO			
Lapeirousia otaviensis					

		Conservation Status			
SPECIES NAME	ENDEMISM	NAMIBIA LEGAL	RED DATA	CITES	IUCN
Leonotis nepetifolia					
Linzia glabra					
Litogyne gariepina					
Ludwigia adscendens					
Maerua sebrabergensis	End		CRIT		
Manilkara mochisia					
Marcelliopsis welwitschii					
Melanthera triternata					
Monelytrum luederitzianum					
Moringa ovalifolia		NCO, FA			
Nesaea ondongana					
Nuxia oppositifolia					
Ocimum sebrabergensis	End		VUL		
Oncocalyx welwitschii					
Ozoroa crassinervia					
Pachypodium lealii	Near End	NCO, FA		Appendix II	
Pavetta sp.					
Pavetta zeyheri					
Pavonia gossweileri					
Pechuel-loescea leubnitziae					
Persicaria attenuata					
Petalidium coccineum					
Petalidium huillense					
Phragmites mauritianus					
Polygala erioptera					
Pycreus pumilus					
Rhigozum brevispinosum					
Rhigozum virgatum					
Rhynchosia minima					
Rogeria adenophylla					
Rorippa humifusa					
Salix mucronata					
Salvadora persica					
Sansevieria pearsonii					
Sclerocarpus africanus					
Sclerocarya birrea		FA			
Senna occidentalis					
Sesamothamnus leistneranus					
Sesamum capense					
Sesamum pedalioides					
Sesamum schinzianum					
Sesbania sesban					
Sesuvium sesuvioides					

		Conservation Status			
SPECIES NAME	ENDEMISM	NAMIBIA LEGAL	RED DATA	CITES	IUCN
Setaria sagittifolia					
Solanum lichtensteinii					
Spermacoce senensis					
Sporobolus consimilis					
Sporobolus fimbriatus					
Steganotaenia araliacea					
Sterculia africana		FA			
Sterculia quinqueloba		FA			
Strophanthus amboensis					
Stylosanthes fruticosa					
Tacazzea apiculata					
Tephrosia burchellii					
Tephrosia oxygona					
Tephrosia uniflora					
Terminalia prunioides					
Triumfetta pentandra					
Tylosema fassoglense					
Urochloa sp.					
Vahlia capensis					
Vangueria infausta					
Xerophyta squarrosa					
Ximenia americana					
Zaleya pentandra					
Ziziphus mucronata		FA			

BIODIVERSITY STUDY AND IMPACT ASSESSMENT

Sodalite and rare earth minerals on ML40, Kunene Region

Prepared for:

Philip Hooks

October 2020

PROJECT	**Vertebrate baseline study and impact assessment: ML40 Sodalite mine**
CLIENT	**Philip Hooks**
DOCUMENT NAME	**Report**
DOCUMENT #	Draft 2
DATE	2020/12/21
AUTHOR	Henriette Potgieter Potgieter Consultancy CC PO Box 11867 Klein Windhoek

DISCLAIMER

ABBREVIATIONS

EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPL	Exclusive Prospecting Licence
IUCN	International Union for Conservation of Nature
KNL	KNL of Namibia (Pty) Ltd
MEFT	Ministry of Environment, Forestry and Tourism
ML40	Mining Licence 40
NBRI	National Botanical Research Institute
SABAP2	The Southern African Bird Atlas Project 2

Table of contents

Table of figures

List of tables

1 INTRODUCTION

1.1 Background

KNL of Namibia (Pty) Ltd (KNL) was granted Mining Licence 40 (ML40) in 1997. The company proposes to continue mining sodalite dimension stone, and to start the mining and processing of iron-titanium ore and rare earth minerals on ML40.

The project is located 130 km northwest of Opuwo and is accessed from the D3701. It is 2.5 km south of the Kunene River and 4 km southwest of Otjimuhaka in the foothills of the Zebra Mountains.

KNL commissioned Philip Hooks to do an Environmental Impact Assessment (EIA) according to the Environmental Management Act (Act. No. 7 of 2007) and its regulations. Philip Hooks requested Potgieter Consultancy CC to do a biodiversity study for the EIA, namely of the vertebrate taxa that might possibly occur on or near the project site. This document consists of a baseline vertebrate biodiversity report, followed by a biodiversity impact assessment report with suggested management/mitigation measures.

The project site falls within the Kaokoveld centre of endemism, a biogeographical region rich in endemic and range-restricted plants and animals (Craven, 2009), (Swanepoel, 2015) and (Swanepoel, 2019). Because of the remoteness of the region there is a dearth of data on biodiversity but recent discoveries of plants (Swanepoel 2015, 2019 and 2019) underline the conservation importance of the region. The cumulative impact of mining and other development in the arid zones of Namibia and Angola means that development in such areas should be planned responsibly, and management measures implemented and monitored diligently.

1.2 Terms of reference [1]

1. Site visit.
2. Baseline description of the vertebrate biodiversity of the project site: mammals, birds, reptiles and amphibians (excluding invertebrates).
3. Biodiversity impact assessment, including possible mitigation measures.

1.3 Assumptions and limitations

The site was visited for four days, which limited the field work to visual observations. Information on the taxa included in this report is based largely on existing literature. It is possible that some factors that could affect the persistence of species and/or composition of populations may have been overlooked during the site visit.

1.4 Methodology

1.4.1 Sources used

Species lists were compiled from specialised literature on the various taxa:

- **Mammals**: Griffin (1998), Griffin (2003), Skinner & Smithers (1990);
- **Birds**: Hockey et al. (2005); SABAP2 (2020); Simmons et al. (2015);
- **Reptiles**: Alexander & Marais (2007), Branch (1998), Griffin (2003);
- **Amphibians**: Griffin (1999), Griffin (2003), Du Preez & Carruthers (2009);

[1] Email from Philip Hooks dated 18 July 2020

The Catalogue of Life: 2019 Annual Checklist: http://www.catalogueoflife.org/annual-checklist/2019/details was consulted for the taxonomy of mammals, reptiles and amphibians.

Namibia Biodiversity Database (2020) was consulted for the Namibian conservation status of mammals, reptiles and amphibians.

The IUCN Red list (IUCN 2016) was consulted for the international conservation status of all species.

1.4.2 Site visit

A site visit was conducted for four days, 4 - 7 August 2020, to examine the nature of the habitats within and adjacent to the project area, and also to look at any ecological factors that might affect the presence of vertebrates. No systematic surveys were done in the short time available, but visible signs of the presence of vertebrate species were recorded, such as spoor, dung, nests, holes/burrows and pathways.

Notes were made of general vegetation structure and the potential role that vegetation could play in sustaining animal taxa. Trees and shrubs were identified as much as possible, but the timing (middle of winter) meant that many plants did not have leaves or other identifying characteristics.

Accessibility was good and the project site was comprehensively covered by vehicle and on foot, focusing on the fenitisation locations and mining sites as pointed out by the geologist on site. Visibility was clear for tens of kilometres.

1.4.3 Habitat categorisation

Potential habitat types were initially identified by inspecting the project site and the surrounding landscape on Google Earth Pro, and they were then reviewed during the site visit.

Habitats were categorised in terms of their functionality for fauna, and the descriptions are based mainly on topography, substrate and vegetation structure.

1.5 Study area

Figure 1 shows the study area (purple) for this report. It extends south beyond the border of ML40 (red) to include a magnetite/sodalite outcrop that is a potential mining site.

Maps and descriptions of the accessory works area and other infrastructure layout were not available at the time of the site visit, resulting in an assessment of these aspects with lower confidence levels.

Any study area in a biodiversity survey is affected by ecological features, processes and functions from the surrounding area. In this case the Kunene River (via the Ondoto River) is an essential ecological feature that will be directly affected by development, and in turn affects the biodiversity characteristics of the study area. This is particularly true of birds and amphibians that occur only along the Kunene River, but will utilise resources on ML40 in a seasonal cycle or opportunistically, since the study area is less than 2.3 km from the river.

When designating a study area for avifaunal data searches, a much wider margin around the project site is usually selected than for other taxa because it ensures more comprehensive data coverage. Birds range widely and utilise ephemeral or occasional resources in areas that are far from their central ranges, much more so than other taxa. In addition, the project site is located in an arid area where confirmed records of bird sightings are sparse. The study area for avifauna is shown in Figure 2, the white squares indicating the SABAP 2 pentads that were used as a source of species records for this report.

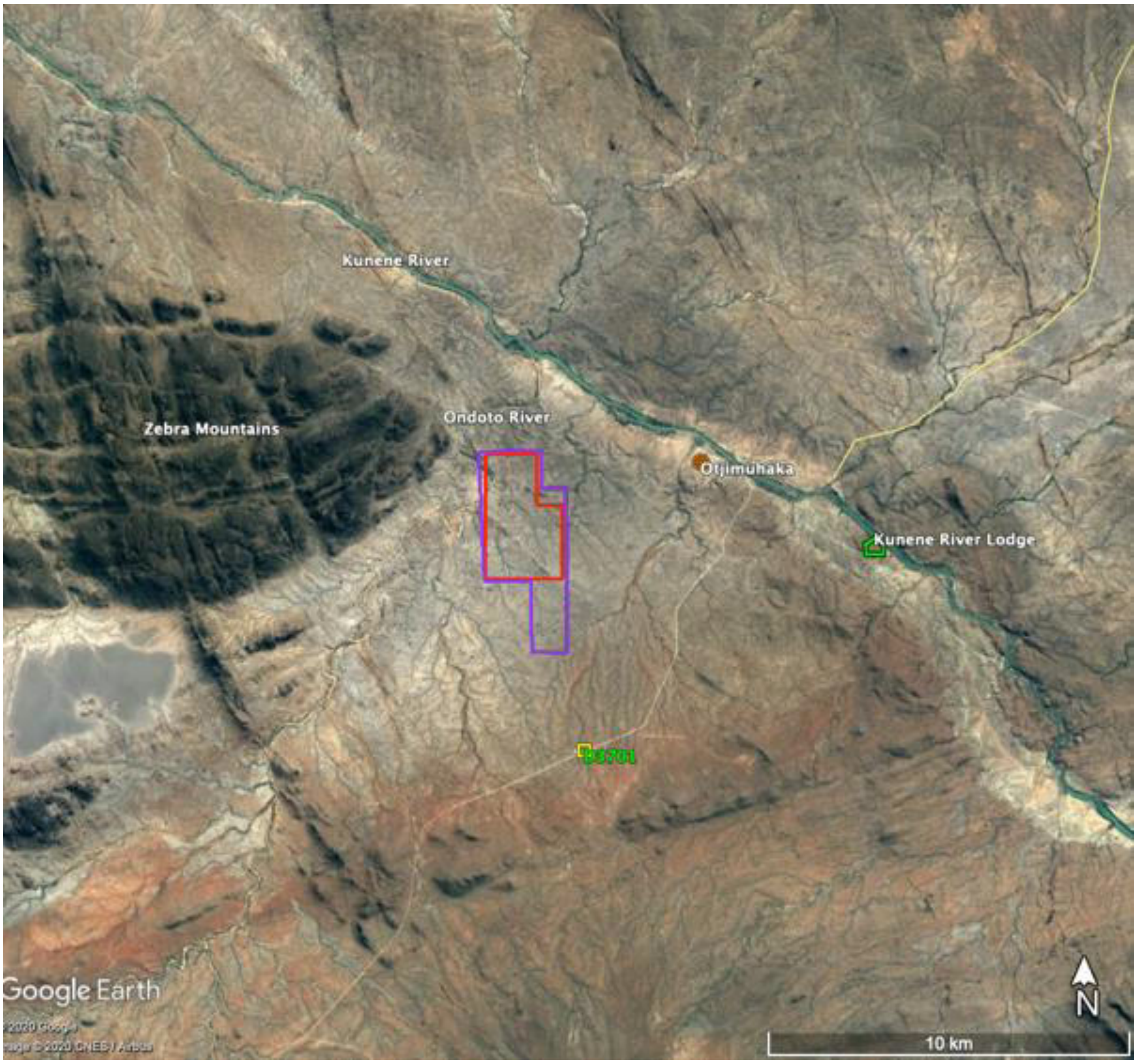

Figure 1. Location of the study area (purple outline) and ML40 (red outline).

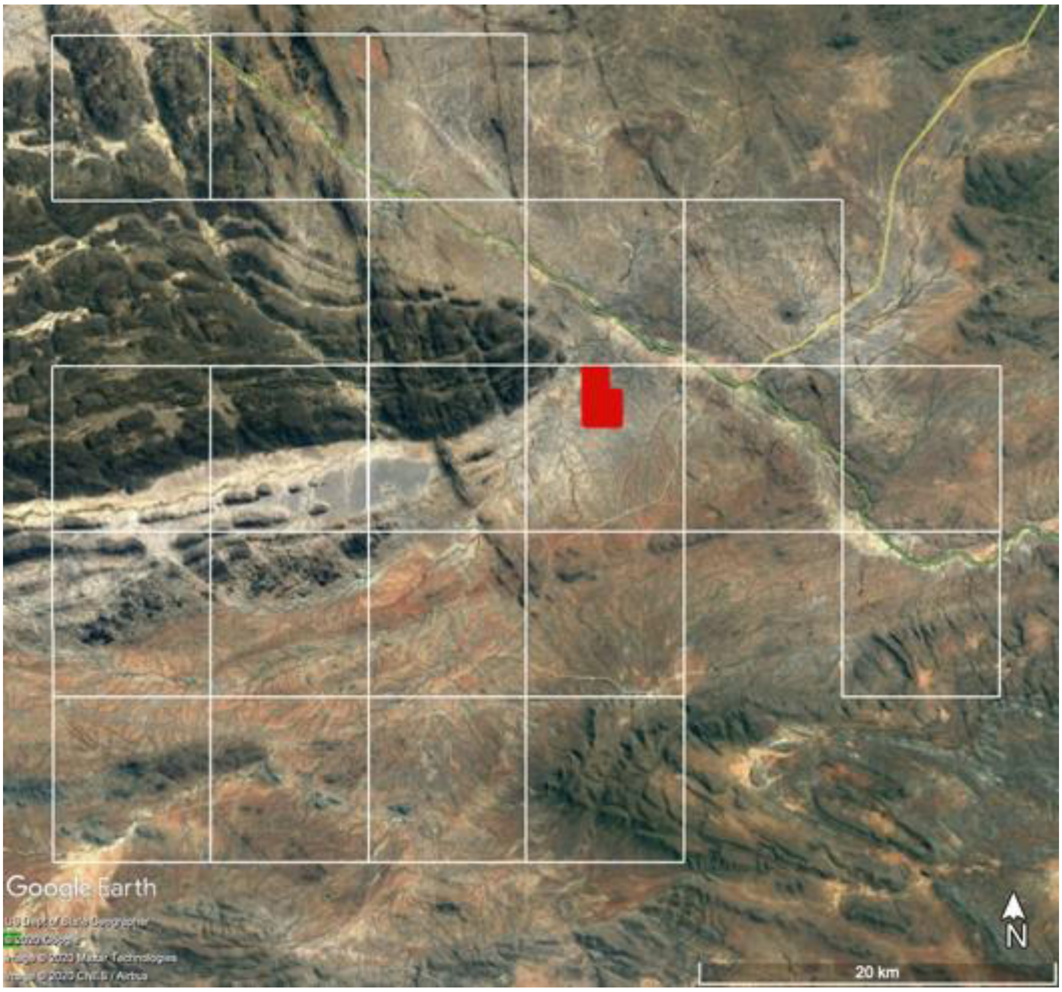

Figure 2. Area used for data search in the bird survey. Red shape: ML40
The white squares are the SABAP2 pentads with recorded bird sightings.

2 BIODIVERSITY

2.1 Landscape description

On the African scale the project site falls in the Savanna biome, in the stable savanna zone where the ratio between woody and grass plants is determined by climate, particularly annual rainfall below 560 mm (Sankaran, et al., 2005). On the Namibian scale the site is located in the Western Highlands biome, which is characterised by an Acacia Tree-and-Shrub Savanna vegetation type and a dominant vegetation structure of grassland and scattered trees (Mendelssohn, et al., 2002).

The climate is tropical with hot summers (average maximum of 34 – 36 °C), mild, dry winters (average minimum of 6 – 8 °C) and no frost (Mendelssohn, et al., 2002). Median annual rainfall is 300-350 mm and the variation in annual rainfall is relatively low at 40%.

The region's biodiversity patterns are variable according to Mendelssohn et al (2002), whose rankings for diversity (the number of species present in an area) are given here. Plant diversity is medium-high and frog diversity is medium-low, corresponding to the generally low levels of amphibian diversity in areas with low rainfall. Mammal diversity is in the second-highest of eight ranks, as is reptile diversity.

Bird diversity is ranked medium by Mendelssohn et al (2002): 141 – 170 species out of more than 650 recorded in Namibia. However, SABAP2 has more current and more complete data: 254 species have been recorded in the pentads shown in Figure 2, bringing the bird diversity ranking to well within the highest rank for Namibia.

On the landscape scale, the scale on which biodiversity conservation needs are addressed, endemism levels are high for many taxa because of ranges that extend from Angola south across the Kunene River (Mendelssohn, et al., 2002). The study area falls within the Kaokoveld centre of endemism and supports many range-restricted plants and animals (Craven, 2009), (Swanepoel, 2019).

Vegetation structure in the region is a shrubland-woodland mosaic, the upper storey dominated by *Colophospermum mopane*, *Terminalia prunioides and Commiphora* species. *Acacia* species are present in drainages and streams, and grass cover is sparse.

On a global scale the project site falls in the Afrotropical Region for all vertebrate taxa (Proches & Ramdhani, 2012). Anthropomorphic modification and the low density of vegetation result in a low density of large mammals.

2.2 Habitat types

Aspects that were considered when assigning habitat categories:

- Physical characteristics (topography, substrate and vegetation structure) of the habitat in terms of the opportunities for breeding and shelter they present to the four vertebrate taxa considered in this report
- The diversity and availability of food in the habitat

Three habitat types were identified: Mopane scrub, river/drainages and rocky outcrops.

The habitats were rated as to their sensitivity, with the caveat that all habitats are sensitive to disturbance and deserving of conservation measures.

A sensitivity rating was assigned based on properties of the habitat itself, including:

- nationally or regionally scarce habitats
- size of habitat, in the context of the total availability of comparable habitats in Namibia and/or the region.
- exceptionally high diversity and/or abundance of species
- high level of endemism
- species of conservation concern are supported
- key ecological processes
- contributes disproportionately to ecological function (nutrient and energy flows)
- provides critical resources
- restorability after disturbance

Human habitation, grazing and mining activities have resulted in modified areas, some of them severely degraded such as the rocky ridge south of ML40 (Figure 4) and the quarry/mine sites (yellow in Figure 3). The village Oroutumba, located in Mopane scrub habitat adjacent to the Ondoto River (Figure 3), is also an anthropologically modified area.

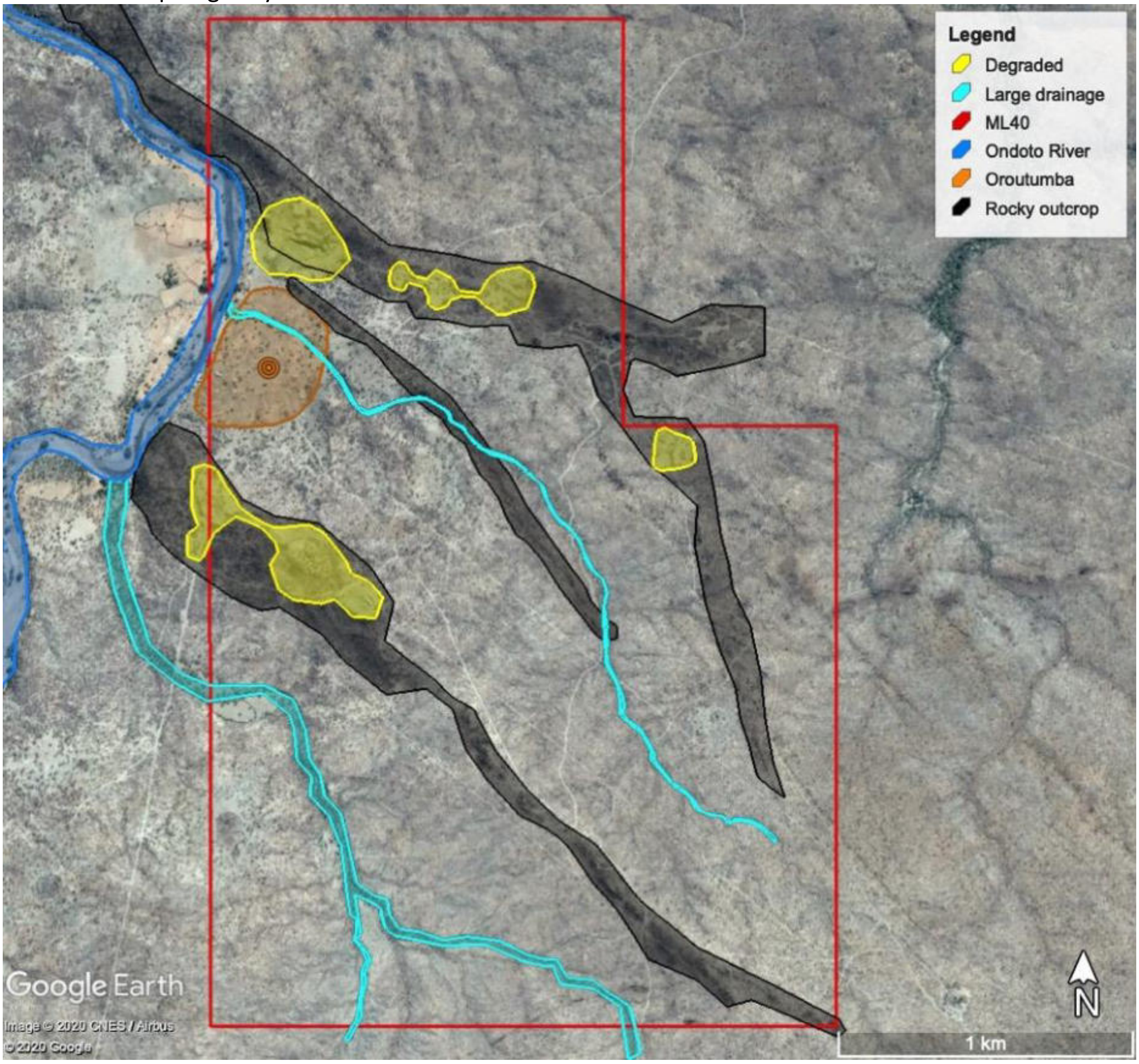

Figure 3. Map showing habitats in the study area.

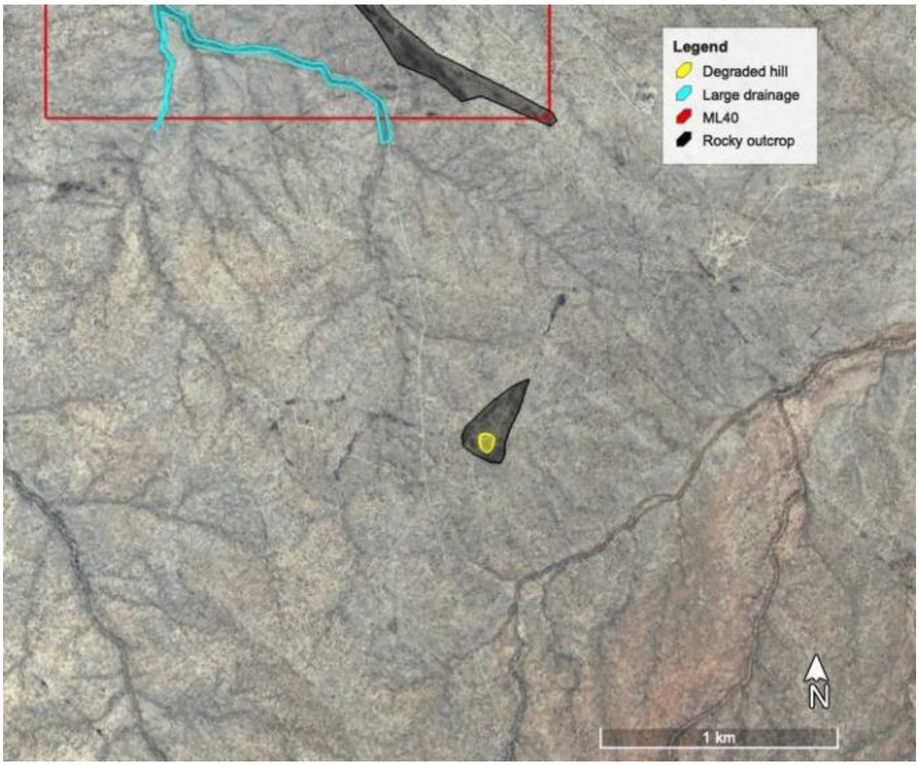

Figure 4. Hill with rocky outcrop south of ML40.
At the request of the client the hill was included for assessment in this report.

2.2.1 Rocky outcrops

This habitat comprises rocky outcrops at the top of rocky outcrops in ML40 (black in Figure 3 and Figure 4), and closely follows fenitisation in the area.

The vegetation structure is layered, providing resources for a variety of taxa. A ground cover of grass was observed and although no forbs were present, they will appear in summer and after rain (Figure 5, Figure 6 and Figure 8). There is a sub storey of shrubs and a well-developed upper storey of trees, dominated by *Colophospermum mopane* and including *Terminalia prunioides, Commiphora mutlijuga*, several other *Commiphora* species, *Sterculia quinqueloba, Sterculia africana, Moringa ovalifolia, Rhigozum virgatum, Boscia albitrunca, Boscia microphylla, Boscia foetida and Ceraria longipedunculata*.

Structured habitats potentially support a large diversity of birds, especially insectivores, and are possibly essential for many invertebrate taxa. Large boulders and rocks, shrubs, annual plants and detritus combine to offer high niche diversity that sustains high species diversity, particularly for invertebrates, reptiles and habitat-specific small mammals (Figure 7 and Figure 9).

Figure 5. Rocky ridge habitat

Figure 6. Rocky slope and a rocky outcrop with large trees such as the near-endemic *Moringa ovalifolia.*

Figure 7. Boulders, rocks, shrubs and detritus provide valuable resources for vertebrates.

Figure 8. Hillside leading up to a rocky ridge, showing a layered variety of vegetation and substrates.

The ridge south of ML40 (Figure 4) was included for assessment in the site visit and this report. It represents a valuable habitat for various taxa surrounded by heavily grazed Mopane scrub, but earthmoving equipment has left the top of the ridge denuded (Figure 9).

Figure 9. Peak of the rocky ridge south of ML40 where topsoil and vegetation were removed.

It is highly likely that three recently described plant species of conservation concern would occur in this habitat: *Maerua sebrabergensis*, *Erythrococca kaokoensis* and *Ocimum sebrabergensis*, since the rocky ridges contain black and grey anorthosite rocks similar to the locations in the Zebra Mountains where these three species were first found.

The rocky outcrops present both abundance and richness of plant species that are much higher than those of the surrounding woodland, contributing to the ecological value of this habitat. The location of the study area in the foothills of the Zebra Mountains and in the Kaokoveld centre of endemism, a biogeographical region rich in range-restricted plants and animals (Swanepoel, 2015), further increases the sensitivity of the rocky outcrops.

Sodalite and the rare earth minerals are located in this habitat; it is where mining will be done and where most of the irreversible impacts (drilling, blasting, open cast mining) will take place.

2.2.2 River/drainages

The Ondoto River crosses the study area for less than a kilometre, but it is an important habitat in terms of both the study area and the region because of two reasons. Firstly, the drainages on ML40 empty into the river and from here it is only six km from where it flows into the Kunene River. Secondly, it is an important source area of high diversity in an arid landscape and a resource during drought years. Any activity in the catchment (i.e. ML40) will affect the ecology of the Ondoto and Kunene rivers.

At this point the river is wide with a rock face on its east bank and a flood plain to the west (Figure 11 and Figure 12). This stretch of the river and its banks contain sparsely distributed large trees, few shrubs and ground cover in the form of annual plants such as grasses and forbs are expected to appear in summer and after rain. The substrate is sandy, with scattered rocks and boulders and a shallow stream (Figure 10).

Plant species in the riverbed and on its banks include *Faidherbia albida*, *Acacia erioloba*, *Ficus cordata*, *Ficus petersii*, *Combretum imberbe*, *Ziziphus mucronata*, *Aloe littoralis*, *Acacia reficiens*, *Hyphaene petersiana, Boscia albitrunca, Combretum apiculatum, Gymnosporia senegalensis.*

The river is an important resource for the Oroutumba community, and it has been modified by historic and current human activities such as grazing and harvesting. Cattle and goats were observed in the river, as well as daily human household activities (water collection, laundry and playing children). Riverine habitats present a high ecological value for most taxa and are considered very sensitive.

Figure 10. Substrate of the Ondoto River.

Figure 11. Mature trees in the river bed. Heavily utilised west bank in the foreground.

Figure 12. Steep, rocky east bank of the river.

After rain, surface water runs via ephemeral drainages from the ridges and outcrops to two large washes and eventually into the Ondoto River. The washes are expected to have surface water after rainfall events and likely contain groundwater that sustains assemblages of perennial vegetation that are more diverse (both floristically and structurally) than the vegetation in the surrounding landscape (Figure 13, Figure 14 and Figure 15). The vegetation in turn provides shelter and food for a variety of animal taxa.

The substrate in this habitat consists of sand, gravel and rocks, providing habitat for burrowing reptiles and for small mammals and reptiles that rely on rocks for shelter. Vegetation in the smaller drainages is dominated by *Colophospermum mopane* and also present are *Acacia nilotica, Acacia reficiens, Terminalia prunioides, Commiphora multijuga and Combretum apiculatum*.

Blocking of surface and/or groundwater flow will result in loss of perennial species and a reduction in the resources, such as food, shelter and soil stabilisation for burrows that they represent to animal taxa and other trophic groups. Washes and drainages play the same important role in arid zones as rivers and are considered very sensitive.

Development that is planned in this habitat includes linear structures such as roads, pipeline and power line that will cross drainages. In the Ondoto River, a new well and pump to provide water to the accessory works area (Figure 19) are the planned developments.

Figure 13. Large drainage southeast of ML40 with sandy substrate and high canopy.

Figure 14. Small drainage near Oroutumba with sandy-gravel substrate and higher canopy than surrounding Mopane woodland.

Figure 15. A small drainage in the east of ML40 with gravel and rocky substrate and denser vegetation than surrounding Mopane scrub.

2.2.3 Mopane scrub

The largest part of ML40 consists of open Mopane scrubland. The topography is gently undulating, bisected by drainages and ridges topped with rocky outcrops. In the east and southeast of the study area the profile is flatter (Figure 16 and Figure 17) than in the west and northwest, where there are more and steeper rocky ridges (Figure 18).

The vegetation structure varies slightly from west to east, broadly corresponding to changes in topography with larger Mopane trees and some Commiphora species in the western parts of the study area (Figure 18). In the east and southeast *Colophospermum mopane* form a scrubby open woodland of homogenous height and structure, interspersed with *Catophractes alexandri*. The substrate consists of loose stones and gravel on packed sand.

Sparsely distributed *Terminalia prunioides*, *Boscia microphylla, Commiphora multijuga* and other *Commiphora* species, as well as *Ceraria pedunculata,* occur in between Mopane scrub and small trees. The understorey is sparse, and grass was the only ground cover observable at the end of winter, but more annual plant species are expected to appear after rain.

The low density and diversity of plant species, combined with the relative homogeneity of this habitat (Figure 17), result in a relatively low ecological value for vertebrates.

This habitat has been modified by human activities such as harvesting and livestock grazing. Both these activities are current and ongoing, and the village Oroutumba is located in a degraded area in Mopane woodland abutting the Ondoto River. Roads and accessory works will be located in this habitat.

It is considered the least sensitive habitat, but care should be taken to maintain the natural flow patterns of surface water in all drainage lines.

Figure 16. Mopane scrub in the southeast of ML40.

Figure 17. Sparse ground cover in Mopane scrub.

Figure 18. Mopane scrub with *Commiphora multijuga* in the west of ML40.

2.3 Species description

The taxa that were investigated are listed in the appendices and the lists were drawn up by perusing distribution maps, habitat and habit descriptions in the sources listed in section 1.4.1. Species were included in the lists if they:

- are expected to occur or have been previously recorded in the study area, AND
- are compatible with the habitats in the study area

Species that are range-restricted endemics, have threatened IUCN status, or are legally protected in Namibia, are potentially of concern. The results of the vertebrate study are discussed in this section and summarised in Table 1.

Table 1. Vertebrate species of conservation concern

	# expected to occur in region	# likely to occur on ML40	IUCN threatened status	Namibian legal protection	Namibia threatened status	Endemic/ near-endemic
Mammals	85	64	8	21	12	2
Birds	254	187	2	156	8	7
Reptiles	66	56	1 DD *	3	7	19
Amphibians	20	17	1 DD *		1	2

* Data deficient

2.3.1 Mammals

An estimated 85 species of mammals have distribution ranges that overlap with the study area and 64 of these are expected to be found in the habitat types in the study area (APPENDIX II). This is a relatively high species richness but the habitat characteristics on the site are limiting for mammal density. In addition, disturbance caused by farming and harvesting has contributed to low densities of large mammals and no signs of large mammals were observed during the site visit.

The Damara Rock Squirrel and Pygmy Rock Mouse are Namibian endemics that are highly likely to occur in the study area. Of the 64 species for which habitat suitability is high or medium, five are listed in the IUCN's Vulnerable or Near-threatened categories and nine are Vulnerable, Rare or Near-threatened in Namibia (pangolin, aardwolf, brown hyena, cape grey mongoose, Damara woolly bat, elephant, African wild cat, bat-eared fox and Cape fox). Bat-eared fox, Cape fox, aardwolf and brown hyena are particularly vulnerable to death by vehicle collision, exacerbated by increased traffic on the D3701.

2.3.2 Birds

The Southern African Bird Atlas Project 2 (SABAP2, 2020) records 254 species in the region (APPENDIX III), and the habitats of the study area are highly suitable for 187. This is a high species richness for such an arid environment, representing 37% of the 687 species recorded for Namibia (Simmons, et al., 2015).

Eight of the expected species are threatened in Namibia, including the Martial Eagle and Tawny Eagle that are also globally threatened. The other six species are Angola Cave-chat (near threatened), Verreaux's Eagle (near threatened), Yellow-bellied Eremomela (endangered), Rüppel's Parrot (near threatened), Wood Sandpiper (vulnerable) and Cinderella Waxbill (endangered). Carp's Tit, Hartlaub's Spurfowl, White-tailed Shrike, Rüppel's Parrot, Damara Hornbill, Monteiro's Hornbill and Bare-cheeked Babbler are near-endemic to Namibia, defined as more than 90% of the world population occurring in the country (Simmons, et al., 2015).

Raptors, bustards and all migrating species are vulnerable in varying degrees to impacts caused by power lines, e.g. collision, electrocution, disturbance and habitat destruction. The location of the power line to service the accessory works area was not finalised at the time of writing, preventing a thorough assessment of this impact. This is addressed in the recommendations in section **Error! Reference source not found.**.

2.3.3 Reptiles

The study area is located in a high diversity zone for reptiles, ranked second-highest in Namibia by Mendelssohn et al, 2002 and the distribution ranges of 66 reptile species overlap with the project site (APPENDIX IV), with habitat suitability considered high or medium for 56 of these species.

Only one of the 56 species, Hellmich's Wolf Snake, is on the IUCN list where it is categorised as Data Deficient. Nationally it is considered Rare. In addition, seven other species are considered Vulnerable, Rare or Endangered in Namibia. It is important to note that 19 species are endemic (100% of breeding population in Namibia) or near-endemic (>75% of breeding population in Namibia), representing 34% of the potentially occurring reptile species in the area and making the project site an area of high concern for reptiles.

The national and international assessment of this taxon is almost 15 years old and it is likely that the situation, specifically regarding threatened species, has changed significantly.

2.3.4 Amphibians

Distribution ranges (Du Preez & Carruthers, 2009) indicate that 20 frog species could potentially occur here (APPENDIX V) and 17 of these species have a medium or high probability of being found on the project site. This is a much higher species richness than the ranking Mendelssohn et al (2002) gives for the region due to data that became available after 2002. The Kunene River and its riparian vegetation contribute to the unexpectedly high potential diversity of amphibians in this arid area.

The Damara Pygmy Toad is endemic and the Marbled Rubber Frog near-endemic to Namibia. A third species of conservation concern is the Giant Bullfrog: near threatened in Namibia and numbers decreasing globally.

The Ondoto River had water in the middle of winter at the point where it intersects ML40, leading to the assumption that standing or slow-moving water is present year-round, providing habitats that may be suitable for the expected species. This increases the likelihood of the study area supporting more frog species than would be expected in such a low rainfall area.

It is essential for frog diversity to keep washes and drainages unobstructed and to maintain the natural runoff patterns of water from the hills to the Ondoto River.

3 IMPACT ASSESSMENT

The criteria that were used to assess possible impacts and to determine their significance follow the Hacking method and are given in Table 2.

Table 2. Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE

			SEVERITY = L		
DURATION	Long term	**H**	Medium	Medium	Medium
	Medium term	**M**	**Low**	**Low**	Medium
	Short term	**L**	**Low**	**Low**	Medium
			SEVERITY = M		
DURATION	Long term	**H**	Medium	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	**Low**	Medium	Medium
			SEVERITY = H		
DURATION	Long term	**H**	High	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	Medium	Medium	High
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE

PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	Medium	Medium	High
	Possible/ frequent	**M**	Medium	Medium	High
	Unlikely/ seldom	**L**	**Low**	**Low**	Medium
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE

Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

The location and layout of the planned support infrastructure are given in Figure 19. This information was not available at the time of the site visit and the impact assessment of infrastructure could not be verified on the ground.

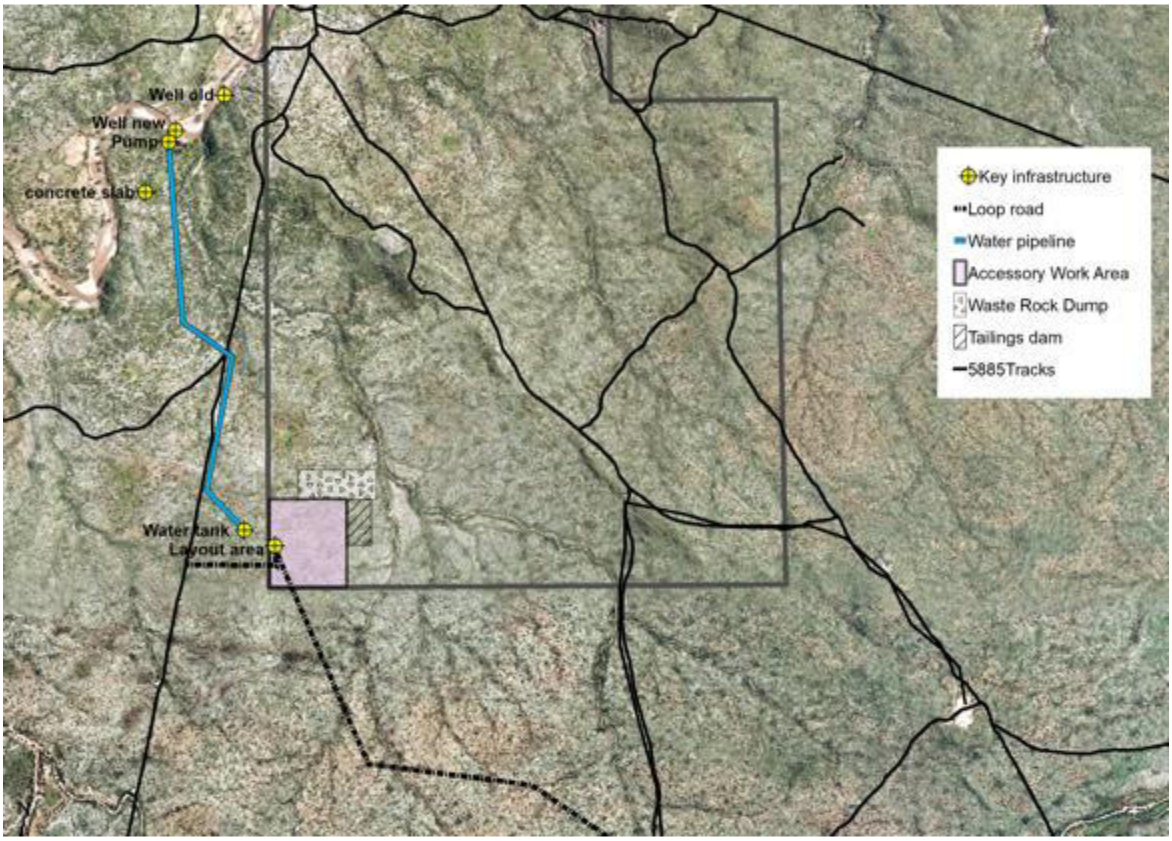

Figure 19. Proposed layout of infrastructure.

IMPACT 1 DESTRUCTION OF ORGANISMS AND HABITATS

SOURCE OF IMPACT

During construction:

Construction and use of roads by vehicles and machinery.

Clearing of land; laydown areas; water tanks; building of infrastructure.

Water pipeline and power line construction and maintenance.

Accommodation for construction staff.

Human activities and vehicle movements.

During operations:

Use of roads by vehicles and machinery.

Excavation of earth by heavy machinery, drilling and blasting.

Human activities and vehicle movements.

RESULT OF IMPACT

Cumulative impact: mining in Kunene Region, especially on ecologically valuable rocky ridges and outcrops.

Death of animals that are struck by earthmoving equipment, vehicles and machinery. Protected and at-risk species such as bat-eared fox, Cape fox, aardwolf and brown hyena are vulnerable to roadkill.

Death of animals due to poaching.

Raptors, bustards and migrating birds are vulnerable to power line impacts such as collision and electrocution.

Bird nests, nesting habitats and feeding habitats are destroyed, affecting the viability of bird populations.

Mammal and reptile burrows, burrow habitats and feeding habitats are destroyed, affecting the viability of the populations of these taxa.

Parts of territories and home ranges are destroyed.

Loss of plants and decline in habitat quality.

Dust causes a decline in air quality and creates conditions for health decline in plants and animals.

Noise disturbs animals and causes increase in stress.

MANAGEMENT/MITIGATION MEASURES

Keep the overall development footprint as small as possible.

The extent and location of the construction site should be fenced and all construction activities should take place within the fence. Adherence should be strictly enforced.

The location of roads, pipelines and power lines must be planned in order to minimise fragmentation or disturbance of habitats.

Anti-erosion measures must be taken where roads and tracks cross a wash or drainage.

Carefully plan the placement of stockpiling construction material so as to avoid sensitive areas.

Limit construction activities to daytime hours to reduce noise.

Educate construction and permanent staff as to their environmental obligations. All contractors should be held responsible for transgressions and significant penalties should be levied in order to ensure compliance.

Position temporary construction infrastructure (e.g. accommodation) in areas that will definitely be disturbed during operations.

Erect linear structures (power lines, water pipelines) as close as possible to existing roads and tracks.

Maintenance roads/tracks for linear structures should be built as close as possible to the structure and access should be limited to essential maintenance.

Do not put water tanks, power pylons or any other large infrastructure in the river or washes.

No sewerage overflow or French drain may be placed within 100 m of a wash or river.

IMPACT 1 DESTRUCTION OF ORGANISMS AND HABITATS

A vertebrate specialist should identify nests, dens and other breeding locations and demarcate them before construction so that these sites can be avoided as part of the EMP.
Reptiles and amphibians that are exposed during ground clearing should be captured for translocation by a qualified expert.

No collection of plants should be allowed. No fires should be allowed.

A comprehensive restoration plan should be drawn up by an expert BEFORE construction commences, at least at conceptual level, and should make provision for monitoring and adaptive management as the project develops. Some rehabilitation actions should be implemented during operations in order to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later; road and pipeline locations.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Medium
SPATIAL SCALE	Medium	Low
DURATION	High	Medium
CONSEQUENCE	High	Medium
PROBABILITY	Medium	Medium
SIGNIFICANCE	High	Medium

IMPACT 2	DISTURBANCE OF ANIMALS AND INTERFERENCE WITH THEIR BEHAVIOUR

SOURCE OF IMPACT

During construction and operations

Increase in human and vehicle presence and movement resulting from mining activities.

Infrastructure and roads form obstacles to the directional movement of animals.

Loud noises caused by blasting and the operation of heavy machinery.

RESULT OF IMPACT

Larger mammals and birds are the taxa most likely to be affected.

The loss of migration corridors causes stress and an increased risk of death to various taxa.

Animals fall in the quarry.

Birds and eggs are poached.

Animals, particularly birds, are disturbed while going about their daily activities, such as feeding and breeding.

Dust creates conditions for health decline in plants and animals, and an increase in stress for animals.

Noise disturbs the normal behaviour of animals, specifically mammals.

MANAGEMENT/MITIGATION MEASURES

The extent of the operation should be clearly demarcated on site layout plans, and on the ground it should be either fenced in or marked with clear signposts.

Areas surrounding the mine, processing plant and exploration sites that are not part of the demarcated development should be considered no-go zones. No employees, visitors, vehicles or machinery should be allowed in such zones.

No off-road driving or driving next to established roads/tracks should be allowed.

Limit activities to day-time hours so as to reduce noise.

No fires should be allowed.

Staff and contractors should be trained in sensitive human-wildlife interaction.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Low	Low
DURATION	Medium	Low
CONSEQUENCE	Medium	Low
PROBABILITY	High	Low
SIGNIFICANCE	**Medium**	**Low**

IMPACT 3 LIGHT POLLUTION
SOURCE OF IMPACT Light sources that are visible outdoors in the processing plant, mining areas and office/accommodation centre.
RESULT OF IMPACT Invertebrates that are attracted to the light provide an unnatural food source for taxa such as bats, geckos, nightjars and frogs. These insectivores are attracted to the food and then face conditions where they are more likely to die from causes such as collisions and predation. Invertebrates die every night from exhaustion or predation, potentially disrupting their population numbers and causing disturbances in ecological processes.
MANAGEMENT/MITIGATION MEASURES Not much is known about the effect of light on populations and ecosystems and the precautionary principle is applied here. Install motion detectors to limit light use to the minimum possible. Outdoor lights should be directed downwards and not up into the sky. Use yellow or amber outdoor lights because invertebrates don't detect yellow light as well as white. Install insect screens in doors and windows located in buildings that are used after sunset.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Low	Low
DURATION	Medium	Medium
CONSEQUENCE	Medium	Low
PROBABILITY	High	Medium
SIGNIFICANCE	**Medium**	**Low**

IMPACT 4 ALTERATION OF TOPOGRAPHY

SOURCE OF IMPACT

Construction and operational phases.

Excavation of the ore bodies leaves deep, open pits, caused by drilling, blasting and open cast mining and the use of equipment such as excavators, compressor driven drill rigs and cutting machines.

The processing plant and waste stockpiles result in large heaps of material deposited on the ground.

RESULT OF IMPACT

This is a cumulative impact of mining in the Kunene Region.

Irreversible alteration of the ecologically valuable rocky outcrops.

This impact may affect ecosystems.

Direct destruction of habitat and organisms (see Impact 1).

Fragmentation of habitat, leading to the loss of migration corridors for various taxa, in turn resulting in the loss of individual organisms and potentially populations.

MANAGEMENT/MITIGATION MEASURES

It may not be possible to rehabilitate the mining sites significantly, but a comprehensive restoration plan would mitigate impacts to some extent.

A comprehensive restoration plan should be drawn up by an expert BEFORE operation commences. Some rehabilitation actions should be implemented during operations in order to be effective, e.g. removal and location of topsoil; location of waste rock dumps to ensure efficient restoration later.

Implement the restoration programme as soon as possible after the impact has ceased.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Medium
SPATIAL SCALE	Medium	Low
DURATION	High	Medium
CONSEQUENCE	High	Medium
PROBABILITY	High	Medium
SIGNIFICANCE	**High**	**Medium**

IMPACT 5 GROUNDWATER DRAWDOWN		
SOURCE OF IMPACT Abstraction of water from the Ondoto River for drilling, mining, ore processing and human consumption.		
RESULT OF IMPACT River vegetation is dependent on groundwater to some extent. Of particular concern are woody species in the Ondoto River, e.g. *Acacia erioloba, Faidherbia albida and Ficus spp.* Deterioration of the river habitat has negative impact on biodiversity outside the boundaries of the project site, specifically the Kunene River.		
MANAGEMENT/MITIGATION MEASURES Monitor groundwater levels. Monitor plant and vertebrate diversity downriver from the abstraction site at a minimum of once a year.		
	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Medium	Medium
DURATION	Medium	Medium
CONSEQUENCE	Medium	Low
PROBABILITY	Medium	Low
SIGNIFICANCE	**Medium**	**Low**

IMPACT 6 CONTAMINATION OF SOIL AND WATER

SOURCE OF IMPACT

Chemicals used in the processing of ore, e.g. radioactive thorium, escape containment and contaminate the soil, surface and groundwater.

RESULT OF IMPACT

Chemicals leach into soil, causing contamination of soil and eventually groundwater.

Effects of chemicals are cumulative and build up in groundwater over time.

Once in the groundwater, there is the potential for contamination to spread beyond site boundaries. The Kunene River is an internationally important ecological feature that could potentially be directly affected.

Birds, mammals and reptiles are attracted by an unnatural source of water (open water body) and either drown or ingest contaminated water.

MANAGEMENT/MITIGATION MEASURES

Containment measures should be strictly enforced to the highest existing standards. Open water structures should be sealed and provide no opportunity for either leakage or entry by animals.

Constant monitoring of open bodies of water and their associated pipes, lining and covers is essential to ensure that there is no malfunction, tear or opening.

Treatment of the final discharge of water should be in such a way as to eliminate any possibility of active chemicals entering the soil or groundwater.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Medium	Low
DURATION	High	Low
CONSEQUENCE	High	Low
PROBABILITY	Medium	Low
SIGNIFICANCE	**Medium**	**Low**

IMPACT 7 IMPACTS LINKED TO ACCOMMODATION OF STAFF

SOURCE OF IMPACT

Construction, operational and closure phases.

Vehicles cause death of organisms.

Poaching and plant collection.

Cooking and lighting practices cause fires.

Water use in an arid zone with few resources.

Sewage practices.

Cooking and cleaning cause oil spillage.

RESULT OF IMPACT

Direct destruction of organisms and habitat: implement the management measures of Impact 1.

Oil spills and sewage contaminate soil and water.

Fires destroy habitats and cause death of animals.

MANAGEMENT/MITIGATION MEASURES

All inhabitants and visitors in the staff compound should receive environmental awareness training, including training on indiscriminate defecation.

The staff compound should be fenced in and the only access allowed outside the fence is on the entrance road.

All cleaning and washing should take place inside a designated area (e.g. kitchen, laundry) and fat traps should be installed at the drain outlet from these areas.

No collection of plants or plant material should be allowed.

No open fires or flames should be allowed in the staff compound.

Gas cooking facilities should be provided.

Lights should be solar or generator powered - no candles or paraffin lamps.

Firefighting equipment should be placed in the compound. It should be tested regularly and in working condition at all times. All inhabitants of the compound should be trained in the use of this equipment and know where it is.

Water saving measures should be put in place, e.g. low pressure shower heads and taps; daily checks of pipes and tanks; immediate repair of leaks.

Sewerage should be of sufficient capacity for the number of people, and should be a sealed breakdown system.

No sewage overflow structure or French drain may be placed within 100 m of a wash, drainage line or river.

	UNMITIGATED	MITIGATED
SEVERITY/NATURE	Medium	Low
SPATIAL SCALE	Medium	Low
DURATION	Medium	Low
CONSEQUENCE	Medium	Low
PROBABILITY	Medium	Low
SIGNIFICANCE	**Medium**	**Low**

4 SUMMARY AND RECOMMENDATIONS

Seven impacts were identified. Five of these impacts are rated as having medium significance, mitigated to low significance provided the suggested management measures are implemented.

Impact 1 (destruction of organisms and habitats) and impact 4 (alteration of topography) both have high unmitigated significance, decreased to medium significance by the stringent application of management measures. The cumulative nature of mining activities in the Kunene Region and in the Kaokoveld Centre of Endemism, the irreversible damage to the rocky outcrops (sensitive, ecologically valuable habitat) and the persistence of excavations after the lifespan of the mine are three factors that decrease the likelihood of these impacts to be mitigated to low significance. However, the strict implementation of mitigation measures and restoration plan can improve the situation significantly for other habitats and aspects such as the accessory works, linear infrastructure and accommodation centre.

It is important to keep the overall project footprint to the absolute smallest size possible, and to keep it inside well-defined and clearly demarcated boundaries by fencing the operational area and putting up visible and effective signs. The purpose of a fence and signs is to inform personnel and contractors of the exact boundaries of the operations area and to effectively control access to areas that will remain undeveloped. Fences and signage go hand in hand with appropriate environmental training and awareness raising of staff, and of contractors and their staff.

A key habitat in the larger woodland mosaic is the rocky outcrops habitat. The physical diversity of the hills and rocky outcrops leads to a higher and more specialised biodiversity than the surrounding Mopane woodland, and it supports many species that would otherwise not be present. Seeing as mineral-bearing ore is located almost exclusively in the rocky outcrops, restoration of this habitat after mining operations will not be possible to any meaningful extent.

Riverine habitat has a high ecological value for all taxa, plays a keystone role in nutrient transport, and serves as important source areas for recolonisation after operations cease. In this project footprint, the Ondoto River is considered very sensitive and apart from the proposed linear infrastructure, no development should take place there. In addition, the natural flow patterns in washes and drainages should be maintained, particularly important when designing and constructing a road network and any other linear development.

For a restoration programme to be effective, it is essential that it be implemented from the earliest possible time after the construction phase, and throughout the operational phase where possible. The protection of source areas from where seeds and organisms will come to re-colonise the disturbed areas is a crucial aspect of restoration, and source areas need to be identified and protected from the beginning. Some mitigation measures need to be implemented during operations to be effective; potential examples include the removal and storage of topsoil, placement of roads, and the shape and placement of waste rock stockpiles. Accurate financial projections need to be made, and financial mechanisms for implementing restoration measures should be put in place before operations. These are some of the reasons why restoration, at least at conceptual level, should be part of the planning phase.

Because the project design has not been finalised, it is not possible to draft a complete restoration programme at this early stage. It is, however, possible to develop a conceptual plan that defines the most likely first implementation steps, as well as the structure of an adaptive management and monitoring plan. The restoration plan should be developed by an expert in conjunction with the mine planners and engineers, and it should be fully integrated with the mine's EMP.

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APPENDIX I. PROJECT DESCRIPTION

The proposed activity focuses on the specific resources of sodalite, iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the ML40 and any claims that the Proponent currently has rights to.

By the Minerals (Mining and Prospecting) Act of 1993 sodalite is categorised in the commodities of dimension stones and semi-precious stones. The mineralisation is unique in Namibia. Sodalite occurs in bright colours (mostly blue), making it a sought-after mineral and that is well known in the dimension stone and also in the semi-precious stone trade for carvings and jewellery. Worldwide, significant deposits are restricted to only a few localities in Canada and the US, Brazil and Bolivia in South America and in Burma and Russia.

Besides the sodalite, lenses and plugs of iron-titanium-oxides occur within ML40. Additionally, narrow, dykes and veins, up to 1 metre wide and with lengths of up to approximately 200m constitute zones of rare earth mineralisation. Both these types of mineralisation, iron and rare earth, belong to the class of base and rare metals.

If purely looking at the available rock material within the mining licence, the estimated mining lifespan could be more than 50 years. However, for this assignment an estimated mining lifespan of up to 25 years is considered.

The following is the summary of envisaged development with mining and processing activities that are expected to be undertaken by the project Proponent during different project development phases.

Construction Phase Activities

This will comprise of the following:

1. Construction of roads (internal within the Mining Licence) and upgrading an access road from the mine to the main road to the north
2. Construction of a new processing facility for iron and rare earth ore
3. Construction of a tailings storage facility
4. Construction of a water pipeline from the Kunene river to the processing plant
5. Construction of a powerline from Otjimuhaka sub-station to the processing plant
6. Construction of fencing as required

The potential route of the water pipeline and electrical powerline can be found in Figure 4. This EIA will review these routes and other potential alternatives for the Proponent to consider as better options from an environmental perspective. The new processing plant, tailings and rock dumps may need to be located at another site and not the existing sodalite processing area due to its close proximity to the Ondoto community. The reason for this is the presence of trace amounts of radioactive thorium which after processing of the ore would become concentrated and potentially dangerous to humans.

Solid non-mineral waste will be removed off site and taken to the nearest rubbish dump either in Otjimuhaka or Ruacana depending on the nature of the waste. Ablution facilities will use sealed septic tanks or a sewage treatment plant. Sewerage sludge will be taken to the Ruacana sewerage plant periodically. Prior to the construction of a new power line, the projects' electricity requirements will rely on diesel generators. Construction staff will be accommodated on site at a temporary camp.

Security will be supplied on a 24-hour basis at the mine and construction sites. Support services and any facilities established during the construction phase will either be removed at the end of this phase or incorporated into the project's operational phase.

It is anticipated that the proposed construction will commence immediately after receiving the ECC from the MEFT and the relevant permits and licences have been issued by the different regulatory bodies.

Operational Phase Activities

Mining

Operation will entail mining, i.e. drilling and blasting of rock outcrops and open cast mining with diamond cutting equipment to extract industrial size blocks of dimension stone. Mining techniques will make use of modern equipment such as excavators, diamond wire saw, circular diamond cutting machines, compressor driven drill rigs, jack hammers and dump trucks. Open cast mining will be established according to good practice procedure. Photo 2 below shows two examples of these types of mine machinery. The mining operations comprise of the phases including site clearing, excavations – by means of drilling and blasting, digging, block cutting, removing and haulage of rock to processing plant and storage yard.

Multiple quarries (i.e. wedge, terrace or trench shaped) will be mined at various places within ML40. Quarry depth will be to about 40 m. Approximately 8,000 t of ore is expected to be removed from the ground and processed on a monthly basis. For all types of mineral ore the excavations are planned to a maximum stripping ratio of 1 : 15. Overall the maximum or total estimate of waste rock produced will be 1.5 million tons annually. Mineral waste will be deposited in waste rock dumps and a tailings storage facility.

Mineral Processing

KNL wants to establish central processing facilities for dimension stone, iron ore and for rare earth mineralisation, all of which occur within the Mining Licences and to some extend also on other surrounding mineral licences.

For dimension stone, in particular for the processing of sodalite mineralisation, blocks are trimmed with a diamond rope machines and cut into slabs. Smaller blocks and boulders are trimmed and cut in slabs and tiles; Smaller lumps and boulders of sodalite rock are stockpiled and sold as ornamental stones.

For iron and rare earth mineralisation the ore is drilled and blasted and removed from the ground in opencast quarries. To concentrate the valuable mineral content the following process is envisaged. The iron ore processing from the Run-of-Mine ore:

I. Run-of-Mine ore crushed to <25 mm
II. screen for size classification
    a) fraction 40 to 25 mm: scan / sorting separation
    b) fraction less 25: magnetic separation

After mining of the rare earth containing rock processing will occur as follows:

I. Run-of-Mine ore crushed to <25 mm
II. screen for size classification
    a) fraction 40 to 25 mm: scan / optical sorting separation
    b) fraction 25 to 6 mm: magnetic sorting
    c) fraction less 6 mm: gravity separation process using limited amounts of water
III. Milling of concentrate
    a) Flotation, using limited amounts of water
    b) leaching of gangue carbonate, using limited amounts of water

Mining has taken place in a number of small quarry areas within ML40. Up to 90 ha of footprint size are envisaged for the accessory works area to accommodate the processing, tailings disposal, product storage, loading facilities, offices, security and workshop facilities within the mining licence area.

At a maximum monthly production of 5,000 t a total of 139 truckloads at 36 t would transport product each month. That is 5 trucks each day. The product would be transported along the gravel road to Ruacana and thereafter along the tar roads to the port of Walvis Bay.

As mentioned already, the EIA will make suggestions as to the location and layout of the accessory works areas based on the findings of the various specialist studies.

Infrastructure Development

KNL presently abstracts ground water from a soft sediment water compartment in the Ondoto river. Gensets are used for power generation. Development of linear infrastructure for pumping water from the Kunene river as well as establishing a new conductor path transmission line from Nampower's Swartbooisdrift substation to the accessory works area are envisaged and therefore form part of the scope for the Environmental Scoping Study.

The new tailings storage facility (including the design) will be located in accord with the recommendations of the EIA.

Waste rock dumps will be located alongside quarries, pits and trenches and where least impact on flora and fauna is expected. They could be potentially used in landscaping during rehabilitation during decommissioning of the same quarries, pits or trenches.

Other infrastructure required and foreseen for the project development are offices and accommodation for a small portion of the work force.

Product Transport

Blocks of dimension stone, lumps of ornamental stone or concentrates of base and rare earth metal products are to be transported as bulk cargo as well as in bagged form. The viability of any mining operation, just like most industries, is particularly sensitive to the logistics concerned with getting the product to market. Different options are presently being investigated for the transport of the products to the harbour of Walvis Bay.

Bulk bags on low-bed trucks or bulk road transport with loads up to 67 tons are envisaged to take the products on the public road infrastructure from the mine site to the harbour of Walvis Bay. Various studies have been undertaken to support the usage of such trucks including road wear analyses, modelling of a tractor-trailer design, bridge assessments.

Decommissioning Phase Activities

The estimated life of the mine is set at 25 years currently. Decommissioning activities will include the removal of infrastructure, preparation of final landforms for closure and to rehabilitate roads and other linear infrastructure where necessary

APPENDIX II. LIST OF MAMMAL SPECIES

A list of the mammal species that are expected to occur in the study area, based on the distribution maps in Skinner & Smithers (1990).
The column "Habitat" indicates how suitable the habitat in the study area is for each species.
Habitat suitability: High = highly suitable with few habitat constraints, project area contains typical habitat for that species. Medium=intermediate suitability with some constraints. Low = Unlikely to be encountered. Empty cells denote unknown probability because the species habitat requirements are not known well enough.
Conservation status, Internat: IUCN (Red List version 2020.1) is given first. CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near threatened, LC: Least Concern, LR: Lower Risk, NE: Not Evaluated, DD: Data Deficient. Then follows **CITES** (2016/11/21 appendix): CITES I: threatened with extinction and international trade is prohibited, CITES II: not now threatened with extinction but may become so and trade may be authorised by export permit, CITES III: International trade is allowed upon presentation of permits or certificates.
Conservation Status, Legal: Protection granted by laws and/or regulations in Namibia. NCO: Nature Conservation Ordinance, 1975, MRA: Marine Resources Act, 2000, FA: Forest Act, 2001
Conservation Status, Namibia: the status sourced from Griffin (2003) and Irish, 2020. Only those that are of concern are noted here. VU: Vulnerable, EN: Endangered, R: Rare, NT: Near-threatened, CR: Critically Endangered, End: Endemic, n-End: near-Endemic. Many of these species' status are provisional pending more data.

					CONSERVATION		
ORDER	FAMILY	SPECIES	COMMON NAME	HABITAT	INTERNAT	LEGAL	NAMIBIA
ARTIODACTYLA	BOVIDAE	*Aepyceros melampus*	Impala	Low		NCO	
ARTIODACTYLA	BOVIDAE	*Madoqua kirkii*	Damara Dik-dik	Medium		NCO	
ARTIODACTYLA	BOVIDAE	*Oreotragus oreotragus*	Klipspringer	Medium		NCO	
ARTIODACTYLA	BOVIDAE	*Oryx gazella*	Gemsbok	Low		NCO	
ARTIODACTYLA	BOVIDAE	*Raphicerus campestris*	Steenbok	Medium		NCO	
ARTIODACTYLA	BOVIDAE	*Sylvicapra grimmia*	Common Duiker	Medium		NCO	
ARTIODACTYLA	BOVIDAE	*Tragelaphus strepsiceros*	Kudu	High		NCO	
ARTIODACTYLA	GIRAFFIDAE	*Giraffa camelopardalis*	Giraffe	Low		NCO	VU
ARTIODACTYLA	SUIDAE	*Phacochoerus africanus*	Warthog	Low		NCO	
CARNIVORA	CANIDAE	*Canis mesomelas*	Black-backed Jackal	High			
CARNIVORA	CANIDAE	*Otocyon megalotis*	Bat-eared Fox	Medium		NCO	VU
CARNIVORA	CANIDAE	*Vulpes chama*	Cape Fox	High		NCO	VU
CARNIVORA	FELIDAE	*Acinonyx jubatus*	Cheetah	Low	VU, CITES I	NCO	VU

ORDER	FAMILY	SPECIES	COMMON NAME	HABITAT	CONSERVATION INTERNAT	LEGAL	NAMIBIA
CARNIVORA	FELIDAE	*Caracal caracal*	Caracal	Low	CITES II		
CARNIVORA	FELIDAE	*Felis silvestris lybica*	African Wild Cat	High			VU
CARNIVORA	FELIDAE	*Panthera leo*	Lion	Low	VU, CITES II		
CARNIVORA	FELIDAE	*Panthera pardus*	Leopard	Medium	VU, CITES I	NCO	
CARNIVORA	HERPESTIDAE	*Cynictis penicillata*	Yellow Mongoose	Medium			
CARNIVORA	HERPESTIDAE	*Galarella pulverulenta*	Cape Grey Mongoose	Medium			R
CARNIVORA	HERPESTIDAE	*Galarella sanguinea*	Slender Mongoose	Medium			
CARNIVORA	HERPESTIDAE	*Helogale parvula*	Dwarf Mongoose	Medium			
CARNIVORA	HERPESTIDAE	*Suricata suricatta*	Suricate	Low			
CARNIVORA	HYAENIDAE	*Crocuta crocuta*	Spotted Hyaena	Low			
CARNIVORA	HYAENIDAE	*Hyaena brunnea*	Brown Hyena	Medium	NT		NT
CARNIVORA	HYAENIDAE	*Proteles cristata*	Aardwolf	Medium		NCO	VU
CARNIVORA	MUSTELIDAE	*Ictonyx striatus*	Striped Polecat	Medium			
CARNIVORA	MUSTELIDAE	*Mellivora capensis*	Honey Badger	Medium		NCO	
CARNIVORA	VIVERRIDAE	*Genetta genetta*	Small-spotted Genet	High			
CHIROPTERA	EMBALLONURIDAE	*Taphozous mauritianus*	Mauritian Tomb Bat	High			
CHIROPTERA	HIPPOSIDERIDAE	*Hipposideros caffer*	Sundevall's Leaf-nosed Bat	Medium			
CHIROPTERA	HIPPOSIDERIDAE	*Hipposideros commersoni*	Commerson's Leaf-nosed Bat	High			
CHIROPTERA	MOLOSSIDAE	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	Medium			
CHIROPTERA	NYCTERIDAE	*Nycteris thebaica*	Common Slit-faced Bat	High			
CHIROPTERA	PTEROPODIDAE	*Eidolon helvum*	Straw-coloured Fruit Bat	Medium	NT		
CHIROPTERA	PTEROPODIDAE	*Epomophorus angolensis*	Angolan Epauletted Fruit Bat	High	NT		
CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus clivosus*	Geoffroy's Horseshoe Bat	High			
CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus denti*	Dent's Horseshoe Bat	High			
CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus fumigatus*	Rüppel's Horseshoe Bat	Medium			
CHIROPTERA	VESPERTILIONIDAE	*Chalinolobis variegatus*	Butterfly Bat	Low			

ORDER	FAMILY	SPECIES	COMMON NAME	HABITAT	CONSERVATION INTERNAT	LEGAL	NAMIBIA
CHIROPTERA	VESPERTILIONIDAE	*Eptesicus capensis*	Cape Serotine Bat	High			
CHIROPTERA	VESPERTILIONIDAE	*Eptesicus somalicus*	Somali Serotine Bat	High			
CHIROPTERA	VESPERTILIONIDAE	*Kerivoula argentata*	Damara Woolly Bat	High			R
CHIROPTERA	VESPERTILIONIDAE	*Miniopterus schreibersii*	Schreibers' Long-fingered Bat	Medium			
CHIROPTERA	VESPERTILIONIDAE	*Myotis seabrai*	Angola Hairy Bat	Medium			
CHIROPTERA	VESPERTILIONIDAE	*Nycticeius schlieffenii*	Schlieffen's Bat	Medium			
CHIROPTERA	VESPERTILIONIDAE	*Scotophilus dinganii*	Yellow House Bat	High			
ERINACEOMORPHA	ERINACEIDAE	*Atelerix frontalis*	South African Hedgehog	Low		NCO	
EULIPOTYPHLA	SORICIDAE	*Crocidura cyanea cyanea*	Reddish-grey Musk Shrew	High			
EULIPOTYPHLA	SORICIDAE	*Crocidura hirta*	Lesser Red Musk Shrew	Medium			
HYRACOIDEA	PROCAVIIDAE	*Procavia capensis*	Rock Hyrax	High			
LAGOMORPHA	LEPORIDAE	*Lepus capensis*	Cape Hare	High			
LAGOMORPHA	LEPORIDAE	*Lepus saxatilis*	Scrub Hare	Medium			
LAGOMORPHA	LEPORIDAE	*Pronolagus randensis*	Jameson's Red Rock Hare	High			
MACROSCELIDAE	MACROSCELIDIDAE	*Elephantulus intufi*	Bushveld Elephant-shrew	High			
MACROSCELIDAE	MACROSCELIDIDAE	*Elephantulus rupestris*	Smith's Rock Elephant-shrew	Medium			
MACROSCELIDAE	MACROSCELIDIDAE	*Macroscelides proboscideus*	Round-eared Elephant-shrew	Low			
PERISSODACTYLA	EQUIDAE	*Equus (Hippotigris) hartmannae*	Hartmann's Zebra	Medium			
PERISSODACTYLA	RHINOCEROTIDAE	*Diceros bicornis*	Black Rhino	Low	CR, CITES I	NCO	CR
PHOLIDOTA	MANIDAE	*Manis temminckii*	Pangolin	Medium	CITES I	NCO	VU
PRIMATE	CERCOPITHECIDAE	*Chlorocebus pygerythrus*	Vervet Monkey	Medium	CITES II		
PRIMATE	CERCOPITHECIDAE	*Papio ursinus*	Chacma Baboon	High	CITES III		

ORDER	FAMILY	SPECIES	COMMON NAME	HABITAT	CONSERVATION INTERNAT	LEGAL	NAMIBIA
PRIMATE	GALAGIDAE	*Galago moholi*	Southern Lesser Galago	Low	CITES II	NCO	VU
PROBOSCIDEA	ELEPHANTIDAE	*Loxodonta africana*	Elephant	Medium	VU, CITES II	NCO	VU
RODENTIA	GLIRIDAE	*Graphiurus murinus*	Woodland Dormouse	High			
RODENTIA	GLIRIDAE	*Graphiurus platyops*	Rock Dormouse	High			
RODENTIA	HYSTRICIDAE	*Hystrix africaeaustralis*	Porcupine	Medium			
RODENTIA	MURIDAE	*Aethomys chrysophilus*	Red Veld Rat	Medium			
RODENTIA	MURIDAE	*Aethomys namaquensis*	Namaqua Rock Mouse	High			
RODENTIA	MURIDAE	*Desmodillus auricularis*	Cape Short-tailed Gerbil	High			
RODENTIA	MURIDAE	*Gerbillurus paeba*	Hairy-footed Gerbil	High			
RODENTIA	MURIDAE	*Lemniscomys rosalia*	Single-striped Grass Mouse	Low			
RODENTIA	MURIDAE	*Malacothryx typica*	Large-eared Mouse	Medium			
RODENTIA	MURIDAE	*Mus indutus*	Desert Pygmy Mouse	Low			
RODENTIA	MURIDAE	*Petromyscus collinus*	Pygmy Rock Mouse	High			n-End
RODENTIA	MURIDAE	*Petromyscus shortridgei*	Shortridge's Rock Mouse	High			
RODENTIA	MURIDAE	*Rhabdomys pumilio*	Striped Mouse	Low			
RODENTIA	MURIDAE	*Saccostomus campestris*	Pouched Mouse	Low			
RODENTIA	MURIDAE	*Tatera leucogaster*	Bushveld Gerbil	High			
RODENTIA	MURIDAE	*Thallomys nigricauda*	Black-tailed Tree Rat	Medium			
RODENTIA	PEDETIDAE	*Pedetes capensis*	Springhare	Low			
RODENTIA	PETROMURIDAE	*Petromus typicus*	Dassie Rat	High			
RODENTIA	SCIURIDAE	*Funisciurus congicus*	Striped Tree Squirrel	High			
RODENTIA	SCIURIDAE	*Xerus inauris*	Ground Squirrel	Low			
RODENTIA	SCIURIDAE	*Xerus princeps*	Damara Ground Squirrel	High			n-End
TUBULIDENTATA	ORYCTEROPODIDAE	*Orycteropus afer*	Aardvark	Low		NCO	

APPENDIX III. LIST OF BIRD SPECIES

A list of the bird species that are expected to occur in the study area, based on the SABAP 2 pentads as indicated in Figure 2.
The column "Habitat" indicates how suitable the habitat in the study area is for each species.
Habitat suitability: High = highly suitable with few habitat constraints, project area contains typical habitat for that species. Medium=intermediate suitability with some constraints. Low = Unlikely to be encountered. Empty cells denote unknown probability because the species habitat requirements are not known well enough.
Conservation status, Internat: IUCN (Red List version 2020.1) is given first. CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near threatened, LC: Least Concern, LR: Lower Risk, NE: Not Evaluated, DD: Data Deficient. Then follows **CITES** (2016/11/21 appendix): CITES I: threatened with extinction and international trade is prohibited, CITES II: not now threatened with extinction but may become so and trade may be authorised by export permit, CITES III: International trade is allowed upon presentation of permits or certificates.
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Conservation Status, Namibia: the status sourced from Griffin (2003) and Irish (2020). VU: Vulnerable, EN: Endangered, R: Rare, NT: Near-threatened, CR: Critically Endangered, End: Endemic, n-End: near-Endemic. Many of these species' status are provisional pending more data.

			CONSERVATION		
COMMON NAME	SPECIES	HABITAT	INTERNAT	LEGAL	NAMIBIA
Apalis Yellow-breasted	*Apalis flavida*	High		NCO	
Babbler Bare-cheeked	*Turdoides gymnogenys*	High		NCO	N-end
Babbler Hartlaub's	*Turdoides hartlaubii*	High		NCO	
Barbet Acacia Pied	*Tricholaema leucomelas*	High		NCO	
Barbet Black-collared	*Lybius torquatus*	High		NCO	
Batis Chinspot	*Batis molitor*	High		NCO	
Batis Pririt	*Batis pririt*	High		NCO	
Bee-eater European	*Merops apiaster*	High		NCO	
Bee-eater Little	*Merops pusillus*	High		NCO	
Bee-eater Madagascar	*Merops superciliosus*	High		NCO	
Bee-eater Swallow-tailed	*Merops hirundineus*	High		NCO	
Bee-eater White-fronted	*Merops bullockoides*	High		NCO	
Bishop Southern Red	*Euplectes orix*	High		NCO	

			CONSERVATION		
COMMON NAME	SPECIES	HABITAT	INTERNAT	LEGAL	NAMIBIA
Boubou Swamp	*Laniarius bicolor*	Medium		NCO	
Brownbul Terrestrial	*Phyllastrephus terrestris*	High		NCO	
Brubru Brubru	*Nilaus afer*	High		NCO	
Buffalo-weaver Red-billed	*Bubalornis niger*	High		NCO	
Bulbul African Red-eyed	*Pycnonotus nigricans*	High			
Bulbul Dark-capped	*Pycnonotus tricolor*	High			
Bunting Cinnamon-breasted	*Emberiza tahapisi*	High		NCO	
Bunting Golden-breasted	*Emberiza flaviventris*	High		NCO	
Bunting Lark-like	*Emberiza impetuani*	High		NCO	
Bush-shrike Grey-headed	*Malaconotus blanchoti*	Medium		NCO	
Buzzard Augur	*Buteo augur*	High	CITES II	NCO	
Buzzard Lizard	*Kaupifalco monogrammicus*	Low	CITES II	NCO	
Buzzard Steppe	*Buteo vulpinus*	High	CITES II	NCO	
Camaroptera Green-backed	*Camaroptera brachyura*	High			
Camaroptera Grey-backed	*Camaroptera brevicaudata*	High		NCO	
Canary Black-throated	*Crithagra atrogularis*	High		NCO	
Canary White-throated	*Crithagra albogularis*	High		NCO	
Canary Yellow	*Crithagra flaviventris*	High		NCO	
Cave-chat Angola	*Xenocopsychus ansorgei*	High		NCO	NT
Chat Familiar	*Cercomela familiaris*	High		NCO	
Cisticola Rattling	*Cisticola chiniana*	High		NCO	
Cormorant Reed	*Phalacrocorax africanus*	Medium		NCO, MRA	
Cormorant White-breasted	*Phalacrocorax lucidus*	Medium		NCO, MRA	
Coucal White-browed	*Centropus superciliosus*	Medium		NCO	
Courser Temminck's	*Cursorius temminckii*	Low		NCO	
Crake African	*Crecopsis egregia*	Medium		NCO, MRA	
Crake Black	*Amaurornis flavirostris*	Medium		NCO, MRA	
Crombec Long-billed	*Sylvietta rufescens*	High		NCO	
Cuckoo Black	*Cuculus clamosus*	High		NCO	

COMMON NAME	SPECIES	HABITAT	INTERNAT	CONSERVATION LEGAL	NAMIBIA
Cuckoo Diderick	*Chrysococcyx caprius*	High		NCO	
Cuckoo Jacobin	*Clamator jacobinus*	High		NCO	
Cuckoo Klaas's	*Chrysococcyx klaas*	High		NCO	
Cuckoo Levaillant's	*Clamator levaillantii*	High		NCO	
Cuckoo-shrike Black	*Campephaga flava*	High		NCO	
Darter African	*Anhinga rufa*	Medium		NCO, MRA	
Dove African Mourning	*Streptopelia decipiens*	High		NCO	
Dove Laughing	*Streptopelia senegalensis*	High			
Dove Namaqua	*Oena capensis*	High		NCO	
Dove Red-eyed	*Streptopelia semitorquata*	High		NCO	
Drongo Fork-tailed	*Dicrurus adsimilis*	High		NCO	
Eagle Martial	*Polemaetus bellicosus*	High	VU, CITES II	NCO	EN
Eagle Tawny	*Aquila rapax*	High	VU, CITES II	NCO	EN
Eagle Verreaux's	*Aquila verreauxii*	High	CITES II	NCO	NT
Eagle Wahlberg's	*Aquila wahlbergi*	High	CITES II	NCO	
Eagle-owl Verreaux's	*Bubo lacteus*	High	CITES II	NCO	
Egret Cattle	*Bubulcus ibis*	High		NCO, MRA	
Egret Great	*Egretta alba*	Medium		NCO, MRA	
Egret Little	*Egretta garzetta*	Medium		NCO, MRA	
Egret Yellow-billed	*Egretta intermedia*	Low		NCO, MRA	
Eremomela Yellow-bellied	*Eremomela icteropygialis*	High		NCO	EN
Falcon Lanner	*Falco biarmicus*	High	CITES II	NCO	
Finch Red-headed	*Amadina erythrocephala*	High		NCO	
Finch Scaly-feathered	*Sporopipes squamifrons*	High		NCO	
Firefinch Jameson's	*Lagonosticta rhodopareia*	High		NCO	
Firefinch Red-billed	*Lagonosticta senegala*	High		NCO	
Fiscal Common (Southern)	*Lanius collaris*	High		NCO	
Fish-eagle African	*Haliaeetus vocifer*	Medium	CITES II	NCO	VU
Flycatcher Ashy	*Muscicapa caerulescens*	High		NCO	

COMMON NAME	SPECIES	HABITAT	INTERNAT	CONSERVATION LEGAL	NAMIBIA
Flycatcher Chat	*Bradornis infuscatus*	High		NCO	
Flycatcher Marico	*Bradornis mariquensis*	High		NCO	
Flycatcher Southern Black	*Melaenornis pammelaina*	High		NCO	
Flycatcher Spotted	*Muscicapa striata*	High		NCO	
Francolin Orange River	*Scleroptila levaillantoides*	High			
Gallinule Allen's	*Porphyrio alleni*	Medium		NCO, MRA	
Go-away-bird Grey	*Corythaixoides concolor*	High		NCO	
Goose Egyptian	*Alopochen aegyptiaca*	High		MRA	
Goshawk Gabar	*Melierax gabar*	High	CITES II	NCO	
Goshawk Southern Pale Chanting	*Melierax canorus*	High	CITES II	NCO	
Green-pigeon African	*Treron calvus*	High		NCO	
Greenbul Yellow-bellied	*Chlorocichla flaviventris*	High		NCO	
Greenshank Common	*Tringa nebularia*	High		NCO, MRA	
Guineafowl Helmeted	*Numida meleagris*	High			
Hamerkop Hamerkop	*Scopus umbretta*	High		NCO	
Harrier-Hawk African	*Polyboroides typus*	High	CITES II	NCO	
Hawk Bat	*Macheiramphus alcinus*	High	CITES II	NCO	
Hawk-eagle African	*Aquila spilogaster*	High	CITES II	NCO	
Helmet-shrike Retz's	*Prionops retzii*	High		NCO	
Helmet-shrike White-crested	*Prionops plumatus*	High		NCO	
Heron Black-headed	*Ardea melanocephala*	Medium		NCO, MRA	
Heron Goliath	*Ardea goliath*	Medium		NCO, MRA	
Heron Green-backed	*Butorides striata*	Medium		NCO, MRA	
Heron Grey	*Ardea cinerea*	Medium		NCO, MRA	
Heron Purple	*Ardea purpurea*	Medium		NCO, MRA	
Heron Squacco	*Ardeola ralloides*	Medium		NCO, MRA	
Honey-buzzard European	*Pernis apivorus*	Low	CITES II	NCO	
Honeyguide Greater	*Indicator indicator*	High		NCO	
Honeyguide Lesser	*Indicator minor*	High		NCO	

COMMON NAME	SPECIES	HABITAT	CONSERVATION INTERNAT	LEGAL	NAMIBIA
Hoopoe African	*Upupa africana*	High		NCO	
Hornbill African Grey	*Tockus nasutus*	High		NCO	
Hornbill Bradfield's	*Tockus bradfieldi*	High		NCO	
Hornbill Damara	*Tockus damarensis*	High		NCO	N-end
Hornbill Monteiro's	*Tockus monteiri*	High		NCO	N-end
Hornbill Southern Red-billed	*Tockus rufirostris*	High			
Hornbill Southern Yellow-billed	*Tockus leucomelas*	High		NCO	
House-martin Common	*Delichon urbicum*	High		NCO	
Ibis Glossy	*Plegadis falcinellus*	High		NCO	
Indigobird Purple	*Vidua purpurascens*	High		NCO	
Indigobird Village	*Vidua chalybeata*	High		NCO	
Jacana African	*Actophilornis africanus*	Medium		NCO, MRA	
Kestrel Grey	*Falco ardosiaceus*	High	CITES II	NCO	
Kestrel Rock	*Falco rupicolus*	High	CITES II	NCO	
Kingfisher Brown-hooded	*Halcyon albiventris*	Medium		NCO	
Kingfisher Giant	*Megaceryle maxima*	Medium		NCO	
Kingfisher Grey-headed	*Halcyon leucocephala*	Medium		NCO	EN
Kingfisher Malachite	*Alcedo cristata*	Medium		NCO	
Kingfisher Pied	*Ceryle rudis*	Medium		NCO	
Kingfisher Woodland	*Halcyon senegalensis*	High		NCO	
Kite Black	*Milvus migrans*	High	CITES II	NCO	
Kite Yellow-billed	*Milvus aegyptius*	High			
Korhaan Red-crested	*Lophotis ruficrista*	High	CITES II	NCO	
Lapwing Blacksmith	*Vanellus armatus*	High		NCO, MRA	
Lapwing Crowned	*Vanellus coronatus*	High		NCO, MRA	
Lark Dusky	*Pinarocorys nigricans*	High		NCO	
Lark Sabota	*Calendulauda sabota*	High		NCO	
Lark Stark's	*Spizocorys starki*	High		NCO	
Lovebird Rosy-faced	*Agapornis roseicollis*	High		NCO	

COMMON NAME	SPECIES	HABITAT	INTERNAT	CONSERVATION LEGAL	NAMIBIA
Martin Banded	*Riparia cincta*	Low		NCO	
Martin Brown-throated	*Riparia paludicola*	High		NCO	
Martin Rock	*Hirundo fuligula*	High			
Masked-weaver Lesser	*Ploceus intermedius*	High			
Masked-weaver Southern	*Ploceus velatus*	High			
Mousebird Red-faced	*Urocolius indicus*	High			
Mousebird White-backed	*Colius colius*	High			
Night-Heron Black-crowned	*Nycticorax nycticorax*	Medium		NCO, MRA	
Night-Heron White-backed	*Gorsachius leuconotus*	Medium		NCO	
Nightjar Fiery-necked	*Caprimulgus pectoralis*	Low		NCO	
Nightjar Freckled	*Caprimulgus tristigma*	High		NCO	
Nightjar Rufous-cheeked	*Caprimulgus rufigena*	Low		NCO	
Nightjar Square-tailed	*Caprimulgus fossii*	High		NCO	
Openbill African	*Anastomus lamelligerus*	Low		NCO	
Oriole African Golden	*Oriolus auratus*	Low		NCO	
Oriole Black-headed	*Oriolus larvatus*	Low		NCO	
Oriole Eurasian Golden	*Oriolus oriolus*	Low		NCO	
Osprey Osprey	*Pandion haliaetus*	Medium	CITES II	NCO	
Ostrich Common	*Struthio camelus*	Low		NCO	
Owl Barn	*Tyto alba*	High	CITES II	NCO	
Owlet African Barred	*Glaucidium capense*	High	CITES II	NCO	
Owlet Pearl-spotted	*Glaucidium perlatum*	High	CITES II	NCO	
Oxpecker Yellow-billed	*Buphagus africanus*	Medium		NCO	EN
Painted-snipe Greater	*Rostratula benghalensis*	Low		NCO	
Palm-swift African	*Cypsiurus parvus*	High		NCO	
Palm-thrush Rufous-tailed	*Cichladusa ruficauda*	High		NCO	
Paradise-flycatcher African	*Terpsiphone viridis*	High		NCO	
Parrot Rüppell's	*Poicephalus rueppellii*	High	CITES II	NCO	NT, n-End
Pelican Great White	*Pelecanus onocrotalus*	Low		NCO, MRA	VU

			CONSERVATION		
COMMON NAME	SPECIES	HABITAT	INTERNAT	LEGAL	NAMIBIA
Penduline-tit Cape	*Anthoscopus minutus*	Low		NCO	
Pigeon Speckled	*Columba guinea*	Medium			
Pipit African	*Anthus cinnamomeus*	High		NCO	
Plover Three-banded	*Charadrius tricollaris*	High		NCO, MRA	
Prinia Black-chested	*Prinia flavicans*	High		NCO	
Prinia Tawny-flanked	*Prinia subflava*	High		NCO	
Puffback Black-backed	*Dryoscopus cubla*	High		NCO	
Pytilia Green-winged	*Pytilia melba*	High		NCO	
Quelea Red-billed	*Quelea quelea*	High			
Reed-warbler African	*Acrocephalus baeticatus*	High		NCO	
Rock-thrush Short-toed	*Monticola brevipes*	High		NCO	
Rockrunner	*Achaetops pycnopygius*	Medium		NCO	n-End
Roller Lilac-breasted	*Coracias caudatus*	High		NCO	
Roller Purple	*Coracias naevius*	High		NCO	
Sandgrouse Double-banded	*Pterocles bicinctus*	High			
Sandgrouse Namaqua	*Pterocles namaqua*	High			
Sandpiper Common	*Actitis hypoleucos*	High		NCO, MRA	
Sandpiper Wood	*Tringa glareola*	High		NCO, MRA	VU
Scimitarbill Common	*Rhinopomastus cyanomelas*	High		NCO	
Scops-owl African	*Otus senegalensis*	High	CITES II	NCO	
Scops-owl Southern White-faced	*Ptilopsis granti*	High	CITES II	NCO	
Scrub-robin White-browed	*Cercotrichas leucophrys*	High		NCO	
Shikra	*Accipiter badius*	High	CITES II	NCO	
Shrike Crimson-breasted	*Laniarius atrococcineus*	Medium		NCO	
Shrike Lesser Grey	*Lanius minor*	Medium		NCO	
Shrike Magpie	*Urolestes melanoleucus*	Low			
Shrike Red-backed	*Lanius collurio*	Medium		NCO	
Shrike Southern White-crowned	*Eurocephalus anguitimens*	High		NCO	
Shrike White-tailed	*Lanioturdus torquatus*	High		NCO	n-End

				CONSERVATION	
COMMON NAME	SPECIES	HABITAT	INTERNAT	LEGAL	NAMIBIA
Snake-eagle Black-chested	*Circaetus pectoralis*	High	CITES II	NCO	
Snake-eagle Brown	*Circaetus cinereus*	High	CITES II	NCO	
Sparrow Southern Grey-headed	*Passer diffusus*	High			
Sparrow-weaver White-browed	*Plocepasser mahali*	High		NCO	
Sparrowhawk Little	*Accipiter minullus*	High	CITES II	NCO	
Sparrowhawk Ovambo	*Accipiter ovampensis*	High	CITES II	NCO	
Sparrowlark Grey-backed	*Eremopterix verticalis*	High		NCO	
Spoonbill African	*Platalea alba*	Medium		NCO, MRA	
Spurfowl Hartlaub's	*Pternistis hartlaubi*	High		NCO	N-End
Spurfowl Red-billed	*Pternistis adspersus*	High			
Spurfowl Red-necked	*Pternistis afer*	High		NCO	
Spurfowl Swainson's	*Pternistis swainsonii*	High			
Starling Burchell's	*Lamprotornis australis*	Low		NCO	
Starling Cape Glossy	*Lamprotornis nitens*	High		NCO	
Starling Greater Blue-eared	*Lamprotornis chalybaeus*	Medium		NCO	
Starling Meves's	*Lamprotornis mevesii*	High		NCO	
Starling Pale-winged	*Onychognathus nabouroup*	High		NCO	
Starling Violet-backed	*Cinnyricinclus leucogaster*	Medium		NCO	
Starling Wattled	*Creatophora cinerea*	Medium		NCO	
Stint Little	*Calidris minuta*	Medium		NCO, MRA	
Stork Black	*Ciconia nigra*	Low	CITES II	NCO	EN
Sunbird Dusky	*Cinnyris fuscus*	High		NCO	
Sunbird Marico	*Cinnyris mariquensis*	Medium		NCO	
Sunbird Scarlet-chested	*Chalcomitra senegalensis*	High		NCO	
Sunbird White-bellied	*Cinnyris talatala*	High		NCO	
Swallow Barn	*Hirundo rustica*	High		NCO	
Swallow Greater Striped	*Hirundo cucullata*	High		NCO	
Swallow Grey-rumped	*Pseudhirundo griseopyga*	High		NCO	
Swallow Lesser Striped	*Hirundo abyssinica*	High		NCO	

			CONSERVATION		
COMMON NAME	SPECIES	HABITAT	INTERNAT	LEGAL	NAMIBIA
Swallow Pearl-breasted	*Hirundo dimidiata*	High		NCO	
Swallow White-throated	*Hirundo albigularis*	High		NCO	
Swallow Wire-tailed	*Hirundo smithii*	High		NCO	
Swamp-warbler Lesser	*Acrocephalus gracilirostris*	High		NCO	
Swift Alpine	*Tachymarptis melba*	High		NCO	
Swift Bradfield's	*Apus bradfieldi*	Medium		NCO	
Swift Common	*Apus apus*	Medium		NCO	
Swift Little	*Apus affinis*	High		NCO	
Swift White-rumped	*Apus caffer*	Medium		NCO	
Tchagra Brown-crowned	*Tchagra australis*	High		NCO	
Tern White-winged	*Chlidonias leucopterus*	Low		NCO, MRA	
Thick-knee Water	*Burhinus vermiculatus*	Medium		NCO	
Thrush Groundscraper	*Psophocichla litsitsirupa*	High		NCO	
Tit Carp's	*Parus carpi*	High		NCO	N-End
Tit Southern Black	*Parus niger*	Low		NCO	
Tit-babbler Chestnut-vented	*Parisoma subcaeruleum*	High		NCO	
Tit-flycatcher Grey	*Myioparus plumbeus*	Low		NCO	
Turtle-dove Cape	*Streptopelia capicola*	High			
Wagtail African Pied	*Motacilla aguimp*	High		NCO	
Warbler Icterine	*Hippolais icterina*	Medium		NCO	
Warbler Willow	*Phylloscopus trochilus*	Medium		NCO	
Waxbill Black-faced	*Estrilda erythronotos*	High		NCO	
Waxbill Blue	*Uraeginthus angolensis*	High		NCO	
Waxbill Cinderella	*Estrilda thomensis*	High		NCO	EN
Waxbill Common	*Estrilda astrild*	Medium		NCO	EN
Waxbill Violet-eared	*Granatina granatina*	High		NCO	
Weaver Chestnut	*Ploceus rubiginosus*	High			
Weaver Golden	*Ploceus xanthops*	High			
Weaver Red-headed	*Anaplectes melanotis*	High		NCO	

			CONSERVATION		
COMMON NAME	SPECIES	HABITAT	INTERNAT	LEGAL	NAMIBIA
Weaver Spectacled	*Ploceus ocularis*	High			
Whydah Shaft-tailed	*Vidua regia*	High		NCO	
Wood-dove Emerald-spotted	*Turtur chalcospilos*	High		NCO	
Wood-hoopoe Green	*Phoeniculus purpureus*	High		NCO	
Wood-hoopoe Violet	*Phoeniculus damarensis*	High		NCO	
Woodpecker Bearded	*Dendropicos namaquus*	High		NCO	
Woodpecker Bennett's	*Campethera bennettii*	High		NCO	
Woodpecker Cardinal	*Dendropicos fuscescens*	High		NCO	
Woodpecker Golden-tailed	*Campethera abingoni*	High		NCO	

APPENDIX IV. LIST OF REPTILE SPECIES

A list of the reptile species that are expected to occur in the study area, based on the distribution maps in Alexander & Marais (2007), Branch (1998) and Marais (2004).
The column "Habitat" indicates how suitable the habitat in the study area is for each species.
Habitat suitability: High = highly suitable with few habitat constraints, project area contains typical habitat for that species. Medium=intermediate suitability with some constraints. Low = Unlikely to be encountered. Empty cells denote unknown probability because the species habitat requirements are not known well enough.
Conservation status, Internat: IUCN (Red List version 2020.1) is given first. CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near threatened, LC: Least Concern, LR: Lower Risk, NE: Not Evaluated, DD: Data Deficient. Then follows **CITES** (2016/11/21 appendix): CITES I: threatened with extinction and international trade is prohibited, CITES II: not now threatened with extinction but may become so and trade may be authorised by export permit, CITES III: International trade is allowed upon presentation of permits or certificates.
Conservation Status, Legal: Protection granted by laws and/or regulations in Namibia. NCO: Nature Conservation Ordinance, 1975, MRA: Marine Resources Act, 2000, FA: Forest Act, 2001
Conservation Status, Namibia: the status sourced from Griffin (2003) and Irish, 2020. Only those that are of concern are noted here. VU: Vulnerable, EN: Endangered, R: Rare, NT: Near-threatened, CR: Critically Endangered, End: Endemic, n-End: near-Endemic. Many of these species' status are provisional pending more data.

				CONSERVATION		
FAMILY	SPECIES	COMMON NAME	HABITAT	INTERN	LEGAL	NAMIBIA
VIPERIDAE	*Bitis arietans*	Puff Adder	Medium			
	Bitis caudalis	Horned Adder	Low			
ELAPIDAE	*Dendroaspis polylepis*	Black Mamba	Low			
	Naja nigricollis nigricincta	Zebra Cobra	High			R, n-End
COLUBRIDAE	*Dispholidus typus*	Boomslang	Low			
	Thelotornis capensis oatesii	Oates' Vine Snake	Medium			
	Philothamnus semivariegatus	Spotted Bush Snake	High			
	Coluber zebrinus	Kunene Racer	Medium			n-End
	Dasypeltis scabra	Common Egg-eater	Medium			
LAMPROPHIIDAE	*Atractaspis bibronii*	Southern Stiletto Snake	High			
	Dipsina multimaculata	Dwarf Beaked Snake	High			n-End
	Psammophes jallae	Jalla's Sand Snake	Medium			R

				CONSERVATION		
FAMILY	SPECIES	COMMON NAME	HABITAT	INTERN	LEGAL	NAMIBIA
	Psammophis leopardinus	Leopard Whip Snake	High			n-End
	Psammophis trigrammus	Western Whip Snake	High			n-End
	Psammophis notosticus	Karoo Whip Snake	Medium			
	Psammophis subtaeniatus	Western Stripe-bellied Sand Snake	Medium			
	Pythonodipsas carinata	Western Keeled Snake	High			n-End
	Lycophidion hellmichi	Hellmich's Wolf Snake	High	DD		R
	Gonionotophis vernayi	Angola File Snake	High			R
PYTHONIDAE	*Python natalensis*	Southern African Python	High		NCO	VU
	Python anchietae	Anchieta's Dwarf Python	High		NCO	EN
	Boaedon capensis	Brown House Snake	Medium			
	Pseudaspis cana	Mole Snake	Medium			
	Prosymna frontalis	South-western Shovel-snout	Medium			
	Prosymna visseri	Visser's Shovel-snout	Medium			
TYPHLOPIDAE	*Afrotyphlops schlegelii petersii*	Peters' Beaked Blind Snake	Low			
LEPTOTYPHLOPIDAE	*Namibiana occidentalis*	Western Worm Snake	Medium			n-End
	Namibiana labialis	Damara Worm Snake	Medium			End
AGAMIDAE	*Agama aculeata*	Ground Agama	High			
	Agama anchietae	Anchieta's Agama	High			
	Agama planiceps	Namibian Rock Agama	High			
CHAMAELEONIDAE	*Chamaeleo namaquensis*	Namaqua Chameleon	High			
LACERTIDAE	*Heliobolus lugubris*	Bushveld Lizard	Low			
	Nucras intertexta	Spotted Sandveld Lizard	High			
	Pedioplanis breviceps	Short-headed Sand Lizard	Low			End
	Pedioplanis gaerdesi	Kaokoveld Sand lizard	High			End
	Pedioplanis namaquensis	Namaqua Sand Lizard	Medium			
	Pedioplanis undata	Western Sand Lizard	Medium			n-End
SCINCIDAE	*Sepsina alberti*	Albert's Burrowing Skink	High			
	Mochlus sundevalli	Sundevall's Writhing Skink	Medium			
	Trachylepis acutilabris	Wedge-snouted Skink	Low			

FAMILY	SPECIES	COMMON NAME	HABITAT	CONSERVATION INTERN	LEGAL	NAMIBIA
	Trachylepis binotata	Ovambo Tree Skink	High			
	Trachylepis chimbana	Chimba Skink	Unknown			R
	Trachylepis hoeschi	Hoesch's Skink	High			n-End
	Trachylepis laevis	Angolan Blue-tailed Skink	HIgh			
	Trachylepis spilogaster	Kalahari Tree Skink	Medium			n-End
	Trachylepis striata	Striped Skink	High			
	Trachylepis sulcata	Western Rock Skink	High			
	Trachylepis variegata	Speckled Sand Skink	Medium			
GERRHOSAURIDAE	*Cordylosaurus subtessellatus*	Dwarf Plated Lizard	High			n-End
	Gerrhosaurus multilineatus	Kalahari Plated Lizard	High			
	Gerrhosaurus nigrolineatus	Black-lined Plated Lizard	Medium			
	Gerrhosaurus validus	Giant Plated Lizard	High			
GEKKONIDAE	*Afroedura bogerti*	Bogert's Rock Gecko	Low			R
	Chondrodactylus fitzsimonsi	Fitzsimons' Thick-toed Gecko	High			n-End
	Chondrodactylus turneri	Turner's Thick-toed Gecko	Medium			
	Lygodactylus bradfieldi	Bradfield'sDwarf Gecko	High			End
	Lygodactylus lawrencei	Lawrence's Dwarf Gecko	High			End, Range
	Pachydactylus caraculicus	Angola Banded Thick-toed Gecko	High			
	Pachydactylus bicolor	Velvety Gecko	Medium			End
	Pachydactylus oreophilus	Kaokoveld Gecko	Medium			
	Pachydactylus sansteyni	San Steyn's Gecko	Medium			
	Pachydactylus scutatus	Common Large-scaled Gecko	High			End
	Rhoptropus barnardi	Barnard's Namib Day Gecko	High			n-End
VARANIDAE	*Varanus niloticus*	Water Monitor	Low	CITES II	NCO	VU
TESTUDINIDAE	*Stigmochelys pardalis*	Leopard Tortoise	High		NCO	VU

APPENDIX V. LIST OF AMPHIBIAN SPECIES

A list of the amphibian species that are expected to occur in the study area, based on the distribution maps in Du Preez & Carruthers (2009).
The column “Habitat” indicates how suitable the habitat in the study area is for each species.
Habitat suitability: High = highly suitable with few habitat constraints, project area contains typical habitat for that species. Medium=intermediate suitability with some constraints. Low = Unlikely to be encountered. Empty cells denote unknown probability because the species habitat requirements are not known well enough.
Conservation status, Internat: IUCN (Red List version 2020.1) is given first. CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near threatened, LC: Least Concern, LR: Lower Risk, NE: Not Evaluated, DD: Data Deficient. Then follows **CITES** (2016/11/21 appendix): CITES I: threatened with extinction and international trade is prohibited, CITES II: not now threatened with extinction but may become so and trade may be authorised by export permit, CITES III: International trade is allowed upon presentation of permits or certificates.
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				CONSERVATION		
FAMILY	**SPECIES**	**COMMON NAME**	**HABITAT**	**INTERNAT**	**LEGAL**	**NAMIBIA**
BREVICEPTIDAE	*Breviceps adspersus*	Bushveld Rain Frog	Medium			
BUFONIDAE	*Amietophrynus gutturalis*	Guttural Toad	Medium			
BUFONIDAE	*Amietophrynus maculatus*	Flat-backed Toad	High			
BUFONIDAE	*Amietophrynus poweri*	Western Olive Toad	Medium			
BUFONIDAE	*Poyntonophrynus damaranus*	Damara Pygmy Toad	Medium	DD		End
BUFONIDAE	*Poyntonophrynus dombensis*	Dombe Pygmy Toad	High			
HYPEROLIIDAE	*Hyperolius nasutus*	Long Reed Frog	High			
HYPEROLIIDAE	*Hyperolius parallelus*	Angolan Reed Frog	Medium			
HYPEROLIIDAE	*Kassina senegalensis*	Bubbling Kassina	Medium			
MICROHYLIDAE	*Phrynomantis annectens*	Marbled Rubber Frog	High			n-End
PHRYNOBATRACHIDAE	*Phrynobatrachus mababiensis*	Dwarf Puddle Frog	Medium			
PHRYNOBATRACHIDAE	*Phrynobatrachus natalensis*	Snoring Puddle Frog	Medium			
PIPIDAE	*Xenopus laevis*	Common Platanna	Low			

FAMILY	SPECIES	COMMON NAME	HABITAT	CONSERVATION INTERNAT	LEGAL	NAMIBIA
PIPIDAE	*Xenopus petersii*	Peters's Platanna	Low			
PTYCHADENIDAE	*Hildebrandia ornata*	Ornate Frog	Medium			
PTYCHADENIDAE	*Ptychadena mascarenienses*	Mascarane Grass Frog	Medium			
PYXICEPHALIDAE	*Pyxicephalus adspersus*	Giant Bullfrog	Medium	Decreasing		NT
PYXICEPHALIDAE	*Tomopterna krugerensis*	Knocking Sand Frog	Medium			
PYXICEPHALIDAE	*Tomopterna tandyi*	Tandy's Sand Frog	High			
PYXICEPHALIDAE	*Tomopterna tuberculosa*	Beaded Sand Frog	Low			

KNL OF NAMIBIA (PTY) LTD

PO Box 81307, Windhoek, Namibia

Otjitanga Project, Mining License 40,
Otjimuhaka, Kunene Region

HYDROLOGICAL AND HYDROGEOLOGICAL ASSESSMENTS

as part of an Environmental Scoping Study for mining of blue sodalite dimension stone, and other minerals.

DRAFT 4 CHANGES

Section 4.2.2, 6.2, 8.4.2, 8.4.3, 9.1, 9.2, 10.5.1
Table 19
Figures 1,9,13,15,17,18,19
Appendix D

March 2021

Namib Hydrosearch | PO Box 20690, Windhoek Namibia, diganta@namibhydro.com

Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms

ABA	Acid Base Accounting
AMD	Acid Mine Drainage
AP	Acid potential
DRWS	Directorate of Rural Water Supply
DTM	Digital Terrain Model
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
HDPE	High-density polyethylene
HLEM	Horizontal loop electromagnetic profiling
ICP-MS	Inductively coupled plasma mass spectroscopy
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbgl	Meters below ground level
ML40	Mining License 40
NIBS	Namibia Integrated Biosystems Projects
REE	Rare earth element
ROM	Run of mine stockpile
RWD	Return Water Dam
NAGpH	Net Acid Generation pH
NNP	Net neutralisation potential
NP	Neutralisation potential
NPR	Neutralisation potential ratio
TSF	Tailings Storage Facility
tpa	Tons per annum

Executive Summary

KNL of Namibia proposes to mine sodalite (blue decorative stone) and also process associated rare earth elements (REE) and iron oxide ore on the Mining License 40, near Otjimuhaka, Epupa Constituency, Kunene Region. Dimension stone and smaller size sodalite mining is proposed. The associated REE is hosted in carbonatite dykes and will be processed to produce a concentrate by gravity separation or flotation techniques. This hydrological and hydrogeological study is part of an Environmental Scoping Assessment being carried out for the proposed mining and associated processing and accessory works operations.

The project area is located approximately 65 km due west of Ruacana, on the eastern edge of the Zebra Mountains. The proposed opencast mining targets are sodalite carbonatite dykes intrusive into anorthosite of the Kunene Complex. The mining area is topographically elevated and slopes northward towards the Kunene River. A large ephemeral river, the Ondoto, flows north to the Kunene through the project area and the mining area is located in the Ondoto River catchment.

The current assessment primarily focusses on possible environmental impact from REE mining activities on the Ondoto River and the alluvial aquifer, in terms of water quality and as a sustainable water source. Groundwater potential of the Ondoto alluvial aquifer is moderate and as the local community is dependent on this source for water, use of alternative water sources is recommended for the envisaged long-term mining and processing operations. Alternative water sources were identified, such as, direct intake from the Kunene River and installation of boreholes in the Dwyka Group rocks along the banks of the Kunene River.

The assessment has identified the management of the tailings and waste rock from processing of REE ore as important environmental concerns as the ore processing activities are located upstream of the Ondoto and Kunene Rivers. Based on the hydrological study, measures for stormwater management and containing any effluent from the processing facility and waste are proposed. The potential for contamination through mobilisation of contaminants from the tailing and waste is considered low due predominance of carbonate minerals in the ore and resulting alkaline conditions of the waste rock and tailings. Possible contaminants such as thorium are being removed from site in the REE concentrate product.

The impact of sodalite mining to a maximum depth of 40 meter is limited as the groundwater level is deep, exceeding 100 m below ground level. Management of stormwater in the quarries and around the accessory work areas is recommended.

1 INTRODUCTION

KNL of Namibia appointed Namib Hydrosearch for the specialist hydrology and hydrogeology study as part of an Environmental Scoping Assessment for their blue sodalite, iron and rare earth element mining in Mining License 40 and six mining claims in the Epupa Constituency, Kunene Region (Figure 1). The work was carried out together with hydrology specialists (Namibia Integrated Biosystems Projects, NIBS) and overall supervision of the lead environmental consultant Philip Hooks. Table 1 gives the scope and components of the Water Study. The work is being carried out in two phases with environmental assessment being completed in phase 1 and work towards establishment of a sustainable water supply in phase 2.

Table 1: Summary of components of the Water Study

Study	Requirement
Hydrocensus and baseline water quality	Hydrocensus and compile list of water points – groundwater and surface water – covering the mine and local catchment areas. Assess availability of water in the immediate mine area. Baseline water quality assessment through well head analyses, sampling and laboratory analyses of samples (Phase 1).
Establishment of a water supply scheme	Assess the potential surface and groundwater sources for supply to the processing plant. Exploration (including geophysical survey), drilling of sites and evaluation of supply potential (Phase 2).
Hydrology	Evaluate the Ondoto catchment at a high level for runoff characteristics and recharge. Evaluate the mine site runoff characteristics (Phase 1).
Hydrology	Assessment in parallel to the above on the feasibility of supplying water from the Kunene River and possible impacts of abstraction and conveyance (Phase 1).
Assessment of mobility of potential radioactive contaminants from mine, stockpile and tailings.	Assess the ore, waste and lithologies in tailings storage facility for mobility of thorium and other potential radioactive contaminants. Results are to be assessed for prediction of leachate production from tailings storage facility and possible impacts (Phase 1).
Water abstraction permit application and technical input	Complete all necessary applications for water abstraction and conveyance to supply the processing plant and for domestic supply. Provide all necessary technical input / reports for the applications. (Phase 2)
Monitoring network	Water level, abstraction rate and water quality monitoring points to be identified and established (Phase 2).
Reporting	Baseline report at the end of the hydrocensus describing the hydrogeology and water quality. Report of specialist study on possible assessment of impact of mining (Phase 1). Borehole siting for water supply to the mine (Phase 2).

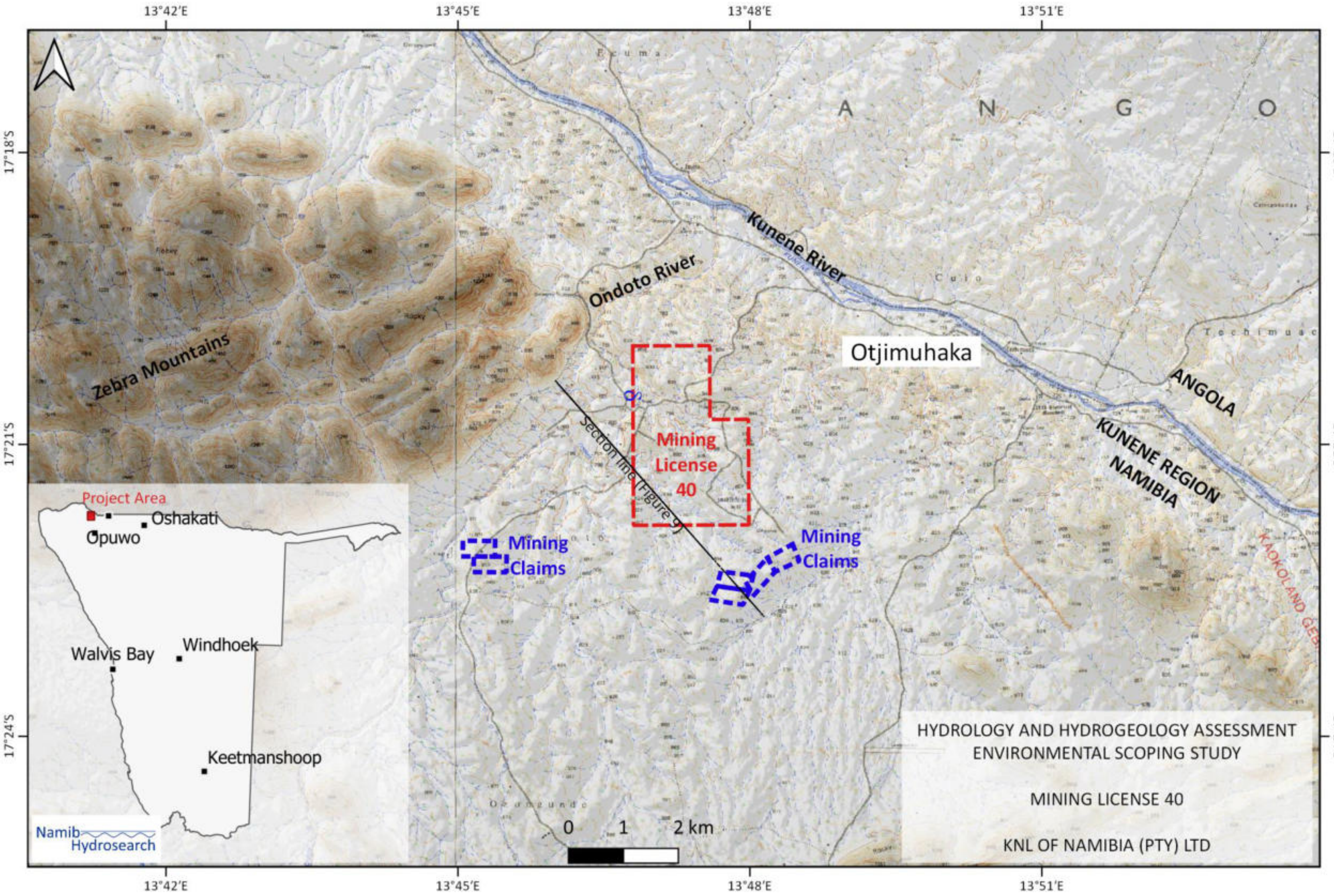

Figure 1: Project area location map

2 PROPOSED MINING ACTIVITIES AND WATER DEMAND

Quarrying for sodalite will continue in Mining Licence 40 (ML40) and the mining claims together with the planned mining and extraction of iron oxide and REE minerals. The sodalite, iron oxide and REE are hosted in related geological units (dykes) in various locations within the license areas and multiple quarries will be in operation. Mining quantities are estimated as 8,000 ton/month (2.9 million tons per year) with the production of 1.5 million tons of waste rock per year. Sodalite dimension stone blocks and lumps will be prepared for bulk transport from site. The REE ore will be concentrated using gravity separation or floatation methods and the concentrate will be transported offsite for further processing. The life of mine is estimated as 25 years. Estimated water demand is 100,000 m³/year (or 12 m³/hour).

3 LEGAL AND REGULATORY REQUIREMENTS

A summary of the applicable acts is given below.

1. To comply with the Namibia National Environmental Policy (Directorate of Environmental Affairs, Jan 1995) it is required that an Environmental Assessment be carried out that includes a hydrogeological assessment.
2. In accordance with the Minerals (Prospecting and Mining) Act 33 of 1992 Section 68(f) the following information or assessment is necessary [called the Environmental Conditions]:
    a. Particulars of the existing conditions of the environment
    b. An estimate of the effect which the proposed operations may have
    c. Steps to be taken to prevent or minimise such effect
    d. This information forms a part of the Pro-forma Environmental Contract between the Government and the applicant and is attached as ‘Appendix A’ to the contract once the Ministry of Environment and Tourism (MET) and Ministry of Mines and Energy (MME) are satisfied with the submitted Environmental Conditions.
3. For compliance and notification during the construction and operation phase Environmental Reports are to be submitted every six months to the Mining Commissioner as per section 48(4) of the Minerals (Prospecting and Mining) Act 33 of 1992.
4. Water abstraction from areas lying within proclaimed Subterranean Water Control Areas (Water Act 54 of 1956, Chapter 3, Section 28) is protected for public interest. Known areas of dolomitic and artesian groundwater resources and other groundwater reserves are protected from undue depletion. The EPL does not fall under Water Control Area (Government notice 189, 1970). However, for bulk groundwater development and abstraction such as for mining purposes a plan has to be submitted to the Geohydrology Division, Department of Water Affairs and Forestry for evaluation and approval. The main concerns usually are the sustainability of the proposed abstraction scheme and effect on exiting groundwater supply sources.

Water quality guidelines of 1988 and proclaimed Subterranean Water Control Areas will be superseded by Water Resources Management Act 2013 once the regulations are implemented.

In summary, the hydrogeological baseline status of the exploration / mining license areas is to be documented followed by an environmental assessment with plans for impact mitigation and monitoring.

In addition to the above, groundwater exploration and development will require application to the Directorate of Water Resources Management (Geohydrology Division) for permission to drill followed by permission to abstract water. Any industrial waste water disposal will require a permit from the Water Environment Division of the same Directorate.

4 SUSTAINABLE WATER SUPPLY TO THE MINE

4.1 Long term surface water supply options

There are two main supply options available, the first is the Ondoto River System (currently being utilized) and the second the Kunene River located approximately 4km north of the project.

4.1.1 Ondoto River System

The Ondoto River runs along the Western boundary of the project, i.e. the Mining Licence area and would be the obvious choice when considering a water supply. The immediate concern is firstly sustainability and secondly the social impact on the surrounding community if the water source is over exploited.

In order to cover all possible water supply options, use of surface water must be considered. This will be in the form of a reservoir (dam) constructed within the Ondoto River or sub-river large enough to capture adequate volumes to sustainably supply the mine and surrounding communities. The construction of a dam within the Ondoto River will require an in depth catchment study to determine the estimated mean annual runoff and peak flows.

4.1.1.1 Catchment analysis and Mean Annual Runoff determination

A background desktop study was conducted in order to gather all available information on the area. A Digital Terrain Model (DTM) and satellite images have been sourced from various online platforms in order to conduct high level hydrological calculations and to better understand the extent on the various catchments affecting the ML40 Area and mining claims.

As part of the background desk study, the Department of Water Affairs, Hydrology Division was approached to determine if any hydrological studies had historically been compiled on the area and system in question.

4.1.1.2 DTM and other online terrain information

Satellite imagery and elevation data has been downloaded from various sources in order to compile a Digital Terrain Model (DTM) of the area. The DTM used to evaluate the various catchments has been sourced from the Japan Aerospace Exploration Agency with a grid resolution of 30m.

Global Mapper V16 has been used to analyse the water shed and determine the sub-catchments within the greater Ondoto Catchment. This data was then used to estimate the hydrological characteristics of the Ondoto River in order to determine if the river could be a viable water source for both, the mine and surrounding communities.

4.1.1.3 Ondoto sub-catchments

The Ondoto River has been analysed for the various sub-catchments as can be seen in Figure 2. This data has then been used to determine the total catchment area for the entire Ondoto river system by encapsulating all sub-catchments within one total catchment area.

The catchment is quite substantial measuring approximately 1,640 km^2. Catchments of this size require a more in depth study by breaking the area up into smaller sub-catchments in order to determine the Mean Annual Runoff (MAR) with any sort of accuracy.

4.1.1.4 Information obtained from Hydrology Division, Department of Water Affairs

As part of a study conducted by the Division of Hydrology in August 1992 to compile Unit Runoff Maps for all major catchments within Namibia, the Ondoto River system was analysed and formed part of the data set used to compile information for the area in question.

The Unit Runoff Maps made use of the collected data from various catchments and calculated MAR per unit area for each of the major catchments in Namibia. The unit runoff method can now be used to calculate the expected runoff for any smaller area located within the specific catchment. This is done by simply multiplying the unit runoff allocated to the area by the area being evaluated which gives a MAR in million cubic meter of water.

According to the report, the Ondoto Catchment has the characteristics listed below in Table 2 andTable 3.

Table 2: Sub-Catchments on the Kunene Region Rivers as Processing Downstream (Abstracted from Table 44 – Unit Runoff Map of Namibia)

Main River Name	Catchment Site Name	Area (km^2)	Stream Length (km)	River Slope	MAP (mm)	Altitude (m AMSL) MAX-MIN
ONDOTO	Ondoto	1640	56	0.00714	325	1858-852

Table 3: Details of the Ondoto Sub-Catchment (Abstracted form Table 45 – Unit Runoff Map of Namibia)

Main River Name	Catchment Site Name	Area (km^2)	Stream Length (km)	Vegetation Type	Soil Type	Predominant Underlying Rock Formation
ONDOTO	Ondoto	1640	56	Mopane Savannah	Acid (Granite)	Granitic/Volcanic Rocks

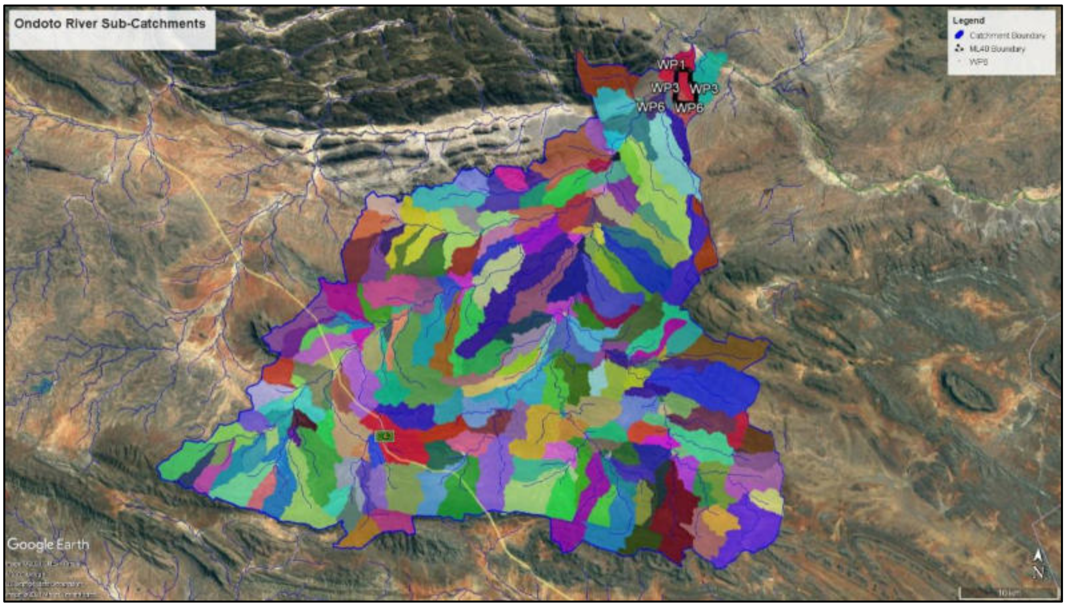

Figure 2: Ondoto River Sub-Catchments

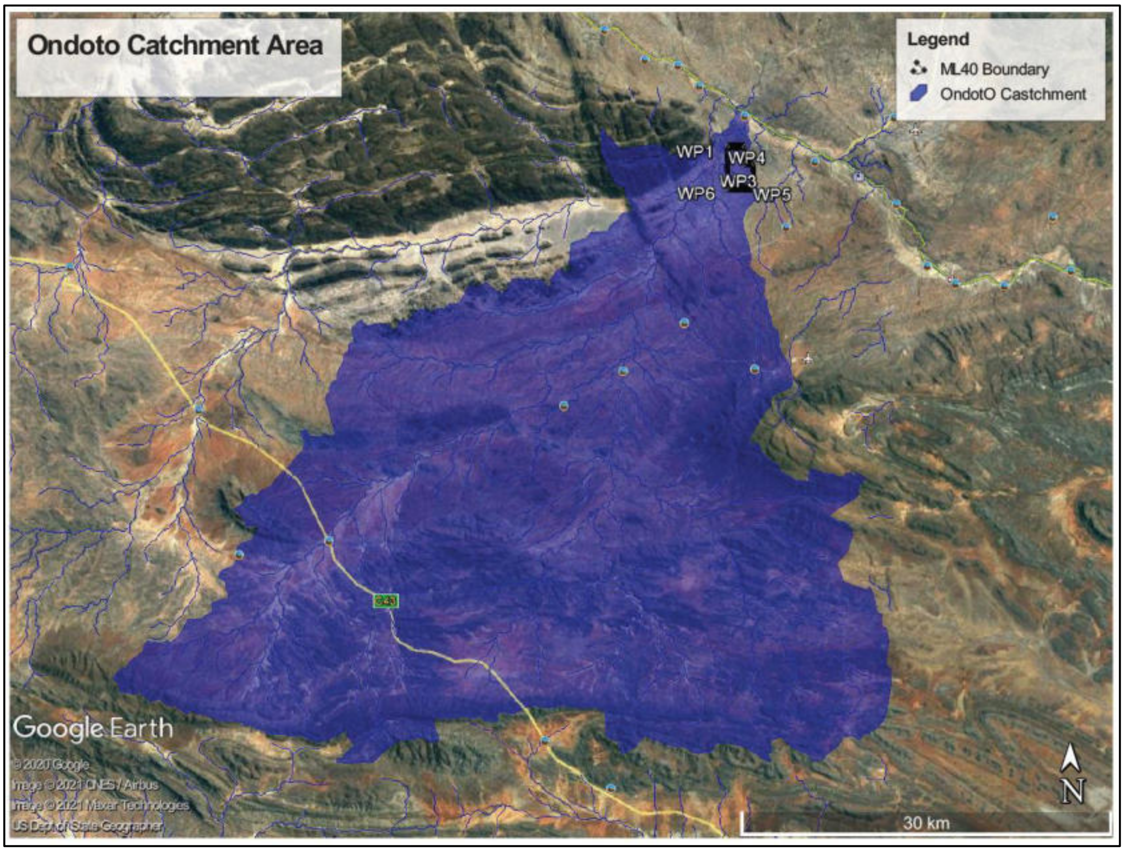

Figure 3: Ondoto Total Catchment

The Unit Runoff Map gives the Mean Annual Runoff (MAR) in Mm^3/year and Unit Runoff (Mm^3)/km^2 of the Ondoto River in Table 4. This Unit Runoff can also be used to determine any runoff within ML40.

4.1.1.5 Ondoto mean average runoff - Unit Runoff report

As can be seen in Figure 2 and Figure 3, the Ondoto catchment spans over a relatively large area totalling 1,640 km^2 and has the potential to yield a MAR of 13.2 Million cubic meter of water. The Mean Annual Precipitation (MAP) of the Ondoto catchment is 325mm per year.

The Ondoto catchment is however located in an area with high rainfall variance. The relatively high MAP is therefore misleading. Generally speaking, the area will receive below average rainfall for long periods followed by periods of high to extreme rainfall seasons. Using this data to determine the long-term sustainability for a water supply can be risky and would require a long period of actual onsite flow monitoring.

Table 4: Ondoto Unit Runoff Details (Abstracted form Table 46 – Unit Runoff Map of Namibia)

River Name	Station / Site Name	MAR (Mm^3)	UR (MAR/A – mm)
ONDOTO	Ondoto	13.200	8.049

4.1.1.6 Required infrastructure

In light of the above, in order to sustainably utilize surface water, a reservoir (dam) large enough to hold at least three to five years' worth of water requirements (including evaporation and infiltration losses) will have to be constructed. The evaporation in this area is approximately 3,000mm per year resulting in extremely large annual losses to evaporation alone.

The Ondoto River System will generate extremely high peak flows resulting in the need for costly in-river and spillway infrastructure.

4.1.1.7 Discussion

Additionally, flow measurement infrastructure would also have to be constructed in the Ondoto River in order to get a more comprehensive idea of the actual on site flow characteristics. In order to utilise the Ondoto River as a sustainable supply high capital intensive in-river infrastructure, i.e. a dam wall, would be required making this option uneconomical.

4.1.2 Kunene River

The Kunene River is a westward flowing perineal river located approximately 4km north of ML40. The catchment area is 107,000 km^2 with an average MAR of 5,200 Million m^3/year (Figure 4 and Figure 5).

The river level is dependent on the discharge from the hydropower station located upstream at Ruacana but subject to seasonal flooding as can be seen on Figure 6 . The minimum flow is mostly experienced in November but the low flow is still approximately 20 m^3/sec (72,000 m^3/hr). The required approximately 15 m^3/hr abstraction to supply the mine and surrounding communities would therefore have negligible effect on the river flow.

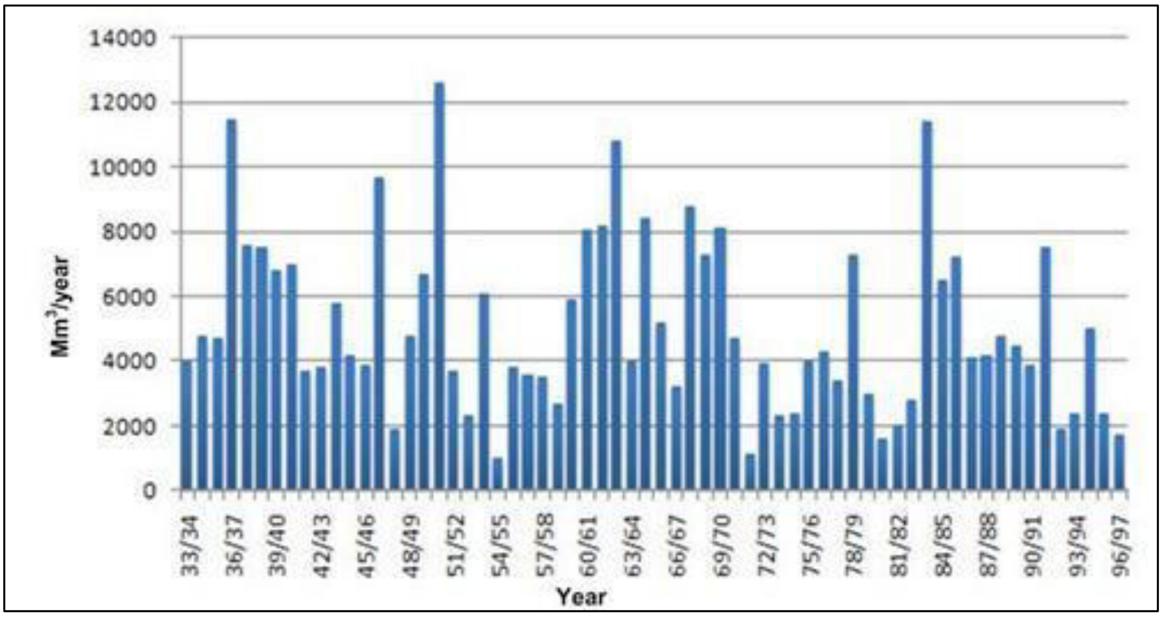

Figure 4: Kunene River Annual Runoff at Ruacana

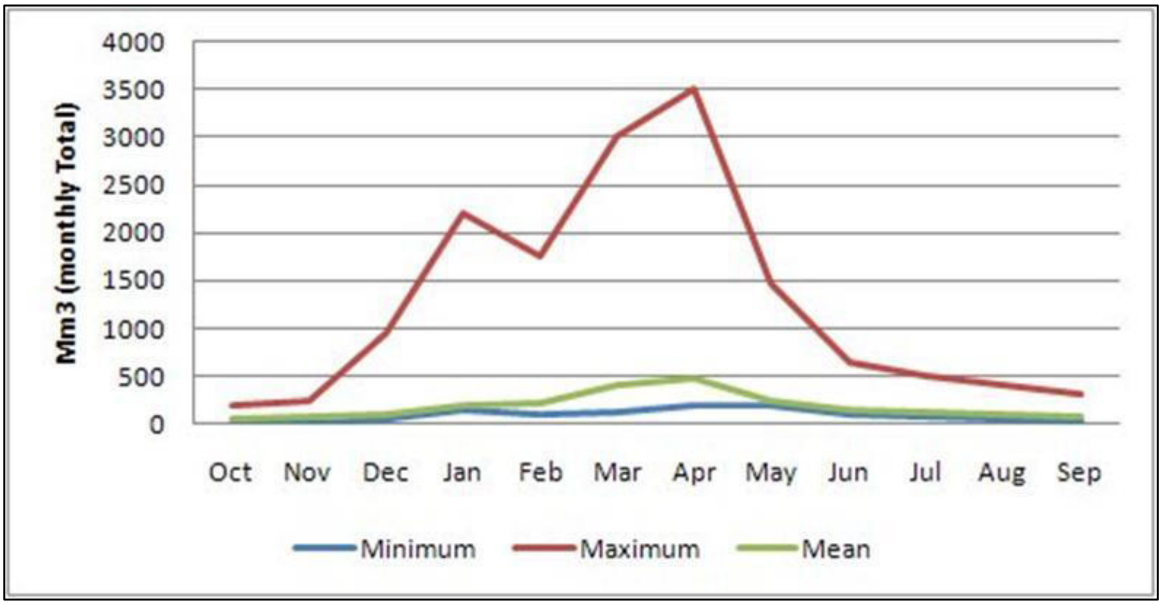

Figure 5: Kunene River Hydrograph, Ruacana

4.1.2.1 Abstraction from the Kunene River

The Kunene River has an extremely high variation in flow (and river level) making river abstraction infrastructure costly and also subject to flood damage. A number of options are available ranging from a floating system to wet wells. In-river infrastructure is generally extremely costly and construction timing during low water season is essential.

Considering the relatively low quantities of water required, the abstraction infrastructure would not have to accommodate large pumps but would need to be constructed large enough to handle flooding and still maintain adequate supply during the low flow periods.

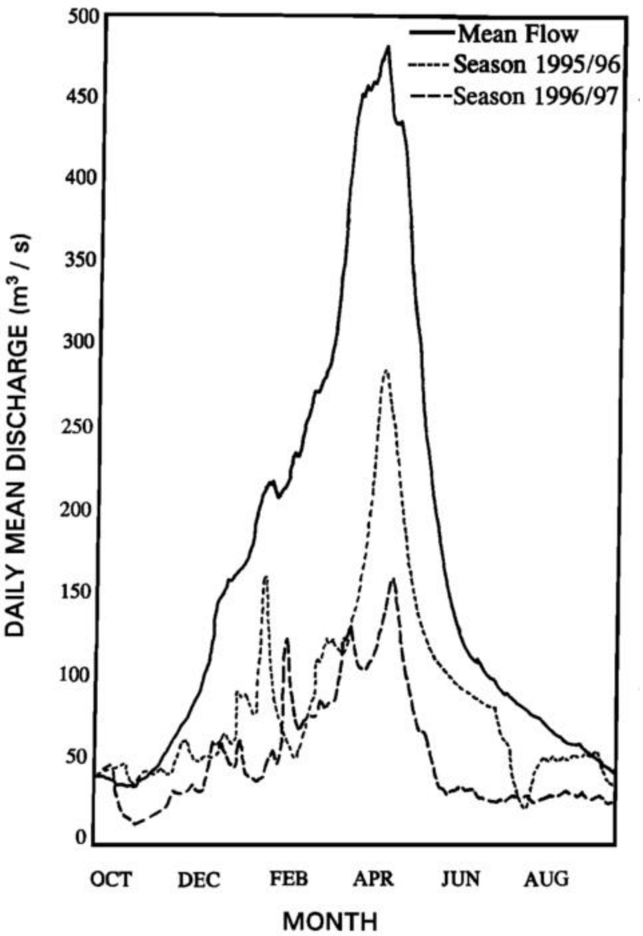

Figure 6: Daily Mean Discharge - Kunene River at Ruacana (from Department of Water Affairs, Namibia)

A floating raft type of system would therefore be ideal but would be susceptible to damage during high flows. A sump would also have to be built to accommodate the low flow periods as the pump intakes would still need to have adequate depth to avoid vortexes and cavitation.

According to the Directorate of Rural Water Supply (DRWS), the Kunene River is relatively unpolluted with a low concentration of phosphorus as well as other nutrients. The river does however have a high sediment load making the water turbid and would therefore require filtration before use.

4.2 Groundwater supply options

Three potential groundwater sources were evaluated, and the findings are summarised here.

4.2.1 Ondoto River alluvium

The main commercial activities in the project area are dimension stone mining, artisanal scale mining of sodalite from various claims and livestock farming by the community. The only source of perennial water in the ML 40 area and immediate surroundings is groundwater in the Ondoto River alluvium. A hand dug well is operated by the project / mining company for supply to the camp and community. Therefore a submersible pump has been placed in the hand-dug well and water is pumped to a filter system before supply. The current water consumption from the well in the Ondoto River is estimated as less than 5m³/day for domestic use by the community and the company. During the hydrocensus conducted no other borehole or well was found. Livestock are watered directly at springs in the Ondoto River in places of outflow from the alluvium where the bedrock is close to surface. The community and government offices in Otjimuhaka (Swartbooisdrift) at the bank of the Kunene source water from the Kunene River.

The reach of the river that includes the well forms an alluvial compartment bounded upstream and downstream by bedrock outcrops. The compartment has a length of 5,700 m and covers an area of 375,600 m². It is digitised from a Google Earth image and is shown in Figure 8. The groundwater level measured in the well is 3.9 m bgl.

Assessment of the Ondoto River alluvium for water supply for the future mining and processing activities could only be done in a cursory manner from the data available. The stored resource in the alluvium compartment with assumed saturated thickness of 4m and a porosity value of 20% is 300,500m³. Further assuming that 50% of the stored volume is abstractable and the aquifer is replenished every 5 years the volume of water available is 30,000 m³/year (or about 80m³/day). The time intervals in which groundwater recharge occur is the critical factor in the sustainability of this supply. Recharge to alluvial aquifers generally occurs by vertical leakage during river flow as known from the better studied ephemeral systems of Namibia (e.g. Kuiseb, Omaruru, and Oanob). The Ondoto River is known to have highly variable flow from year to year as discussed above but actual flow monitoring data is not available for analysis.

A detailed evaluation of the sustainability of the source would require measurement of the alluvium thickness over the length of the compartment, estimation of aquifer properties and flow gaging information. Notwithstanding the above constraints in the evaluation of the aquifer, the variability of river flow and recharge suggests that the overall long-term sustainability of the resource is doubtful when subjected to regular abstraction at the required rate.

4.2.2 Anorthosite of the Kunene Complex

Anorthosite rocks of the Kunene Complex underlie the area with minor intrusives of alkaline rocks and altered anorthosite. The overall groundwater potential of the Kunene Complex lithologies is described as poor in the Hydrogeological Map of Namibia (Christelis and Struckmeier, 2001). The groundwater potential is however inadequate for a thorough evaluation as no water drilling data from the anorthosite is available. The igneous rocks have very low primary porosity and higher groundwater potential will be limited to where the Complex is affected by faulting.

While most mineral exploration boreholes drilled to depths of about 100 m were dry in the mining license area four boreholes drilled to the southeast of the mining license area, in a mineral claim included in this study, recorded water strikes. The water level in these boreholes was at 31 to 37 m below ground level (808 to 810 m amsl). It is conceptualised that the groundwater table slopes from this area to the north, towards the Kunene River (river level at approximately 720 m amsl). Locally, flow towards the Ondoto River channel (789 m amsl) occurs.

The groundwater flow as conceptualised is shown in the cross-section in Figure 9 (see Figure 1 for section line). The groundwater level at the mine licence area is approximately 16m above the water level in the Ondoto River. It is possible that the groundwater discharges to the alluvium in certain stretches of the River.

Figure 7: Hand-dug well in the Ondoto River alluvium used to supply the mining camp and local community

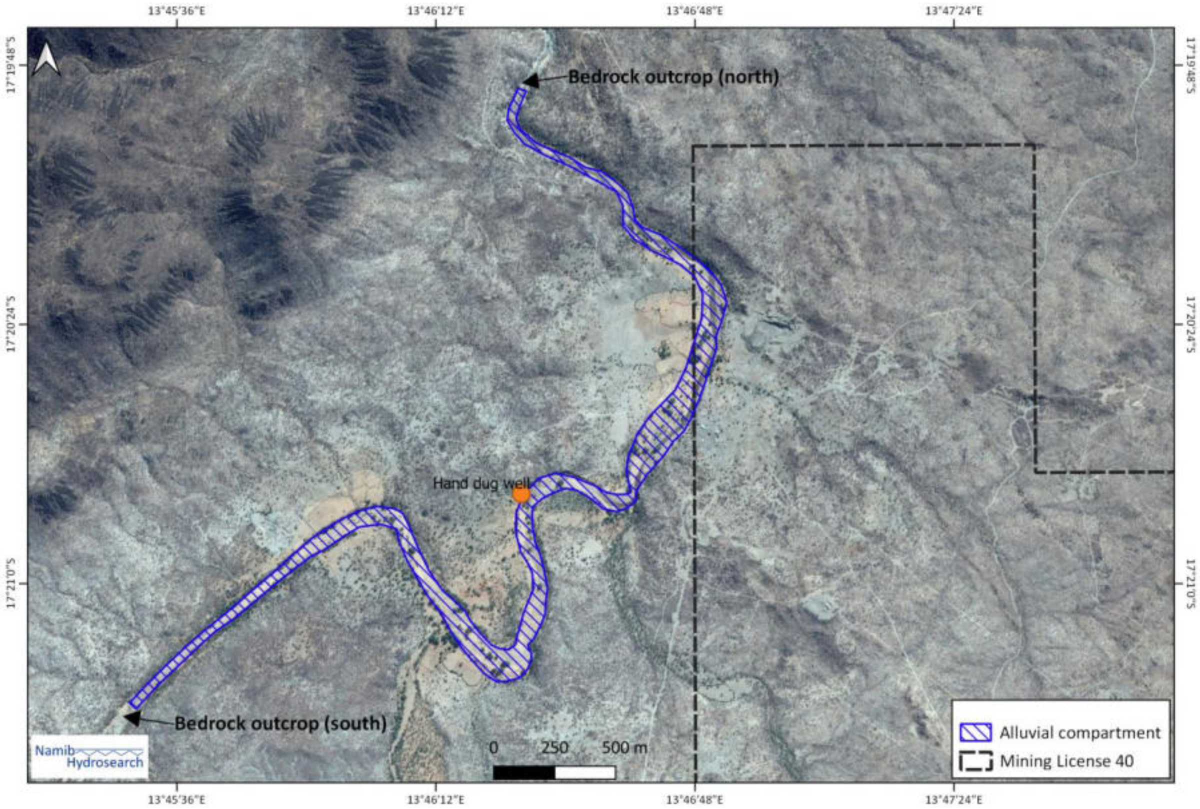

Figure 8: Ondoto River alluvial deposit between bedrock outcrops close to Mining License 40

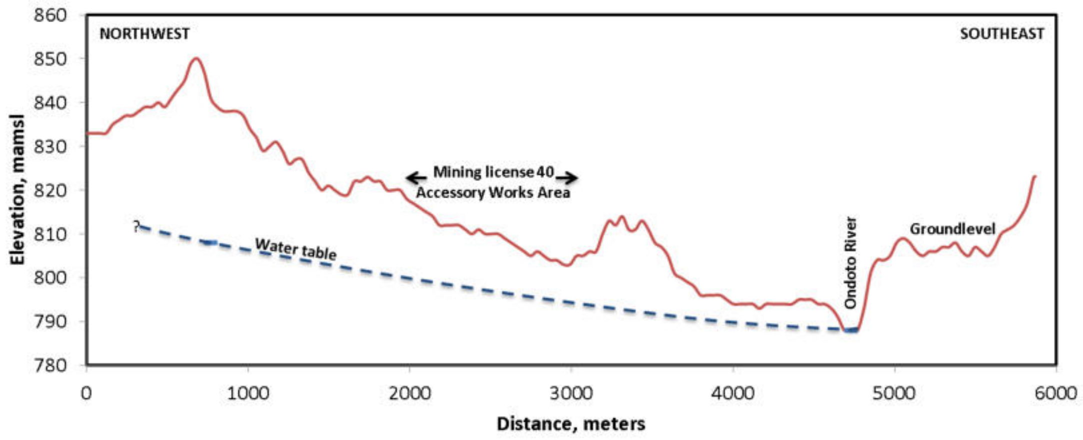

Figure 9: Northwest-Southeast cross-section showing the conceptualised groundwater level in the anorthosite bedrock

With the area's proximity to a perennial river and limited water demand for activities, no drilling of water boreholes has been done in the past and the potential remains unknown. In Okanguwati, some 65km to the west of the project area, on the western side of the Kunene Complex, high yielding boreholes have been drilled in the Kunene and Epupa Complex rocks.

4.2.3 Dwyka Group sediments

To the north of the mining license between the east-west road to Otjimuhaka and the Kunene River, exposures of Dwyka Group sediments are present. The lithologies include tillite, mudstone and some sandstone units. The sediments and the contact with the underlying Kunene Complex anorthosite are visible in the Ondoto River cutting, immediately south of the road to Otjimuhaka. From the outcrop the Dwyka strata dips northwards towards the Kunene River.

The groundwater potential of the Dwyka Group sediments is usually considered poor (e.g., central and south Namibia). The potential of sandstone units within the Group and the contact zone between the Dwyka and the underlying anorthosite is however considered high as direct leakage from the Kunene River is possible. The extent of the exposed Dwyka Group is about 700m till the Kunene River channel. A preliminary outline of the sub-cropping Dwyka is shown in Figure 10. There are currently no boreholes in this unit.

Abstraction from a single or a series of boreholes drilled within a safe distance from the river edge but still supplied by the river via lateral infiltration would alleviate the need for any in-river infrastructure and if placed correctly would not be susceptible to flood damage. Low water periods would also not be an issue as the river bed level will still be much higher than the pump intake level with adequate hydraulic gradient to ensure adequate supply.

Water quality would be vastly improved especially when considering the low pollutant but high sediment load of the river water. Therefore water supply boreholes in the Dwyka may have the benefit of requiring little treatment and being free of suspended solids and microbiological pollution.

High efficiency submersible pumps can be used so the borehole can be drilled to any depth allowing for an adequate sump to accommodate this type of pump.

The exact location and potential yield would however have to be investigated further before a final decision can be made. This activity is planned for phase 2 of the project.

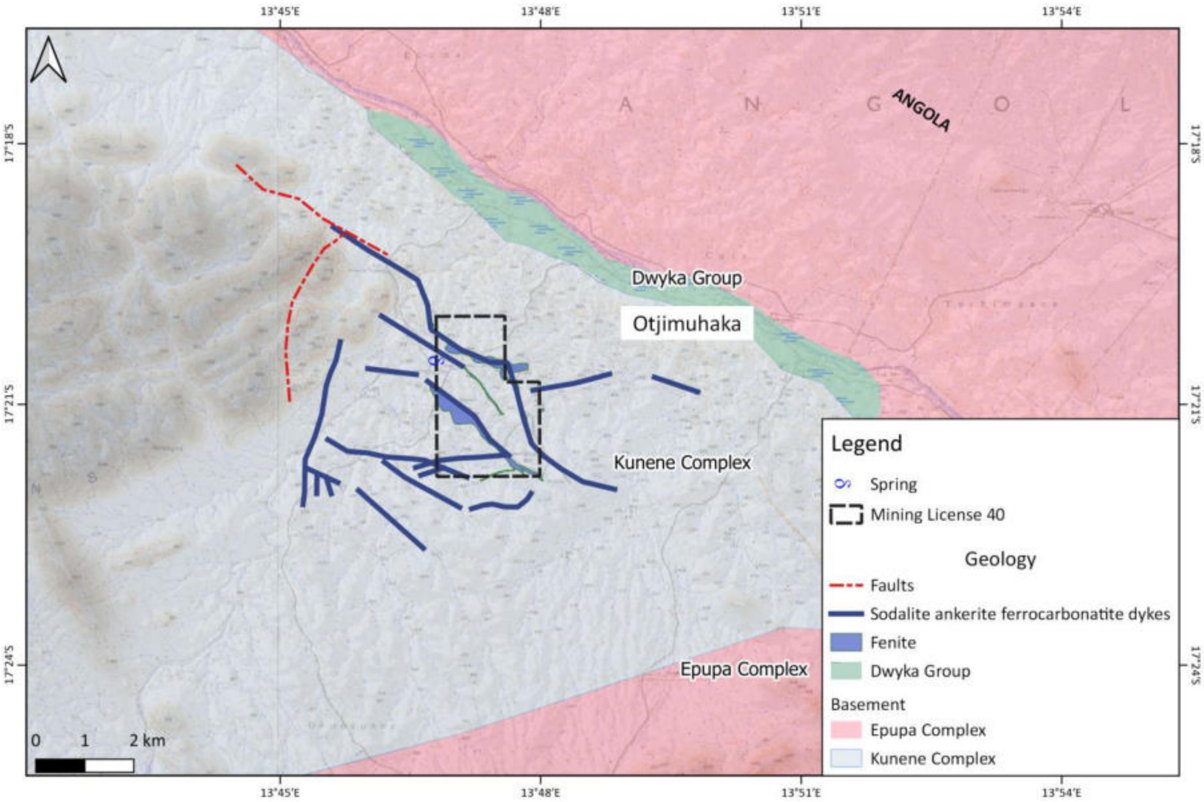

Figure 10: Geology of the project area (after Miller, 2008)

4.3 Supply Infrastructure

A main supply pipeline will be required to convey water from the river / borehole abstraction infrastructure at the Kunene River (Figure 13) to an elevated storage reservoir. The pipeline will be approximately 3.36km with an elevation difference of 110m. Figure 10 shows the pipeline route. The route is kept reasonably straight to reduce length and therefore friction loss. A detailed pipeline design with costing will have to be conducted. However a preliminary sizing analysis has been complied in order to get a better understanding of the required infrastructure. Table 5 indicates two sizing options using HDPE pipe material of 110mm and 90mm nominal diameter. As can be seen, the 110mm option results in a flow speed of 0.66 and 0.61 m/s and a total required head (elevation + friction losses) of 131.12m from the river level. Option 2 is a 90mm HDPE pipe with a higher total required head of 160.51m.

HDPE Pipe class up CL16 (can safely operate under pressure of up to 160m) is relatively common and therefore less expensive than any custom manufacture higher classes. The 110mm HDPE option (with a single lift pressure requirement of 131.12m) is therefore advisable. The lower section of pipeline installed with a standard class 16 pipe will eliminate the need for a booster pump station and water can safely be conveyed with a single lift from the river level.

Figure 11: Arenaceous unit within Dwyka Group sediments in the southern bank of the Kunene River

Figure 12: Possible Pump Station Site

Table 5: Preliminary Pipeline Sizing

Main Pipeline Design

Outlet	Length	Total L	Flow	Velocity	Pipe Di	Pipe di (ID)	PN	Fric	Other	Static H	Total H	Heights
no	(m)	(m)	(m^3/h)	(m/s)	mm	(mm)		(m)	5%F	(m)	(m)	(contour)

ML40 Main Pipeline Design - 110mm

Storage											3.00	840.00
Bend	1100	1100	15.00	0.61	110.00	93.30	13	4.915	0.2457	90.00	98.16	750.00
Pump TOC	2260	3360	15.00	0.66	110.00	89.45	16	12.345	0.6173	20.00	131.12	730.00

ML40 Main Pipeline Design - 90mm

Storage											3.00	840.00
Bend	1100	1100	15.00	0.91	90.00	76.20	13	12.909	0.6455	90.00	106.55	750.00
Pump TOC	2260	3360	15.00	0.99	90.00	73.10	16	32.334	1.6167	20.00	160.51	730.00

Installing a 90mm HDPE pipeline would either require a class 20 pipeline for the lower section for a single lift or a booster pump station located approximately in the middle of the elevation profile. A booster pump station will complicate the operation of the system and will require an additional power supply point at the booster pump location.

Table 6: Estimated Pump Station Power Requirements

Option	Pump Head (m)	Pump Eff (%)	Mototr Eff (%)	System Eff (%)	Flow Rate (m^3/hr)	Fluid Density (kg/m^3)	Gravity (m/s^2)	Power Absorbed (kW)	(10hrs per day)kWh/Annum
1	131.12	80	75	60	15.00	1000	9.8	8.92	32,571
2	160.51	80	75	60	15.00	1000	9.8	10.92	39,870

Table 6 above indicates calculated power requirement for both the 90mm and 110mm HDPE option. As can be seen, the power absorbed is less for the 110mm option as there is lower friction loss due to the larger internal diameter of the pipe. The pump and motor efficiency has been assumed but will depend on the actual pump/motor configuration eventually installed.

An additional pipeline from the Ondoto River well to the Accessory Works Area and community supply point is shown in Figure 10 . The supply potential from the Ondoto River alluvial aquifer is discussed in Section 5.2.1. This supply option is for the initial development phase of the project and is discussed further in Section 10 and Section 11.

4.4 Storage infrastructure

Adequate elevated storage will be required to supply enough water for between 1 and 3 days. Assuming a flow rate of 24m^3/hr and pumping duration of 12 hours per day, a total of 288m^3 per day will be pumped to the storage.

A preliminary location has been identified (Figure 13) with an elevation of 840m amsl, located within the ML40 area. From this point, a gravity distribution network can supply water to the majority of the site.

4.5 Distribution infrastructure

The elevation of the site varies between 800m and 840m amsl. By placing the elevated storage reservoir on the proposed location at 840m amsl, a gravity fed supply network could in theory supply water to the majority of the current ML40 quarry sites and processing facilities at the accessory work area without the need for pressure booster pumps.

The final location would however need to be placed outside of any current or future workings with a detailed supply network design done once the location has been determined.

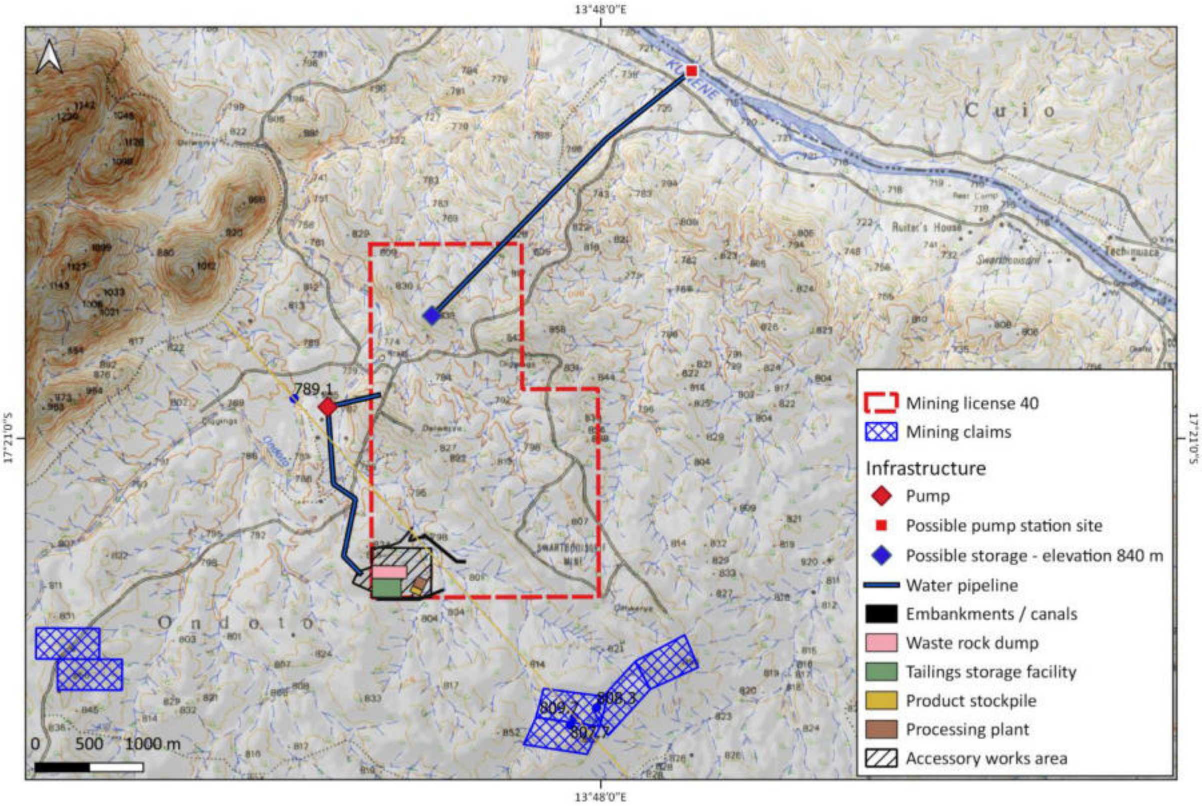

Figure 13: Possible supply and storage layout

4.6 Discussion on water supply options

In light of the above information, the most viable option for sustainable water supply is a borehole or series of boreholes drilled close to the Kunene River into the Dwyka sandstone target lithologies. This option is not totally immune to flood damage but will also ensure adequate supply during the low flow periods with potential benefits as listed below.

- Water quality will be greatly improved alleviating the need for water treatment infrastructure.
- Efficient high pressure multistage submersible pumps can easily be installed without the need for expensive in-river infrastructure.
- A detailed pipeline design will have to be drawn up but from the preliminary pipe sizing, standard 110mm HDPE pipe can be installed with standard off the shelf fittings.
- Water storage can be located within the ML40 Mining area with a potential pressure of 20m (2 bar) over a large portion of the area. Final location would however be dependent on the mining activities.
- A second reservoir near the new processing plant could be supplied by both the Kunene and the borehole/well in the Ondoto River (Figure 13).

5 STORM WATER MANAGEMENT PLAN

The ML40 area falls within the lower section of the Ondoto catchment approximately three kilometres before reaching the Kunene River. The area receives relatively high rainfall (MAP 325mm per annum) and has a high runoff potential.

A comprehensive storm water management plan is therefore imperative to prevent any dirty water runoff from processing areas, drainage from tailing storage facilities or stockpiles entering the Ondoto River System and ultimately the Kunene River.

The Strom Water Management Plan will therefore focus on the preliminary infrastructure required in order to:

- Effectively prevent, where possible, any surface water runoff entering the ML40 area and coming in contact with any mining or processing activities, rock or material stock piles or workings that have the potential of contaminating such water. This includes run of mine stockpile (ROM), waste rock dumps, tailings storage facility, chemical and reagents safe storage in the designated area in the south west corner of ML40 (Figure 13).
- Divert, store and evaporate any surface runoff generated from any processing and workings within the ML40 area.
- Identify any area where additional mitigation measures will be required

5.1 Catchments within the ML40 Area

There are two main catchments present within the ML40 area. Catchment 1 is indicated in green (south) in Figure 14 and contributes to both incoming surface water as well as generated surface water. Catchment 2, indicated in dark red (north), in Figure 14, falls predominantly within ML40 and will therefore have limited surface runoff entering the area but will generate substantial runoff within the mining area.

5.2 Storm water entering the area

Unit runoff maps produced by the Hydrology Division, Department of Water Affairs has been used to calculate the estimated Mean Annual Runoff (MAR) from each catchment. Runoff from each catchment has been divided into two parts, runoff entering ML40 and runoff generated within ML40. As can be seen in Table 7, Catchment 1 generates a relatively high MAR which drains down the south western portion of ML40 and enters the Ondoto River west of ML40.

5.3 Surface runoff from the area

The same method as above has been used to calculate the MAR for surface water generated within the ML40 area. **Catchment 2** generated double the amount of surface runoff than **Catchment 1** within the ML40 area with a total surface runoff generated within the ML40 Mining area estimated at 47,811 m^3/year.

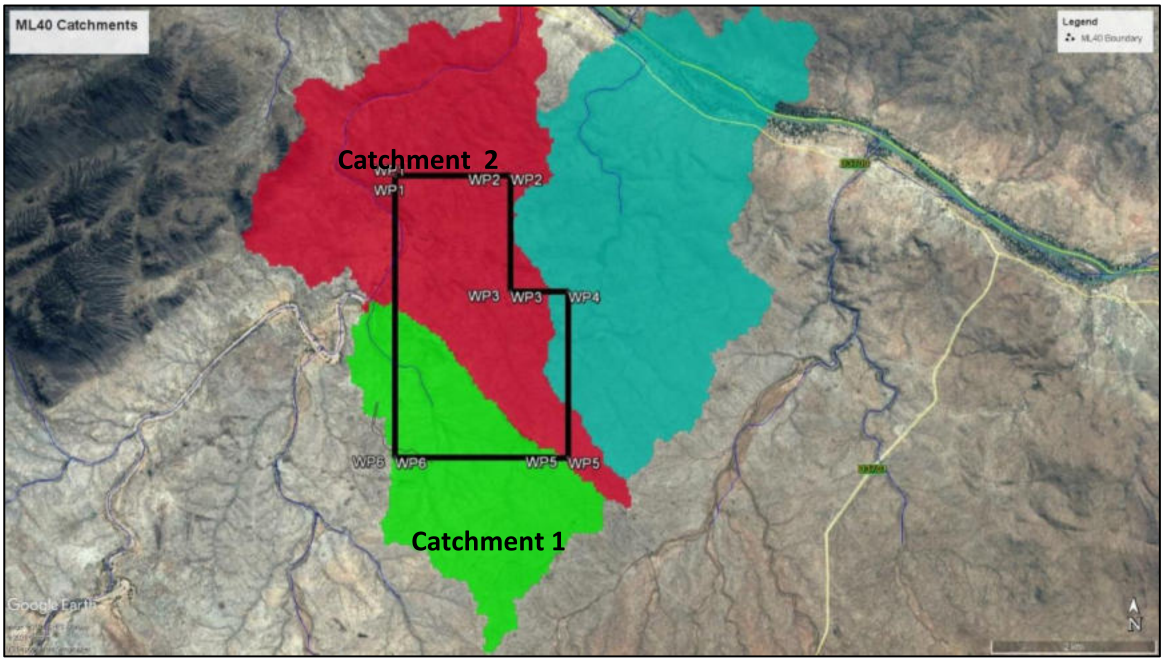

Figure 14: ML40 Catchments

Table 6: ML40 Catchment Areas

Catchment	Area within ML40(km^2)	Area feeding the ML40 (km^2)	Area below the ML40 (km^2)	Total catchment area (km^2)
1 (Green)	1.82	3.58	0.65	6.05
2 (Dark red)	4.12	0.31	7.5	11.93

Table 7: Surface Runoff Entering ML40

Catchment	Area feeding the Ming area (km^2)	Unit Runoff(mm)	MAR (m^3/yr)
1 (Green)	3.58	8.05	28,815
2 (Dark red)	0.31	8.05	2,495

Table 8: Surface runoff generated within ML40

Catchment	Area within ML40 (km^2)	Unit Runoff (mm)	MAR (m^3/year)
1 (Green)	1.82	8.05	14,649
2 (Dark Red)	4.12	8.05	33,162

5.4 Areas requiring mitigation infrastructure

The ML40 area has been divided into two predominant catchments with drainage paths flowing in a north westward direction. **Catchment 1** covers the southern part of ML40 and **Catchment 2** covers the northern part. In the project area (Figure 15), five fenitization zones and six mineral claims have been identified where workings have occurred in the past and will be extended in the future. **Catchment 1** will be affected by the Accessory Works Area as well as fenitization Zones 1 & 2 whereas **Catchment 2** will be affected by fenitization Zones 2, 3, 4 & 5 (Figure 15). See Figure 15 for the location of the fenitization zones.

The majority of the mining activities are located on a ridge line which is also the watershed between the two catchments. Surface water flowing into the excavations is therefore limited. Zone 1 (Figure 16) however will require diversion of surface water from flowing into the excavation pits, therefore not hampering the operations and the water not becoming contaminated.

It would be impractical to try and divert and store all runoff from the fenitization Zones 2 to 5 as the areas span a long narrow ridge. A number of small diversion canals will therefore be required on both the south and northern extents of each individual excavation where excavations are across river channels in order to prevent any surface runoff from entering the drainage lines. A similar approach can be taken for the six mining claims to the southwest and southeast of ML40. **Catchment 2** contains the remainder of the fenitization zones and will require the similar individual protection of any working as discussed for **Catchment 1**. From the laboratory tests conducted it appears that the potential for leaching and chemical mobility of the mined minerals is low. Please refer to Section 8 for a detailed discussion on the elemental mobility potential of the project and associated minerals.

The Accessory Works Area located in the south western corner of ML40 will however need a higher level of protection and a water storage and evaporation facility in the form of diversion embankments and an earth dam (referred to as the Containment Dam in the rest of the report).

5.4.1 Diversion embankments and Containment Dam

In order to prevent the surface runoff and fines from the Accessory Works Area and Zone 1 entering the drainage lines, a stormwater diversion embankment, a stormwater diversion canal around the area of concern must be constructed on a contour line basis. The diversion canal and earth dam storage should be designed for a 1 in 100 year flood event (Table 9).

The diversions will direct the water to the main channel and Containment Dam. The objective will be to capture and store the storm water runoff from Zone 1 and the Accessory Works Area Accessory Works Area for a long enough period to allow the potentially contaminated water to evaporate. A spill way must however still be sized and constructed to ensure the structural integrity of the dam during longer return period floods. Dam break will result is a more severe environmental problems than an overflow scenario.

5.4.1.1 Diversion Canal, storage and spillway design criteria

The extent of this study does not include final designs of the infrastructure however a detailed design criteria is included for final design purposes below.

5.4.1.2 Design flood

A design flood of 1/100 years is used to determine the peak discharge from contaminated areas. The Rational Method (Chow, et al., 1998) of determining the peak design flood is used based on the following equation and information:

$Q = 0.2778 \times C \times I \times A$ for each catchment, where

Q = Peak discharge (m³/s)

$C = C_1 \times C_2$ = Runoff coefficient

I = Rainfall intensity (mm/hour)

A = Drainage Area (km²)

- MAP = 325mm
- Maximum 24 hour Rainfall = 110mm
- Rainfall Intensity = 70mm/hr
- Catchment cover factor C_1 vegetation cover – semi-arid, eroded = 0.6 – 0.75
- Catchment size factor C_2, catchment area less than 5km^2 = 1

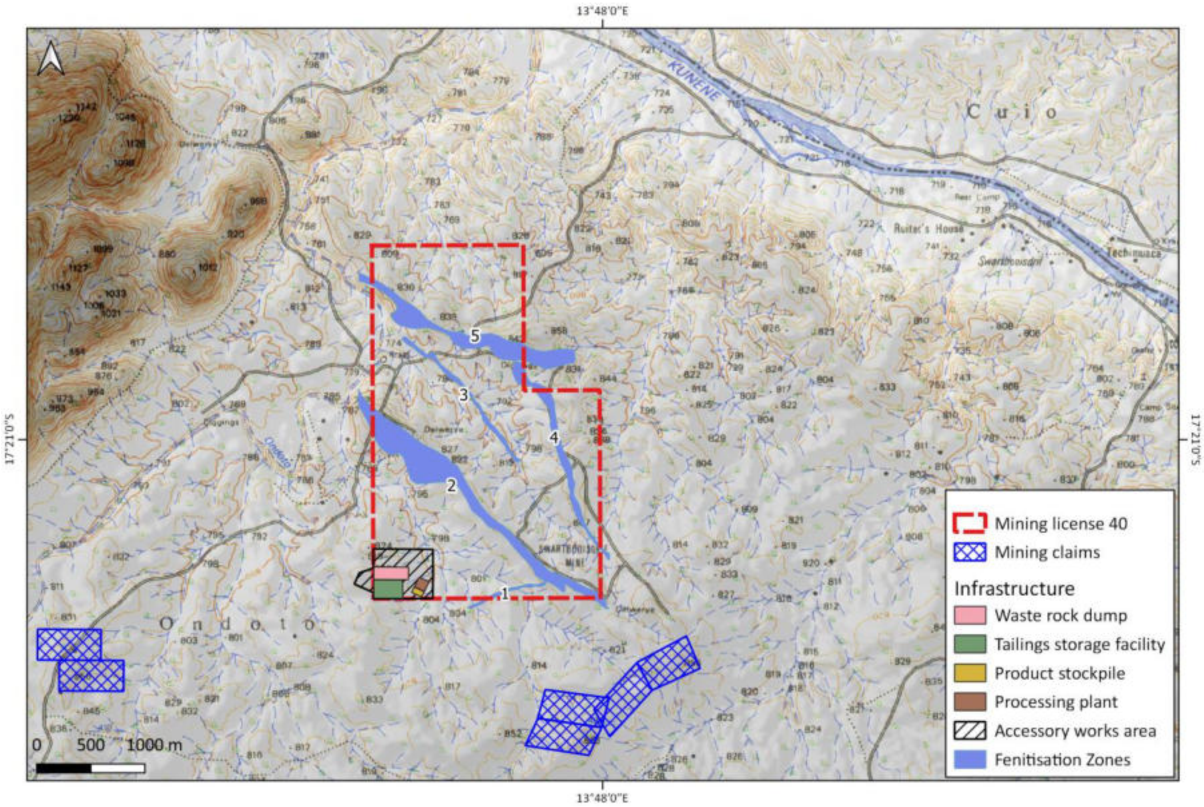

Figure 15: ML 40 with potential excavations and the Accessory Works Area

The design flood for the Accessory Works Area is detailed in Table 9. The Accessory Works Area will produce a peak discharge of 3.7m³/sec during a 1 in 100 year flood. All surface water diversion, storage and spill way infrastructure must therefore be designed to handle the peak discharge as calculated in Table 9.

5.4.1.3 Diversion canals

Diversion canals must be capable of safely diverting the peak discharge flow rate to a dam location. The canal will be trapezoidal in cross-section and have a maximum horizontal slope of 0.005m/m in order to limit erosion.

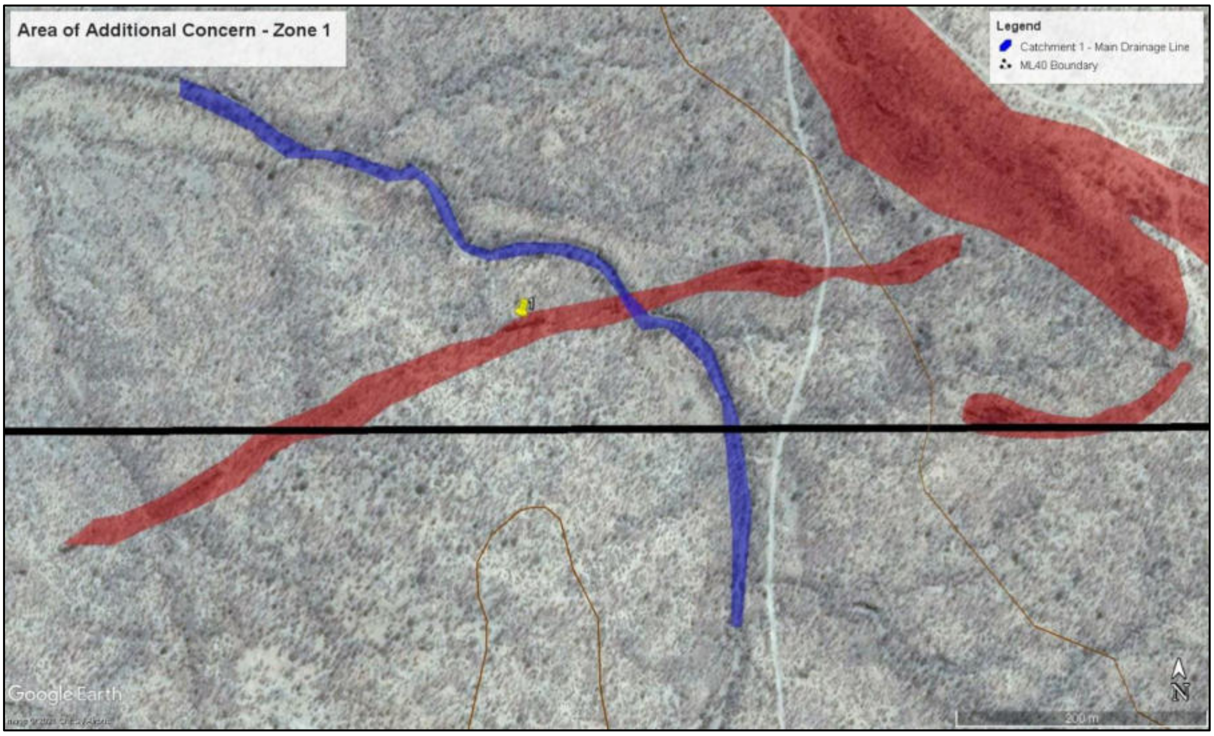

Figure 16: Area of Additional Concern – Zone 1, near central southern boundary ML40

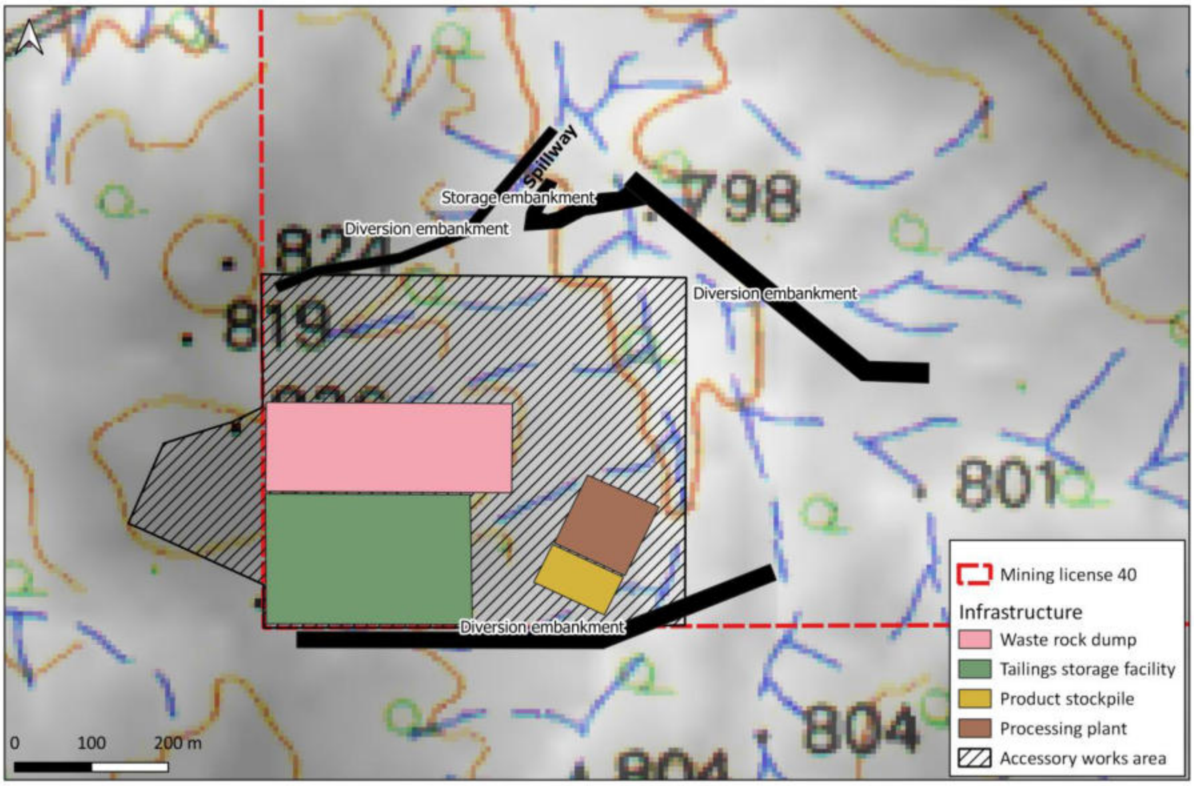

Figure 17: Proposed surface runoff diversion and storage infrastructure, Accessory Works Area

5.4.1.4 Containment Dam, diversion embankments and canals

The Containment Dam will be constructed as an earth embankment dam with a minimum capacity of twice the MAR of the catchment as calculated using the Unit Runoff Method. The dam must be constructed with a large surface area in order to maximise the evaporation potential (Table 9 and Table 10).

The Accessory Works Area is located in the south western corner of ML40 and interferes with a minor river course from the south. In order to limit storm water entering the area, an embankment/canal will be required to divert incoming storm water to the east of the area. An embankment/canal to the north will prevent runoff generated by the Accessory Works Area from entering the river course (Figure 17). This structure will separate flow from the west via a minor channel towards the Containment Dam and keeping it away from areas inhabited by people to the north. Incoming storm water entering the ML40 from the east will be diverted and deposited into the river course below the Containment Dam and therefore directed northward northwards (Figure 17).

Table 9: Design Flood Calculations – Accessory Works Area

CATCMENT AREA (A)	0.29	km^2
LONGEST WATER COURCE LENGTH (L)	0.76	km
HEIGHT AT SOURCE (H_1)	822	m
HEIGHT AT DAM (H_2)	803	m
CATCHMENT SLOPE (S)	2.5	%
M.A.P	325	mm
TABLE 1: C1 (Semi-Arid)	0.65	
TABLE 2: C2	1	
RUNOFF COEFFICIENT: C	0.65	
TIME OF CONSENTRATION (h)	0.22	hour
TIME OF CONCENTRATION (min)	13.33	min
RETURN PERIOD	100	years
TABLE 4: MAX 24h RAINFALL (mm)	110	mm
TABLE 5: RAINFALL INTENSITY (mm/h)	70	mm/h
PEAK DISCHARGE (Q)	3.67	m^3/s

Table 10: Containment dam sizing – Accessory Works Area

Catchment	Area (km^2)	Unit Runoff(mm)	MAR (m^3/yr)	Design Capacity (m^3)
Accessory Works Area	0.29	8.05	2,334	4668.42

5.4.1.5 Spillway design

Spillway design is compiled using the following criteria and details are given in Table 11:

- Trapezoidal in cross-section

- Max horizontal slope = 0.005 m/m
- Maximum side slope = 1:1
- Maximum permissible velocity (Erodible Channels) = 2m/s

Table 11: Spillway Design – Accessory Works Area

SPILLWAY DESIGN (TRAPEZOIDAL)	*Table 7.3*	*Table 7.2*	
FLOW DEPTH (Y)	1.1	0.7	m
CROSS SECTIONAL AREA (A)	2.09572	3.99	m^2
WETTED PERIMETER (P)	3.8104	6.98	m
TOP WIDTH (W)	2.5399	6.4	m
BOTTOM WIDTH (B)	1.2705	5	m
SIDE SLOPE (Z)	0.57	1	
HYDRAULIC RADIUS	0.55	0.578	m
HYDRAULIC MEAN DEPTH (D_M)	0.83	0.628	m
HORISONTAL SLOPE	0.005	0.005	m/m
Nature of channel			
MAN N (*Table 7.1*)	0.025	0.05	
MAXIMUM FLOW (Q)	3.979	3.89	m^3/s
FLOW VELOCITY (V)	1.899	0.97	m^2/s
MAX PERMISSIBLE VELOCITY (*Table 7.5*)	2	2	m^2/s

6 HYDROGEOLOGY – BASELINE CONDITIONS

The hydrogeological information of the area is compiled from mapped geology and field hydrogeological investigation. This section describes the baseline hydrogeological status of the project area.

6.1 Geology

The project area is underlain by massive anorthosite and layered anorthosite – troctolite of the Kunene Complex (Miller, 2008). The Proterozoic age large, layered intrusion is emplaced in the Archean to early Proterozoic age Epupa Complex (Figure 10). The anorthosite intrusion is associated with peripheral ultramafic and mafic intrusives.

Sodalite-ankerite ferrocarbonatite dykes intrude into the anorthosite in the ML40 area. The dykes are emplaced along earlier syenite or lamprophyre dykes in the anorthosite country rock (Miller, 2008). Three main rock types are present in the dyke a) massive carbonatite (dolomite, ankerite and sodalite), b) the main body of ankerite with albite, titaniferous magnetite, analcite and sodalite, and c) layered carbonatite containing sodalite, ankerite, analcite, albite and magnetite.

The REE and iron mineralisation and sodalite are associated with the sodalite-ankerite ferro carbonatite dykes (Figure 10) and the area falls in the Ondoto River catchment. Mining of the sodalite as semi-precious stone and dimension stones are ongoing on a small scale mainly by trenching and pits.

6.2 Hydrogeology

The hydrogeology and hydrology of the mining area is discussed under Sections 4 and 5 above. The water table in the anorthosite is 30m bgl. Mineral exploration drilling has confirmed the overall poor groundwater potential of the anorthosite. Groundwater and surface water drainage is northwards towards the Ondoto River and ultimately to the Kunene River. Surface flow from the mining and processing infrastructure areas currently (pre-mining) flow to the Ondoto River and infiltrates the unconfined and shallow alluvial aquifer. The control measures of surface flow from these areas are discussed in Section 5 above.

6.3 Baseline groundwater quality

The natural groundwater chemistry was evaluated (a) for a baseline record of the water quality from the mine area prior to starting the new mining activities and (b) to know the natural processes active in the evolution of the groundwater chemistry.

6.3.1 Sampling, analysed parameters and data quality

Water samples were collected during the hydrocensus (Appendix A) from the hand-dug well in the Ondoto River alluvium, water point in the village and from the Kunene River. The water quality data is given in Appendix B. The following samples were collected.

1. 250 ml acidified (pH < 2) sample for 42 element ICP-MS scan from the well and community water point

2. Non-acidified 1000 ml sample for standard water quality analysis from the well, community water point and the Kunene River.
3. Non-acidified 1000 ml sample for 'waste water' parameter analysis from the well.

Samples were stored in insulated boxes during transport and delivered to the laboratory within 48 hours of sampling. Field measurements of pH, temperature, and electrical conductivity were taken and field and laboratory parameters were compared for accuracy.

Water samples were analysed by Analytical Laboratory Services in Windhoek. The analysed parameters included physical parameters (pH, temperature, electrical conductivity and turbidity), major cations (Na^+, K^+, Ca^{2+}, Mg^{2+}, Mn^{2+}, Fe^{2+}), anions (Cl^-, SO_4^{2-}, CO_3^{2-}, HCO_3^-, NO_3^{2-}, NO_2^-, F^-) and, minor and trace elements using an ICP-MS (42 element scan). Checks on the quality of the water analyses were carried out. Ionic balance of all analyses had less than 5% ionic balance error.

Table 12: Well head chemistry and water level at the hand-dug well supplying to the community and exploration camp, Ondoto River

Location	Water level	Temperature	Electrical conductivity	pH
Hand-dug well, Ondoto	3.43 m bgl	28.4˚ C	189 mS/m	7.3

6.3.2 Quality of groundwater in the project area and surroundings

Groundwater sampled in the Ondoto hand-dug well is generally used for supply for domestic use to the local community and exploration camp, and for livestock watering. The overall quality of the water is categorised as Group B, Good quality water according to the water quality guidelines (MAWF, 1988). The water has temporary hardness, sodium and chloride levels exceeding Group-A level. Higher sodium and chloride (and consequently the total dissolved solids) usually results from evaporative concentration of water over time in semi-arid areas. Mixing of older water with recent recharge water of Ca-Mg–bicarbonate type and lower salinity determines the overall chemistry of the water.

Iron and manganese content of the sample taken from the hand-dug well is slightly higher when compared to the supplied water at the community water point. Aeration during pumping and transfer possibly causes iron to precipitate as oxide/hydroxides and is removed during filtration before supply. Equilibrium calculations show that the well water is supersaturated in terms of calcite, dolomite, goethite, and hematite. Precipitation of carbonate and iron oxide/hydroxide phases is therefore expected.

Additional physicochemical parameters were analysed (Table 15) of the hand-dug well water and all analysed parameters are within maximum recommended limits (General standard limits of Article 21 permits, effluents, regulation R553, 1962).

Analysed minor and trace elements are within acceptable limits. The compared limits are Cu 2 mg/l, Zn 10 mg/l, B 4 mg/l, Co 1 mg/l, Pb 0.2 mg/l (Water Quality Guidelines of Namibia, MAWF 1988) and Cu 2 mg/l, B 2.4 mg/L, and Pb 0.01mg/l WHO (2011). See Appendix B for the results.

The above parameter values are indicative of the level to be expected naturally and should form the baseline levels for the monitoring of water quality in the future. The sodium, chloride and sulphate levels in the Ondoto River alluvium may decrease or increase depending on frequency of recharge and rate of abstraction.

7 POTENTIAL IMPACTS OF QUARRYING

The blue sodalite dimension stone mining operations is limited to a depth of about 40 m which is well above the water table and no direct threat of groundwater inflow exists. Accumulation of rainwater and runoff water in the pits could infiltrate underground or overflow and can potentially contaminate surface flow. Diversion of storm water from the pits with berms (1 m) will be necessary. Waste rock produced at site can be used for construction of the berms. On completion of mining the final surface is to be prepared so that breaching of the berms can be avoided or the pit can be refilled and the ground levelled off to avoid ponding. All infrastructures should be removed from site. No hazardous waste is to be disposed in the pits during operation or after closure of the mine pit. Chemically the sodalite and anorthosite lithologies are inert and leaching experiments carried out on the REE ore is discussed in Section 8.3 below.

Table 13: Water quality guidelines (from Water Quality Guidelines of Namibia, MAWF 1988)

Recommended maximum limits	**Human consumption**			**Livestock**
Parameter	**Group A**	**Group B**	**Group C**	**watering**
p H	6-9	5.5-9.5	4-11	4-11
Electrical Conductivity (mS/m)	150	300	400	
Turbidity (NTU)	1	5	10	
Total Dissolved Solids (mg/l)				6000
Total Hardness as mg/l $CaCO_3$	300	650	1300	
Ca-Hardness as mg/l $CaCO_3$	375	500	1000	2500
Mg-Hardness as mg/l $CaCO_3$	290	420	840	2057
Chloride as Cl^- mg/l	250	600	1200	3000
Fluoride as F^- mg/l	1.5	2.0	3.0	6
Sulphate as SO_4^{2-}	200	600	1200	1500
Nitrate as N mg/l	10	20	40	100
Nitrite as N mg/l				10
Sodium as Na mg/l	100	400	800	2000
Potassium as K mg/l	200	400	800	
Magnesium as Mg mg/l	70	100	200	500
Calcium as Ca mg/l1	150	200	400	1000
Manganese as Mn mg/l	0.05	1.0	2.0	10
Iron as Fe mg/l	0.1	1.0	2.0	10

Table 14: Major ion water chemistry of the Ondoto Alluvium and the Kunene River

Parameter	Unit	Hand-dug well	Community water point	Kunene River
pH		7.5	7.7	8.1
Electrical Conductivity	mS/m	180.8	180.2	6.1
Turbidity	NTU	0.45	1.1	116
Total dissolved solids	mg/l	997	995	33
Total hardness	mg/l $CaCO_3$	568	568	18
Ca hardness	mg/l CaCO3	305	305	11
Mg hardness	mg/l $CaCO_3$	264	264	7
Na	mg/l	148	147	4.2
Ca	mg/l	122	122	4.6
Mg	mg/l	64	64	1.7
K	mg/l	4.8	4.3	3.0
Mn	mg/l	0.08	0.02	0.02
Fe	mg/l	0.14	0.03	2.8
Cl	mg/l	305	308	4
SO_4	mg/l	111	112	<1
NO_3 as N	mg/l	1	<0.5	<0.5
NO_2 as N	mg/l	0.11	<0.01	<0.01
F^-	mg/l	0.5	0.4	0.1
Ondoto River alluvium groundwater categorised as Group B: Good Quality Water. Parameters exceeding Group A levels are underlined.				

Table 15: Additional parameters analysed of the Ondoto River alluvium

Parameter	Unit	Value
Dissolved Oxygen as O_2	mg/l	6.7
Redox Potential	mV	207
Total Suspended Solids	mg/l	10
Chemical Oxygen Demand as O_2	mg/l	11
Ortho-Phosphate as PO_4	mg/l	0.17
Ammonia Nitrogen as N	mg/l	0.05
Kjeldahl Nitrogen as N	mg/l	0.7
Sodium as Na	mg/l	149

8 POTENTIAL IMPACTS OF PROCESSING OF REE MINERAL ORE

The processing of the REE ore will entail stockpiling the ore material from small scale quarrying within a processing area in the southwest corner of ML40 (Figure 18). Ore stockpiles, processing, waste rock dumps, tailing storage facility (TSF) and product will be stockpiled in the Accessory Works Area. The tailings will be wet and all accumulated material will receive rainfall and potentially generate some leachate. The expected leachate from the mined material and its management is discussed below. The management of storm water is discussed in Section 5 above.

8.1 Minerals in the ore body

The REE ore is present in ankerite bearing carbonatite dykes with associated sodalite, aegirine fenite and gabbro in the anorthosite host rock. The REE ore phases are mainly bastnäsite (75 to 90%) with lesser amounts of monazite (20%) and occasional carbocernaite. Bastnäsite is REE fluorocarbonate, monazite is REE phosphate and carbocernaite has the chemical formula (Ca, Na) (Sr, Ce, Ba) $(CO_3)_2$.

There is associated thorium in the ore minerals that potentially poses a problem for safe disposal at site. Assay results show that REE oxide and thorium content are chemically positively correlated indicating that the thorium is hosted in a REE mineral (probably monazite) that cannot be separated during processing.

Mineral processing at site will produce a mineral concentrate consisting mainly of mineral phases – bastnäsite and monazite (Ellmies R, 2021, per comm.) and no chemical leaching of ore minerals will take place. *This evaluation is based on an ore processing method where no acid or alkaline leaching of the REE ore is carried out. The leaching of REE oxides will produce waste rich in thorium that would require further environmental evaluation before disposal.*

Other minerals present are silicates (albite, anorthite, pyroxenes and aegirine), carbonates (calcite, dolomite, kutnohorite, and siderite) and iron oxide (magnetite). Uranium content in the ore and in trial concentrates is very low (0.5 ppm U and 0.9 ppm U in 63.3% total REE oxide concentrate).

8.2 Mineral content in the tailings and waste rock dump

The REE ore consists of bastnäsite and monazite that will be concentrated by either a floatation or gravity separation method. Both methods will use water and additives. The mineral concentrate or the product will be removed from site after processing, leaving the waste rocks and tailings virtually free of thorium. The information available on the TSF is summarised in Table 16.

The waste rock and tailings produced will be a generated from mechanical separation and this remaining material will be mostly carbonates (ankerite, Ca $(Mg,Fe,Mn)(CO_3)_2$), and silicate rocks - aegirine fenite (aegirine, $NaFeSi_2O_6$ and feldspars) and anorthosite (anorthite, $CaAl_2S_2O_8$). Water used for processing will be sourced initially from the Ondoto River alluvium and on a permanent basis from the Kunene River and discharged with the tailings. The water is alkaline (pH 8.1, see detail on Kunene River water, Appendix B) and in the presence of carbonate phases and absence of any acid producing phases, the leachate from the tailings is expected to remain alkaline. Mobility of metals from the waste rock and tailings is therefore likely to be low.

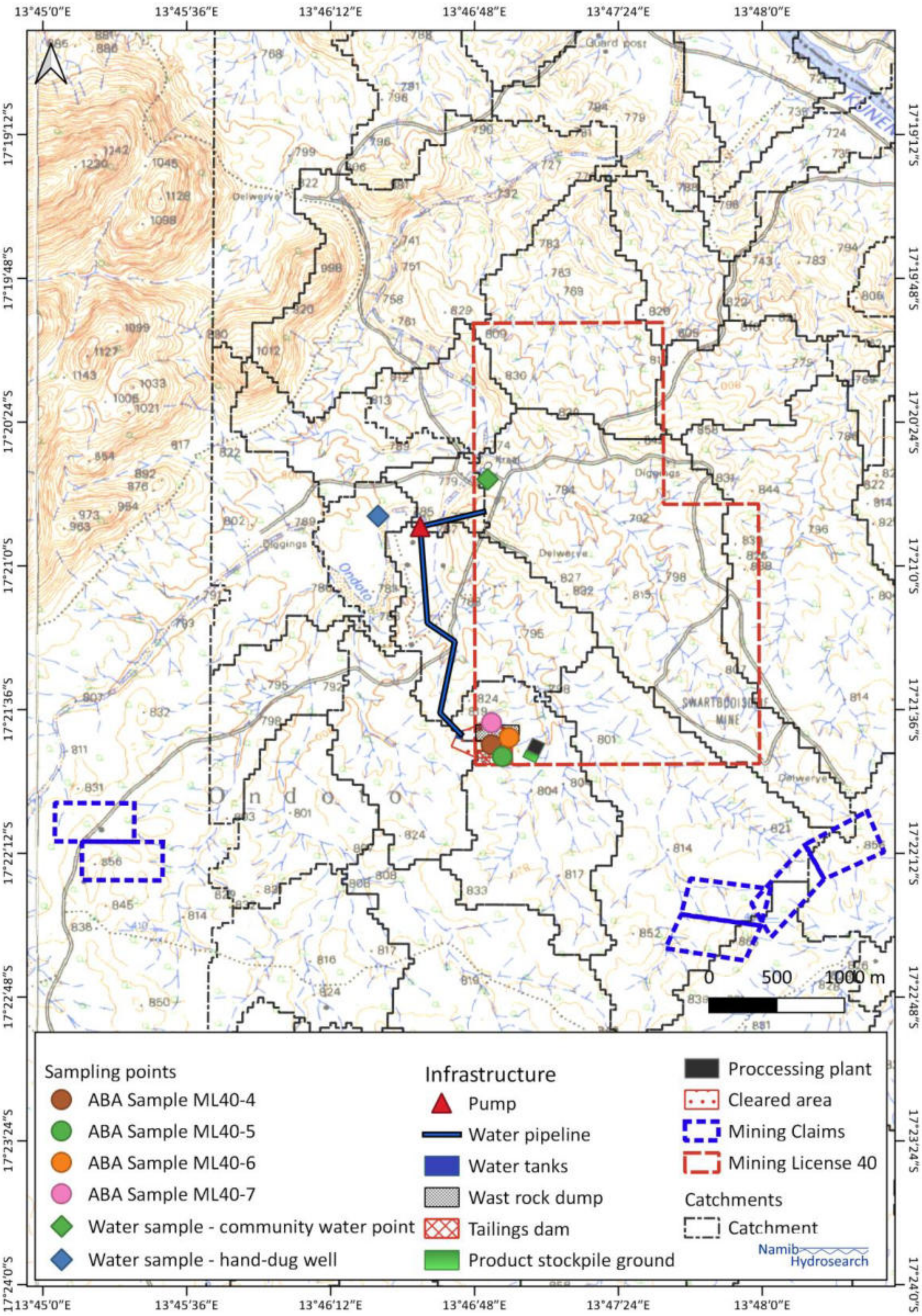

Figure 18: Mine infrastructure, Accessory Works Area, water and rock sample locations

The waste rock dump will receive mainly silicate rock (anorthosite and aegirine fenite). Possible contaminants from the tailings and waste rock dumps are listed in Table 17. The expected water usage is about 10m³/h. No plan of retrieval of water is made but it is expected that a large fraction will evaporate. Excess water drained from the tailings will accumulate in the Containment Dam discussed in Section5 above. Reclaiming and reuse of water from the tailings for the processing is recommended to limit the volume of water discharged with the tailings.

Table 16: Summary information on the tailings, waste rock and processing area

Tailings and waste rock production	400,000 m^3/a ; 900,000 tons in 25 years
Tailings height	6 m
Tailings and waste rock footprint	2,700 m^2/year (approximate)
Tailing base	Bare ground (dominantly anorthosite lithology); low permeability.
Surface water management	Perimeter effluent trench Diversion embankment and storage of storm and process water. Allow for 1-in-100 year 24-hour storm event.
pH of tailings	Alkaline due to dissolution of carbonates in the gangue and waste rock.

Table 17: Possible contaminant sources and impacts

Source	Pathway	Condition / Mitigation
TSF	Water content in tailings and seepage of rainwater. Expected high intensity rain events. Surface flow and seepage into unsaturated zone.	Effluent alkaline to neutralise after interaction with carbonate minerals. Metals likely to be immobile. Thick unsaturated zone and inert underlying rock types.
TSF	Seepage from wet tailings. Structural condition of the TSF due to seepage or erosion in the long-term.	Possibility of overflow and contamination at surface. Contaminated water might flow to the Ondoto River or tributaries if not contained. Containment dam required avoiding downstream flow and control of any material resulting from erosion. Reclaim and reuse water.
Waste rock dump	Possible seepage of rainwater. Expected high intensity rain events. Surface flow and seepage into unsaturated zone. Structural compromise or erosion in the long-term.	Waste rock would be neutral to alkaline effluent producing. Containment dam required avoiding downstream flow and control of any material resulting from erosion.
Product stockpile	Possible seepage of rainwater. Surface flow and seepage into unsaturated zone.	Waste rock would be neutral to alkaline effluent producing. Runoff contained in containment dam.

8.3 Leaching potential of the mined minerals

A preliminary leaching potential of the ore was investigated using USEPA Method 1311 (USEPA, 1992) toxicity characteristic leaching procedure. The leaching procedure is designed to assess concentration of metals and compounds in leachate from stockpiled materials (landfills) under controlled pH of 4.9 (buffered acetic acid and NaOH). The leachate was analysed for 39 elements with Inductively Coupled Plasma Mass Spectroscopy ICP-MS. Three ore samples were collected (ML40-1 to ML40-3). The results are given in Appendix C. The 39 elements concentrations are below USEPA standards for metals in soil. The metals that leached at relatively higher amounts are Mn, Ba, Sr and La. These metals concentration in solution are controlled by sulphate and carbonate phases and are likely to precipitate. Precipitated material will be trapped in the TSF or in the evaporation dam.

8.4 Acid Base Accounting (ABA)

The potential of the base of the Accessory Works Area material to generate acid is of importance in assessing the mobility of any metals during operation and in the post closure phase of a mine. In an open cast mine, larger volumes of waste rock and tailings are brought in contact with water and atmospheric oxygen which potentially leads to the formation of acidic effluent in the presence of sulphide minerals. The availability of oxygen introduced by infiltrating water causes sulphide oxidation reaction and the release of sulphate, iron and possible heavy metal ions (Appelo and Postma, 2007). The resulting effluent of such process has a low pH (typically below 3).

The neutralisation of the acidic effluent can be achieved by reaction with carbonate minerals. The resulting neutralised effluent however leads to formation of high levels of dissolved sulphate, often above the recommended maximum limits (1,500 mg/L) in view of to the Namibian Water Quality Guidelines. The increase in pH usually causes the dissolved metal load to precipitate leaving residual metal compounds and products of buffering reactions (British Columbia Acid Mine Drainage Task Force, 1989).

Four samples for an acid base accounting study were collected from the processing, tailings and waste rock dump area to assess the potential reactions of the bedrock to seepage from the tailings and waste rock dump.

8.4.1 Field sampling

Sampling for ABA analyses was carried out following the listed procedure adopted from MEND (2001).

- Four grab samples were collected (Figure 18) numbered ML40-4 to ML40-7 (Appendix A)
- Once obtained in the field, samples were packed into thick polythene bags and sealed airtight. The samples were then packed into boxes and delivered at the laboratory within 48 hours of sampling. A chain of custody was maintained during handling and transport.
- Lithological descriptions of the grab samples were produced.

8.4.2 Acid Base Accounting static tests

The main principle of ABA is to determine the neutralising potential and acid generating potential of a particular sample. The sample preparation procedure follows on internationally recognised methodology for the different sample types. The following equipment and sampling preparation steps were applied.

- Initial crushing of samples with a 5'' x 7" Terminator Jaw crusher (model JCT#1AL)
- Pulverising of samples to -75µm using a LM2 Essa mill B2000 with chrome steel balls. The possible carry over from pulveriser disks and the balls is as follows: 20-500 ppm chromium, 0.1-0.5% iron, traces: Ni, S, Mn, C.
- Splitting samples using a Jones riffle splitter (20 chutes, chute width 1.3cm)
- Compressed air and quartz blank were used for cleaning
- Test sieves

8.4.3 Results

The results of analyses of the reference material (NBM-1) are also indicated with this table (Appendix D). The initial measurement was done by means of a fizz tests whereby a pulverized sample is introduced to diluted acid (about 25% strength hydrochloric acid). The strength of the reaction is observed and recorded as an indication of acid neutralising reactive phases (mostly carbonates) in the sample. The paste pH test (read after 10 minutes and after 24 hours) determines the pH of a paste made from finely ground sample (-75µm) with water to indicate if the sample contains readily available acidity or alkalinity. A pH below 5 indicates that the material has inherent acidity from prior acid generation (MEND 2001).

The acid generating potential or the Acid Potential (AP) of a sample is computed from the total sulphur content of a sample and provides the most conservative (highest AP values) measure of the acidification potential. The sulphur is assumed to be present in the sample as pyrite (MEND, 2001).

*Acid Potential (AP) = Sulphur content (%)*31.25 kg $CaCO_3$/tonne*

The acid consuming capacity of the sample, termed the Neutralisation Potential (NP), is estimated using the Sobek method. It is an aggressive test that provides the 'best case' values. The NP is calculated from the analytical data using the following formula:

Neutralization Potential (NP) =

*((Acid normality*Volume)-(Base normality*Volume)*50)/(weight of sample)*

The values for AP and NP are expressed in units of kg $CaCO_3$ equivalent per ton of rock and can be used together to indicate whether a sample has a stoichiometric balance that favours net acidity or net alkalinity. Interpretations are based on the Net Neutralisation Potential (NNP) and the Neutralisation Potential Ratio (NPR) using the equations as provided in the following:

Net neutralisation potential (NNP) = NP – AP, and

Neutralisation potential ratio (NPR) = NP / AP

Interpretation of NNP and NRP values are done according to the criteria as set out by MEND, 2001:

NNP < -20 kg/ton $CaCO_3$, indicates net acid producing material, NNP > 20 kg/ton $CaCO_3$ indicates net non-acid producing material and values between -20 and 20 kg/ton $CaCO_3$ indicate uncertain results.

NPR < 1 indicates acid producing material and NPR > 3 indicates non-acid producing material

The Net Acid Generation (NAG) pH, provides an empirical measure of NNP (a NPR is not calculable). The method may be used as a crosscheck on the AP method. NAGpH values less than 4.5 indicate the sample has the potential to generate net acidity. The overall results using the above tests are in agreement and the following observations are made.

- The anorthite samples were found to be non-acid producing (lab no. 4 to 7 in Appendix D).
- Samples have an alkaline paste pH (>8) and moderate to slight reaction in fizz tests.
- NNP values are in the range 30 to 72, indicating non-acid producing material.
- NRP values are higher than 3, also indicating non-acid producing material.

The suitability of these rocks for the placement of the tailing storage facility (TSF) is supported by the findings. Seepage of acidic effluent into the bedrock is likely to be neutralised and therefore to reduce the risk of some metal mobility.

9 ASSESSMENT OF ENVIRONMENTAL IMPACT

9.1 Risks to the receiving environment

The overall risk of contamination from the tailings storage facility (TSF) to the downstream receiving environment is considered low with the implementation of the Containment Dam capturing runoff and eroded material from the Accessory Works Area. The following reasons are cited:

- The predicted seepage volumes and rates through the base of the TSF are small due to moderate volumes of water involved and also due to the low hydraulic conductivity of the anorthosite rocks on which the tailings and waste rock dump will be positioned.
- The tailings will be alkaline.
- The underlying basement rock is non-acid producing in nature.

The following risks are identified and are to be considered in the design of the TSF and waste rock dump.

- The groundwater level below the TSF is estimated to be at about 30 m below ground and the groundwater table slopes towards the Ondoto River. It is possible that seepage from the tailings infiltrate underground. There is enhanced risk of seepage to the basement rocks during the start-up period. Also, presence of yet unmapped fault / fracture or contact zones within the anorthosite could result in increased seepage rates. A lined base with compacted calcrete/clays is recommended below the TSF. A perimeter drain to direct water to the Containment Dam will be necessary around the TSF and Waste Rock Dump. Monitoring of the water balance in the overall mining and processing operation is to be carried out and evaluated for unaccounted loss of water.

- The relatively high MAP in the area and short rainy seasons points to high intensity rainfall events as can be expected in arid regions. The integrity of the stormwater infrastructure and its capacity to contain all the water during summer storm events is to be ensured. The sizing of the diversion canal and storage has to be adequate.
- The mine is located in an elevated area and surface flow with eroded material to downstream users is a long term concern (post closure). The sediment load and water quality of the sources in the Ondoto River is to be closely monitored. See recommendations in Section 10.5.

9.2 Sustainability of water supply and impact on local water supply

Fresh water supply to the mine can be sourced from either the Ondoto River alluvium, or from boreholes in the Dwyka Group rocks on the bank of the Kunene or alternatively directly from the Kunene river via an intake in the river. The Ondoto River alluvium can be a source of water in the initial development phase of the project. *The use of the Ondoto River loose sediment compartment resource should be limited to a period of one year if no replenishment occurs.* It is reported by local community members that the last replenishment or flow in the River was recorded in 2017-2018. Without information on the aquifers stored volume the risk of dewatering the aquifer with pumping to supply the project will be high. The potential of the Ondoto River alluvium is currently unknown and preliminary assessment shows that the resource is likely to be limited. Close monitoring of the water level in the alluvium and flow in the Ondoto River will be necessary if abstraction is carried out. Investigations to estimate the possible yield from the aquifer include estimates of aquifer dimensions, hydraulic properties of the aquifer and river flow gauging.

The mine area is underlain by anorthosite that generally has poor groundwater potential. Supply from the Kunene River or from the Dwyka Group aquifer on the Kunene River bank is preferred as the long term sustainable water sources. The water sources from the Kunene River is independent of resources in the local mine area and will have no influence on local supply.

9.3 Possible residual impacts after closure

The main long term potential impact after closure of the mine arises from the conditions of the TSF and waste rock dumps. The TSF could have the following effect after the closure of the mine.

- Seepage from TSF to the surface water from residual water in the tailings.
- Infiltration of rainwater into the tailings and generation of effluent.
- Erosion of the TSF and its embankments, and mobilisation of tailing material downstream.

10 MANAGEMENT OF IDENTIFIED IMPACTS

The identified risks are rated according to criteria given in Table 18 (Hooks P, 2021). The impacts identified and the approach towards their management are discussed below and summarised in Table 19.

10.1 Tailings Storage Facility, Waste Rock Dump and Accessory Works Area

The containment of effluent and runoff from the tailings and waste rock dump, particularly in the rainy season is of concern. Water diversion structures and a containment dam for the run-off and seepage need to be constructed with design capacity of the diversion and Containment Dam adequate for handling large rainfall events as experienced in this area.

During the operation of the mine, the sediment material accumulated in the Containment Dam should be moved to the tailings at regular intervals so that the maximum capacity of the dam is retained and the risk of mobilising the material downstream is reduced.

The TSF base is to be lined with compacted clay/calcrete and a perimeter drain constructed to direct any effluent to the Containment Dam. Six groundwater monitoring boreholes of 50m depth are recommended at indicated positions around the Accessory Works Area. The groundwater levels are to be measured and water sampled for water quality tests (standard water quality and ICP-MS scan discussed in Section 6.3) to record the baseline conditions.

The water content in the tailings and overall water use can be reduced by water recovery during ore processing. Reduction of water content in the tailings will also limit the potential seepage and effluent production during operation and is recommended.

Upon closure of the mine, the surface of the TSF should be graded to avoid ponding and encourage surface runoff thus limiting infiltration. Placement of a low permeability seal on the TSF is the preferred measure to avoid infiltration and salt accumulation in accordance with best practice measures proposed by the British Columbia Acid Mine Drainage Task Force (1989). For establishing such top seal, a large quantity of clay rich material would be required which may not be available locally. Alternatively other material of good compatibility or low permeability such as compacted calcrete can be used.

10.2 Mine pits

For the management and mitigation of possible impacts from the mining pits the following measures are recommended.

- The pits to a maximum depth of 40 m bgl will be above the groundwater level and no groundwater inflow is expected in most places. However, if groundwater levels are found at shallower depths then management of inflow will be necessary.
- Surface flow to the pits is possible and the pits should be protected against inflow of surface runoff water and discharge from the pits should be avoided. Therefore the pits should be cordoned off with berms (1 m high) to avoid surface inflow to the pit
- On closure the pits should be cordoned off with berms to prevent access to the sites by animals and humans.

10.3 Waste water disposal

The mine personnel will be housed at site and the mine will operate in shifts on a 24 hour basis with a water consumption of 2.0 m^3/day for non-mining activities. Waste water deriving from the processing plant and offices will require disposal by means of an evaporation pond. This water cannot be disposed of to the natural environment without ensuring that the quality meets the waste water / effluent quality guidelines (MAWF, 1988). Furthermore a Waste Water Discharge Permit will be submitted to the Directorate of Water Resource Management (Division Water Environment).

10.4 Sustainability of water supply

Supply from the Kunene River or the Dwyka Group rocks constitutes a sustainable source of water and is recommended. Use of the Ondoto River alluvium groundwater could be practiced for the limited initial period only. Such use could possibly be extended if sufficient replenishment should occur and depending on groundwater level, abstraction and water quality monitoring results. It is recommended that the depths of alluvium and alluvial aquifer hydraulic properties are determined.

10.5 Monitoring requirements

10.5.1 Water level and discharge monitoring points

Groundwater levels monitoring is recommended for the Ondoto River hand-dug well (Figure 19), and also for the proposed new boreholes. Water levels are to be measured continuously, preferably by using pressure transducers.

Overall the water balance of the mine and associated operations are to be monitored particularly on the following main components:

- Water disposal in tailings
- Recovered water and decrease in recovered water volumes
- Intake of freshwater to the mine and plant form the water supply wellfield
- Increase or decrease of outflow to the evaporation dam

Gauging of the Ondoto River is recommended at a selected reach (Figure 19) where the River has a straight course and flows over bedrock. The purpose of such monitoring will be to record river flow and therefore the frequency of recharge of the groundwater resource in the alluvium in case this source is tapped for mine supply. Declining water levels can be related to abstraction or lack of recharge. Monitoring is to be carried out using a pressure transducer housed in an installed perforated borehole casing. The level of the pressure transducer, cross-section and slope of the reach can be surveyed and flow rates estimated from the information.

10.5.2 Water quality monitoring

The following recommendations are made for the water quality monitoring (Figure 19).

1. Water quality monitoring will include the following well head parameters for all water points. Well head chemistry parameters would include pH, EC, temperature, and alkalinity. Monitoring will be carried out in-house at one month intervals.
2. The above parameters will be monitored also on the ponding on the storage /evaporation dam and outflow, if any, from the tailings and waste rock dumps.
3. Quarterly sampling and analyses of water chemistry is to be done during the initial year of operation from the supply boreholes, storage / evaporation dam, the Ondoto hand-dug well and any water point established in the future downslope of the mine (north). The parameters will include major ions, minor and trace ions analysed during the project (Appendix B).
4. Reassessment of sampling parameters and frequency of the sampling is recommended after 1 year of operation

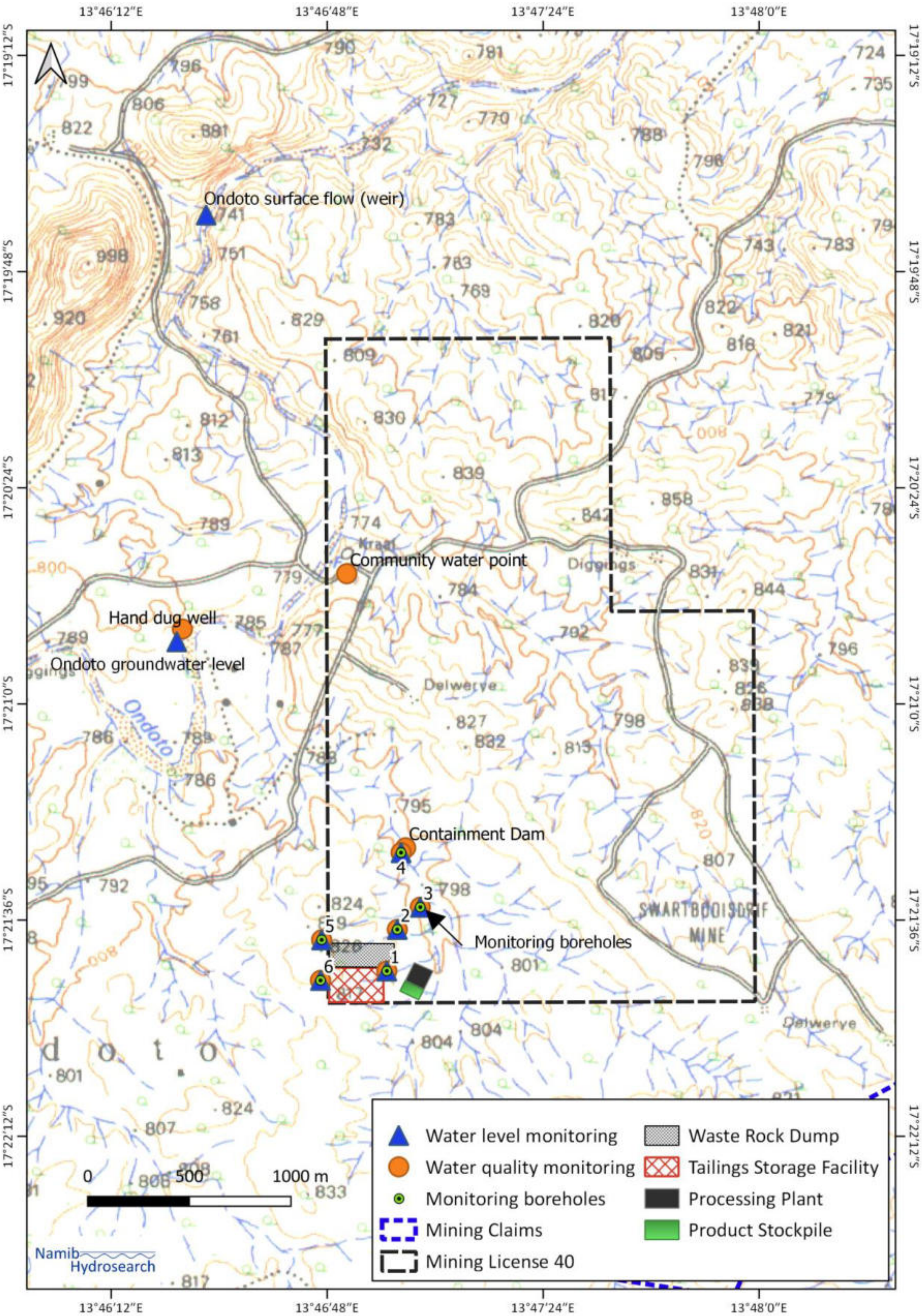

Figure 19: Recommended water monitoring points

Table 18: Criteria of environmental impact assessment rating

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised – Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE

SEVERITY = L

DURATION	Long term	**H**	Medium	Medium	Medium
	Medium term	**M**	**Low**	**Low**	Medium
	Short term	**L**	**Low**	**Low**	Medium

SEVERITY = M

DURATION	Long term	**H**	Medium	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	**Low**	Medium	Medium

SEVERITY = H

DURATION	Long term	**H**	High	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	Medium	Medium	High
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE

PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	Medium	Medium	High
	Possible/ frequent	**M**	Medium	Medium	High
	Unlikely/ seldom	**L**	**Low**	**Low**	Medium
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE

Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

Table 19: Summary of possible impacts and its managements

Impact Event	**Mining activities may affect water resources through over utilisation**					
Description	Water demand for mining, processing and domestic use is estimated as 100,000 m³/year. Water will be sourced from the Ondoto River alluvium, close to Mining License 40. The sustainable yield of the Ondoto River is low mainly due to irregular river flow and recharge.					
Nature	Negative					
Phases	Phases during which mining activities may impact the water resources are highlighted below.					
Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**			
Alluvial aquifer of the Ondoto River	Alluvial aquifer of the Ondoto River	Alluvial aquifer of the Ondoto River	With ceasing of abstraction, water level in the aquifer will be restored with time.			
Groundwater (via borehole abstraction)	Groundwater (via borehole abstraction)	Groundwater (via borehole abstraction)				
Severity	Recommended water level could often be violated. Interruption of supply to mine and community.					
Duration	Reversible over time.					
Spatial Scale	Fairly widespread, in the mine site and neighbouring village.					
Probability	Definite / continuous					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**H**	**M**	**M**	**M**	**H**	**H**
Significance of Consequence	A high significance is expected if no mitigation measures are implemented.					
Prevention	Alternative water sources to be developed such as direct intake from the Kunene River or aquifer in the bank of the Kunene River are sustainable sources. Monitoring of groundwater level and water quality should serve as early warning of overexploitation of groundwater.					
Mitigation Action	Limit the use of the Ondoto River alluvium to initial stages of the project. Monitor groundwater level, gage river level, rainfall and abstraction on a daily basis. Develop alternative source of water (Kunene river or Dwyka Aquifer) for long term use.					
Rehabilitation	If the Ondoto River alluvial aquifer shows signs of overexploitation (drop in groundwater level and increasing salinity), the use of the resource should be stopped and alternative sources used. The community affected by the disruption of supply should be supplied from the alternative source till supply from the Ondoto River is restored.					
Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Mitigated	**M**	**M**	**L**	**M**	**L**	**L**
Significance of Consequence	With development of alternative sources and ending abstraction from the Ondoto River alluvial aquifer groundwater level will be restored with recharge over time.					
Confidence Level	The restoration of any impact of abstraction of groundwater is dependent on groundwater replenishment by river flow. Arid region river flow and recharge is episodic and not often predictable. Continuous monitoring will provide feedback on the restoration of conditions of the water resource.					

Impact Event	**Mining activities may affect water resources through contamination**
Description	Leaching of contaminants and erosion of material from TSF and waste rock dumps into surface water channels and infiltration underground. Source of water could be discarded process water and rain events of high intensity. The leachate from the TSF and mine waste are however likely to be alkaline thus limiting the mobility of metals. Erosion of material and mobilisation of precipitates and fines is possible. Wastewater disposal reaching natural drainage.
Nature	Negative
Phases	Phases during which mining activities may impact the water resources are highlighted below.

Construction Phase	**Operational Phase**	**Decommissioning Phase**	**Post Closure**
Alluvial aquifer of the Ondoto River	Alluvial aquifer of the Ondoto River	Alluvial aquifer of the Ondoto River	The waste rock dump and TSF will remain exposed to risk of erosion and mobilisation into surface water channels. Wastewater disposal will cease.
Eroded material and fines reaching the alluvial aquifer during severe rainfall events.	Eroded material and fines reaching the alluvial aquifer during severe rainfall events. Effluent reaching alluvium though underground seepage.	Eroded material and fines reaching the alluvial aquifer during severe rainfall events.	

Severity	The mobilisation of material from the TSF and waste rock dump into natural water channels and eventually to the Ondoto River is possible. The area experiences high intensity rainfall following extended dry periods that can mobilise sediments and material.
Duration	The duration of the impact will continue through the development, operational and after closure of the mine.
Spatial Scale	Fairly widespread, in the mine site and neighbouring village.
Probability	Possible / continuous

Mitigation	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability of Occurrence**	**Significance**
Unmitigated	**M**	**H**	**M**	**H**	**M**	**H**

Significance of Consequence	A high significance is expected if no mitigation measures are implemented.
Prevention	Reclaim of process water and reuse to limit the amount of water used. Design, construction and maintenance of TSF and waste rock dumps to prevent erosion. Line bottom of TSF with low permeability material. Construct perimeter drain to channel water to Containment Dam.
Mitigation Action	Construction of a containment dam downstream of the processing plant, TSF, waste rock dump and other stockpiles. Evaporation of contained water that is not reused. Maintain water balance as a check on any significant water leakage from the operation. Regular inspection of TSF and waste rock dumps. Monitor field water quality parameters of downstream aquifer, seepage (TSF, waste dumps, containment dam); quarterly sampling and analyses.
Rehabilitation	Grading of waste rock dumps and covering the waste rock dumps and TSF with compacted soil/calcrete to prevent seepage and erosion. Avoid surface water inflow and outflow from the processing, TSF and waste dump area.

Mitigation	Severity	Duration	Spatial Scale	Consequence	Probability of Occurrence	Significance
Mitigated	**M**	**L**	**L**	**M**	**L**	**L**
Significance of Consequence	The possibility of waste water, leachate and eroded material reaching the natural river channels is significantly reduced by the construction of a containment dam. The overall risk of leaching of metals will be low due to the alkaline nature of the tailings.					
Confidence Level	Continuous monitoring and implementation of mitigation measures will significantly reduce the probability of waste material reaching the downstream natural drainage channels.					

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APPENDIX A – CHAIN OF CUSTODY RECORD

CHAIN OF CUSTODY RECORD

Client:
ML40, KNL of Namibia (Pty) Ltd / Gecko Exploration (Pty) Ltd., PO Box 8912, Swakopmund

Analytical Services Providers:
Namib Hydrosearch
P O Box 20690, Windhoek, Namibia
+264 81 2753927
diganta@namibhydro.com

Analytical Laboratory Services cc (ALS)
P O Box 86782 Windhoek, Namibia
+264 61 210 132 Fax +264 61 210 058
analab@mweb.com.na

PO / Project name: EIA ML-40

Chain of possession:

Send from	Dispatch date	Dispatch to	# of samples	Courier	Date received	Received by	# of samples
ML40	19/12/2020	ANALAB	13	HAND DELIVERED	21-12-20	MM	13
Send from	Dispatch date	Dispatch to	# of samples	Courier	Date received	Received by	# of samples
Send from	Dispatch date	Dispatch to	# of samples	Courier	Date received	Received by	

No	Description	Vol, ml	Sample date & time	Sampled by	Tests required:
1	ML40-01, ore	+/- 500g	17/12/2020	D SARMA	Leach study
2	ML40-02, ore	+/- 500g	17/12/2020	D SARMA	Leach study
3	ML40-03, ore	+/- 500g	17/12/2020	D SARMA	Leach study
4	ML40-04, anorthosite	+/- 500g	17/12/2020	D SARMA	ABA
5	ML40-05, anorthosite	+/- 500g	17/12/2020	D SARMA	ABA
6	ML40-06, anorthosite	+/- 500g	17/12/2020	D SARMA	ABA
7	ML40-07, anorthosite	+/- 500g	17/12/2020	D SARMA	ABA
8	Ondoto well	1 litre	18/12/2020	D SARMA	STANDARD WATER QUALITY
9	Ondoto well	1 litre	18/12/2020	D SARMA	WASTEWATER
10	Ondoto well	250 ML	18/12/2020	D SARMA	42 ELEMENT SCAN
11	CAMP / COMMUNITY WATER PNT	1 litre	18/12/2020	D SARMA	STANDARD WATER QUALITY
12	CAMP / COMMUNITY WATER PNT	250 ML	18/12/2020	D SARMA	42 ELEMENT SCAN
13	KUNENE RIVER WATER	1 litre	18/12/2020	D SARMA	STANDARD WATER QUALITY

Remark:
Please fax/e-mail completed copy of Chain of Custody to the client

All samples and associated documentation were received in good order	Name, Date & Signature	Yes ✓ No	Yes No		Yes No

APPENDIX B: GROUNDWATER QUALITY DATA

Major trace and minor ions in a groundwater sample from Ondoto River alluvial aquifer analysed by Analytical Laboratory Services, Windhoek.

TEST REPORT

To: **Namib Hydrosearch**
P.O. Box 20690
Windhoek

Date received: 21-Dec-20
Date analysed: 7 January - 12 January 2021
Date reported: 25-Jan-21

Attn: Mr Diganta Sarma
e-mail: diganta@namibhydro.com
Tel: 081-275 3927

Client Reference no.: EIA ML-40
Quotation no.: QU-5113
Lab Reference: I210144
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	Ondoto well
Date of sampling	2020/12/18
Test item number	I210144/1

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.5**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**180.8**	**mS/m**	B	150	300	400	
Turbidity	**0.45**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**997**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**0**	**mg/l**					
Total Alkalinity as $CaCO_3$	**395**	**mg/l**					
Total Hardness as $CaCO_3$	**568**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**305**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**264**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**305**	**mg/l**	B	250	600	1200	1500-3000
Fluoride as F^-	**0.5**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**111**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**1.0**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.11**	**mg/l**					10
Sodium as Na	**148**	**mg/l**	B	100	400	800	2000
Potassium as K	**4.8**	**mg/l**	A	200	400	800	
Magnesium as Mg	**64**	**mg/l**	A	70	100	200	500
Calcium as Ca	**122**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**0.08**	**mg/l**	B	0.05	1.0	2.0	10
Iron as Fe	**0.14**	**mg/l**	B	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.8**						
Langelier Index	**0.7**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.1**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**1.4**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

TEST REPORT

To: **Namib Hydrosearch**
P.O. Box 20690
Windhoek

Date received: 21-Dec-20
Date analysed: 07-Jan-20-02-21
Date reported: 22-Feb-21

Attn: Mr Diganta Sarma
e-mail: diganta@namibhydro.com
Tel: 081-275 3927

Client Reference no.: EIA ML-40
Quotation no.: QU-5113
Lab Reference: I210144
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	Ondoto well
Date of sampling	2020/12/18
Test item number	I210144/1

Parameter	**Dissolved Metals* Value**	**Units**		**Dissolved Metals* Value**	**Units**
Lithium as Li	**3.1**	**µg/l**	**Aluminium as Al**	**137**	**µg/l**
Beryllium as Be	**<0.329**	**µg/l**	**Silicon as Si**	**19342**	**µg/l**
Boron as B	**322**	**µg/l**	**Phosphorous as P**	**10**	**µg/l**
Strontium as Sr	**1489**	**µg/l**	**Sulphur as S**	**36940**	**µg/l**
Zirconium as Zr	**<0.045**	**µg/l**	**Titanium as Ti**	**3.7**	**µg/l**
Molybdenum as Mo	**5.1**	**µg/l**	**Vanadium as V**	**5.7**	**µg/l**
Cadmium as Cd	**0.06**	**µg/l**	**Chromium as Cr**	**<1.345**	**µg/l**
Tin as Sn	**<0.223**	**µg/l**	**Manganese as Mn**	**78**	**µg/l**
Antimony as Sb	**0.08**	**µg/l**	**Iron as Fe**	**232**	**µg/l**
Tellurium as Te	**<0.273**	**µg/l**	**Cobalt as Co**	**0.34**	**µg/l**
Barium as Ba	**179**	**µg/l**	**Nickel as Ni**	**1.0**	**µg/l**
Lanthanum as La	**0.44**	**µg/l**	**Copper as Cu**	**6.0**	**µg/l**
Tungsten as W	**0.05**	**µg/l**	**Zinc as Zn**	**6.6**	**µg/l**
Iridium as Ir	**0.01**	**µg/l**	**Arsenic as As**	**1.4**	**µg/l**
Platinum as Pt	**<0.019**	**µg/l**	**Selenium as Se**	**<0.932**	**µg/l**
Gold as Au	**0.09**	**µg/l**	**Ruthenium as Ru**	**0.33**	**µg/l**
Mercury as Hg	**0.23**	**µg/l**	**Rhodium as Rh**	**0.08**	**µg/l**
Thallium as Tl	**0.18**	**µg/l**	**Palladium as Pd**	**0.57**	**µg/l**
Lead as Pb	**0.66**	**µg/l**	**Silver as Ag**	**0.12**	**µg/l**
Bismuth as Bi	**0.02**	**µg/l**			
Thorium as Th	**0.06**	**µg/l**			
Uranium as U	**2.6**	**µg/l**			

Remark: * = outsourced to Lab'O'Link, South Africa

Major, minor and trace ions water sample from the community water point analysed by Analytical Laboratory Services, Windhoek.

TEST REPORT

To:	**Namib Hydrosearch**		
	P.O. Box 20690	Date received:	21-Dec-20
	Windhoek	Date analysed:	7 January - 12 January 2021
		Date reported:	25-Jan-21
Attn:	Mr Diganta Sarma	Client Reference no.:	EIA ML-40
e-mail:	diganta@namibhydro.com	Quotation no.:	QU-5113
Tel:	081-275 3927	Lab Reference:	I210144
		Enquiries:	Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	Gecko camp
Date of sampling	2020/12/18
Test item number	I210144/3

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.7**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**180.2**	**mS/m**	B	150	300	400	
Turbidity	**1.1**	**NTU**	B	1	5	10	
Total Dissolved Solids (calc.)	**995**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**0**	**mg/l**					
Total Alkalinity as $CaCO_3$	**395**	**mg/l**					
Total Hardness as $CaCO_3$	**568**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**305**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**264**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**308**	**mg/l**	B	250	600	1200	1500-3000
Fluoride as F^-	**0.4**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**112**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**<0.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**147**	**mg/l**	B	100	400	800	2000
Potassium as K	**4.3**	**mg/l**	A	200	400	800	
Magnesium as Mg	**64**	**mg/l**	A	70	100	200	500
Calcium as Ca	**122**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**0.02**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.03**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.8**						
Langelier Index	**0.9**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**5.9**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**1.4**	increasing corrosive tendency		Applies to w ater in the pH range 7-8 w hich also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

TEST REPORT

To: **Namib Hydrosearch**
P.O. Box 20690
Windhoek

Date received: 21-Dec-20
Date analysed: 07-Jan-20-02-21
Date reported: 22-Feb-21

Attn: Mr Diganta Sarma
e-mail: diganta@namibhydro.com
Tel: 081-275 3927

Client Reference no.: EIA ML-40
Quotation no.: QU-5113
Lab Reference: I210144
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	Gecko camp
Date of sampling	2020/12/18
Test item number	I210144/3

Parameter	**Dissolved Metals* Value**	**Units**		**Dissolved Metals* Value**	**Units**
Lithium as Li	3.1	µg/l	Aluminium as Al	64	µg/l
Beryllium as Be	<0.329	µg/l	Silicon as Si	20533	µg/l
Boron as B	299	µg/l	Phosphorous as P	7.2	µg/l
Strontium as Sr	1517	µg/l	Sulphur as S	37199	µg/l
Zirconium as Zr	<0.045	µg/l	Titanium as Ti	<0.442	µg/l
Molybdenum as Mo	5.4	µg/l	Vanadium as V	5.3	µg/l
Cadmium as Cd	0.05	µg/l	Chromium as Cr	<1.345	µg/l
Tin as Sn	<0.223	µg/l	Manganese as Mn	22	µg/l
Antimony as Sb	0.07	µg/l	Iron as Fe	50	µg/l
Tellurium as Te	<0.273	µg/l	Cobalt as Co	0.07	µg/l
Barium as Ba	178	µg/l	Nickel as Ni	0.53	µg/l
Lanthanum as La	0.06	µg/l	Copper as Cu	2.2	µg/l
Tungsten as W	0.06	µg/l	Zinc as Zn	6.1	µg/l
Iridium as Ir	<0.012	µg/l	Arsenic as As	1.0	µg/l
Platinum as Pt	<0.019	µg/l	Selenium as Se	<0.932	µg/l
Gold as Au	0.04	µg/l	Ruthenium as Ru	0.27	µg/l
Mercury as Hg	0.69	µg/l	Rhodium as Rh	0.06	µg/l
Thallium as Tl	0.07	µg/l	Palladium as Pd	0.64	µg/l
Lead as Pb	0.52	µg/l	Silver as Ag	<0.1	µg/l
Bismuth as Bi	0.02	µg/l			
Thorium as Th	0.01	µg/l			
Uranium as U	2.6	µg/l			
Sodium as Na		µg/l			

Remark: * = outsourced to Lab'O'Link, South Africa

Major and minor ions water sample from the Kunene River analysed by Analytical Laboratory Services, Windhoek.

TEST REPORT

To:	**Namib Hydrosearch**		
	P.O. Box 20690	Date received:	21-Dec-20
	Windhoek	Date analysed:	7 January - 12 January 2021
		Date reported:	25-Jan-21
Attn:	Mr Diganta Sarma	Client Reference no.:	EIA ML-40
e-mail:	diganta@namibhydro.com	Quotation no.:	QU-5113
Tel:	081-275 3927	Lab Reference:	I210144
		Enquiries:	Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	Kunene river
Date of sampling	2020/12/18
Test item number	I210144/4

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**8.1**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**6.1**	**mS/m**	A	150	300	400	
Turbidity	**116**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**33**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**0**	**mg/l**					
Total Alkalinity as $CaCO_3$	**26**	**mg/l**					
Total Hardness as $CaCO_3$	**18**	**mg/l**	A	300	650	1300	
Ca-Hardness as $CaCO_3$	**11**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**7**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**4**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.1**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**<1**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**<0.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**4.2**	**mg/l**	A	100	400	800	2000
Potassium as K	**3.0**	**mg/l**	A	200	400	800	
Magnesium as Mg	**1.7**	**mg/l**	A	70	100	200	500
Calcium as Ca	**4.6**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**0.02**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**2.8**	**mg/l**	D	0.1	1.0	2.0	10
Stability pH, at 25°C	**9.3**						
Langelier Index	**-1.2**	corrosive		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**10.5**	corrosive		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.3**	increasing corrosive tendency		Applies to w ater in the pH range 7-8 w hich also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

APPENDIX C – LEACHING POTENTIAL OF THE MINE ORE

TEST REPORT

To: **Namib Hydrosearch**
P O Box 20690
Windhoek

Attn: Mr D. Sarma

Date received: 21-Dec-20
Date analysed: 11-Jun-07-Jul-20
Date reported: 12-Feb-21

Your reference: PO / Project name: EIA ML-40
Lab Reference: I210144

Type of Test: Leaching test
Method Reference: Method 1311, Toxicity characteristic leaching procedure (buffered acetic acid/NaOH, pH 4.9) followed by ICP-MS

Units: Lab No.		Li µg/kg	Be µg/kg	Sr mg/kg	Zr µg/kg	Mo µg/kg	Cd µg/kg	Sn µg/kg	Sb µg/kg	Te µg/kg	Ba mg/kg	La mg/kg	W µg/kg	Ir µg/kg	Pt µ/kg	Au µg/kg
1	**ML40-01**	**102**	**<7**	**157**	**2**	**260**	**20**	**<4**	**<1**	**<5**	**99**	**25**	**<1**	**<1**	**<1**	**<1**
2	**ML40-02**	**116**	**<7**	**114**	**15**	**340**	**22**	**<4**	**<1**	**<5**	**96**	**39**	**1**	**<1**	**<1**	**<1**
3	**ML40-03**	**90**	**<7**	**604**	**1**	**1280**	**32**	**<4**	**1.2**	**<5**	**118**	**50**	**9**	**<1**	**<1**	**<1**
		0.10		**0.29**	**0.01**	**0.63**	**0.02**		**0.00**		**104.15**	**37.73**	**0.01**			

Type of Test: Leaching test
Method Reference: Method 1311, Toxicity characteristic leaching procedure (buffered acetic acid/NaOH, pH 4.9) followed by ICP-MS

Units: Lab No.		Hg µg/kg	Tl µg/kg	Pb µg/kg	Bi µg/kg	Th µg/kg	U µg/kg	Al µg/kg	P µg/kg	S mg/kg	Ti µg/kg	V µg/kg	Cr µg/kg	Mn mg/kg	Fe µ/kg	Co µg/kg
1	**ML40-01**	**<1**	**<1**	**250**	**<1**	**1**	**17**	**<11**	**<13**	**51**	**<9**	**1**	**<27**	**1268**	**<24**	**158**
2	**ML40-02**	**<1**	**<1**	**120**	**<1**	**1**	**7**	**180**	**120**	**62**	**<9**	**1**	**<27**	**994**	**<24**	**144**
3	**ML40-03**	**<1**	**<1**	**630**	**<1**	**1**	**5**	**<11**	**<13**	**66**	**<9**	**<1**	**<27**	**569**	**500**	**58**
				0.333		**0.001**	**0.010**	**0.180**	**0.120**	**59.620**		**1.300**		**943.493**	**0.500**	**0.120**

Type of Test: Leaching test
Method Reference: Method 1311, Toxicity characteristic leaching procedure (buffered acetic acid/NaOH, pH 4.9) followed by ICP-MS

Units: Lab No.		Ni µg/kg	Cu µg/kg	Zn µg/kg	As µg/kg	Se µg/kg	Ru µg/kg	Rh µg/kg	Pd µg/kg	Ag µg/kg
1	**ML40-01**	**43**	**100**	**140**	**1**	**19**	**25**	**9**	**132**	**6**
2	**ML40-02**	**31**	**<8**	**120**	**1**	**19**	**13**	**4**	**86**	**4**
3	**ML40-03**	**19**	**8**	**240**	**9**	**19**	**127**	**28**	**580**	**4**
		0.031	**0.054**	**0.167**	**0.004**	**0.019**	**0.055**	**0.014**	**0.266**	**0.005**

Remark: All concentrations reported in µg/kg except where highlighted

APPENDIX D – ACID BASE ACCOUNTING DATA

To: **Namib Hydrosearch**
P O Box 20690
Windhoek

Attn: Mr D. Sarma

Date received: 21-Dec-20
Date analysed: 05-Jan-09-Mar-2021
Date completed: 9-Mar-21

Your Reference: PO / Project name: EIA ML-40
Lab Reference: I210144

Type of Test:		pH sat. paste	pH sat. paste	Total sulphur*	Acid potential**	Net acid generation (NAG)	NAGpH	Fizz rate	Neutralisation potential	Net neutralisation potential (NNP)	Neutralisation potential ratio NRP
Method Reference:		Sobeck et al. (1978), Page et al. (1982		Combustion	calculated	Lapakko & Lawrence			Sobek NP	calculated	calculated
Units:		after 10 min	after 24h	% S m/m	/tons	kg H_2SO_4 /ton			kg $CaCO_3$ /tons	NNP	NP/AP
Lab No.	**Anorthosite**										
4	ML40-04	**9.4**	**9.3**	**<0.01**	**0.3**	**0**	**6.29**	**moderate**	**69**	**69**	**222**
5	ML40-05	**9.5**	**9.3**	**<0.01**	**0.3**	**0**	**6.31**	**moderate**	**72**	**72**	**232**
6	ML40-06	**9.5**	**9.4**	**<0.01**	**0.3**	**0**	**6.24**	**slight**	**30**	**30**	**96**
7	ML40-07	**9.4**	**9.2**	**<0.01**	**0.3**	**0**	**6.28**	**slight**	**30**	**30**	**96**
	Ref: NBM-1	8.49	8.24	0.32	-	0	7.20	slight	**55.0**		
	expected	-	8.45	0.28	-	-	-	slight	49.6		

Remark: Analytical work:
* = outsourced to SGS, South Africa
** Acid potential is calculated on the basis of sulphide sulphur, namely sulphate sulphur is deducted from total sulphur

Remark: Interpretation
If NNP < -20 kg/ton CaCO3 = acid producing
If NNP > 20 kg/ton CaCO3 = non acid producing
NNP values between -20 and 20 kg/ton CaCO3 are in the grey range of uncertainty
If NPR <1 = acid producing
If NPR >3 = non-acid producing

NNP and NPR indicate that all four samples are non acid producing

File:	C:\MyWorks\Projects\NHN237 ML40 EIA\Report\NHN237_ML40_Hydrology_Hydrogeology_EnviroAssessment_DS_DFR_V4.docx
Status	Draft Final Report
Revisions	Four (4)
Author 1	Diganta Sarma, Hydrogeologist, Namib Hydrosearch
Author 2	Peter van der Merwe, Namibia Integrated Biosystems Projects
Reviewer	Phillip Hooks, Environmental Consultant and Team Leader
Reviewer	Oliver Krappmann, Geologist

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ARCHAEOLOGICAL AND HERITAGE IMPACT ASSESSMENT REPORT

FOR THE PROPOSED MINING ACTIVITIES ON MINING CLAIMS NO. 75160, 75161 & 75162 NEAR OTJIMUHAKA VILLAGE, EPUPA CONSTITUENCY IN THE KUNENE REGION, NAMIBIA.

Compiled by:

TARO ARCHAEOLOGICAL & HERITAGE CONSULTANTS

Trading as TARO INVESTMENTS CC, Reg. no: cc/2013/10742
P.O. Box 19730, Omuthiya, Namibia
Email: rolandmushi@taroarchaeology.com
Tel: +264 81 333 237 3

Prepared for: Nina Smit

As required under Section 53 (7) and Section 54 (7) of the National Heritage Act (No. 27 of 2004).

Document Information/Project Details

Item	Description
Report Title	Archaeological and Heritage Impact Assessment Report for the Mining Activities in the Kunene Region
Project Location & Site Name	The Proposed Project is located near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region.
Granted Date	*Pending ECC*
Expiry Date	*Pending ECC*
Target Commodities & Minerals	The Proposed Project intends to explore Rare Earth Elements (REE).
Approximately Coordinates	*Refer to Table 1*
Purpose of the Archaeological & Heritage Assessment	The purpose of the study is to identify, record and recommend measures for mitigation in areas of archaeological and cultural heritage significance, this includes rock art sites, artefacts, graves or burial grounds features, paleontological, structures, buildings, landscapes etc. that might be impacted by the proposed project.
Address & Contacts of the Project Proponent/Developer	Nina Smit P.O. Box 8912 Swakopmund, Namibia.
Total size of the application areas (MCs)	53.4771 (ha)
Author Identification	Prepared by TARO Archaeological & Heritage Consultants Cell: +264 81 3332373 Email: rolandmushi@gmail.com
Site Survey and Report Writing	Mr. Roland Mushi (*Archaeologist & Cultural Heritage Specialist*)
Heritage Research Permit	Permit No. 11/2025 *Issued under section 52(1) of the National Heritage Council Act (Act 27 of 2004).*
Competent Authority	National Heritage Council of Namibia
Report Date	13/10/2025
Cite this document as:	*Mushi, R. 2025. (AHIA) Archaeological and Heritage Impact Assessment for Mining Claims No. 75160, 75161 & 75162 located near Otjimuhaka Village, Epupa Constituency in the Kunene Region.*

Copyright & Disclaimer

Geographic Co-ordinate Information: Geographic coordinates in this report were obtained using a hand-held Garmin Global Positioning System device *GPSmap 60CSx*. The accuracy device as stated by the manufacturer states that these devices are accurate to within 11 feet which is equivalent to ± 3 meters. Maps: Maps included in this report use data extracted from the GIS Database, Spatial datasets, Google Earth Pro and Coordinates.

Declaration of Independence

Specialist Name/Archaeologist who prepared this report	Mr. Roland Mushi Contacts**:** +264 85 3332373 Email: rolandmushi@gmail.com
Declaration of Independence	I/we, TARO Archaeological & Heritage Consultants, hereby confirm my/our independence as an Archaeologist/Heritage specialist and declare that I/we have no interest in the business of our client, other than fair remuneration for work performed on this project/contract as well as the execution of archaeological sound fieldwork and the submission of a professional report to our client and Body of Authority (National Heritage Council of Namibia). This Archaeological & Heritage Assessment Report has been prepared according to the provisional of Section 51 (3) of the National Heritage Act, No 27 of 2004, and National Heritage Guidelines for Heritage Impact Assessment of 2021, Environmental Management Act, No 7 of 2007, and other relevant legislations.
Signature & Stamp	
Date	13/10/2025

The expertise of the Specialist

Roland Mushi has several years of experience working in desert environments, particularly within the Namib Naukluft National Park, where he served as a researcher. Since 2021, he has transitioned into a full-time role as an archaeologist. Academically, Roland holds a Master of Science (MSc) in Natural Resources Assessment and Management, as well as a Bachelor of Arts (B.A. Hons) in History and Archaeology. His academic focus is on Lithic and Fauna Analysis in Archaeology, with both degrees earned from the University of Dar Es Salaam. In addition to his professional and academic background, Roland is an accredited member of the following professional organizations:

- **ASAPA** - Association of Southern African Professional Archaeologists **# 480**
- **SAfA** - Society of Africanist Archaeologists
- **SAMA** - South African Museums Association **# NCM 008**
- **MAN** - Museums Association of Namibia **# 1311556**
- **EAPAN** - Environmental Assessment Professionals Association of Namibia **# 179**
- **ICOM –** International Council of Museums **# 177513**

SUBMISSION OF REPORT

Please note that the National Heritage Council of Namibia needs to comment and review this report. The Project Proponent/Client is advised not to proceed with any action before receiving the necessary consent/comments from NHCN.

Executive Summary

*TARO Archaeological & Heritage Consultants (TARO AHC) was appointed by Phillip Hooks on behalf of Nina Smit to conduct an Archaeological and Heritage Impact Assessment (AHIA) for the proposed mining project located at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region. The combined total footprint areas of the proposed mining and quarrying project is about 53.4771 (ha), topographically, the claims are situated on mountains and hills. Archaeologically, the findings from the surface survey conducted are of **LOW** significance.*

Findings and Observation made

Identification, mapping, classification and assessment of the significance of the archaeological, historical and cultural heritage resources in the area were conducted accordingly to the National Heritage Guidelines of 2021. The site surveys were undertaken on the 01th of September 2025 and 07 of October 2025. Key findings of this AHIA assessment include:

- ***Weathered outcrops and Stone Artefacts:*** *The mining claims area is characterized by prominent weathered outcrops, which are the most noticeable natural features observed during the survey. However, surface scatters were the only notable features detected. No evidence of significant archaeological importance was found within the claim. Therefore, based on the findings, the archaeological potential of the area is considered to be low.*

- ***Grave site:*** *No visible graves or burial sites have been recorded within the surveyed mining claims. The closest known grave is located approximately 4.3 kilometers away in the Ondoto West village. Based on the observations within the claim area, no substantial impact on archaeological resources is expected during the mining activities.*

- ***Rock shelters:*** *No rock shelters were identified within the proposed mining project area, further indicating the low archaeological significance of the site.*

Conclusion and Recommendations

*The Archaeological and Heritage Impact Assessment (AHIA) has identified no significant impacts expected at the proposed mining site. The surface-level assessment has shown that the proposed mining claim areas are not archaeologically sensitive. Consequently, the overall impact significance of the proposed project has been assessed as **LOW**.*

It is strongly recommended that project activities focus exclusively on the identified target sites. Strict compliance with the mitigation measures outlined in Section 16.2 is essential. Additionally, the adoption and implementation of Chance Find Procedures as part of the Environmental Management Plan (EMP) is required, pending approval from the relevant authority.

While the recommended mitigations pertain specifically to archaeological and heritage considerations, it is important to note that project authorization is still subject to approval. The proposed exploration activities may only proceed upon review and approval by the National Heritage Council of Namibia.

Document information

The contents of this Heritage Assessment Report are according to compliance with the National Heritage Act, No. 27 of 2004 and the Guidelines for Heritage Impact Assessment 2021 of Namibia.

This Specialist Report is prepared in terms of the NHC Guidelines, and contains the following;	**Addressed in the Specialist Report**
A. Title Page: - Title of the report, Subheading: Property name and portion (where applicable), Area, Region; - Type of development; - Author of the AHIA; - - Name of Proponent, - Consultant and Date of the AHIA. **Details of-** - the specialist who prepared the report; and - the expertise of that specialist to compile a specialist report including a curriculum vitae and relevant documents	Page i & ii (Preliminary Section of this report) Page iv (Preliminary Section of this report)
B. Executive Summary: - The purpose of the study; - A brief development project description; - Brief methodology including desktop study - Identification and/or outline of consultations with interested and affected parties relating specifically to heritage resources; - - Findings: Brief description of heritage resources, Significance of the resources and potential impacts and; Recommendations and reasoned opinions made by the heritage consultant.	Page v (Preliminary Section of this report)
C. Declaration of Independence and CV: - Heritage consultants must provide a very brief summary of their experience, - Qualifications, - Membership affiliations and membership numbers, and accreditation level if relevant, - A detailed CV and certified copies of degree certificates and ID must be attached in the Appendix); - - Heritage consultant(s) must declare (and sign) their independence from the developer.	Page iv (Preliminary Section of this report) Appendix 2 & 3
D. Contents Page: - List of acronyms used in the report and glossary.	Page xiv & xv (Preliminary Section of this report)
E. Introduction and Background Information: - Introduction to the development project and background information; - Detailed terms of reference as provided to the heritage consultant from the commissioning body	Section 1 & 1.1 Section 1.2
F. Project Description:	Section 2

- General project area and the specifics of the development i.e. Size of farm and portions, Magisterial District, location, aerial or geographic map and co-ordinates of the project development;	
G. Legislation Requirement – A summary of which legislation (including the relevant NHA sections) and other local by-laws are relevant to the proposed project, and those identified must be subsequently outlined and quoted;	Section 3
- An indication of the scope of, and the purpose for which, the report was prepared;	Section 4
- A description of any assumptions, limitations made and any gaps in knowledge;	Section 5
H. Methodology - A description of the methodology used in undertaking a field survey including site investigation, and preparation of the report	Section 6 (including photographs, and weather conditions of the study area during the site visit)
I. Consultation and Stakeholder Engagement - A description of the result of consultation undertaken during the site visit (Relevant to heritage resources only) - Any abridged copies received	Section 8.1 N/A
Literature reviews - Summary of reports used **-** Description of the Study Area/topography - Geology of the project area	Section 9, 9.1.1 & 9.1.2 Table 11
J. Detailed Assessments - Site investigation details	Section 7, Table 6
K. Site Investigation	Section 6.5
L. Site Significance Rating	Section 8, Table 7, 8, 9, & 10
(i) Background and general Heritage Context of the area - Desktop Study/ Regional Archaeological & Heritage context.	Section 10, 10.1
(ii) Physical and Environmental Context of the area - Vegetation and Landscape - Site context	Sections 11 & 11.1
(iii) Assessment of the findings - On-site findings	Sections 12 & 12.1, Table 15
(iv) Potential Impacts on Cultural Heritage Resources - Archaeological, historical, built environment and cultural	Sections 13, 13.1, 13.1.1
(v) Tabulated summary of the Impact evaluation of the proposed project	
(vi) Impact Assessment	Table 16
Summary of the Impact	

- Archaeological & Heritage consideration for inclusion in the Project EMP	
(**vii) An identification of any areas to be avoided, including buffers;** **-** A superimposed map of the sensitivities areas of the site to be avoided, including 500m to 1 km buffer zones;	None
(viii) Identification of Key Impact	Section 15
(ix) Residual Impact	Section 15.1
(x) Identification of Alternatives	Section 15.2
M. Management Plan and Mitigation Measures **-** Any mitigation measures for inclusion in the proposed project EMP - Conclusion and Recommendation - Recommended Mitigations **Statement and reasoned opinion of the specialist** - whether the proposed development should be authorized or not;	Section 16 Table 21 Section 16.1 Section 16.2 Section 16.3
N. References	Section 16
M. Appendices **-** Any archaeological and heritage monitoring requirements for inclusion in the EMP or Environmental Authorization;	 Appendix 1

Table of Contents

List of Figures

List of Tables

Glossary list used in this report

Abbreviation	***Description***
AHIA	*Archaeological and Heritage Impact Assessment*
AMP	*Archaeological Management Plan*
AD	*Anno Domini*
ASAPA	*Association of Southern African Professional Archaeologists*
CFP	*Chance Find Procedure*
EAPAN	*Environmental Assessment Professionals Association of Namibia*
ECC	*Environmental Clearance Certificate*
ECO	*Environmental Control Officer*
EIA	*Environmental Impact Assessment**
EMP	*Environmental Management Plan*
ESA	*Early Stone Age*
GIS	*Geographical Information System*
NHC	*National Heritage Council*
MAN	*Museum Association of Namibia*
MSA	*Middle Stone Age*
LSA	*Late Stone Age*
PM	*Project Manager*
SM/I	*Site Manager/Inspector*
SAfA	*Society of Africanist Archaeologists*
SAMA	*South African Museums Association*

Definitions of Key Concepts and Terms

Archaeological	*In relation to a place or an object, means (a) any remains of human habitation or occupation that are 50 or more years old found on or beneath the surface of the land or in the sea; (b) rock art, being any form of painting, engraving or other representation on a fixed rock surface or loose rock or stone which is 50 or more years old;*
Archaeological Site	*This means an area in which archaeological objects are situated. Archaeological remains can be defined as any features or objects resulting from human activities, which have been deposited on or in the ground, reflecting past ways of life and are either 50 years old or older than that.*
An artefact or artefact	*A general term for an item made or given shape by human culture, such as a tool or a work of art, especially an object of archaeological interest*
Isolated finds	*Occurrences of artefacts or other remains that are not in-situ or are located apart from archaeological sites. Although these are noted and recorded but do not usually constitute the core of an impact assessment, unless if they have intrinsic cultural significance and value*
In-situ	*Refers to material culture and surrounding deposits in their original location and context, for example, an archaeological site that has not been disturbed by farming.*
Built environment	*The built environment includes an array of historic buildings, structures and objects, from missions, forts and rock walls to entire town sites and settlements.*
Monuments	*Architectural works, works of monumental sculpture and paintings, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science;*
Heritage significance	*Means aesthetic, archaeological, architectural, cultural, historical, scientific or social significance;*

Cultural Heritage	*Encompasses the range of tangible material reflecting past and present human culture (e.g., archaeology), as well as cultural practices, performance, indigenous knowledge, and oral traditions (intangible) that is bequeathed from one generation to the next, and which each subsequent generation molds and adapts to suit the changing conditions of its time.*
Heritage, Intangible	*Aspects of culture that cannot be touched, including song, dance, oral traditions, indigenous knowledge, etc. However, most sites of material or tangible heritage are imbued with intangible elements – thus, a site where a famous battle took place is inextricably linked to the oral traditions and history surrounding the site and any material remains related to the battle itself.*
Heritage, Tangible	*Physical heritage material or sites that include buildings, graves, sacred pools, rock art and other sites, e.g., stone age pottery, tools, iron smelting sites, etc*
A grave	*A place of interment (variably referred to as burial) includes the contents, headstone or other markers of such a place, and any other structure on or associated with such place. A grave may occur in isolation or in association with others where it is referred to as being situated in a cemetery (contemporary) or burial ground (historic).*
Boulder	*A large fragment of bedrock that has detached from the mountainside.*
Historic building	*Refers to structure or building which is over 50 years or more.*
Chance Finds	*This means archaeological artefacts, features, structures or historical cultural remains such as human burials that are found accidentally in the context previously not identified during cultural heritage scoping, screening and assessment studies. Such finds are usually found during earth-moving activities.*
Study area or 'proposed project area'	*Refers to the area where the Proponent/developer wants to focus its development activities.*
Periodization	*Archaeologists divide the different cultural epochs according to the dominant material finds for the different periods. This periodization is usually region-specific, such that the same label can have different dates for different areas. This makes it important to clarify and declare the periodization of the area one is studying. These periods are nothing a little more than convenient time brackets because their terminal and commencement are not absolute and there are several instances of overlap.*
Pleistocene	*Is a basis for the Quarternary period which started around 2.58 million years ago to 11.7 thousand years ago*
Mid-Pleistocene	*A period known as the Mid-Pleistocene Transition (MPT) or The Mid-Pleistocene Revolution (MPR) was the transition that happened approximately 1.25–0.7 million years ago, in the Pleistocene epoch. In other words, this middle Pleistocene transition (MPT) began 1250 kya and was completed by 700 kya.*
Later Pleistocene	*The Late Pleistocene is an unofficial age in the international geologic timescale in chronostratigraphy, it is currently defined as the time between c. 129,000 and c. 11,700 years ago.*
Holocene	*Started from 11.7/ 10 Kya to present*
ESA	*>2 600 000 years ago – 250 000/200 000 years ago*
MSA	*250 000/200 000 years ago – 40/25 000 years ago*
LSA	*25 000 years ago – AD 200 (up to historic times in certain areas)*
Iron Age Period	*AD 200 – AD 1840*
Historic Period	*AD 1840 - 1950*

1. Introduction

TARO Archaeological & Heritage Consultants (TARO AHC) was appointed by Phillip Hooks on behalf of Nina Smit (*hereafter referred to as the Proponent*) to undertake an Archaeological and Heritage Impact Assessment (AHIA) for the proposed mining activities at Mining Claims No. 75160, 75161 & 75162. The targeted mineral commodities are Rare Earth Elements (REE) and other minerals. Ore processing will occur within the accessory works area of Mining Licence (ML) 40, which has already been granted mining rights and an Environmental Clearance Certificate (ECC) for operations.

The mining claim is situated at the northern border of Namibia, near Otjimuhaka (formerly known as Swartbooisdrif), within the Kunene Region. This report, compiled by TARO AHC, draws extensively on information gathered during the surface survey, as well as archaeological and historical records from various sources, site reconnaissance, and other relevant documentation. This report is subject to the scope of work undertaken and the assumptions made during the assessment, in addition to the other sections contained within this document.

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The primary objective of this study is to provide specialist input into the screening process for the Environmental Application, which is necessary for the issuance of the Environmental Clearance Certificate (ECC). This input will inform the Environmental Scoping Assessment (ESA) Report and the Environmental Management Plan (EMP). Heritage Impact Assessments in Namibia are required under the National Heritage Act (No. 27 of 2004) and the Environmental Management Act (No. 27 of 2007).

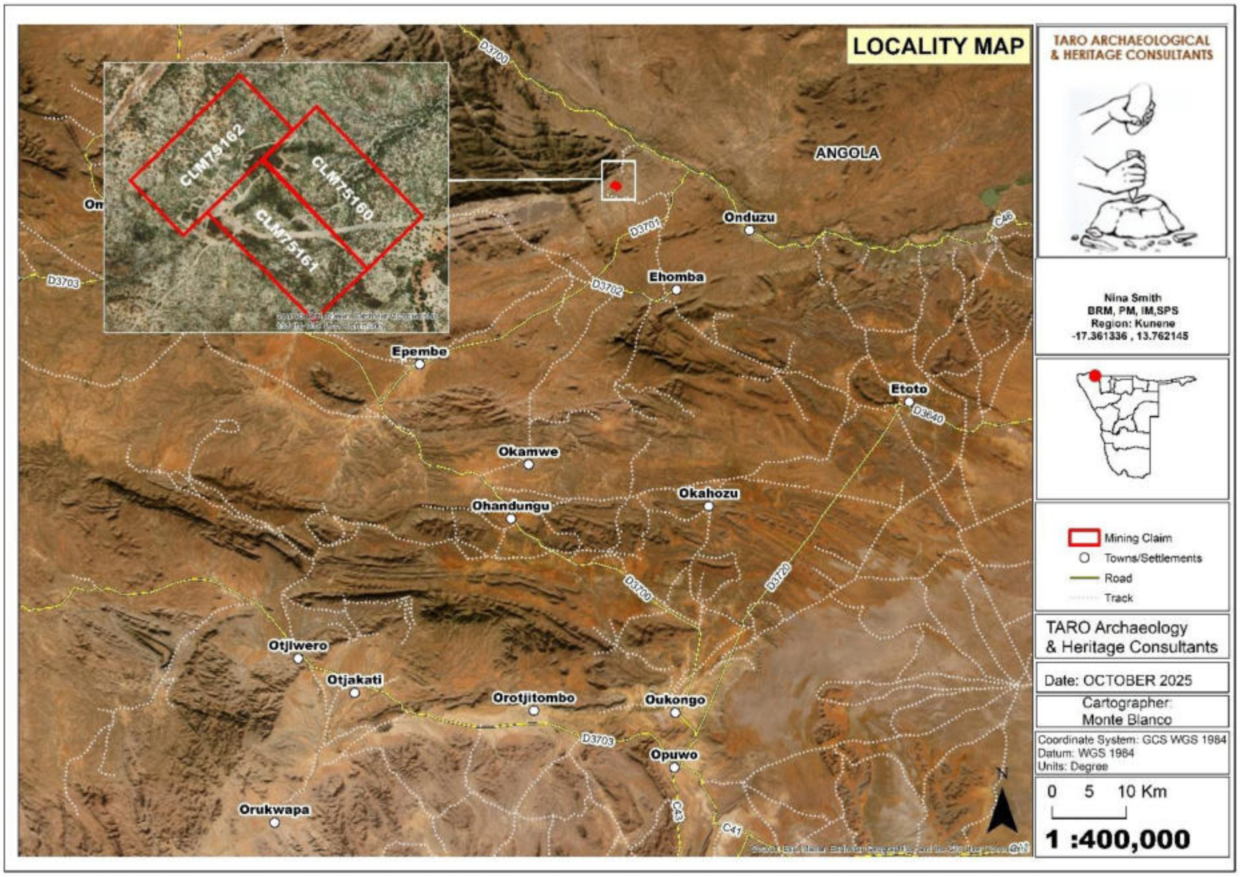

Figure 1: Locality map of the area of interest.

1.1. Mining Claims Coverage

The extent of the mining claim was primarily influenced by the accessibility of the landscape, which features slightly dense vegetation, as illustrated in Figure 2 below. The claim is located near the Otjimuhaka/Ondoto village, situated on the rocky foothills of Zebra Mountain to the northwest. Despite the challenging topography, site accessibility was not a significant issue, and the survey was successfully conducted without any major obstacles

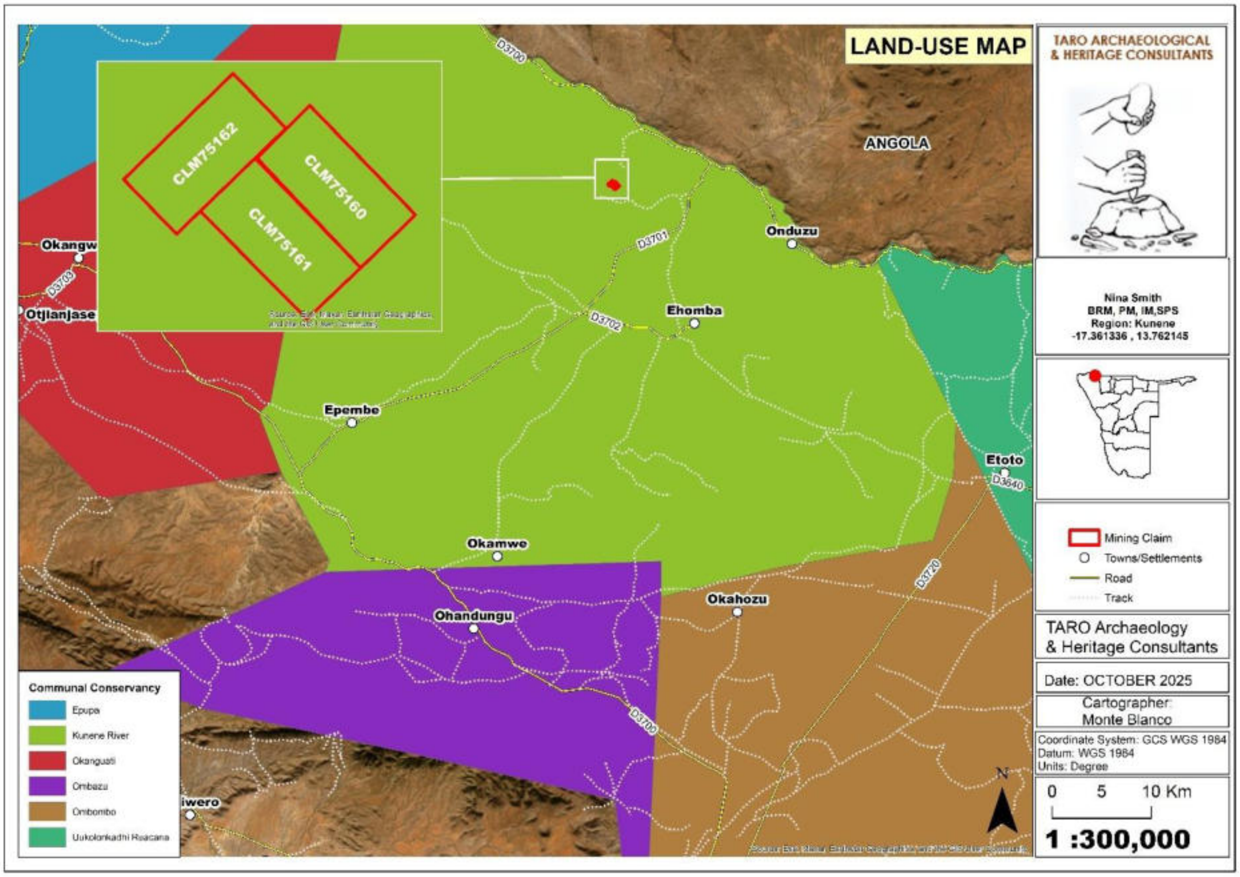

Figure 2: Land-use map of the proposed project.

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1.1.1. Accessibility, Location and Landscape

The Mining Claims No. 75160, 75161 & 75162 lies approximately 130 km northwest from Opuwo and is located about 3.5 km south of the Namibian-Angolan border, which is marked by the river Kunene, and 6 km south-west of the settlement Otjimuhaka (previously Swartbooisdrif). The Claims comprises a total area of about 53.4771 hectares. The mining areas are situated on the foothills of the NE-striking ridges of the Zebra Mountains in the north-west. A tributary of the ephemeral Ondoto River flows for about 500m through the claims.

Table 1: Approximate GPS Centre Coordinates of the Proposed Project Site

Geographic Positioning System Points in degrees, minutes & seconds			Total Area of the Mining Claims No. 75160, 75161 & 75162 is 53.4771 ha
Centre Coordinates for MC 75060	17° 21' 38" S	13° 45' 50" E	
Centre Coordinates for MC 75061	17° 21' 45" S	13° 45' 42" E	

Centre Coordinates for MC 75062	17° 21' 34'' S	13° 45' 32'' E	

1.2. Terms of Reference

Terms of reference for this archaeological and heritage impact assessment study were to;

- Locate, identify all objects, record, photograph and describe sites of archaeological, historical or cultural interest located in the area of the proposed development,
- Record coordinate points (GPS) of identified areas as significant and photographing,
- Determine the levels of significance of the various types of heritage resources that might be affected by the proposed project, and
- Suggest or propose appropriate management and mitigation measures for the archaeological and cultural heritage resources that might occur in the area proposed for exploration or mining activities which can be potentially destroyed in the course of quarrying and other related development.
- Review applicable legislative requirements.

2. Project Description

Nina Smit (*hereinafter referred to as "Proponent"),* intends to conduct mining and quarrying in the specified Mining Claim No. 75160, 75161 & 75162 has a combined total area of 53.4771 (ha). Therefore, Archaeological and Heritage Impact Assessment was conducted to identify the possible impacts on the archaeological or heritage resources on the site. Project components and the location is outlined in ***Table 2*** and ***3*** below.

Table 2: Project Area

Project Area	The proposed development site is located near Otjimuhaka/Ondoto Village.
Project Site/Name of the area	The proposed development site is located near Otjimuhaka/Ondoto Village is located approximately 130 km northwest from Opuwo.
Magisterial District/Location	Epupa Constituency in the Kunene Region.
Co-ordinate of the development	Refer to Table 1 above
Topographic Map Number	N/A

Table 3: Infrastructure and project activities

Types of Development	Prospecting Application: Mining Permit for the aforementioned minerals commodities.
Size of the MCs	53.4771 (ha)
Project Components	The proposed activity focuses on the specific resources of iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the Mining Claims 75160, 75161 & 75162. Narrow, dykes and veins, up to 1 metre wide and with lengths of up to approximately 200m constitute zones of rare earth mineralisation. Both these

	types of mineralisation, iron and rare earth, belong to the class of base and rare metals.
Mining and Quarrying methods and techniques to be used specifically for the Base and Rare Metals, Dimension Stones, Semi-Precious Metals and Precious Metals.	Mining activities will comprise various phases. For this assessment, the phase-based activities are categorized to enable impact assessment and analysis. The different project sections are as follows: **1. Construction Phase (Site Preparation)** • Construction of roads (internal within the Mining Claims) (an access road from the claim to the main road to the north and the processing plant in ML40 already exist) • Construction of new quarries within Mining Claims 75160, 75161 & 75162 • All other infrastructure for mining and processing of the ore has all been covered by the ECC for the ML40. Due to the presence of trace amounts of radioactive thorium within the REE ore the processing plant is located remotely from the local communities. The existence of one operational processing plant within the adjacent mining licence for all the associated mining claims reduces the cumulative impact or potentially danger to humans. • Solid non-mineral waste will be removed off site and taken to the nearest rubbish dump either in Otjimuhaka or Ruacana depending on the nature of the waste. Ablution facilities will use sealed septic tanks or a sewage treatment plant. Sewerage sludge will be taken to the Ruacana sewerage plant periodically. Prior to the construction of a new power line, the projects' electricity requirements will rely on diesel generators. Construction staff will be accommodated on site at a temporary camp. Security will be supplied on a 24-hour basis at the mine and construction sites. Support services and any facilities established during the construction phase will either be removed at the end of this phase or incorporated into the project's operational phase. **2. Operational Phase** • Operation will entail mining, i.e. drilling and blasting of rock outcrops and open cast mining. Mining techniques will make use of modern equipment such as excavators, compressor driven drill rigs, jack hammers and dump trucks. Open cast mining will be established according to good practice procedure.
Site Clearance	Land clearing: Small land parcels will be cleared for the establishment of base or field camps and staging areas. Proponent shall ensure that areas identified are those that present minimal disturbance to the natural environment and wildlife.
Machinery and Vehicles to be used	Bulldozers, excavators, trucks, 4 x 4 vehicles etc.
Human Resources & Employment	Once all operational activities commence for all the mining claims in the area, approximately 50 personnel would be employed on a permanent basis. Security staff are included in that number. This excludes the labour for transporting the products to the port in Walvis Bay. It is estimated that 10 truck drivers would be employed for this purpose as and when haulage is required. Approximately 20 staff would reside on site on an intermittent basis.
Site Access	Creation of access routes and haul tracks: Apart from the existing roads network leading to target areas, additional tracks (extensions from existing roads) may be created. Additional roadways may be considered for the purposes of accessing target sites. Where deemed necessary, graveling, and compaction of vehicle track's surfaces may be considered to allow for less track maintenance and seam less flow of traffic. No roads of bitumen standard exist in the Mining Claims area

Temporary roads	Where necessary, new access tracks will be created to access site specific areas on the MCs.
Expected impacts	**Positive impacts include** Employment opportunities, boosting the local economy, infrastructural-related development, investment opportunities, and skills transfer, improved geological understanding of the area and increased support for local business. **Negative impacts include** Physical land and soil disturbance, destruction of archaeological/cultural materials through unintentional uncovering of unknown archaeological materials and objects, environmental pollution, disturbance of local habitat (flora and fauna), potential social nuisance i.e. the conflict between farmers/landowners and the project proponent due to lack of communication etc. **-**Physical land/soil disturbance resulting in compaction and erosion, -Disturbance of grazing land for wildlife -Impact on local biodiversity (fauna and flora) and habitat disturbance, -The potential impact of illegal hunting/poaching of wildlife in the area,

3. Legislative context

This chapter outlines the regulatory framework applicable to the proposed project. **Table 4** provides a brief list of applicable legislation and relevance to the project.

National Heritage Act of Namibia (No. 27 of 2004)

This Act provides for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. The Client should ensure that if any archaeological or palaeontological objects, as described in this Act, are found in the course of the development, such findings be reported to the line Ministry immediately. If necessary, the relevant permits must be obtained before disturbing or destroying any heritage significance as envisaged by this Act.

Therefore, this AHIA report is a component of a broader Environmental Impact Assessment (EIA)/ Scoping Assessment (ESA) study and addresses the requirements of the National Heritage Act, No. 27 of 2004 and National Heritage Regulations (Government Notice 106 of 2005, in line with EIA Terms of Reference, and regarding the assessment of impacts of the proposed development on the archaeological, cultural and heritage resources associated with the receiving environment.

In principle, the National Heritage Act, 2004 (Act No. 27 of 2004) provides for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. Special provision is given for the protection and management of certain heritage resources in Namibia, these are listed in **Part VI from paragraphs (53-58)** including listed buildings which are 50 years old or more than that, archaeological objects or paleontological interest in existence which is 50 years or more years old, meteorite, historic shipwrecks and shipwreck objects (Underwater heritage) this include the remains of all ships that have been situated on the coast or in the territorial waters or the contiguous zone of Namibia for 35 years or more are historic shipwrecks for this section.; and other heritage resources.

Part I, Section1 paragraph (a) and (b) defines "archaeological" concerning a place or an object, which means (a) any remains of human habitation or occupation that are 50 or more years old found on or beneath the surface on land or in the sea; and (b) rock art, being any form of painting, engraving or other representation on a fixed rock surface or loose rock or stone which is 50 or more years old. While **Part V Section 46** of the Act prohibits the removal, damage, alteration or excavation of heritage Sites or remains. **Section 48** sets out the procedure for the application and granting of permits such as might be required in the event of damage to a protected site occurring as an inevitable result of development.

Furthermore, **Section 51 (3)** sets out the requirements for impact assessment. **Part VI Section 55 Paragraphs (3) and (4)** require that any person who discovers an archaeological site should immediately notify the National Heritage Council.

Table 4: Summary of the relevant Act(s) and Ordinance

National Regulatory	Summary	Applicability to the Project
National Heritage Act, No. 27 of 2004.	The Act makes provision for the protection and conservation of places and objects with heritage significance **Section 55** compels exploration companies to report any archaeological findings to the National Heritage Council after which a permit needs to be issued before the find can be disturbed.	There is potential for heritage objects to be found during the clearance of land and operations, therefore the Stipulations in the Act have been taken into consideration and are incorporated into this A/HIA report and the overall project EMP. The Proponent should ensure compliance with these Acts' requirements. The necessary management measures and related permitting requirements must be taken. This will be done by consulting with the National Heritage Council of Namibia.
National Monuments Act of Namibia (No. 28 of 1969) as amended until 1979.	No person shall destroy, damage, excavate, alter, remove from its original site or export from Namibia: Meteorites, fossils, petroglyphs, ornamental infrastructure graves, caves, rock shelters, middens, shells that came into existence before the year 1900 AD: or any other archaeological or paleontological finds.	
Burial Place Ordinance, Act No. 27 of 1966.	To prohibit the desecration or disturbance of graves in burial places and to regulate matters relating to the removal or disposal of dead bodies.	Graves and burial places such as stone cairns/mounds can occur anywhere (on surface and sub-surface) within the landscape, therefore this Act is very relevant, and adoption of ***Chance find***

	The Municipal Ordinance 13 of 1963 has been replaced by the Local Authorities Act 23 of 1992. (3) No person shall, except with the permission of the Administrator, in any way disturb, damage, remove or destroy a grave, monument, gravestone, cross, inscription, rail, enclosure, chain or erection of any kind whatever, or part thereof in any burial place.	should be mandatory for envisaged prospected works. The ***Chance Find Procedure*** is commonly included in archaeological and heritage impact assessments (AHIAs) and project management plans to ensure the protection of heritage sites when such discoveries happen. These procedures often outline the steps to follow when an unanticipated find is made, ensuring the preservation and respectful treatment of the cultural material, while allowing the project to continue with minimal disruption
Environmental Management Act (7 of 2007) Government Notice 232 27th December 2007	**PART I:** The definition of the environment employed by the Environmental Management Act (7 of 2007) Specifically includes "anthropogenic factors" such as archaeological remains or any other evidence of human activity. **PART II:** Environmental impact assessment (EIA) in Namibia is governed by this legislation and usually includes a specialist archaeological survey and assessment, following the stated Principles of Environmental Management which require that Namibia's cultural heritage must be protected and respected for the benefit of present and future generations.	Archaeological materials, heritage resources, historical, cultural landscapes or topographical settings are part of the environment in its context; hence this Act is very relevant to the proposed project and the Proponent is henceforth mandated to take into consideration all the necessary steps so as not to affect or destroy the environment where heritage resources are found.
Environmental Assessment Policy of Namibia 1995	The policy seeks to ensure that environmental consequences of development projects and policies are considered, understood and incorporated into the planning process, and the term environment is broadly interpreted to include biophysical, political, economic, social aspects, traditional norms,	This Archaeological and Heritage Assessment study considers the term environment to be part and parcel of archaeological and cultural heritage in its contexts.

	cultural and historical components.	

4. Scope of the Study and Objective of the Report

This Archaeological & Heritage Impact Assessment (AHIA) aims at identifying any significant heritage resources before any envisaged exploration or mining begins so that these can be managed in such a way as to allow the development to proceed without undue impacts on the heritage resources of a particular area. Also, this report aims to fulfil the requirements of the Heritage Authorities of Namibia who will review the AHIA and grant or refuse authorization. Similarly, the report will inform the EIA in the development of a comprehensive EMP to assist the project applicant/Proponent in responsibly managing the identified heritage resources to protect, preserve, and develop them within the framework provided by the National Heritage Council Act (Act No 27 of 2004). And thus, the AHIA report will outline any management and mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorization should this be granted.

5. Assumptions, Limitations and knowledge gaps

The archaeological and heritage study reported herein was carried out at the surface levels only and hence any completely buried archaeological sites could not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Based on this assumption, the possibility of the discovery or unearthed of heritage resources during the clearing of vegetation, or prospecting, exploration cannot be excluded. However, this limitation can be successfully mitigated with the implementation of a chance find procedure as recommended throughout the report. As with mitigation measures recommended in this report.

6. Approach and Methodology

6.1. Literature Review

The methodology for the study includes a survey of available literature conducted to extract data and information on the area in question to provide a general heritage context into which the proposed project would be set. This literature search included published material and unpublished reports, dissertations, papers, EIA reports, and internet search engines including online material from various websites, followed by a field assessment. The latter was conducted according to generally accepted HIA Guidelines 2021 practices and was aimed at locating all possible objects, sites and features of cultural significance in the area of proposed project sites.

6.2. Documentation

All recorded sites, features, artefacts and objects identified were documented according to the general minimum standards accepted by the archaeological standard, heritage impact assessment guidelines and profession in Namibia. Co-ordinates of individual localities were determined by means of the Global

Positioning System (GPS). The information was added to the description (Table 14) in order to facilitate the identification of each locality.

6.3. GIS Spatial analysis

Google Earth and topographic maps of the area were utilized to identify the geologic, and topographic, elevation of the area and possible places where sites of heritage significance might be located. Also, the GIS spatial database was utilized to collect any useful information on any of the above-mentioned in the area, as well as for geo-referencing purposes. The GIS and mapping sources were provided by the TARO Archaeological & Heritage Consultants.

6.4. Public Consultation and Advertisements

The Public Consultation meeting took place on 11th of September 2025 at Otjimuhaka Primary School at Otjimuhaka Village. Surface surveys were conducted on the 1st of September, 2025 and the 07th of October 2025.

Table 5: Placement of Newspaper adverts

Newspaper	Date of placement
Market Watch	01 September 2025
Market Watch	03 September 2025
Market Watch	09 September 2025

6.5. Site Investigation

The site visit aimed to; (a) survey the proposed project area to locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest (*if any*); (b) record GPS points of sites/areas identified as significant areas; (c) determine the levels of significance, grading of the various types of heritage resources recorded in the project area.

TARO Archaeological & Heritage Consultants inspected the environments in which the proposed project is located including its surrounding areas on the 01th of September 2025 (***Table 6***). Sufficient and extensive surface surveys of the ground were conducted for the farms which are covered by the EPL. Among others, the site surveys comprised the pre-planned foot investigation along the targeted areas for the proposed mineral exploration. Photographs were taken with a Digital Camera - Nikon DX D3200 and a representative selection of photography images are included in this report. Also, a professional *Dji Drone* was used to investigate difficult and inaccessible terrains. Geographic coordinates were obtained using a handheld Garmin global positioning unit (*Garmin GPSmap 60CSx*). ***Table 6*** below highlights the situation during the field survey on the proposed development area.

7. Detailed Assessment

Table 6: Site Investigation Details

General Site Investigation	
Date of a visit	The site visit was undertaken on the 01th of September 2025 & 07 of October 2025 by the TARO Archaeological & Heritage Consultants personnel. Since the area of interest is completely situated at the foothills of the mountain, and rugged terrains, accessibility was limited to footpaths, especially to the areas which were physically possible to access, and driven only to the already established tracks (figure 4).
Season/Weather conditions and site visibility	Mild and pleasant weather
Details of equipment used in the survey (GPS)	All readings and site positions were determined in the field by hand-held Garmin *etrex 32x GPS* and *GPSmap 60CSx* (Accuracy levels is ± 3 meters). The Global Positioning System receiver was set to the hddd^{0}mm’ss.s”. Real-time aerial orientation, by means of a mobile QField application, was also employed to navigate and survey the areas.
Details of equipment used in the survey (Camera)	Photographs were taken using a Digital Camera - Nikon DX D3200.

Figure 3: The views of the Mining Claim areas

8. Site Significance Rating

The presence and distribution of archaeological, historical, cultural or heritage resources define a ‘heritage or cultural landscape’ of an area. In this particular landscape, every site is relevant, and because heritage resources are non-renewable, heritage surveys are needed to investigate the proposed project area or a representative sample, depending on the nature of the project. In all the initial investigations and surface surveys, however, the undersigned TARO Archaeological & Heritage Consultants (TARO AHC) is responsible only for the identification of resources visible on the surface. The grading and level of significance of the identified heritage resources in the area of interest are given in the following pages in *Table 16*.

Table 7: Grading of Heritage Significance and Field Rating

Level of significance	Grading	Description
Exceptional/upper higher	5	• Major national heritage resources • A rare and outstanding example • Containing unique evidence of the high regional and national significance
Considerably high	4	• Very important to the heritage of the region • A high degree of integrity/ authenticity • Multi-component site and objects • High research potential
Moderate	3	• Contributes to the heritage of the locality and region • Have some altered or modified elements, not necessarily detracting from the overall significance of the place • Forming part of an identifiable local distribution or group • Research potential
Low	2	• Isolated minor finds in undisturbed primary context, with diagnostic materials • Makes some contribution to the heritage of the locality, usually in combination with similar places or objects
Little	1	• Makes a little contribution to the heritage resources of the locality • Heritage resources in a disturbed or secondary context, without diagnostic or associated heritage
Zero/ no significance	0	• Absence of heritage resources • Highly disturbed or secondary context, without diagnostic or associated heritage

8.1. Impact Assessment Methodology as developed by QRS Namibia

This Archaeological and Heritage Impact Assessment followed a two-based process of assessment; desktop and field-based assessments. The methodologies were adopted in line with the standards for environmental assessment and the protocol developed for archaeological heritage assessment in Namibia that reflect

Namibian conditions and are accepted as a basis of evaluation by the National Heritage Council. To establish the heritage significance of the resources, and their vulnerability to possible disturbance in the course of development activities, the assessment criteria below developed by QRS (Kinahan, 2012) established parallel 0-5 scales, as summarized in (***Tables 8-10***) below.

Table 8: Archaeological Significance and Vulnerability Rankings (Kinahan, 2012)

Scale	Significance Ranking	Scale	Vulnerability Ranking
0	no significance	0	Not vulnerable
1	Disturbed or secondary context, without diagnostic material	1	No threat posed by current or proposed development activities
2	Isolated minor finds in undisturbed primary context, with diagnostic material	2	low or indirect threat from possible consequences of development (e.g. soil erosion)
3	Archaeological site (s) forming part of an identifiable local distribution or group	3	Probable threat from inadvertent disturbance due to the proximity of development
4	Multi-component site (s), or central site (s) with high research potential	4	High likelihood of partial disturbance or destruction due to the proximity of development
5	Major archaeological site (s) containing unique evidence of the high regional significance	5	The direct and certain threat of major disturbance or destruction

Table 9: Assessment criteria for the evaluation of cumulative impacts on archaeological sites devised by the QRN.

Criteria	Category	Description
The extent or spatial influence of impact	National Regional Local	Within Namibia Within the Region On-site or within 200 m of the impact site impact
The magnitude of impact (at the indicated spatial scale)	High Medium Low Very Low Zero	Social and/or natural functions and/ or processes are severely altered Social and/or natural functions and/ or processes are notably altered Social and/or natural functions and/ or processes are slightly altered Social and/or natural functions and/ or processes are negligibly altered

Criteria	Category	Description
		Social and/or natural functions and/ or processes remain unaltered
Duration of impact	Short Term Medium Term Long Term	Up to 3 years 4 to 10 years after construction More than 10 years after construction

Table 10: Reversibility Rating Criteria

Reversibility Ratings	Criteria
Irreversible	The activity will lead to an impact that is permanent.
Reversible	The impact is reversible, within a period of 10 years

8.2. Results of Public Consultation and Stakeholder Engagement

The Public Consultation meeting took place on 11th of September 2025 at Otjimuhaka Primary School at Otjimuhaka Village. The surveys took place on 1st of September 2025 and 10th of October 2025.

9. Literature Survey/ Background Study

A survey of available literature was carried out to assess the archaeological and heritage contexts into which the proposed project would be set (*Table 11*). The study focused on an in-depth review of all the published and unpublished literature relevant to the history of the Kunene Region and nearby villages. Maps of the area were used to identify the geologic, topographic, archaeological, landscape and elevation of the proposed project area.

Table 11: Some of the reports consulted for Archaeological and Heritage sites

Author	Year	Project	Findings
Albrecht et al	2001	A Late Holocene in Northwestern Namibia	Evidence of occupation and animal domestication 3000-2000 BP
Kinahan, J.	1991	The Early and Middle Holocene in the Namib	Recorded sites of ESA and MSA periods
MacCalman	1972	late Pleistocene	Evidence of late Pleistocene evidence from Kunene Region
MacCalman and Grobbelaar	1965	late Pleistocene evidence from the area sequence in Namibia	Observations on stone tool use by contemporary hunter-gatherer groups

Wadley	1993	The Early and Middle Holocene in the Namib	Recorded sites of ESA and MSA periods

9.1. Description of the Study Area

9.1.1. Topography and Landscape of the Project Area

Topographically, the mining claims area is surrounded by mountains, with elevations ranging from 547 and 951 meters above sea level (masl). The Site landscape Karstveld, which according to Mendelson *et al* (2002) extends as a narrow, raised margin that encircles the lower-lying Owambo Basin in central northern Namibia.

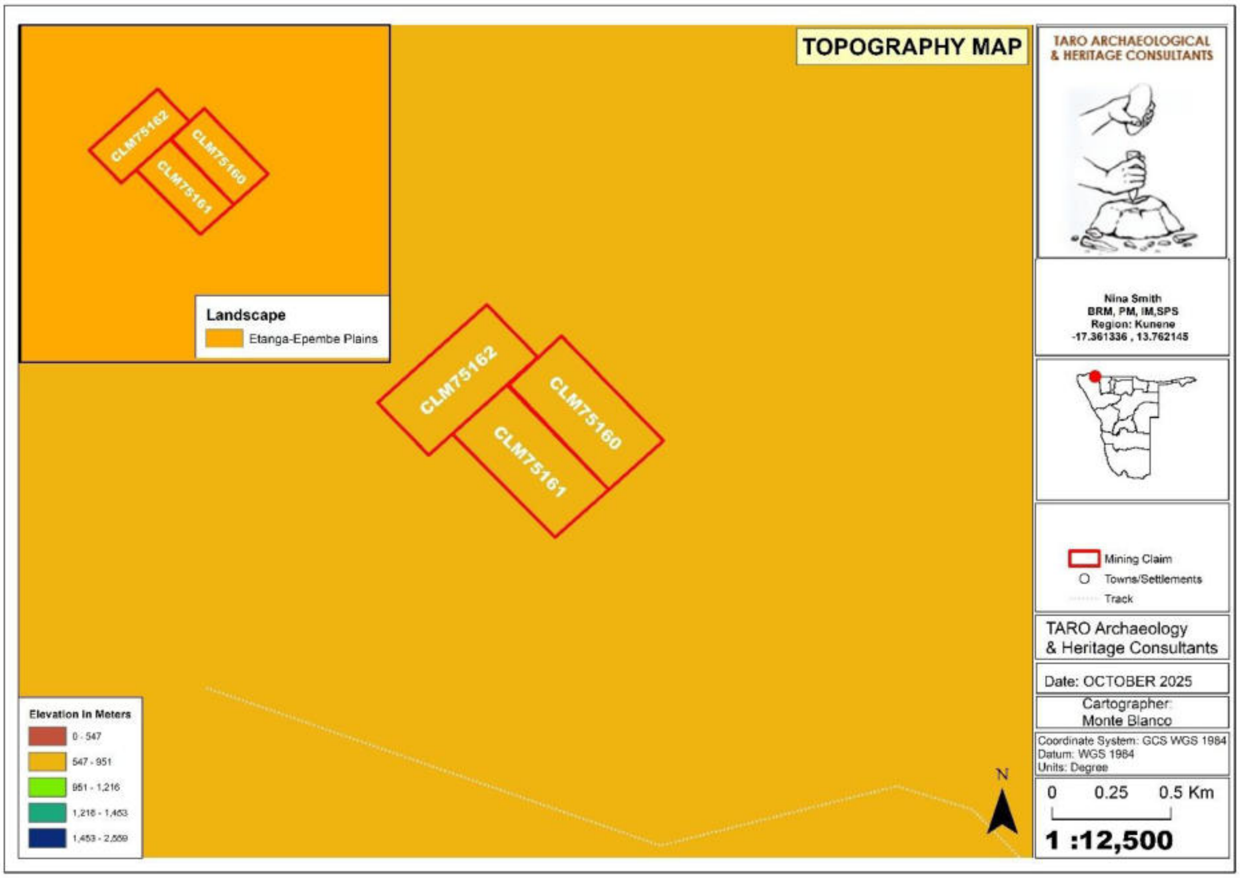

Figure 4: Topographic map of the area of interest.

9.1.2. Geology of the Project Area

The mining claims are underlain by anorthosite rocks and associated mafic intrusions of the Kunene Intrusive Complex which is 1.3 billion years old and which comprises of rocks that intruded the intensely metamorphosed and deformed rocks of the Epupa Metamorphic Complex, with rock ages of up to 1810 million years.

The proposed activity focuses on the specific resources of iron ore and rare earth mineralisation and mining will take place within the boundaries of known mineralisation within the Mining Claims 75160, 75161 & 75162.

Narrow, dykes and veins, up to 1 metre wide and with lengths of up to approximately 200m constitute zones of rare earth mineralisation. Both these types of mineralisation, iron and rare earth, belong to the class of base and rare metals (figure 5).

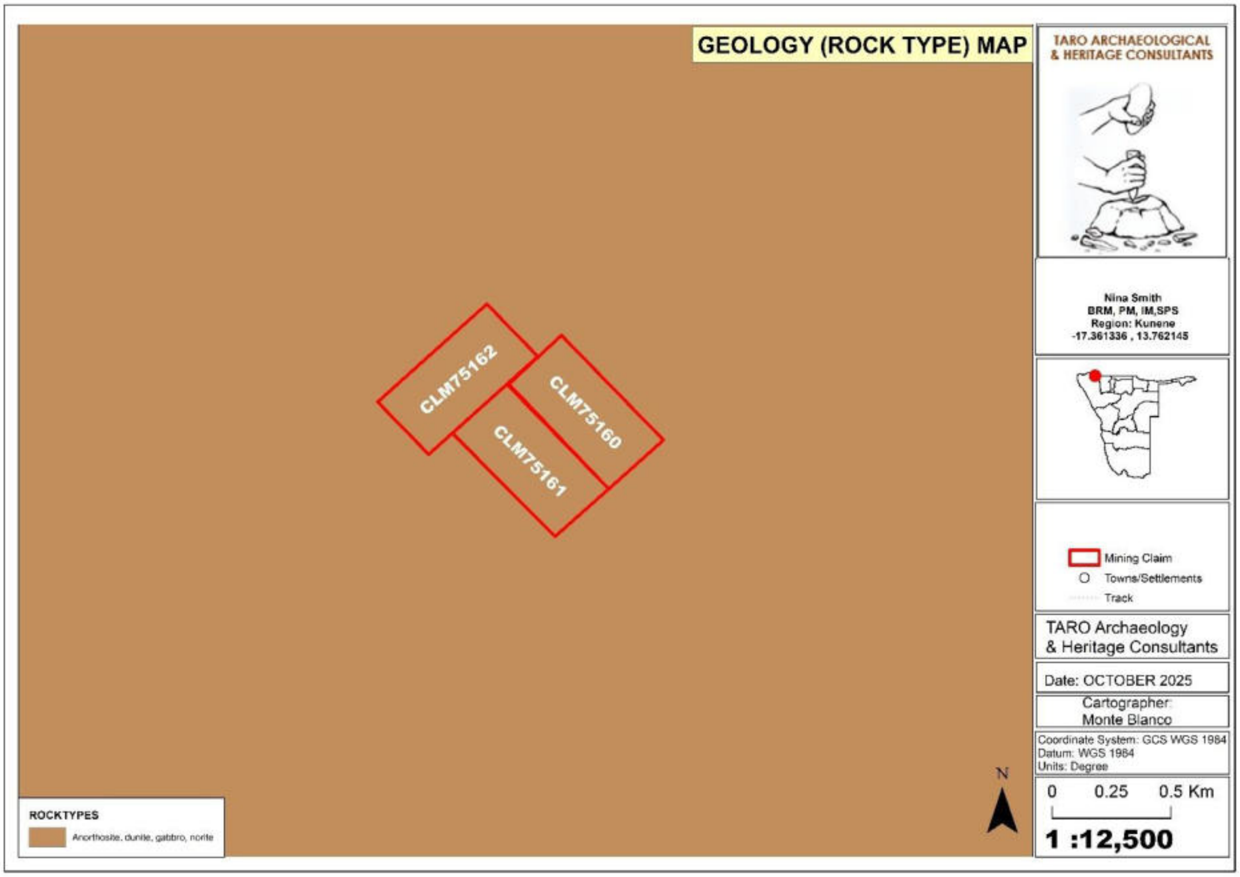

Figure 5: A Geological map of the proposed project site.

10. Background and general Heritage Context of the area

10.1. Regional Archaeological and Heritage Context

The available archaeological records indicate that evidence of early humans in Namibia dates back from the Early Stone Age period, more than one million years ago as evidenced by hominin fossil records (Kinahan, 2017). The geospatial data on the distribution of archaeological sites show that sites are concentrated mainly in the central highlands, escarpment, and the Namib Desert. In summary, researchers over the past several decades have reported an abundance of archaeological data from Namib and the surrounding region. As a result, there is a reasonably good understanding of Namib's long and complex cultural history. The early and middle Holocene prehistory of the Namib is better developed relative to earlier periods and a larger number of sites have been excavated and dated (e.g. Kinahan 1991, Wadley 1993).

These investigations can only be described as preliminary, but they have indicated something of the area's archaeological potential, particularly with respect to the history of the OvaHimba, the last remaining traditional pastoralist society in southern Africa. The interest in the OvaHimba archaeology lies partly in the history of the people themselves, and partly in the comparative value of such archaeological evidence for the understanding of pre-colonial pastoralist societies in other parts of Africa (Mason, 1984). Some evidence from this part of Kunene Region for human occupation over at least the last one million years. The earliest evidence, dating from the mid-Pleistocene, is primarily in the form of crude stone implements found as surface scatters in the vicinity of major drainage lines. Later Pleistocene remains include well-fashioned bifacial stone hand-axes which in the last 200 000 years were superseded by a complex toolkit of smaller artefacts that could be attached to wooden spear shafts and scraper tool handles, using vegetable resin.

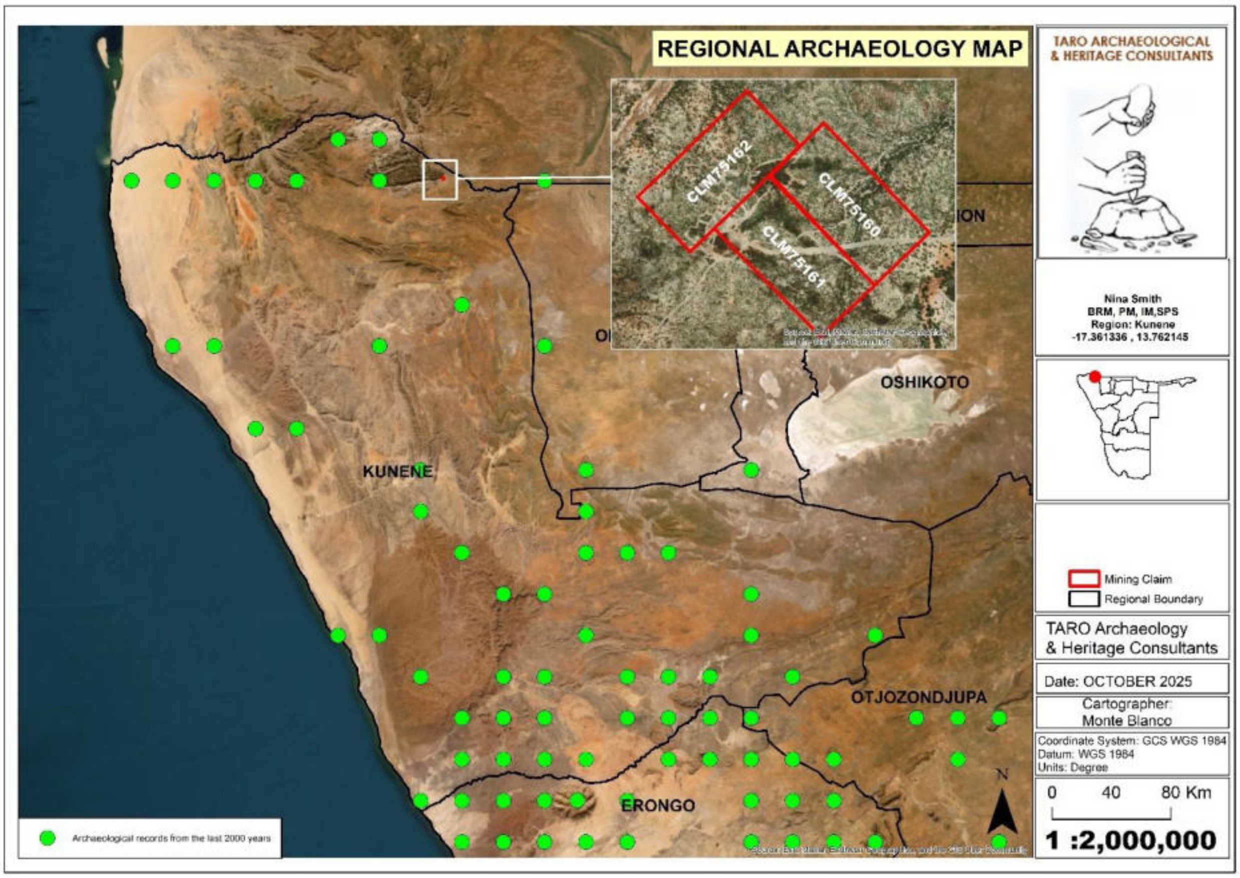

Figure 6: A Regional map of archaeological distribution in the Kunene Region

10.2. The Archaeology of the Subject land

The landscape of the subject land is of archaeological concerns in some areas, research and records from previous works showed that evidence of occupation and practice of pastoralism was carried out about 3000 years ago. A study conducted by Albrecht *et al* 2001, revealed that several LSA phases could be distinguished and the appearance of pottery and remains of domesticated animals were common by at least 2000 BP. Oruwanje 95/1 rock shelter is one of the significant archaeological sites in the area, and this site is located about 10km west of Kaoko-Otavi village.

From other research works, available evidence shows that so far, the Kunene Region will have abundant traces of Pleistocene occupation but that much of this evidence will have been displaced by sheet erosion on high-angle slopes. Holocene-age material is also present in the region, including some examples of rock art in the form of engravings on outcrops near the Epupa Falls (Sherz, 1975) and in the adjacent parts of southern Angola (Kinahan, 1997). Previous archaeological surveys in the Kunene Region have shown a correlation between archaeological site location and landscape.

Early investigations by MacCalman (1972) and MacCalman and Grobbelaar (1965), drew attention to the presence of late Pleistocene evidence from the area, and more spectacularly, observations on stone tool use by contemporary hunter-gatherer groups. More recent investigations have documented a late Holocene occupation sequence (Albrecht et al, 2001) and some of the detailed archaeological characteristics of nomadic pastoral settlement patterns in the area (Kinahan, 2001).

10.3. Brief Ethnographic background of the Subject Land

As it is known, majority of the ethnic group around the landscape of which the proposed project is located are the Himba or OvaHimba, like many others the OvaHimba are part of the wide spread Bantu group living in the so-called Kaokoveld, in the north-western part of Namibia and across the Kunene River in Angola. They speak Otjhimba, a dialect of Otjiherero, which is a Bantu language. Around 20,000 Ovahimba are currently living in the Kaokoveld. There pastoral lifestyle was and is still semi-nomadic. The Himba emerged as a distinct ethnic group toward the end of the last century. According to the oral traditions (Bollig 1997).

The Ovahimba are the original traditional Herero who crossed the Kunene and came from Angola to Namibia in the middle of the 16th century. They settled in the Kaokoveld, the north-western part of Namibia and lived a semi-nomadic, pastoral lifestyle. The early history of the Herero was fraught with severe droughts and other disasters. Large groups of the Herero people left the Kaokoveld and looked for better grazing grounds for their herds in the south-east. The remaining Herero in the Kaokoveld came under attack from the Swartbooi and Topnaar Nama in the 19th century. The Nama entered the Kaokoveld from the south, also looking for better grazing grounds. In 1850 the Nama established a base in Sesfontein from where they organized raids against the Herero of the Kaokoveld. Due to the fact that the Herero were widely scattered and the Nama had much better weapons, large cattle herds were raided from the Herero in the next 20 years[1].

As the situation deteriorated and the loss of their material and social wealth increase the Herero of the Kaokoveld fled over the Kunene River into Angola and took shelter with the Ngambwe, which granted support to the refugees. They called the Herero "Ovahimba", which means "beggar" in the language spoken

[1] *https://www.lcfn.info/ovahimba/information/ethnology*

by the Ngambwe. Over the years the Herero took over this name still use it until today. Most of the Ovahimba followed a popular warrior named Vito back to Namibia in 1920. Ever since and up to the Namibian independence in 1990 the Himba were able to live their traditional lifestyle. During the recent years the Ovahimba have been more exposed to the influences of the modern world, although this mainly refers to the consumption of unhealthy foods, cool drinks and alcohol. The positive achievements of modern society like a proper health system, modern schools, pension funds etc. did not yet reach the majority of Ovahimba[1].

According to the National Heritage Council of Namibia, Kunene Region has about 7 known heritage sites which are listed as national monuments (Declared Sites/Lists of National Heritage). The table below (Table 12) shows the declared heritage sites in Kunene Region in Namibia. However, these declared heritage sites are occurring far from the proposed project.

Table 12: Declared Heritage Sites in Kunene Region

Designation	Description	Built/Construction Period	Location	Monument number
Rock Engravings at Peet Alberts Koppie	Rock engravings		Kamanjab Karte	036/1967
Naulila-Denkmal	Monument	1933	Outjo Karte	052/1971
Stone Tower	Wasserturm	1900	Outjo Karte	027/1975
Dorsland Tractor Cottage	Historic building	1878		009/1951
Petrified Forest	Petrified Wood	250 million years	Khorixas	004/1950
Twyfelfontein	Cave, rock carvings	about 4000 BC	Khorixas	016/1952
Burnt Mountain	Rock Formation	80 million years	Khorixas	024/1956

10.4. The General Archaeo-Historical Context of Southern Africa.

For the sake of understanding the archaeology of Southern Africa, Namibia included and to enable the reader to understand archaeological objects, features and sites that could be unearthed and disturbed during development, it is necessary to give a background regarding the different phases of human history. It is however important to note that periods and dates are relative and only provide a broad framework for interpretation. The Southern African archaeological environment is divided into the Stone Age, the Iron Age/Farmer Period and the Historical Period. Table 13 below summarizes different periods of the chronological sequence of periods, cultural groups, technological advancement and cognitive evolution.

Table 13: The Archaeological Context: Sequence, Period and Definitions across Southern Africa

Period	Epoch	Associated Cultural Group	Typical Material Expressions
Early Stone Age 2.5m – 300000/250 000 kya	Pleistocene	Early Hominins: *Australopithecines* *Homo habilis* *Homo erectus*	Typically, large stone tools such as hand axes, choppers and cleavers
Middle Stone Age 250 000/200000 – 25 000 kya	Pleistocene	First *Homo sapiens* species	Typically, smaller stone tools such as scrapers, blades and points.
Late Stone Age 20 000 BC – present	Pleistocene / Holocene	*Homo sapiens sapiens* including San people	Typically, small to minute stone tools such as arrowheads, points and bladelets.
Early Iron Age: Early Farmer Period 300 – 900 AD	Holocene	First Bantu-speaking groups	Typically, distinct ceramics, bead ware, iron objects, grinding stones.
Middle Iron Age: Early Later Farmer Period 900 – 1350 AD	Holocene	Bantu-speaking groups, ancestors of present-day groups	Typically, distinct ceramics, bead ware and iron/gold / copper objects, trade goods and grinding stones.
Late Iron Age: Later Farmer Period 1400 AD to1850 AD	Holocene	Various Bantu-speaking	Distinct ceramics, grinding stones, iron objects, trade objects, remains of iron smelting activities including iron smelting furnace, iron slag and residue as well as iron ore.
Historical/Colonial Period ±1850 AD to present	Holocene	Various Bantu-speaking groups as well as European farmers, settlers and explorers	Remains of historical structures e.g. homesteads, missionary schools etc. as well as, glass, porcelain, metal and ceramics.

Source: Exigo Sustainability 2021.

10.5.Archaeological Sequence in Namibia

To put Namibian heritage and archaeological contexts into perspective, the following information is crucial to the general understanding of the occurrence and the associated period in different time-frames that would represent the known human occupation sequence in Namibia and Southern Africa in general. This helps in building knowledge about past adaptations and cultural dynamics. According to Nankela (2017), the archaeological sequences of Namibia can be summarized as follow (*Table 14*).

Table 14: Archaeological Sequences in Namibia

Period	Year	Area/Location	Evidence	Description
Pleistocene	400 000 - 100 000	Namib Plains, Namib Desert & Lower Kuiseb	Bone fragments of extinct elephants and stone tools	
Holocene	10 000 - 1 000	Around Namibia	Scattered artefacts, rock art sites, potsherds, beads, grave cairns, hut circles, human remains, axes, pointed flakes, cleavers and blades.	Sites are fragile, inaccessible and due to inadequate archaeological investigations in some sites.
Historic Period	500	Around Namibia	Cemeteries, old mine workings, waste rock walling, architectural heritage and WWI military engagements.	Namibia has an indication of intensive settlements between indigenous people and Europeans.

11. Physical and Environmental Context of the Area (Physiography)

The proposed project site is located in the southwest direction of Opuwo. Generally, the area is situated in the rugged Kunene Hills landscape (cf. Mendelsohn *et al.* 2002), the vegetation types of the subject land comprise shrub trees such as *Colophospermum mopane* (Mopane tree), *Commiphora specie*, Prosopis specie, *Vachellia reficiens and mellifera*, *Terminalia prunioide*, *Catophractes Alexandri* (Trumpet Thorn) and other tree species

Figure 7: *Vegetation types* within the landscape.

Topographically and environmental settings of the proposed development footprints: characterized by areas of prominent outcrops, hills, weathered outcrops, ephemeral rivers, Rocky Mountains and general a rugged landscape (*Figure 8*).

Figure 8: Landscape views of the Subject land

12. Assessment of the Findings within the Proposed Project

12.1. On-site findings

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Namibia's unique and non-renewable archaeological and palaeontological heritage sites are protected in terms of the National Heritage Act No. 27 of 2004 and may not be disturbed at all without a permit from the relevant heritage authority such as National Heritage Council.

12.2. Observation made during the Site Survey of the Subject land

The mining claim No. 75160, 75161 & 75162 is located at the northern border of Namibia, near Otjimuhaka (previously Swartbooisdrif) in the Kunene Region. The claims are slight situated on top but more like on the slope edges of the hill toward the Ondoto River. The features observed and recorded are the weathered outcrops and surface scatter, the surface is rocky and hence there was no visible graves around the claim, to a great extent, nothing of archaeological or cultural significance recorded within the boundaries of this particular mining claim. The archaeological and cultural significance in this claim is of ***Very Low.***

Figure 9: Aerial view of the subject land

Figure 10: Observation of the kraal from above

Table 15: Cultural Heritage Resources within the Landscape

Heritage resource type	Observation and recording made
Landscapes and Natural Features	Mountains and hills, also a tributary of the ephemeral Ondoto River flows for about 500m through the claims.
Holy Places	None were recorded
Historical Mine	None
Rock shelters and Caves	None were recorded within the proposed project
Archaeological sites	None were recorded within the proposed project
Graves and burial places	A single grave was recorded within Ondoto West which is far from the mining license area. This grave is for the late Chief Mandjavara who died in 2022. Outside the mining claim *refer to figure 17*.
Historical settlements and Buildings	None were recorded within the proposed project
Places associated with oral traditions or living heritage	None
Public monuments and memorials	None
Movable objects	Scattered stone artefacts

12.3.Sensitivity of the Receiving Environs

The proposed project is situated on the plateau of the mountain ranges from steep slopes, to undulating terrain and mountainous landscape. Specifically, the Mining Claims 75160, 75161 & 75162 lie approximately 130 km northwest from Opuwo and is located about 3.5 km south of the Namibian-Angolan border, which is marked by the river Kunene, and 6 km south-west of the settlement Otjimuhaka (previously Swartbooisdrif). The mining area is situated on the foothills of the NE-striking ridges of the Zebra Mountains in the north-west. A tributary of the ephemeral Ondoto River flows for about 500m through the claims. Archaeologically, there was nothing sensitive recorded within, only features that were in abundance in most of the surveyed areas, are the weathered outcrops, loose boulders and surface scatter here and there. Generally, all the findings within the mining claim are of ***Very LOW sensitivity***.

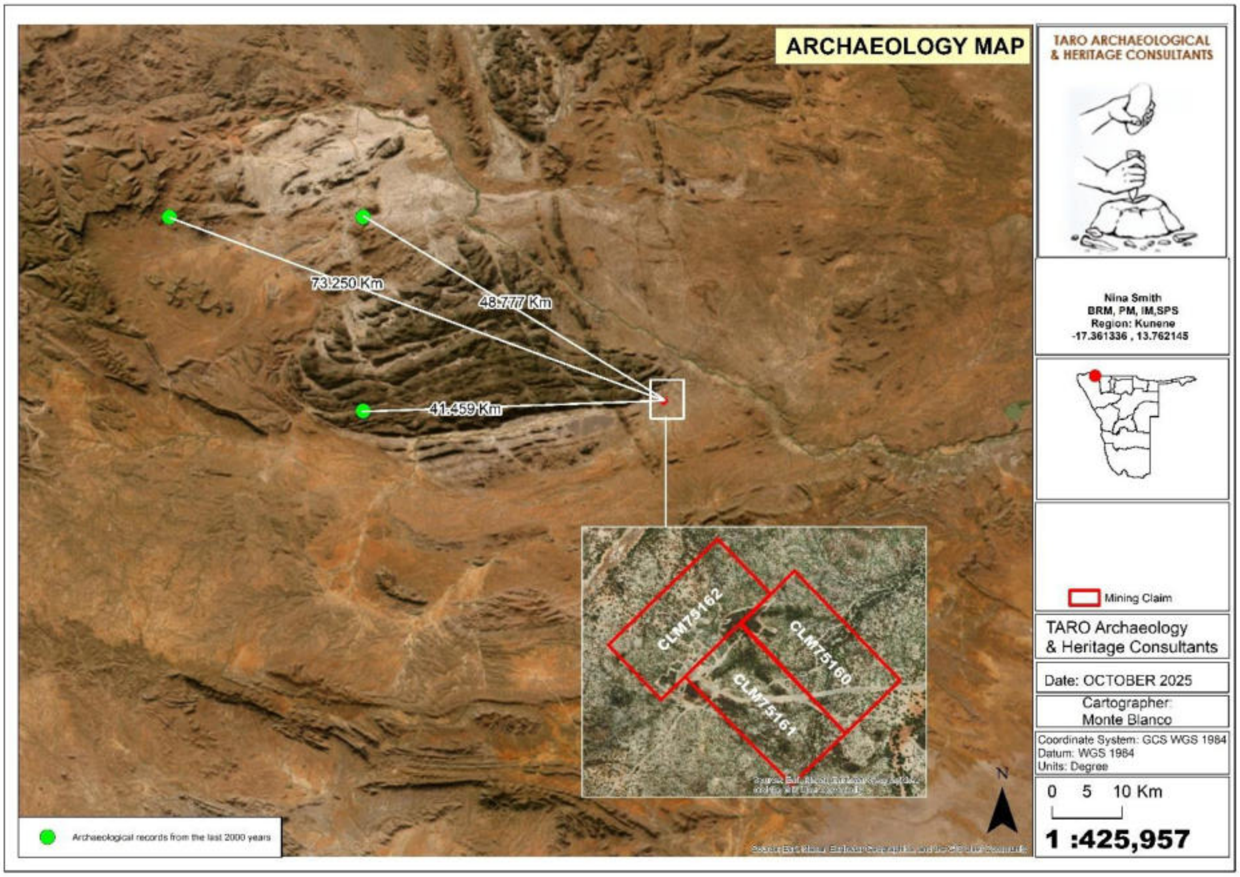

Figure 11: Landscape Archaeological Map

12.4. Photographic Documentation of the recorded features within the traversed areas.

All sites, objects and features that are were identified during the surface walk over are documented according to the general standards accepted by the NHC Guidelines 2021 and Archaeological Profession. Coordinates of individual localities are determined by means of the Global Positioning System (GPS) and plotted on a map. This information is usually added to the description in order to facilitate the identification and grading of each locality.

12.5. Tracklog Surveys of the selected tracking of the survey was conducted by using the QField program.

Tracklogs are useful in archaeological surveys because they provide a detailed record of the paths traversed during fieldwork (**Error! Reference source not found.**), allowing for accurate spatial documentation and a nalysis of archaeological sites. The QField program was used to track the paths taken, as seen below. This helps in mapping the distribution of artifacts, identifying potential areas of interest, and creating comprehensive site plans. The assessment of significance and grading of Archaeological and Heritage Resources on the Proposed Project are presented in **Error! Reference source not found.**.

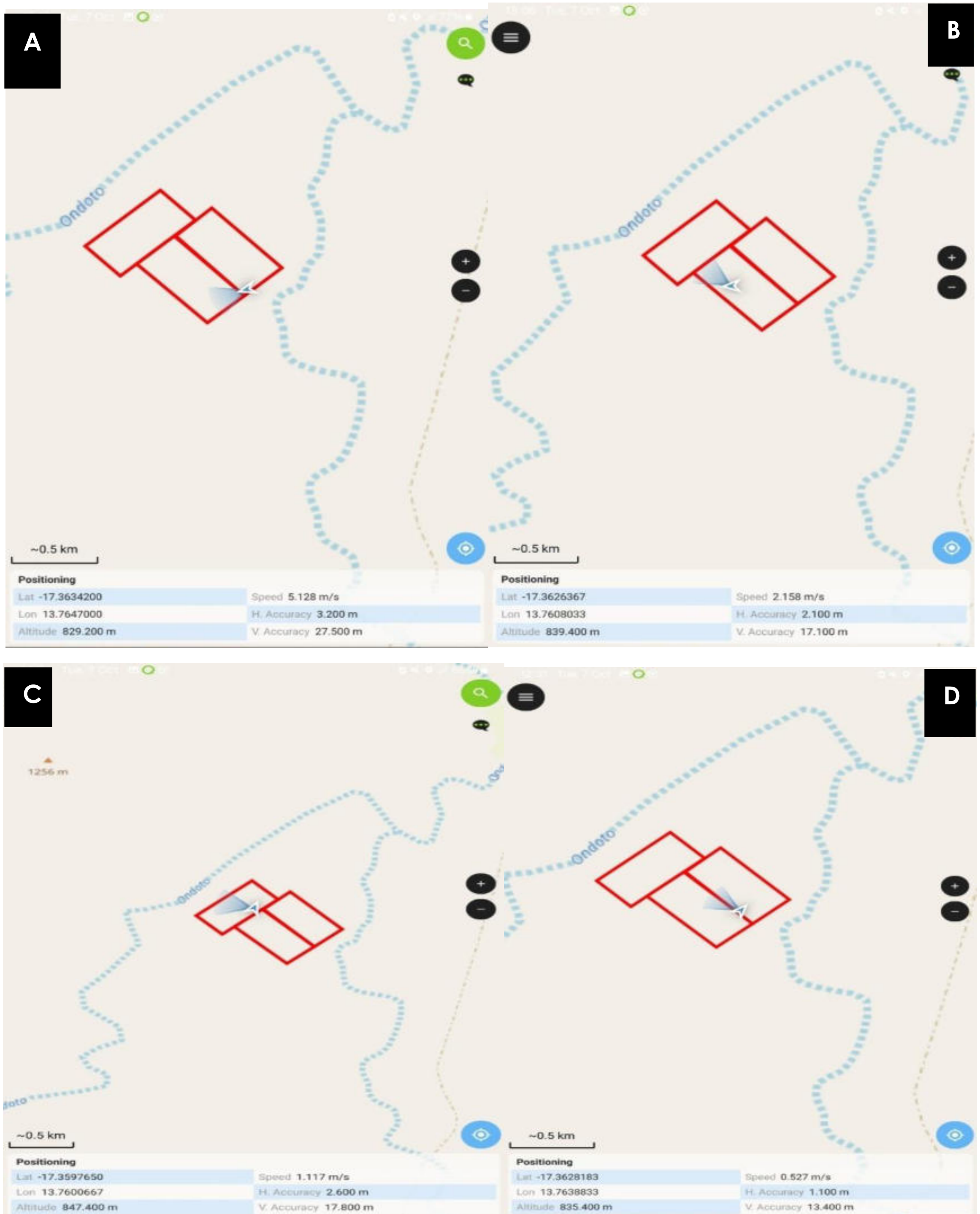

Figure 12: Tracklogs of the surveyed areas within the mining claims

Mining Claims No. 75160, 75161 & 75162: These mining claims cover an area of approximately 53.48 hectares, with the primary targeted commodity being Rare Earth Elements (REE), along with other associated mineral ores. From an archaeological and cultural heritage perspective, the overall significance of these claims is assessed as **very low**

Centre Coordinates: S 17⁰ 21' 38"
E 13⁰ 45' 50"

Status of the mining claim: Low significance

Figure 13: Aerial observations for kraal and outcrops within the Mining Claims

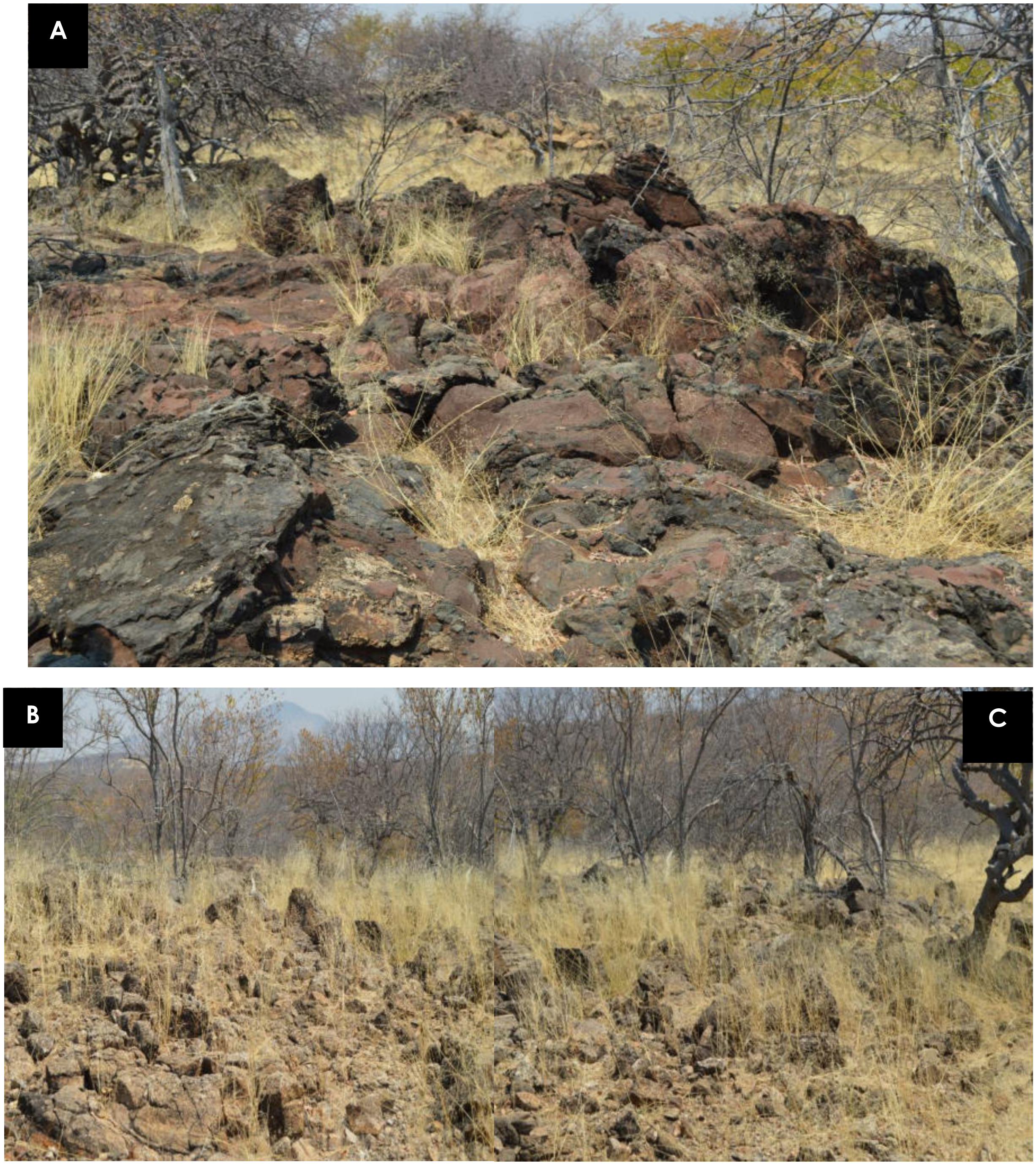

Figure 14: Weathered outcrops


A


B

Figure 15: Some of the weathered outcrops which contains rare earth minerals

Figure 16: Rock boulders as seen from above

Mining Claim No. 75161: General findings on this claim include loose rock boulders and weathered outcrops.

Centre Coordinates: S 17⁰ 21' 45"
E 13⁰ 45' 42"

Status of the mining claim: Low significance

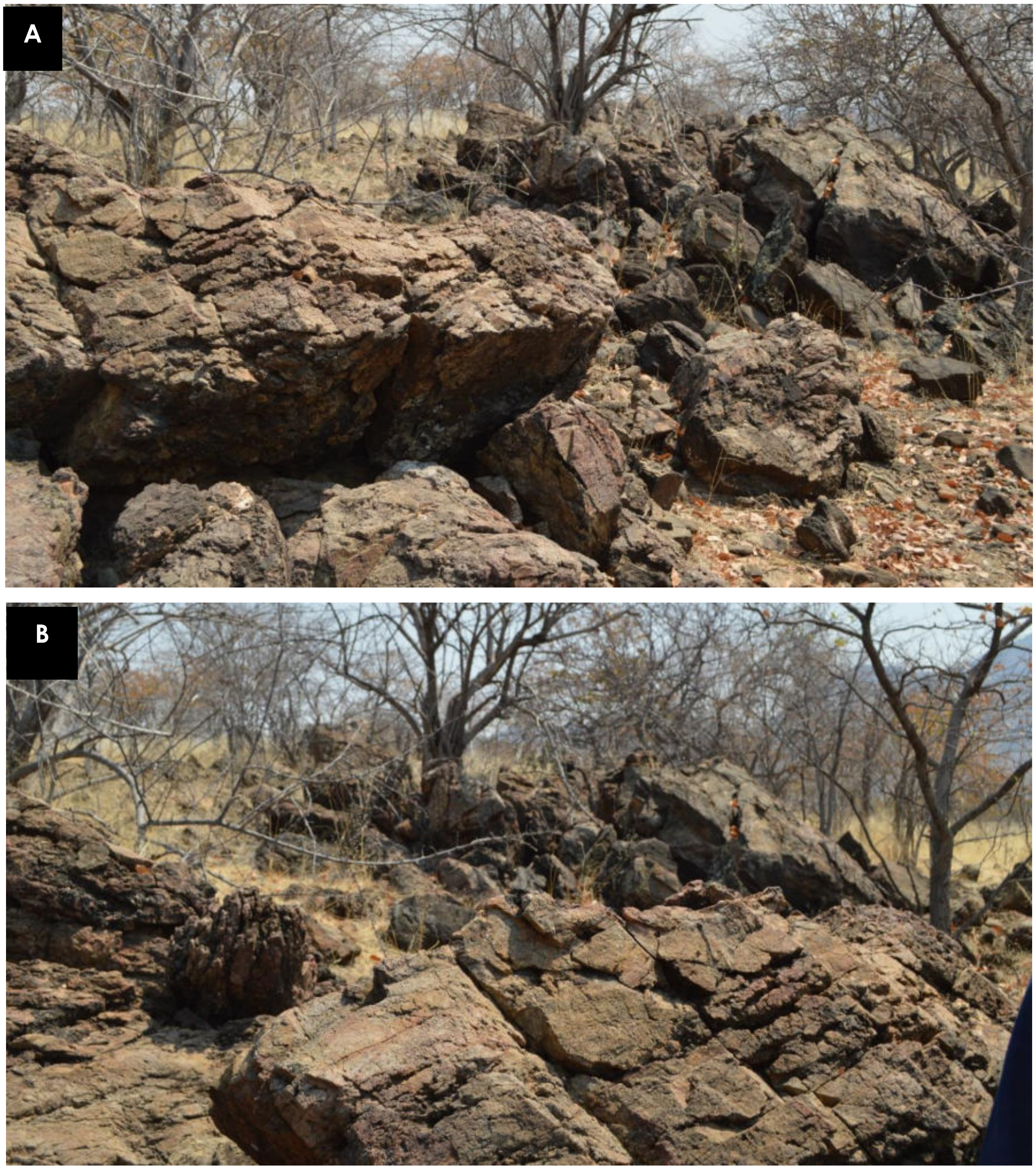

Figure 17: Outcrops

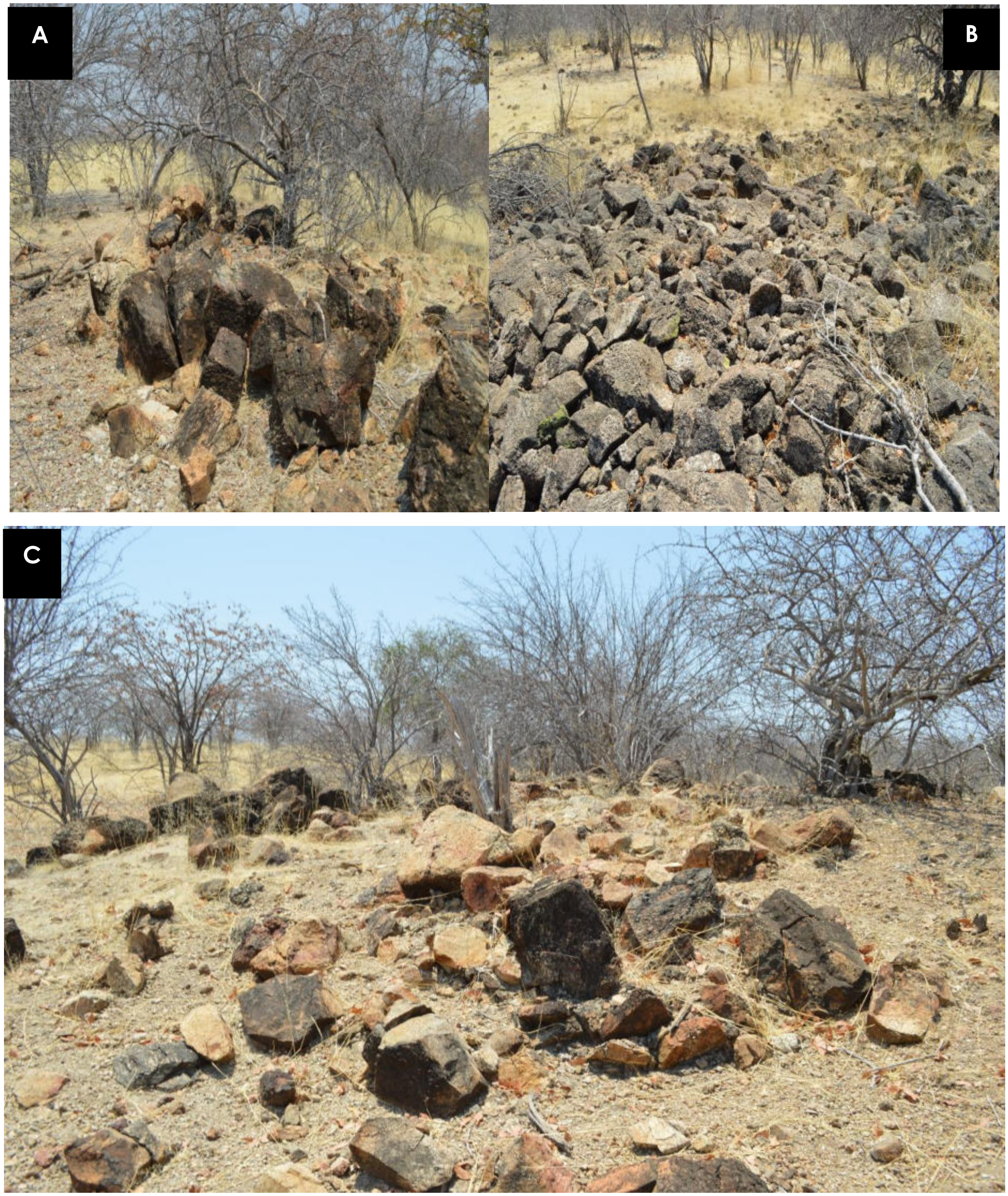

Figure 18: weathered outcrops/boulders

Figure 19: Stone tool

Mining Claim No. 75162: The findings from this particular claim are of limited significance. The dominant features observed and recorded include weathered outcrops, boulders, and surface scatter.

Centre Coordinates: S 17^{0} 21’ 34”
E 13^{0} 45’ 32”

Status of the mining claim: Very low significance

Figure 20: (A) Outcrops & (B) trenched area/site

Figure 21: Borehole site

Figure 22: Outcrops

Figure 23: Borehole sites

Ondoto West Village

The only site of high cultural heritage significance was the single grave located at Ondoto West village; the late Chief Ngombe is buried not far from his homestead. However, the site is far from the mining claim and thus no any impact is expected.

Figure 24: The grave site of Chief Ngombe recorded at Ondoto West

Table 16: Assessment of Significance and Grading of Archaeological and Heritage Resources on the Proposed Project

Waypoint	Location	Elevation	Description of the findings	Heritage Significance	Grading	Vulnerability Description
Mining Claim No. 75160						
TAHC 354	S 17^0 21' 48.9" E 13^0 45' 52.9"	819 m	Disturbed areas/sample taken around this waypoint.	Low	2	3
TAHC 355	S 17^0 21' 51.5" E 13^0 45' 51.5"	820 m	Weathered outcrops/targeted site	Little	1	3
TAHC 356	S 17^0 21' 52.1" E 13^0 45' 51.7"	823 m	Weathered rock outcrop/targeted site.	Little	1	3
TAHC 357	S 17^0 21' 53.1" E 13^0 45' 52.3"	819 m	Weathered rock outcrop/targeted site (Presence of Rare Earth materials).	Little	1	3
TAHC 358	S 17^0 21' 54.3" E 13^0 45' 52.9"	825 m	Rare Earth elements (weathered outcrops), expected a targeted site.	Little	1	3
TAHC 359	S 17^0 21' 52.3" E 13^0 45' 52.0"	820 m	Outcrops (Rare Earth elements)/targeted site.	Little	1	3
TAHC 360	S 17^0 21' 46.3" E 13^0 45' 38.6"	822 m	Outcrops (Rare Earth elements)/targeted site.	Little	1	3
TAHC 429	S 17^0 21' 49.3" E 13^0 45' 56.9"	818 m	Drilled site (Borehole)	Little	1	3
TAHC 430	S 17^0 21' 50.0" E 13^0 45' 56.7"	820 m	Weathered outcrops	Little	1	3
TAHC 431	S 17^0 21' 48.8" E 13^0 45' 52.9"	823 m	Disturbed area	Little	1	3
TAHC 432	S 17^0 21' 49.1" E 13^0 45' 52.4"	823 m	Middle point/a border between MC 75060 and 75061	n/a	n/a	n/a
TAHC 433	S 17^0 21' 45.9" E 13^0 45' 50.0"	816 m	Outcrops/weathered materials	Little	1	3
Mining Claim No. 75161						
TAHC 434	S 17^0 21' 47.4" E 13^0 45' 48.6"	817 m	River stream/channel	n/a	n/a	n/a
TAHC 435	S 17^0 21' 50.2" E 13^0 45' 48.1"	816 m	Outcrops/weathered materials			

TAHC 436	S 17^{0} 21' 49.5" E 13^{0} 45' 49.8"	824 m	Outcrops/weathered materials	Little	1	3
TAHC 437	S 17^{0} 21' 50.9" E 13^{0} 45' 50.3"	820 m	Outcrops/weathered materials	Little	1	3
TAHC 433	S 17^{0} 21' 51.6" E 13^{0} 45' 51.2"	828 m	Outcrops/weathered materials	Little	1	3
TAHC 433	S 17^{0} 21' 46.8" E 13^{0} 45' 39.0"	833 m	Outcrops/weathered materials	Little	1	3
Mining Claim No. 75162						
TAHC 440	S 17^{0} 21' 41.1" E 13^{0} 45' 31.1"	828 m	Corner point/peg of this claim	n/a	n/a	n/a
TAHC 441	S 17^{0} 21' 43.7" E 13^{0} 45' 31.5"	842 m	Outcrops	Little	1	3
TAHC 442	S 17^{0} 21' 40.5" E 13^{0} 45' 30.0"	836 m	Outcrops	Little	1	3
TAHC 443	S 17^{0} 21' 40.1" E 13^{0} 45' 32.1"	839 m	Drilled site/Borehole	n/a	n/a	n/a
TAHC 444	S 17^{0} 21' 37.5" E 13^{0} 45' 35.3"	834 m	A dug hole, probably for borehole	n/a	n/a	n/a
TAHC 445	S 17^{0} 21' 36.9" E 13^{0} 45' 36.7"	838 m	Dense presence of outcrops in a single area	Little	1	3
TAHC 446	S 17^{0} 21' 33.0" E 13^{0} 45' 31.2"	836 m	Borehole	n/a	n/a	n/a
TAHC 447	S 17^{0} 21' 29.6" E 13^{0} 45' 26.5"	840 m	Borehole	n/a	n/a	n/a
Ondoto West						
TAHC 361	S 17^{0} 23' 00.5" E 13^{0} 44' 28.2"	846 m	A grave of Chief Mandjavara Ngombe. ***Outside the mining claim (figure 24).***	Considerably High	4	0

13. Identification of the Archaeological and Heritage Sensitivity Map

The aim of the topographic map below is to show (*if any*) sensitive sites are identified during the surface survey, rightfully so, one single grave was identified and recorded at Ondoto West, this grave is for the late Chief of the area, so this is categorized as a cultural heritage site, however the site is way outside the mining claims. Hence, no archaeological/cultural heritage impact is expected.

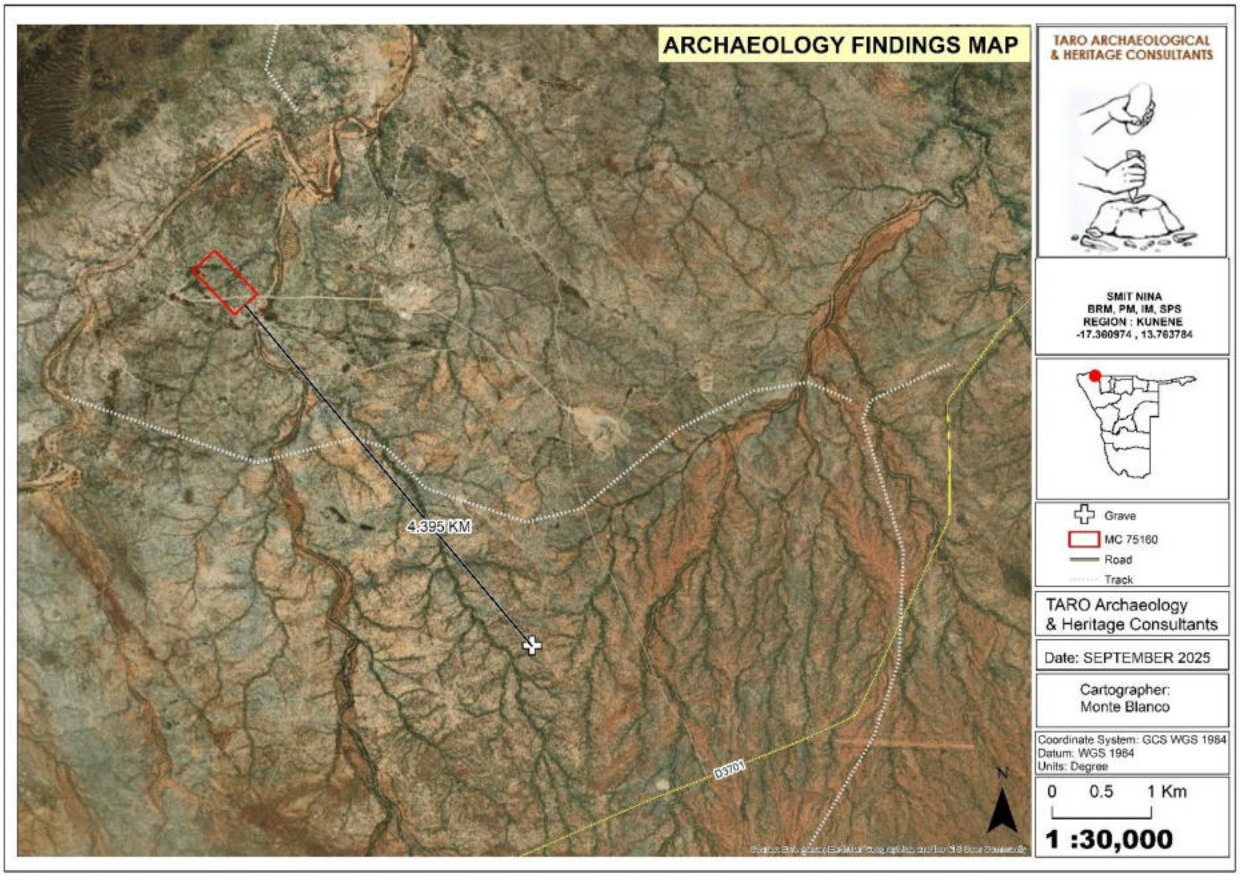

Figure 25: Archaeological finding map for Mining Claims No. 75160, 75161 & 75162

13.1.Sensitivity Analysis Summary Statement

The field survey conducted has revealed that the majority of the areas within the mining claims is actually of ***very low sensitivity***. The only recorded site of ***high sensitivity*** was the grave site of the late Chief Ngombe; this grave is located at Ondoto West village, which is about 4.3km SE from the mining claims (*see figure 25*).

Archaeologically, it is evident that majority of the areas within the claim is low/little sensitivity, and that the remainder of the study area, outside the claim boundaries is of low sensitivity except where the grave was recorded which is of ***high sensitivity***. However, this does not mean that no archaeological or heritage resources will be present in within the mining claim but the probability of resources of high cultural significance being found there is considered to be very low.

13.1. Identification and Description of the Potential Impact on Cultural Heritage Resources

13.1.1. Impact Assessment

Data collected during the site surveys on the archaeological and cultural heritage assessment revealed that the proposed project activities may have little to low negative, direct and indirect impacts during the mining of Rare Earth. The purpose of the assessment was to identify potential sites or areas of cultural heritage importance, consider potential impacts thereof and thereafter enhance the positive impacts and minimize. The potential impact of the proposed project on archaeological and cultural heritage resources is assessed as follows (Table 17).

Table 17: Impact Assessment/Impact Evaluation

Potential Impact	Impact Criteria		Significance Ranking (Without mitigation)	Potential Mitigation Measures	Significance Ranking (With mitigation)	Confidence Levels
Damage/destruction of archaeological sites or materials	Extent or Spatial of impact	Local	**Moderate/high**	Mining activities should be implemented on targeted sites only. - Minimise cut-and-fill and landscape scarring in general -Ensure less micro siting of loads to avoid the chance of impacts - Ensure effective rehabilitation of areas not needed during mining works. - Ensure proper micro-siting of mining equipment to avoid impacts -Demarcate and respect the No-Go-Zone of the identified sites. - Report any chance finds - Protect *in situ* materials	**Low**	**High**
	Duration of impact	Long-term				
	Probability (Threat)	Unlikely				
	Magnitude of impact	Low/little				
	Reversibility	Non-reversible				
	Can impacts be mitigated?	N/A				
Damage/destruction of graves and burial grounds	Extent or Spatial of impact	Local	**Moderate/high**	Mining activities should be	**Low**	**High**

	Duration of impact	Long-term		implemented on targeted sites only. - Graves and burial grounds should be avoided at all costs. - Minimise cut-and-fill and landscape scarring in general - Ensure effective rehabilitation of areas not needed during quarrying and mining works. - Ensure proper micro-siting of infrastructure and mining equipment to avoid impacts - Report any chance finds - Protect *in situ* materials		
	Probability (Threat)	Unlikely				
	Magnitude of impact	Zero				
	Reversibility	Non-reversible				
	Can impacts be mitigated?	Yes				
Damage to the rock shelters and caves	Extent or Spatial of impact	Local	**Moderate/high**	Mining activities should be implemented on targeted sites only. - Minimise cut-and-fill and landscape scarring in general - Ensure effective rehabilitation of areas not needed during mining works.	**Low**	**High**
	Duration of impact	Long-term				
	Probability (Threat)	Unlikely				
	Magnitude of impact	Low				
	Reversibility	Non-reversible				

	Can impacts be mitigated?	N/A		- Ensure proper micro-siting of infrastructure and mining equipment to avoid impacts - Avoid drilling or digging near rock shelters (*if any*). - Report any chance finds - Protect *in situ* materials		
Cumulative impacts	Archaeological sites are non-renewable and the impact on any archaeological context or material will be permanent and destructive.			• Ensure proper micro-siting and sitting of infrastructure and mining and quarrying equipment to avoid a proliferation of archaeological sites and materials.		
Residual impacts	With the implementation of mitigation measures mentioned herein, the significance level of the impacts identified will be reduced to either minor adverse/low or negligible.			• The undertaking of the mitigation measures outlined here before and during the proposed mining and quarrying activities of the aforementioned commodities will lead to *Minor* overall residual effects on archaeology. The recommended buffer zone of known archaeological sites in the vicinity of the application area to at least a distance of 50 m radius from the visual edge of the targeted site will ensure that these sites are preserved *in situ* and thus will not be impacted by the mining activities.		

14. Summary of the Impacts

Direct or indirect impacts or risks of impact on archaeological sites located near or in the vicinity of the proposed mining project can be reduced to acceptable levels by the adoption of appropriate recommended mitigation measures including integration of the archaeological heritage record and *Chance Finds procedure* in the project EMP (see *Appendix 1, & recommended mitigations*). Special efforts should be made to reduce and avoid impacts on any discovered site, artefacts or yet-to-be-discovered archaeological sites.

No significant archaeological or cultural heritage resources were noted within the project area (MC) and no adverse impact to heritage resources is expected especially within the boundaries of surveyed mining claim. Any additional effects to subsurface heritage resources can be successfully mitigated by implementing a *chance find procedure.* Mitigation measures as recommended in this report should be implemented during all phases of the project. Impacts of the project on heritage resources is expected to be low during mining activities (Table 18). The only visible grave noted during the surveys was the grave of the late Chief Ngombe (*refer to figure 24*), which is about 4.4km away from the proposed site, hence no any Impacts whatsoever is expected during the mining activities

Low Overall Impact: The conclusion that the overall impact on archaeological and cultural heritage is considered "low" is somewhat a good sign, but it does not absolve the project of responsibility and compliance. Environmental, Archaeological and Heritage Impact Assessments (EIA/AHIA) should always plan for the unexpected.

Table 18: Archaeological & Heritage consideration for Inclusion in the Project EMP

Expected Impacts	**Mitigation/management objectives & outcomes**	**Mitigation/management actions**	**Monitoring**		
			Methodology	Frequency	Responsibility
Impacts on archaeology and graves					
Damage or destruction of archaeological sites or graves (known or unknown)	Avoid any impacts, if not possible or locate and sample or rescue sites/burials before disturbance	Pre-construction survey, micro-siting of infrastructures & equipment	Appoint an archaeologist to conduct a survey well before construction	Once-off	Project Proponent
	Rescue information, artefacts or burials before extensive damage occurs	Reporting chance finds as early as possible, protect *in- situ* and stop work in the immediate area	Inform staff and carry out inspections of excavations	On-going basis Whenever on site (at least weekly)	Contractors ECO
Impacts on the cultural landscape					
Visible landscape scarring	Minimize landscape scarring	Ensure disturbance is kept to a minimum and does not exceed project requirements. Rehabilitate areas not needed during operation.	Monitoring of surface clearance relative to approved layout	Ongoing basis Whenever on site (at least weekly)	Construction Manager or Contractor ECO

15. Identification of Key Impacts

The key impacts of the proposed development on the archaeological and heritage resources will be the physical disturbance or destruction of sites or remaining within or close to the designated footprint of the proposed development and its associated surface works, and disruption of the landscape setting or physical context of the archaeological sites or remains. Such impacts will be both local, in the sense of the specific site, and at the landscape level where the proposed project will take place.

15.1.Residual Cumulative Environmental Effects

Although some archaeological materials such as stone artefacts and sites are likely to be lost during the clearance of land or construction of other facilities necessary for exploration works. Similarly, the focus of mitigation measures in this report is to recommend the layout of the project to avoid all known significant heritage or cultural sites and burial places and will thus make a negligible contribution to cumulative impacts. The cumulative impacts are deemed to be of **low** significance in this case but with project-specific mitigation as listed in ***Section 16.2,*** this would drop to **very low** after mitigation.

15.2.Identification of alternatives

There are no site alternatives for the proposed project but the targeted site has already been identified so as to reduce impact upfront. However, the layout will be designed accordingly to avoid any damage to the already known and located archaeological/cultural or heritage sites. This is to suggest that if the site is located already, the development project has to find an alternative location to either avoid the site completely, mitigate it or rescue it before any damage could be done, and to do this a proper permit from the National Heritage Council of Namibia will be required.

15.3.Anticipated Impacts on Visual and Landscape

All known significant archaeological and heritage resources will be/should be avoided by the proposed project (aside from the landscape where the proposed project will take place) i.e. practically the landscapes cannot be mitigated in the conventional archaeological sense, and impacts to them are contextual (visual impact affecting the sense of a place) mitigation usually involves avoidance, careful placement of the proposed project infrastructures and other development, or the creation of appropriate buffer zones to minimize visual intrusion.

16. Management Plan and Mitigation Measures

Detailed mitigation measures are given herein in the form of recommendations (refer to the bulleted list in ***Section 16.2*** below under the conclusion and recommendation section). These mitigation measures will be included and implemented along with the general EMP of the project, as well as the implementation of the *Chance Find Procedures* and *Heritage Monitoring Plan* for the proposed project as set out in *Appendix 1* below.

16.1. Conclusion and Recommendation

The study has identified no significant impacts to the areas allocated for mining activities. As reported, the location where the claim is characterized with weathered outcrops and boulders which most of them are sites of focus since, they contain Rare Earth mineral elements, rocky surface and mountains, surface scatter is relatively prominent in most of the slopes of the hills. No visible graves were observed neither any significant features within the boundaries of the Mining Claim No. 75160, 75161 & 75162, and thus the overall impact on archaeological and cultural heritage records is considered to be ***Low***. However, cognizance should be taken of heritage resources and archaeological material that might be present in surface and sub-surface deposits. If, during mining activities such as digging, excavation or construction, any possible archaeological material culture discoveries are made, the operations must be stopped and a qualified archaeologist be contacted for an assessment of the find.

16.2.Recommended Mitigation Measures

It is extremely important for the Project Proponent, and all those involved in the project to fully understand that all archaeological and palaeontological objects and meteorites are the property of the State, except such an archaeological or palaeontological object the private possession and ownership of which (a) was acquired not in contravention of ***Section 12*** of the National Monuments Act, 1969 (Act No. 28 of 1969) or a law repealed by that Act; and thus, as part of mitigation measures, it should be noted that according to National Heritage Act No. 27 of 2004 that all activities that will involve digging or excavating the ground will require a permit from National Heritage Council of Namibia. Therefore, to prevent accidental damage to the archaeological landscape, including any potential sub-surface archaeological finds or features, the following mitigation strategies are proposed and recommended;

- If any archaeological materials or human burials or skeletal remains are uncovered during mining activities, then the work in the immediate area should be halted, the finds would need to be reported to the Heritage Authority and may require inspection by an Archaeologist. The ECO should have the area fenced off and contact NHC (**Tel: +264 61 244 375**), National Forensic Laboratory (**+264 61 240 461**) immediately.
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Act (Act No. 27 of 2004), Section 52 (2).
- Early Staff Training: Ensure that all workers involved in the project are trained to recognize potential archaeological materials, whether on the surface or subsurface. This can help avoid delays and ensure the process is efficient.
- Any pile of stones or mound of the earth looking even remotely like a grave should be avoided at all costs.
- A “No-Go-Area” should be put in place where there is evidence of sub-surface archaeological materials, archaeological sites, gravesites, historical, rock paintings, cave/rock shelters or past

human dwellings. It can be a demarcation by fencing off or avoiding the site completely by not working closely or near the known site. The ‘No-Go Option’ might have a NEUTRAL impact significance.

- Cognizance must be taken of the larger cultural & heritage landscape of the area to avoid the destruction of previously undetected heritage sites. Should any previously undetected heritage or archaeological resources be exposed or uncovered during the development phases of the proposed project, these should immediately be reported to the heritage specialist or heritage authority (National Heritage Council of Namibia).
- The Proponent and Contractors should adhere to the provisions of **Section 55** of the National Heritage Act in the event significant heritage and cultural features are discovered in the course of developmental works.
- It should be noted that the subterranean presence of archaeological and/or historical sites, features or artefacts is always a distinct possibility. Care should therefore be taken when development commences that if any of these are discovered, work on site cease immediately and a qualified archaeologist be called in to investigate the occurrence.
- Documentation and Reporting: All findings should be documented thoroughly. Even minor artifacts or features should be recorded, as they can help build a broader understanding of the region's history, or they may be relevant to future heritage projects or conservation efforts.
- Bi-annual auditing is highly recommended.

It should be taken into consideration that, according to **Part VI sub-section (1), (2)** or **(3)** A person who contravenes these provisions commits an offence and is liable to a fine not exceeding N$100 000 or to imprisonment for a period not exceeding 5 years, or to both such fine and such imprisonment. A Project Proponent should heed these recommendations and comply with the existing legislation and Act as reflected in this report.

16.3.Statement and reasoned opinion of the specialist

It is the reasoned opinion of the undersigned archaeologist that the overall impact of the proposed project is considered to be **low**. Residual impacts can be managed to an acceptable level through the implementation of the recommendations provided in this report. Furthermore, the anticipated **socio-economic benefits** of the development are considered to outweigh the potential impacts, provided that appropriate **mitigation measures** are effectively applied throughout the project lifecycle.

It is therefore recommended that a **Chance Finds Procedure** be implemented during **all phases** of quarrying and mining activities to safeguard any unforeseen archaeological discoveries.

17. References

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Appendix 1: Archaeological "*Chance Finds Procedure*"

A ***Chance Find Procedure (CFP)*** outlines the actions to be taken when previously unknown cultural heritage resources, especially archaeological sites or artifacts, are discovered during a project. This procedure ensures that such discoveries are handled responsibly, potentially halting construction or development activities while assessments are conducted. The CFP aims to protect these resources and ensure compliance with relevant regulations.

Key Steps in a Chance Find Procedure:

1. **Discovery and Reporting:** Anyone who discovers a potential heritage resource must immediately halt work and report the find to their supervisor or the project manager.
2. **Site Security:** The supervisor or project manager ensures the site is secured to prevent further damage or disturbance.
3. **Expert Assessment:** A qualified archaeologist or heritage specialist is consulted to assess the significance of the discovery and determine appropriate actions.
4. **Further Action:** Based on the assessment, the project may proceed with caution, construction may be halted, or further investigation (e.g., archaeological excavation) may be required.
5. **Compliance:** The project must comply with relevant regulations and guidelines for handling heritage resources.

Examples of Chance Finds:

- Burials or remains of deceased individuals
- Palaeontological, archaeological sites, such as settlements, burial grounds, or rock art
- Isolated artifacts, like pottery, tools, or other objects of potential cultural significance

Purpose of the Chance Find Procedure (CFP):

- **Protection of Heritage:** To prevent damage or destruction of cultural heritage resources.
- **Legal Compliance:** To ensure compliance with heritage protection laws and regulations.
- **Preservation of Information:** To document and potentially preserve important information about the past.
- **Public Education:** To raise awareness of the importance of cultural heritage and encourage responsible stewardship.

Project Manager or ECO/Site Manager/Supervisor must report the finding to the following competent authorities:

- **National Heritage Council of Namibia (061 244 375)**
- **National Museum (+264 61 276800),**
- **National Forensic Laboratory (+264 61 240461).**

Heritage Monitoring and Management Requirements

Throughout the development phases of the proposed project, monitoring is necessary to ensure compliance with measures agreed upon in the recommended mitigation as well as to assess how effective the mitigation measures are in protecting the values and significance of the heritage resources. This can be achieved through regular monitoring of the project site or random visits the compliance with measures outlined in the recommendation section is monitored, recorded, and reported. However, in principle, heritage monitoring and management should be conducted and implemented by an archaeologist/heritage specialist or trained personnel while other activities especially day-to-day monitoring can be done by Environmental Control Officer (ECO) or in some cases a trained Site manager can be responsible for this.

Site monitoring: As most heritage resources occur below the surface, all earth-moving activities need to be routinely monitored in case of accidental discoveries. The greatest potential impacts are the initial soil removal and subsequent earthworks during the construction or development of the area. The ECO should monitor all such activities daily. If any heritage resources are found, the *chance finds procedure* must be followed as outlined in **Appendix 1 and 2**.

Monitoring is generally only considered appropriate where changes are probable or likely, and where these changes could be significant and would require remedial or specific management measures. This process can be done in all stages of the development of the proposed project, and during the actual operational phases where more impact on archaeological and heritage resources is probable.

Appendix 2: Archaeological and Heritage Monitoring Measures for Mining Claim No. 75160, 75161 & 75162

Table 19: Chance Find and Heritage Monitoring Measures

Area/Site	**Archaeological/Heritage Aspect**	**Potential Impact**	**Mitigation Measures**	**Responsible Party**	**Method Statement required**
Chance Find (Chance Archaeological and Heritage sites (Accidental discoveries)	General area where the proposed project is taking place (i.e. proposed development which may yield archaeological, cultural materials or human remains. This means that there are possibilities of encountering unknown archaeological sites during subsurface mining work which may disturb previously unidentified chance finds.	Possible damage to previously unidentified Archaeological and heritage sites during the mining and quarrying phase. Unanticipated impacts on archaeological sites where project actions inadvertently uncovered significant Archaeological sites. Loss of historic cultural landscape; Destruction of burial sites and associated graves (if any)	In situations where unpredicted impacts occur mining activities must be stopped and the heritage authority should be notified immediately. Where remedial action is warranted, minimize disruption in mining scheduling while recovering archaeological data. Where necessary, Implement emergency	Project Proponent-Contractor/ Mining crews, Project Manager (PM) / Environmental Control Officer (ECO) or Site Manager.	Monitoring measures should be issued as instruction within the Project EMP. PM / ECO / Site Manager / Archaeologist Should monitor development works on sites where such development projects commence within the project site.

Area/Site	Archaeological/Heritage Aspect	Potential Impact	Mitigation Measures	Responsible Party	Method Statement required
		Loss of aesthetic value due to exploration work Loss of sense of place Loss of intangible heritage value due to change inland use.	measures to mitigate. Where burial sites are accidentally disturbed during prospecting and mining and quarrying, the affected area should be demarcated as a 'no-go zone' by use of fencing during construction, and access thereto by the construction team must be denied. Accidentally discovered burials in a development context should be		

Area/Site	Archaeological/Heritage Aspect	Potential Impact	Mitigation Measures	Responsible Party	Method Statement required
			salvaged and rescued to safe sites as may be directed by relevant heritage authorities. The heritage officer responsible should secure relevant heritage and health authorities permit for possible relocation of affected graves accidentally encountered during exploration work.		
Compliance Review	A review of archaeological and cultural heritage incidents, their impacts, mitigation used and success of mitigation should be conducted at a certain stage of the project. The review should be looking at mitigation measures in place, and ways of improvement if needed. This exercise can be done after every 6 months or whenever the Project Proponent sees fit. The overall objective is to				

Area/Site	Archaeological/Heritage Aspect	Potential Impact	Mitigation Measures	Responsible Party	Method Statement required
	ensure full compliance with relevant legislation, especially Under Section 5 (4) of the National Heritage Act No. 27 of 2004, Chance Find Procedure, and the recommendations made by the Heritage Specialist.				

Knowledge Gaps

Due to the subsurface nature of heritage resources, the possibility of discovery of any archaeological or heritage resources during the prospecting and exploration activities phases cannot be excluded. However, this limitation is successfully mitigated with the adoption and implementation of a ***Chance Find Procedure*** as elaborated above in Table 18.

Appendix 3: Site Notice and Newspaper Advert for the Mining Claims

PUBLIC MEETING NOTICE

ENVIRONMENTAL IMPACT ASSESSMENTS OF MINING CLAIMS, OROU-TUMBA, EPUPA CONSTITUENCY, KUNENE REGION

In terms of the Environmental Management Act (No 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations (Government Notice No. 30 of 2012), notice is hereby given to all potential interested and affected parties that three applications will be made to the Environmental Commissioner for environmental clearances for mining and processing rare earth and rare metal (titanium) minerals within mining claims 55km east north east of Okongwati, near Oroutumba community, south west of Otjimuhaka (previously Swartboois Drift).

Figure. Mining claims' locations near Oroutumba

Proponents:

1. Mr. Timo Smit (Mining Claims 75206, 75207, 75212)
2. Mr. Morne du Toit (Mining Claim 75211)
3. Miss Nina Smit (Mining Claims 75160, 75161, 75162)

Environmental assessment practitioner: Mr. Philip Hooks

Public Information Meeting:

Thursday, 11th September 2025, at Otjimuhaka Primary School, Otjimuhaka at 11am

You are hereby invited to attend the meeting and to share any comments, issues or concerns related to the proposed mining activities, for consideration in the EIA Reports and Draft Environmental Management Plans. Should you require any additional information please contact Mr. Philip Hooks / Ms. Lovisa Amwele

E-Mail: philip.nigel.hooks@gmail.com / enviro.aec@gmail.com

Please send comments for the Draft Impact Assessments by 11th October 2025

Figure 26: Site notice and snippets of Newspapers Adverts for Mining Claims No. 75160, 75161 & 75162

Appendix 4: Supporting Documents

(i) **CV of a Specialist**
(ii) **Relevant Certificates**
(iii) **Identity Document**