Namwaste Management Facility

Final Environmental Impact Assessment Report

Namwaste (Pty) Ltd

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Prepared by:

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Making Sustainability Happen

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Executive Summary

1.0 Introduction

This Executive Summary provides a synopsis of the Final Environmental Impact Assessment Report (FEIR) prepared as part of the Environmental Impact Assessment (EIA) process that is being undertaken for an application for the proposed development of the Namwaste Management Facility (NMF) near Arandis in the Erongo Region (See Figure 1).

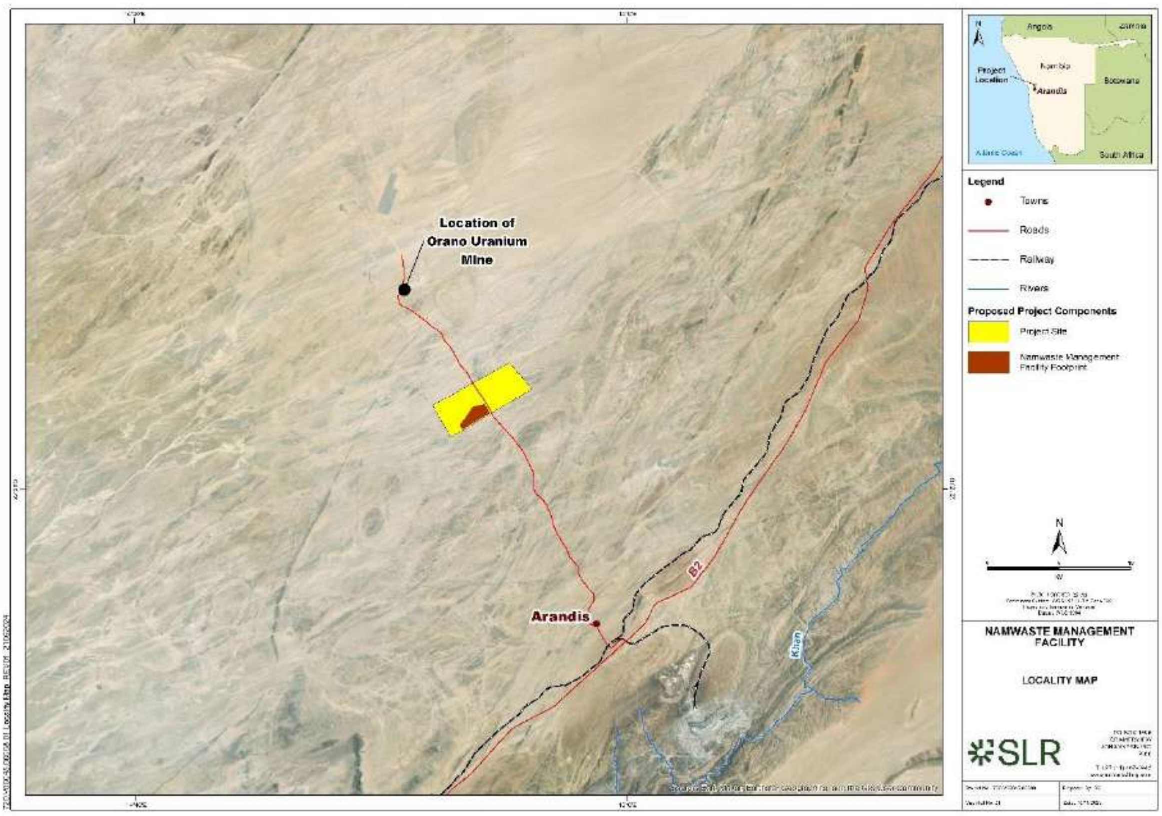

Figure 1: Locality of Project Site

2.0 Project Background and Location

Rent-A-Drum (Pty) Ltd (Rent-A-Drum) has been operating in the Namibian waste management sector for 34 years. The Rent-A-Drum Group was acquired by the Séché Environnement Group in 2023. The Séché Environnement Group owns a majority stake in the Rent-A-Drum Group, of which Namwaste (Pty) Ltd (Namwaste), is a subsidiary. Namwaste (Pty) Ltd is the applicant for the proposed Project.

The Séché Environnement Group, an established French-owned company, which has been in operation for 35 years and operates in 15 countries throughout the world is a major player in the circular economy and waste management, decontamination and emergency environmental services sectors. The Rent-A-Drum Group currently offers integrated waste management solutions and has an operational footprint in 6 of Namibia’s regions, serving over 2 000 customers and employing approximately 550 full time staff members.

Currently Namibia as a whole is serviced by only two hazardous landfill sites. The Kupferberg facility in Windhoek reportedly has 2 years airspace remaining, and the facility in Walvis Bay is not an engineered disposal facility. Given the lack of suitable hazardous waste disposal facilities in Namibia, the hazardous waste stockpiles which exist on many of the mines in the country and the fact that the mining, oil and gas, and other industrial sectors are predicted to grow significantly in the next decade, there is a need for the development of a suitable facility for the treatment and disposal of hazardous waste in Namibia.

Namwaste proposes to develop a new general and hazardous waste treatment and disposal facility in the Erongo region (to be known as the Namwaste Management Facility (NMF)), which will address the pressing shortage of solutions for hazardous waste management in the country and contribute to the protection of the environment, whilst also creating employment opportunities and fostering economic growth.

The proposed Project site is located ~50 km north-east of Swakopmund, ~15 km north-west of Arandis, along the Trekkopje Road (Orano Uranium Mine access road), as shown in Figure 1. The project site is approximately 1 500 ha in extent, whilst the development footprint would be approximately 177 ha and occupy a portion of the site. Some of the supporting infrastructure (e.g. road, water and electricity) is located between the site and in Arandis.

The NMF will include general and hazardous waste treatment and disposal facilities as well as all required ancillary and support infrastructure. The NMF will be developed in phases for the disposal of general and hazardous solid and (pre-treated) liquid waste, arsenic waste. The disposal of low-level radioactive waste is not included in the current Project scope.

SLR Environmental Consulting (Namibia) (Pty) Ltd has been appointed by Namwaste as the independent Environmental Assessment Practitioner (EAP) to undertake a full Scoping and EIA process for the proposed NMF Project.

2.1 Opportunity to Comment

Interested and Affected Parties (I&APs) *were* invited to comment on the draft EIA Report which was distributed for a 21-day comment period from **9 August 2024 to 02 September 2024**.

All comments received during the review period have been collated into a Comments and Response Report and included in this FEIR which has been submitted to the delegated authority, MEFT, for consideration and review.

3.0 EIA Process

The EIA process is an interdisciplinary and multi-step procedure to ensure that environmental considerations are included in decisions regarding projects that may impact the environment (See Figure 2). The EIA process for the NMF project is currently in the EIA Phase.

The EIA process consists of a series of steps to ensure compliance with the objectives and the EIA Regulations, commencing formally with the Scoping phase and completing with the Impact Assessment phase. The EIA process involves an open, participatory approach to ensure that impacts are identified, and that decision-making takes place in an informed, transparent and accountable manner.

The EIA process for the NMF Project was undertaken in three phases:

- Project Initiation/Screening phase (completed);
- Scoping phase (completed); and
- Impact Assessment phase (current, *FEIR submitted*).

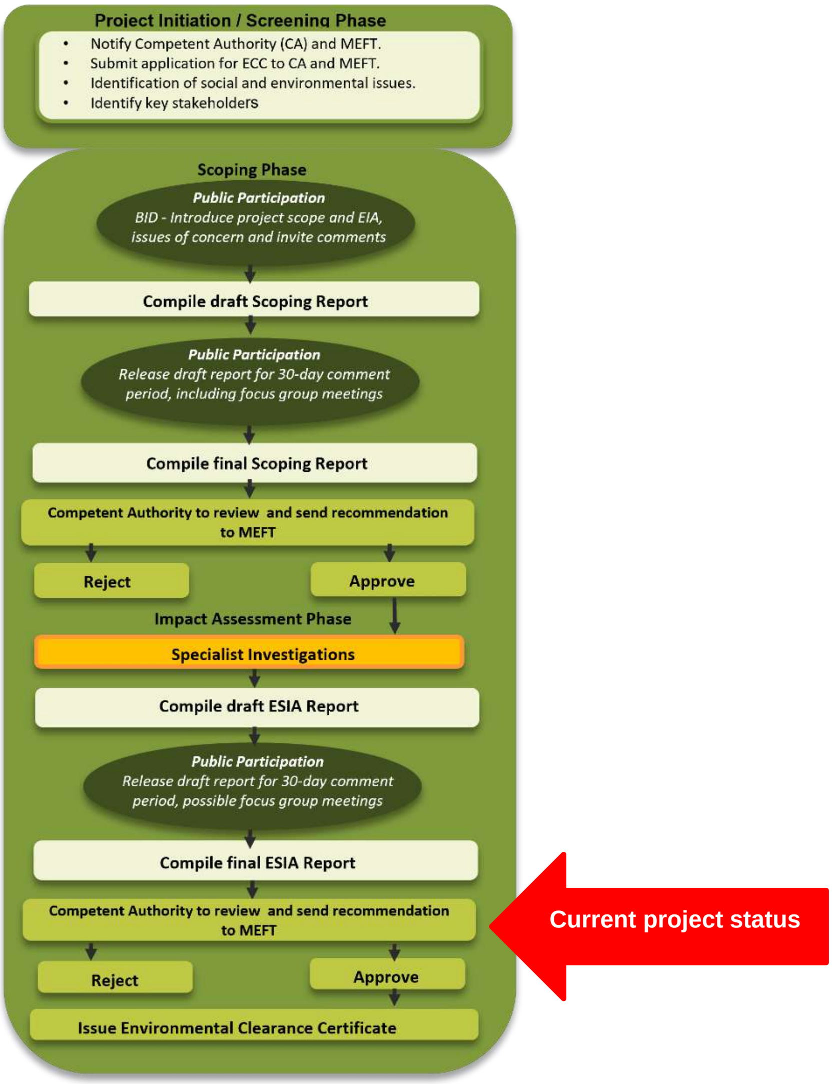

Figure 2: EIA Process

4.0 Project Need and Desirability

Namibia has entered a period of economic growth in recent years. In 2023, the country's economy grew by 4.2%, mainly driven by the mining sector and investments in oil exploration (The World Bank, 2024). As activities in the mining, offshore oil and gas, and green hydrogen sectors continue to increase in response to global market conditions, further growth is expected in years to come. Development related to these industries is likely to result in population growth (naturally and through in-migration from other counties), increasing levels of urbanisation in towns linked to development nodes and improved economic status for those engaged with the developments.

It is generally accepted that increased economic activity and production, as well as increased population, urbanisation and improved economic status, lead to increased waste production. The increasing volumes of waste will necessitate greater inputs and efforts into waste management services and infrastructure.

The management of waste from growing industrial sectors such as the mining and offshore oil and gas sectors is of particular concern in light of the existing shortage of suitable facilities for the treatment and disposal of general and hazardous waste in Namibia, as evidenced by the waste stockpiles which exist on many of the mines and other industrial sites in the country.

According to the MEFT (2017) waste disposal is one of the major concerns within the solid waste management system in Namibia and the country is currently serviced by only two hazardous landfill sites which accept waste from industrial sources for disposal. The Kupferberg facility in Windhoek reportedly has 2 years airspace remaining, and the facility in Walvis Bay is not an engineered disposal facility. The anticipated increase in waste generation due to increased economic activity further exacerbates the pressing need for suitable facilities to manage general and hazardous waste from industry.

The Namibian Pollution Control and Waste Management Policy (2003) recommends the use of environmentally safe measures and best practice to reduce, reclaim, recycle and dispose of hazardous waste. The treatment, recovery (where feasible) and disposal of waste to engineered, sanitary landfills are best practice and is socially and environmentally just. Doing so protects human health, living conditions, the environment and ensures that ecosystems services are not compromised.

The proposed NMF would service the mining, oil and gas, meat processing, construction and other industrial and business sectors, allowing for treatment and disposal of waste from clients across the country. The majority of the waste which would be treated and/or disposed at the facility would be hazardous, and as such would support the objective to implement feasible options for hazardous waste management in Namibia as outlined in the National Solid Waste Management Strategy (MEFT, 2017). The NMF would offer the opportunity for disposal of general waste from surrounding communities, such as the nearby town of Arandis. The location of the NMF was selected to minimise risk to environmental and social receptors. The EIA process has considered potential social, economic and biophysical impacts that could result through the implementation of the proposed NMF. Section 7.0 of this ESIA Report sets out the project issues and impacts that have been assessed. Measures to avoid, minimise and/or remedy potential impacts on and/or degradation of the environment that may occur as a result of the proposed NMF are presented in the EMP Report (Appendix N).

The development of the proposed NMF would generate approximately 50 employment opportunities during the initial construction period and approximately 20-25 construction jobs every 2 years for a period of 6 months during the construction of new disposal cells. Furthermore, during operation 20-25 permanent employment opportunities are expected to be created on average, comprising of both skilled and unskilled jobs. The local communities would be given due consideration related to employment opportunities. In addition, training and skills development would be offered to employees.

The Namibian Vision 2030 policy aims to develop wealth and prosperity among the population while taking cognisance of the importance of protecting biodiversity in this process (Namibia Vision 2030, 2004). This aligns with the Séché Environnement Group’s approach to the preservation of biodiversity, which has been one of the Group’s core values since its inception over 40 years ago. A dedicated team of ecologists drive sustainable development by linking the landscape, biodiversity and environment into all activities of the Group. The development of this approach has evolved over time and Séché is now implementing biodiversity preservation and restoration programmes across operations internationally in alignment to its voluntary commitments to Act4Nature which are audited annually.

Accordingly, Namwaste would implement programmes to restore, preserve and enhance biodiversity around the proposed NMF, in consultation with the local community and the #Gaingu Conservancy. Biodiversity preservation and restoration would be incorporated into the design and ongoing development and management of the NMF.

5.0 Project Description

The main project components are outlined in Table 1. The project components are detailed in Chapter 5.0 of the Final EIA Report.

Namwaste proposes to develop the NMF as a new general and hazardous waste treatment and disposal facility in the Erongo region, which will address the pressing shortage of solutions for industrial general and hazardous waste management in Namibia and contribute to the protection of the environment, whilst also creating employment opportunities and fostering economic growth.

Namwaste identified a potentially suitable site for the development of the NMF following a screening study (Environmental Compliance Consultancy, 2022) and a Technical Feasibility Study (SLR, 2023). The site is located ~15 km north-west of Arandis, along the Trekkopje Road (Orano Uranium Mine access road) in the Erongo Region. The site is approximately 1 500 ha in extent, within which Namwaste selected a proposed footprint of approximately 177 hectares for development of the NMF.

Supporting infrastructure (water supply pipeline, electrical supply pipeline and access road) will be developed as part of the NMF Project. The water supply pipeline and electrical supply powerline will travel from the NMF Project site along the Trekkopje Road until Arandis. Within Arandis the infrastructure (water supply, electrical supply and access road) will be developed to the east of the town.

The proposed NMF will include waste treatment and disposal facilities as well as all required ancillary infrastructure in order to facilitate management of general and hazardous wastes in terms of applicable regulations and market requirements. The NMF will be developed in phases for the disposal of general and hazardous solid and (pre-treated) liquid waste, and arsenic waste. The disposal of low-level radioactive waste is not included in the current project scope. The main project components of the NMF are listed in Table 1.

Table 5: Summary of Project Components

Project Component	Details
Waste Treatment Facility and Ancillary Infrastructure	• Waste treatment facility (a series of concreted, lined, bunded, treatment bays under roof used to blend treatment additives into wastes streams that require treatment prior to disposal) with silos for storage of additives to be used in treatment (e.g., lime, cement, ferrous sulphate, ash and soil); • Laboratory to test and verify the make-up of incoming and/or treated waste as required;
Waste Disposal Facility and Ancillary Infrastructure	• Waste Disposal Facility comprising phased cells; • Warehouse with a concrete slab for off-loading of arsenic waste in bulk bags; • Landfill leachate collection and containment in suitable facilities; • Workshop; • Office block; • Parking area; • Yard for trucks and skips, fuel storage facilities (20 kL diesel storage tank); • Plant/vehicle washing bay and vehicle maintenance area with contaminated runoff control; • Staff dining and ablution facilities; and • Package sewage plant (all sewage generated on the site will be treated on site).

Project Component	Details
Stormwater Management Infrastructure	• Stormwater/ run-off management infrastructure for collection and containment of any contaminated water in suitable containment facilities; • Upstream cut-off drain to divert clean stormwater off site;
Access Infrastructure	• Access road (~8 m wide) from the entrance of the industrial area of Arandis to Trekkopje Road (~5 km); • Access control facilities including perimeter fencing; • Weighbridges and control room; and • Internal roads.
Water Infrastructure	• Bulk water supply pipeline (approximately 20 km long) to convey water to the site. The pipeline will connect to the existing pipeline from the Rossing Reservoir towards Arandis Town; • On-site water storage at NMF (2 x 30 m^3 JOJO type tanks); • Boreholes for abstraction of water (50 m^3 per day); • Borehole water monitoring network;
Electrical Infrastructure	• Electrical supply via underground cable and overhead lines (33kV) and substation (500kVA) connected to nearest supply in Arandis (overhead line approximately 16 km)

The current conceptual layout of the NMF, informed by the consideration of a range of legislative, technical, financial and environmental aspects, is presented in Figure 3 and Figure 4.

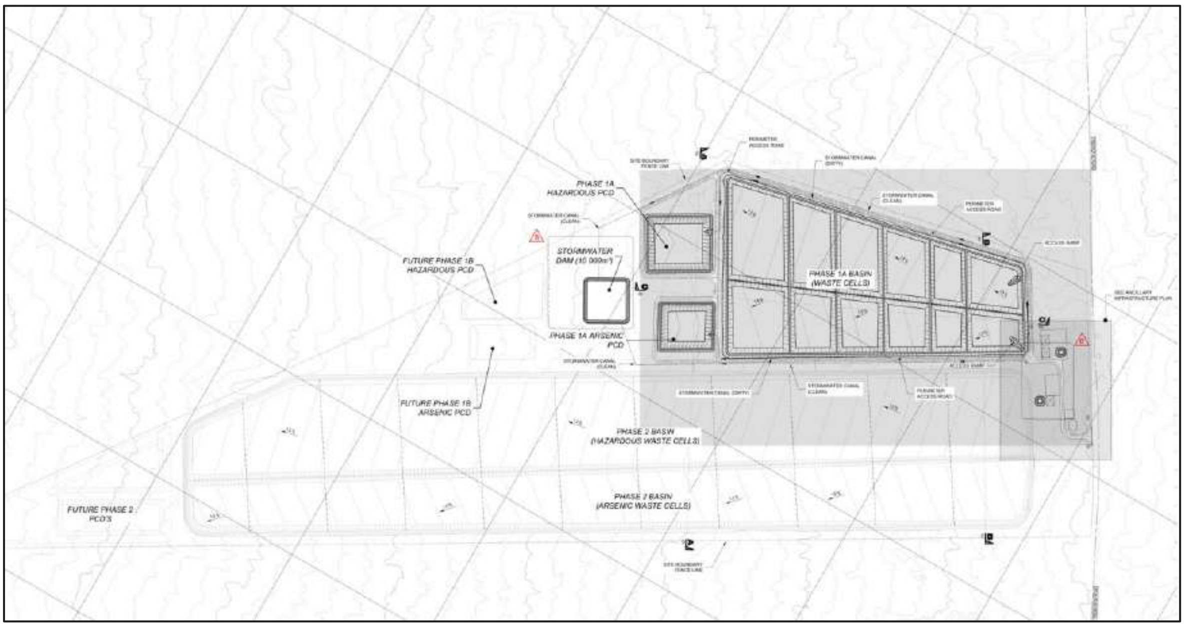

Figure 3: Final Phase 1 - General conceptual site layout

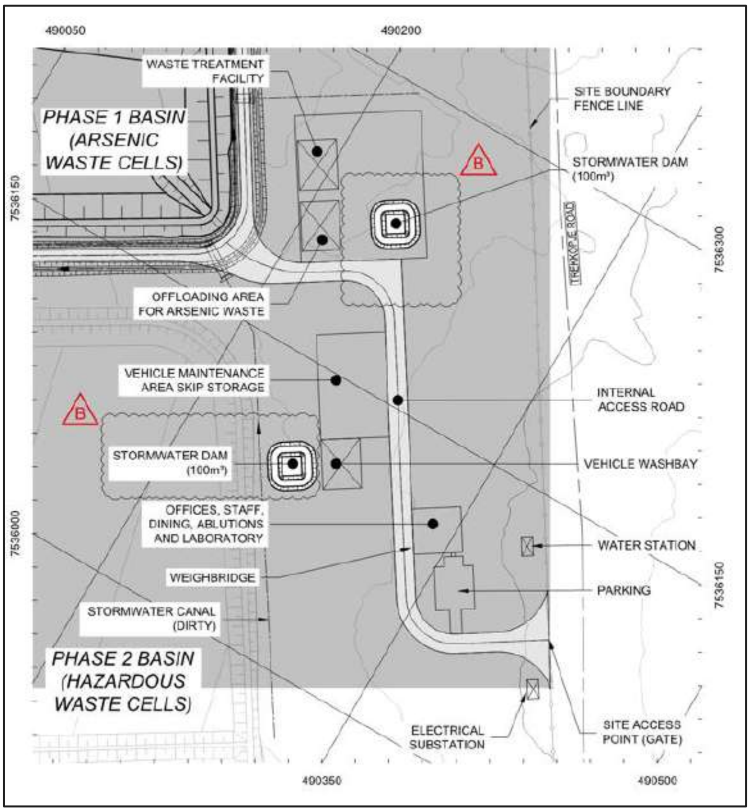

Figure 4: Conceptual ancillary infrastructure Layout

6.0 Description of the Receiving Environment

This section provides a brief description of the attributes of the receiving environment of the Project site. The receiving environment is discussed in detail in Chapter 6.0 of the Final EIA Report.

Receptor/variable	Description
Climate	• Project site located in the Namib Desert. • Low annual rainfall (approximately 50 mm) and annual fog deposition of approximately 10 mm. • High solar radiation, low humidity, and high temperature lead to very high evaporation rates. • The dominant winds are SSW and NNE, the latter occasionally reaching storm speeds during winter (warm east winds, or Bergwind). • The range of temperatures are wide, with average maximums exceeding 34°C (December) and average minimums being under 5°C (July).
Topography	• Relatively gently rolling terrain, sloping (gently) from approximately 580 m above sea level at the north-eastern boundary, down to approximately 490 m at the south-western boundary. • Plains and various shallow washes and low ridges characterise the target area. • Quartz gravel covers most of the plains, and sand dominates in washes. • A few relatively small outcrops were found across the Project site. • Various ephemeral washes (draining lines) traverse the proposed Project footprint in an east to west alignment and drain toward the coast.
Geology	• Project footprint is located within the Southern Central Zone of the Damara Orogeny where, on a regional perspective, Swakop Group lithologies are mostly predominant.
Soils	• Soils that form in the Namib Desert are predominantly mineral soils. • The soils that occur on the desert plains are sensitive to wind and water erosion and have a significantly shallower rooting depth (on average) than alluvial soils. • Four representative soil forms were identified within the NMF footprint and project buffer area (50 m) which include the Koiingnaas, Namib, Glenrosa and Mispah forms. • The following land potential levels have been determined: ○ Land potential level 7 (this land potential level is characterised by low potential. Severe limitations due to soil, slope, temperatures, or rainfall. Non-arable); and ○ Land potential level 8 (this land potential level is characterised by Very Low potential. Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable). • The proposed Project footprint associated with plains which are dominant in the current Project area was assigned a “Low” sensitivity.

Receptor/variable	Description
	• The proposed Project footprint falls within "Very Low to Low" and areas along drainage lines have a "Medium" land capability sensitivity. • The soil characteristics within the Project footprint have limited agricultural capability and potential. There are no crop boundary areas which were identified within the Project footprint. There is no active agriculture or crops present within the proposed Project footprint. Moreover, there is no working irrigation infrastructure, such as centre pivots or drip irrigation present within the Project footprint and irrigated agriculture is currently not practised in the area. • However, the naturally occurring plants grow in drainage lines, providing important habitats for animals, specifically in the washes which can be sensitive for the biodiversity and terrestrial ecology. • Considering the soil properties, agricultural potential as well as the current land use of the proposed development area, the area has a low agricultural sensitivity. • Based on the confirmed sensitivities, the overall sensitivity of the proposed Project footprint is categorized as "Low".
Land use	• Conservation - under control of the #Gaingu Conservancy. • No ML over the project site. • EPL application by Chaneni Investment (Pty) Ltd, pending ECC.
Hydrogeology	• Project site falls outside the Swakop-Khan River and Omaruru River Catchments. • Washes and drains, mapped via satellite imagery, flow to the west and a source of recharge to aquifers. • Active flow in the drains was confirmed during the site visit. • Based on geological information, two types of aquifers, primary and fractured, should be classified in the Project site. • Drilling show only a fractured aquifer (mainly from fractures, karsts and contacts) in marble is prevalent in the site. • Groundwater potential is low at the site. • Groundwater quality is expected to be brackish with no potable or commercial use locally. • Regional groundwater flow is directed towards the southwest from mainland Spitzkoppe Mountain area. In this regard, there is no flow towards the strategic river catchments.
Hydrology	• The Project site is drained by several well-defined drainage lines, that flow in the westerly direction to join the non-perennial rivers downstream of the project site. • The site is also characterized by a number of small, shallow clustered drainage lines, the soil of which becomes saturated during rainfall, resulting in sheet flow over the entire site surface and localised flooding. • These drainage lines are active and are the source of recharge to aquifers. • The Project site is bounded by a main channel on the right and a much flatter channel on the left (facing downstream). • The NMF footprint and its ancillary infrastructure will be traversed by some of these flatter channel drainage lines.

Receptor/variable	Description

Biodiversity	• Rocky ridges (which tend to trap moisture from rare rain events and from fog) and drainage lines within the gravel plains, which store water in often extensive sandy aquifers.
	• The Project site lies within the Biodiversity Yellow flag Area #35 in terms of the SEA for the central Namib Uranium Rush.
	• The following sensitive habitats have been identified on the Project site:
	  o Gravel plains;
	  o Rocky ridges; and
	  o Drainages.

Archaeology	• Heritage sites identified in proximity to the site include the following: • Potential Seed diggings (48m, 56m, 52m and 43m from the proposed access road; 26.51m and 800m from the proposed bulk water pipeline; Directly within the proposed bulk electricity line). • Potential Hunting Blind (20m from the proposed site footprint). • Arandis Cemetery (800m from the proposed access road). • Trekkopje Historic Cemetery (20 km from the site footprint). • Historic Railway Station (20 km from the site footprint). • Potential Grave 01 (67.28m from the proposed bulk electricity and water pipelines). • Potential Grave 02 (67.28m from the proposed bulk electricity and water pipeline) • Y shaped summit mark with copper locker (potential historic point) (2.63km from the proposed access road) . • Potential Historic insignias from WWI marked 'Scott" and "Jesus" with a cross. This could however be a recent addition from a nearby community (32.02m from the proposed bulk electricity line and water pipeline).
Air quality	• In Namibia air quality is generally good. • Few industrial sources mainly associated with mining and smelting activities, which are generally remote from populated areas. • Socio-economic activities such as minerals exploration and industrial development in Namibia have the potential to promote fugitive dust production. • DFO rates measured at the Project site was well below the South African NDCR residential limit (600 $mg/m^2/day$). • The dataset indicates low dust fallout onsite during the monitoring period. • SO_2 concentrations measured well below the annual WHO AQG (50 $\mu g/m^3$). The highest concentration was measured at DFO2 (1.19 $\mu g/m^3$). • NO_2 concentrations measured well below the annual WHO AQG (10 $\mu g/m^3$). The highest concentration was measured at DFO3 (0.76 $\mu g/m^3$). • All VOCs measured below the detection limit of the analytical technique. • This dataset indicates low levels of monitored gases over the month of measurement.

Receptor/variable	Description

Radiology	• The average annual public radiation exposure dose at the Project site is due to the following individual exposure dose contributions:
	  ○ Due to the inhalation of radon and its decay products: approx. 0.2 mSv/a, as inferred from radon measurements at Swakopmund, Walvis Bay, and a monitoring location in-between Arandis and the Rössing Mine;
	  ○ Due to the inhalation of radioactive ambient atmospheric dust containing long-lived radioactive constituents: approx. 0.003 mSv/a for adults and 0.002 mSv/a for infants, as inferred from a recent regional air quality assessment; and
	  ○ Due to exposure to gamma radiation from terrestrial and cosmic sources: approx. 0.95 mSv/a, as inferred from the terrestrial and cosmic contributions determined during the on-site gamma dose rate assessment.

Socio-economic	• Arandis is the nearest town to the Project site. • The project site is within the #Gaingu Communal Conservancy.
Traffic	• The existing intersection incorporates dedicated turning lanes for traffic turning off the B2 towards Arandis. This allows for safe turning manoeuvres on a road with significant traffic volumes. • The existing traffic volumes allow for an A rating (free flow) at the relevant intersections.
Visual	• The site gives the impression of being a pristine desert landscape, which however, has been compromised with vehicle tracks leaving stark imprints on the desert surface. • In addition to the visually intrusive nature of vehicle tracks, the natural desert characteristics of the landscape for the supporting infrastructure (e.g. new road, overhead powerline) has been compromised with infrastructural activities. • The activities and land-uses in the Project area are common within the sub-region. • However, the desert, with its openness and huge expanses of rolling gravel plains, interspersed with rocky outcrops, exerts a moderately strong sense of place. Yet, within the context of the sub-region, it is regarded as a common landscape which is being impacted by mining, infrastructure and urbanization activities. • Although the Project area occurs within the #Gaingu Conservancy, there are no nearby tourist destinations i.e. Spitzkoppe is 60 km to the north east and the coast is approximately 55 km west of the NMF site.

7.0 Impact Description and Assessment

This section provides a summary of the key findings, and positive and negative impacts of the proposed Project from a physical, biological and social perspective during the construction and operational phases (Table 2). The assessment of the impacts is documented in Chapter 7.0 of the Final EIA Report.

Table 2: Summary of specialist findings

Potential Impact	Significance of Impacts	
	Without Mitigation	With Mitigation
Soils, Land Use, Land Capability and Agriculture		
Loss of Land Capability, Soil Erosion and Compaction - Construction Phase	Medium	Low
Loss of Land Capability, Soil Erosion and Compaction – Operational Phase	Medium	Low
Air Quality		
Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors	Medium	Medium*[1]
Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors	Medium	Medium*
Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors	Medium	Medium*
Short-term WHO odour nuisance AQG exceedances for H2S emissions and the potential for nuisance impacts offsite	Low	Low
Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.	Low	Low
Visual		
Change in landscape characteristics and key views – Construction Phase	Insignificant	Insignificant
Change to the landscape characteristics and key views - Operational Phase	Insignificant	Insignificant
Traffic		
B2 LoS during construction and operational phase	Low	Low
B2/Rossing Access Intersection (Location 1) during construction and operational phases	Medium	Low
Orano Mine Gravel Access Road during construction and operational phases	Low	Low
Hydrology		

[1] * Impact rating is medium because the existing air quality baseline in Arandis related to particulate emissions was taken into account in the assessment. The air quality specialist study found that particulate emissions due to NMF activities could be mitigated to an acceptable level at all sensitive receptors.

Potential Impact	Significance of Impacts	
	Without Mitigation	With Mitigation
Contamination of surface water resources – Construction Phase	Medium	Low
Contamination of surface water resources – Operational Phase	Medium	Low
Flooding – construction and operational phase	Medium	Low
Alteration of natural drainage paths and flows	Medium	Low
Hydrogeology		
Disruption of natural groundwater recharge conditions	Low	Low
Groundwater contamination through development over existing borehole (WW206579)	Medium	Very Low
Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems	High	Low
Groundwater contamination as a result of leachate seepage from facility	High	Low
Local aquifer drawdown as a result of groundwater abstraction	Medium	Low
Biodiversity		
Destruction of Habitats and Organisms	High	Low
Disturbance of Animals and Interference with their Behaviour	High	Low
Soil and Water Contamination	Medium	Very low
Vehicle Tracks	High	Low
Light Pollution	Medium	Low
Birds and Powerline Interactions	High	Low
Socio-economic		
Increased employment opportunities (construction phase)	Low +	Low +
Increased opportunities for local contractors and businesses	Low +	Low +
Reduced road safety (construction phase)	Low	Low
Increased spread of disease	Low	Very low
Increased incidence of crime	Very low	Insignificant
Increased tension and conflict	Very low	Insignificant
Increased permanent employment opportunities (operational phase)	Medium +	Medium +
Compliance with waste management standards	Very high +	Very high +
Loss of revenue for the Walvis Bay Municipality	Medium	Medium

Potential Impact	Significance of Impacts	
	Without Mitigation	With Mitigation
Increased support for community	High +	High +
Perceived health risks associated with hazardous waste	Medium	Very Low
Perceived risks due to the transportation of hazardous waste	Medium	Medium
Reduced road safety (operational phase)	Medium	Medium
Archaeology		
Disturbance, damage or loss of cultural / archaeological resources, artefacts, graves, burial sites	Low	Low

8.0 Conclusion and Recommendations

While potential negative environmental impacts have been identified for the proposed NMF, the majority of these are considered to be of medium to low significance without mitigation. Mitigation to reduce the significance of all impacts, including those of high significance, to acceptable levels has been identified. All specialists have confirmed that no fatal flaws have been identified and ultimately conclude that the proposed Project can be authorised. The measures to mitigate and manage potential impacts associated with the proposed Project have been provided and incorporated into the EMP for implementation. Additionally, the proposed project is aligned with Namibia's planning objectives and will address the pressing shortage of solutions for general and hazardous waste management in Namibia and contribute to the protection of the environment, whilst also creating employment opportunities and fostering economic growth. On this basis, it is SLR's opinion that, subject to the implementation of EMP, the proposed Namwaste Management Facility should be approved and granted an ECC.

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Appendices

Acronyms and Abbreviations

Acronym / Abbreviation	Definition
CITES	Convention on International Trade in Endangered Species
DEA	Department of Environmental Affairs
DEAWMPCI	Division of Environmental Assessment, Waste Management and Pollution Control, and Inspections
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMA	Environmental Management Act (Act 7 of 2007)
EMP	Environmental Management Plan
EPL	Exclusive Prospecting Licences
ERT	Electrical Resistivity Tomography
ESIA	Environmental and Social Impact Assessment
FEL	Front-end loader
FEIR	Final Environmental Impact Report
GDP	Gross Domestic Product
I&APs	Interested & Affected Parties
IPPR	Institute for Public Policy Research
LC	Leachable Concentration
MAWLR	Ministry of Agriculture, Water and Land Reform
MEA	Multilateral Environmental Agreements
MEFT	Ministry of Environment, Forestry and Tourism
ML	Mining Licence
MME	Ministry of Mines and Energy
MWT	Ministry of Works and Transport
NACSO	Namibian Association of Community Based Natural Resource Management Support Organisations
Namwaste	Namwaste (Pty) Ltd
NGL	Natural Ground Level
NHC	National Heritage Council
NIMT	Namibian Institute of Mining and Technology
NMF	Namwaste Management Facility (the Project)
NNE	North northeast
NNNP	Namib Naukluft National Park
NRPA	National Radiation Protection Authority
NSA	Namibia Statistics Agency
Orano	Orano Mining Namibia (Pty) Ltd
PPP	Public Participation Process
Rent-A-Drum	Rent-A-Drum (Pty) Ltd
RUL	Rössing Uranium Limited
SADC	Southern African Development Community
SANS	South African National Standards
SEA	Strategic Environmental Assessment

Acronym / Abbreviation	Definition
Séché	Séché Environnement Group
SLR	SLR Environmental Consulting (Namibia) (Pty) Ltd
SR	Scoping Report
SSW	South southwest
TC	Total Concentration
TDS	total dissolved solids
TLB	Tractor Loader Backhoe
TSAS	Technical Services Acceptance Sheet
UNCBD	United Nations Convention on Biological Diversity
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
WMF	Waste Management Facility

1.0 Introduction

This chapter briefly describes the Project, introduces the purpose and structure of the Report and details the opportunity to comment.

1.1 Project Background

Rent-A-Drum (Pty) Ltd (Rent-A-Drum) has been operating in the Namibian waste management sector for 34 years. The Rent-A-Drum Group was acquired by the Séché Environnement Group in 2023. The Séché Environnement Group owns a majority stake in the Rent-A-Drum Group, of which Namwaste (Pty) Ltd (Namwaste), is a subsidiary. Namwaste (Pty) Ltd is the applicant for the proposed Project.

The Séché Environnement Group, an established French-owned company, which has been in operation for 35 years and operates in 15 countries throughout the world is a major player in the circular economy and waste management, decontamination and emergency environmental services sectors. The Rent-A-Drum Group currently offers integrated waste management solutions and has an operational footprint in 6 of Namibia's regions, serving over 2 000 customers and employing approximately 550 full time staff members.

Currently Namibia as a whole is serviced by only two hazardous landfill sites. The Kupferberg facility in Windhoek reportedly has 2 years airspace remaining, and the facility in Walvis Bay is not an engineered disposal facility. Given the lack of suitable hazardous waste disposal facilities in Namibia, the hazardous waste stockpiles which exist on many of the mines in the country and the fact that the mining, oil and gas, and other industrial sectors are predicted to grow significantly in the next decade, there is a need for the development of a suitable facility for the treatment and disposal of hazardous waste in Namibia.

Namwaste proposes to develop a new general and hazardous waste treatment and disposal facility in the Erongo region (to be known as the Namwaste Management Facility (NMF)), which will address the pressing shortage of solutions for hazardous waste management in the country and contribute to the protection of the environment, whilst also creating employment opportunities and fostering economic growth.

1.2 Project Overview

The proposed Project site is located ~50 km north-east of Swakopmund, ~15 km north-west of Arandis, along the Trekkopje Road (Orano Uranium Mine access road), as shown in Figure 1-1. The project site is approximately 1 500 ha in extent, whilst the development footprint would be approximately 177 ha and occupy a portion of the site. Some of the supporting infrastructure (e.g. road, water and electricity) is located between the site and in Arandis.

The NMF will include general and hazardous waste treatment and disposal facilities as well as all required ancillary and support infrastructure. The NMF will be developed in phases for the disposal of general and hazardous solid and (pre-treated) liquid waste and arsenic waste. The disposal of low-level radioactive waste is not included in the current Project scope but will be considered in future phases of the project and as such will be subject to a separate environmental authorisation process in future.

The main components of the proposed NMF are detailed in Table 1-1 below. The Project components are discussed in further detail in Section 5.0 of this report.

Table 1-1: Summary of Project Components

Project Component	Details
Waste Treatment Facility	• Waste treatment facility (a series of concreted, lined, bunded, treatment bays under roof used to blend treatment additives into wastes streams that require treatment prior to disposal) with silos for storage of additives to be used in treatment (e.g., lime, cement, ferrous sulphate, ash and soil); • Landfill leachate collection and containment in suitable facilities; • Laboratory to test and verify the make-up of incoming and/or treated waste as required;
Waste Disposal Facility and Ancillary Infrastructure	• Waste Disposal Facility comprising phased cells; • Warehouse with a concrete slab for off-loading of arsenic waste in bulk bags; • Workshop; • Office block; • Parking area; • Yard for trucks and skips, fuel storage facilities (20 kL diesel storage tank); • Plant/vehicle washing bay and vehicle maintenance area with contaminated runoff control; • Staff dining and ablution facilities; and • Package sewage plant (all sewage generated on the site will be treated on site).
Stormwater Management Infrastructure	• Stormwater/ run-off management infrastructure for collection and containment of any contaminated water in suitable containment facilities; • Upstream cut-off drain to divert clean stormwater off site;
Access Infrastructure	• Access road (~8 m wide) from the entrance of the industrial area of Arandis to Trekkopje Road (~5 km); • Access control facilities including perimeter fencing; • Weighbridges and control room; and • Internal roads.
Water Infrastructure	• Bulk water supply pipeline (approximately 20 km long) to convey water to the site. The pipeline will connect to the existing pipeline from the Rossing Reservoir towards Arandis Town; • On-site water storage at NMF (2 x 30 m^3 JOJO type tanks); • Boreholes for abstraction of water (50 m^3 per day); • Borehole water monitoring network;
Electrical Infrastructure	• Electrical supply via underground cable and overhead lines (33kV) and substation (500kVA) connected to nearest supply in Arandis (overhead line approximately 16 km)

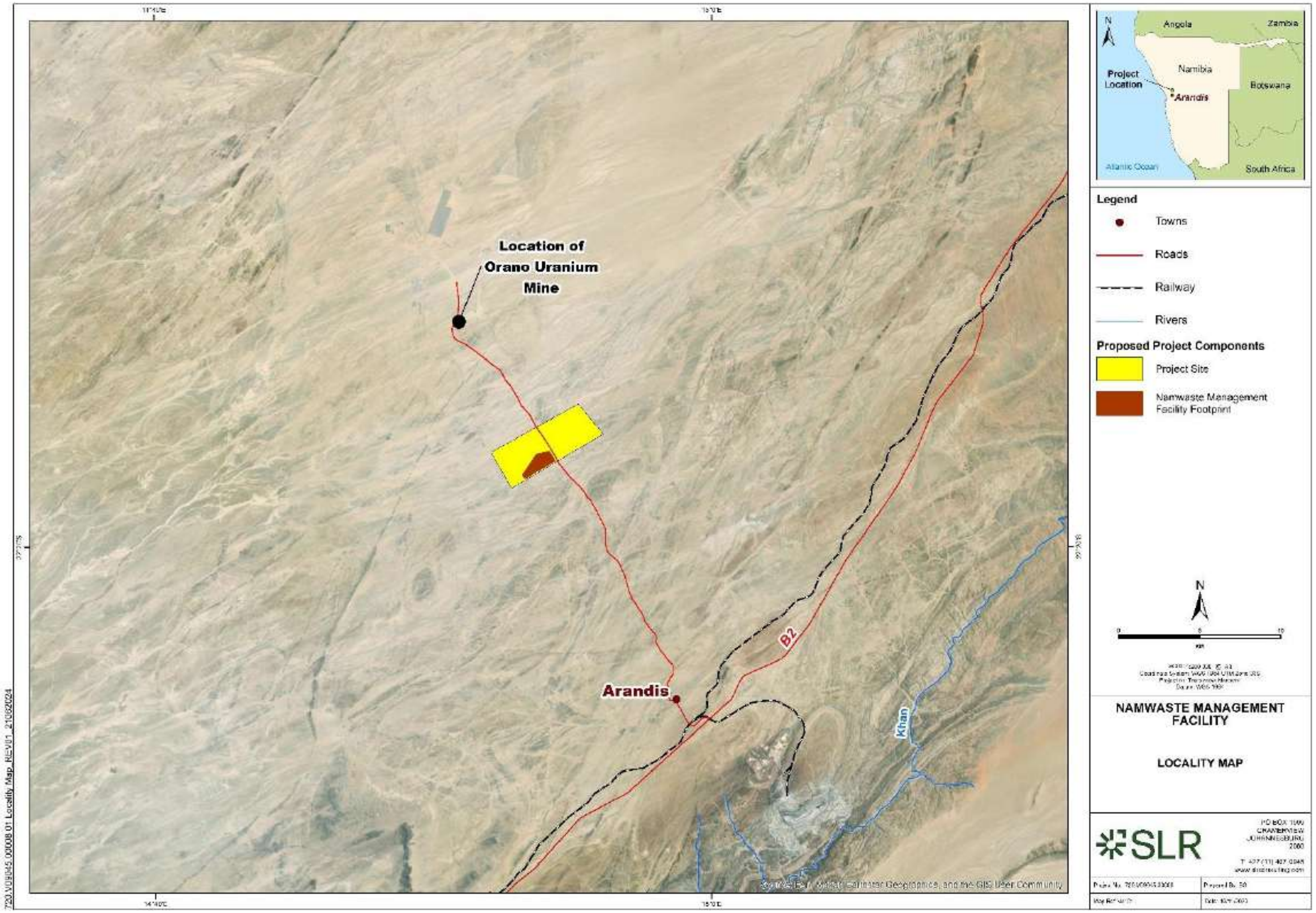

Figure 1-1: Locality of Project Site

1.3 Legislative Overview

Given the nature of the proposed NMF, the activities, anticipated waste volumes and supporting infrastructure, authorisation is required in terms of the Environmental Management Act No 7 of 2007 (EMA). In terms of EMA, certain identified activities may not commence without an environmental clearance (or amendment thereto) that is issued by the office of the environmental commissioner in the Ministry of Environment, Forestry and Tourism (MEFT).

The restricted activities are detailed in GN No. 29 published in terms of EMA and are prohibited until an Environmental Clearance Certificate (ECC) has been obtained from MEFT. An ECC application will only be considered once there has been compliance with the Environmental Impact Assessment (EIA) Regulations, promulgated on 6 February 2012 (GN No. 30). The EIA Regulations set out that an EIA process must be undertaken and detail the procedures and documentation that need to be complied with in undertaking an EIA process.

SLR Environmental Consulting (Namibia) (Pty) Ltd has been appointed by Namwaste as the independent Environmental Assessment Practitioner (EAP) to undertake a full Scoping and EIA process for the proposed NMF Project.

1.4 Purpose of this Report

This Final Environmental Impact Assessment Report (FEIR) has been prepared as part of the EIA process that was undertaken for the proposed Project. The FEIR has been prepared in compliance with the EIA Regulations and Section 35 of the EMA and is based on the Plan of Study presented in the final Scoping Report (SLR, January 2024), which was accepted by the MEFT on 5 March 2024.

The draft EIA Report *was* released to I&APS for review and comment *prior to the submission of the FEIR* to the MEFT for decision-making on Namwaste's application for ECC. Comments received *have been* considered and incorporated into an updated version of the draft EIA Report. The FEIR will then be released by MEFT for a second review and comment period (on the MEFT website), after which MEFT will review the report for decision-making.

1.4.1 Structure of the EIA Report

The structure of the EIA Report is summarised in Table 1-2 below.

Table 1-2: Structure and Content of the EIA Report

Section	Contents
Executive Summary	Provides a comprehensive synopsis of the EIA Report.
Chapter 1	**Introduction** Provides a brief description of the project background, describes the purpose of this report, describes the structure of the report and outlines the opportunity for comment.
Chapter 2	**Environmental Policy, Planning and Legal Framework** Outlines the key legislative requirements applicable to the proposed project.

Section	Contents
Chapter 3	**Environmental Impact Assessment Approach and Methodology.** Presents the EIA Project Team, EIA assumptions and limitations, and outlines the approach and process followed during the EIA. Presents and describes the public consultation process undertaken during the EIA process.
Chapter 4	**Project Need and Desirability** Details the strategic context within which the project is framed and provides the motivation for the project.
Chapter 5	**Project description** Provides general Project information and a detailed description of the proposed activities and associated Project alternatives.
Chapter 6	**Description of Baseline Environment and Specialist Findings** Describes the existing biophysical and socio-economic environment that could potentially be affected by the proposed Project. It additionally outlines the specialist findings on the various aspects.
Chapter 7	**Impact Description and Assessment** Describes and assesses the potential impacts of the proposed Project on the affected environment. It also presents mitigation or optimisation measures that could be used to reduce the significance of any negative impacts or enhance any benefits.
Chapter 8	**Conclusion and Recommendations** Provides conclusions to the EIA and summarises the recommendations for the proposed Project.
Chapter 9	**References** Provides a list of the references used in compiling this report.
Appendices	Appendix A: Curriculum Vitae of the project team Appendix B: Public consultation documentation Appendix C: Authority correspondence and documentation Appendix D: Specialist Soils and Agriculture Impact Assessment Appendix E: Specialist Air Quality Impact Assessment Appendix F: Specialist Visual Impact Assessment Appendix G: Specialist Traffic Impact Assessment Appendix H: Specialist Hydrological Impact Assessment Appendix I: Numerical Groundwater Modelling Report Appendix J: Specialist Hydrogeological Impact Assessment Appendix K: Specialist Terrestrial Biodiversity and Ecology Impact Assessment Appendix L: Specialist Socio-Economic Impact Assessment Appendix M: Specialist Heritage Impact Assessment *Appendix N: Alternative Access Roads Investigation Report* Appendix O: Environmental Management Plan

1.4.2 Opportunity to Comment

Interested and Affected Parties (I&APs) *were* invited to comment on the draft EIA Report which *was* distributed for a 21-day comment period from **09 August 2024 to 02 September 2024**.

All comments received during the review period have been collated into a Comments and Response Report and included in this FEIR which has been submitted to the delegated authority, MEFT, for consideration and review.

2.0 Environmental Policy, Planning and Legal Framework

This chapter provides an overview of relevant Namibian legislation and policy, summarises the Namibian administrative framework and describes the international treaties, industry standards and guidelines applicable to the EIA process for the NMF Project. In accordance with the EIA Regulations, all legislation and guidelines that were considered in the project's EIA process are documented.

2.1 Namibian Institutional and Administrative Structure

2.1.1 Introduction

The Namibian Constitution makes provision for the creation and enforcement of applicable legislation. Namibia has five tiers of law which include the following:

- The Constitution;
- Statutory law;
- Common law;
- Customary law; and
- International law.

At Independence in 1990, the Government of the Republic of Namibia recognized the importance of the environment by including the protection of natural resources in the Constitution. Within this context, and in accordance with the Constitution, Namibia has passed numerous laws intended to protect the natural environment and to mitigate against adverse environmental impacts.

Several of the Acts, as well as various policies, are relevant to the NMF Project. This section details the institutional framework responsible for implementing the relevant legislation (described in Section 2.2).

2.1.2 Ministry of Environment, Forestry and Tourism

The mission of the MEFT is to promote biodiversity conservation in the Namibian environment through the sustainable utilization of natural resources and tourism development for the maximum social and economic benefit of its citizens. MEFT develops, administers and enforces environmental legislation and policy.

The MEFT's Department of Environmental Affairs (DEA) is mandated to give effect to Article 95L of the Constitution by promoting environmental sustainability. The Environmental Commissioner serves as head of the DEA. The DEA is responsible for, inter alia, the administration of the EIA process undertaken in terms of the EMA and the EIA Regulations.

  - The DEA will be responsible for issuing a decision on the application for an ECC.

2.1.3 Ministry of Mines and Energy

The Ministry of Mines and Energy (MME) comprises six directorates including the Directorate of Energy, which is responsible for developing and implementing Namibia's energy sector policies, strategies, and plans and the Directorate of Mines who is responsible for the supporting mineral resource development and is the responsible authority for administration of Namibia's mining licences.

The MME is a key stakeholder in the project and the EIA process due to the proposed electrical transmission infrastructure to be developed as part of the NMF, as well as in relation to the extraction of material to be used for construction purposes and as cover material during waste disposal (e.g. borrow pits on site). MME will be required to review the Scoping and EIA Reports and submit comments to MEFT.

2.1.4 Ministry of Works and Transport

The Ministry of Works and Transport (MWT) aims to ensure and regulate the provision of safe, effective and efficient infrastructure and services which are responsive to the socio-economic needs of the public.

The Department of Transport is responsible for transport in the different modes, namely road, rail, air and sea. Its mission is to ensure the provision of safe and efficient transport services and infrastructure in the country in balance with demand in the different modes.

The MWT is a key stakeholder in the Project and the EIA process due to the proposed roads to be developed to ensure access to the NMF. MWT will be required to review the Scoping and EIA Reports and submit comments to MEFT.

2.1.5 Ministry of Agriculture, Water and Land Reform

The Ministry of Agriculture, Water and Land Reform (MAWLR) has as its mission the realization of the potential of the Agricultural, Water and Land Reform sectors towards the promotion of an efficient and sustainable socio-economic development for a prosperous Namibia. The MAWLR is mandated to promote, develop, manage and utilize agricultural and water resources.

The MAWLR is a key stakeholder in the project and the EIA process due to the proposed groundwater abstraction to be undertaken to supply water to the NMF. MAWLR will be required to review the Scoping and EIA Reports and submit comments to MEFT.

2.1.6 National Radiation Protection Authority

The National Radiation Protection Authority (NRPA) is established to provide for adequate protection of the environment and of people in current and future generations against the harmful effects of radiation by controlling and regulating the production, processing, handling, use, holding, storage, transport and disposal of radiation sources and radioactive materials, and controlling and regulating prescribed non-ionising radiation sources.

The NRPA would need to review and approve the Radiation Management Plan to be developed as part of the Radiation Impact Assessment. However, as radioactive waste falls outside of the current scope, a Radiation Management Plan will not be developed within this Environmental and Social Impact Assessment (ESIA) process.

2.1.7 National Heritage Council

The National Heritage Council (NHC) was established by the National Heritage Act, No. 27 of 2004. It is the administrative body responsible for the protection and conservation of Namibia's cultural and natural heritage resources.

The NHC would need to review the Heritage Impact Assessment and provide consent for the project in terms of Sections 53(7) and 55(8) of the National Heritage Act, 2004 (Act No.27 of 2004)).

2.2 Namibian Legal Framework

The following sections outlines the legislative, policy and regulatory framework relevant to undertaking an EIA in accordance with the EIA Regulations. It is however noted that the following is not an exhaustive list of all legislation and compliance with additional statutes may be required.

2.2.1 The Constitution of the Republic of Namibia (1990)

Article 91 defines the function of the Ombudsman and, 91 (c) describes the duty to investigate complaints concerning the over-utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystem and failure to protect the beauty and character of Namibia.

Article 95 (l) of the Constitution of the Republic of Namibia states that *"the State shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at … maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of natural resources on a sustainable basis for the benefit of all Namibians both present and future; in particular the Government shall provide measures against the dumping or recycling of foreign nuclear and toxic waste on Namibian Territory."*

Article 100 states "that the land, water and natural resources below and above the surface of the land … shall belong to the State if they are not otherwise lawfully owned."

Article 101 of the Namibian Constitution further states that the principles embodied within the constitution *"shall not of and by themselves be legally enforceable by any court, but shall nevertheless guide the Government in making and applying laws. … The courts are entitled to have regard to the said principles in interpreting any laws based on them."*

The constitutional recognition of environmental concerns triggered widespread legislative reform relating to the management of natural resources in Namibia. The country's environmental protection effort is currently comprised of the EMA and its Regulations.

2.2.2 Namibia's Environmental Impact Assessment Policy

The EIA Policy of 1995 promotes accountability and informed decision making through the requirement of EIAs for listed programmes and projects (activities). The EIA Policy is currently enforced through the EMA and the EIA Regulations. Refer to the following sections for details thereof.

2.2.3 Environmental Management Act, 2007

The EMA was promulgated in December 2007 and came into effect on 6 February 2012. Part 1 of the EMA describes the various rights and obligations that pertain to citizens and the Government. The main objectives of the Act are to ensure that:

- Significant effects of activities on the environment are considered carefully and timeously;
- There are opportunities for timeous participation by I&APs throughout the assessment process; and
- Findings are taken into account before any decision is made in respect of activities affecting the environment.

Part 2 of the EMA sets out a number of principles of environmental management which give effect to the provisions of the Constitution for integrated environmental management. Decision-makers must take these principles into account when deciding whether or not to approve a proposed project. In terms of this legal framework certain identified activities may not commence without an environmental clearance (or amendment thereto) that is issued by the office of the environmental commissioner in the MEFT.

2.2.4 Environmental Impact Assessment Regulations, 2012

The EIA Regulations, promulgated in 2012 in terms of Section 56 of the EMA provides for the control of certain listed activities. These listed activities are provided in GN No. 29 and are prohibited until an ECC has been obtained from MEFT. Such ECCs, which may be granted subject to conditions, will only be considered once there has been compliance with the EIA Regulations. The EIA Regulations set out the procedures and documentation that need to be complied with in undertaking an EIA process.

Namwaste is applying in terms of the EMA for an ECC for activities relating to the development and operation of a general and hazardous waste treatment and disposal facility and construction of the associated infrastructure (i.e., powerline, water pipeline and road). The following activities identified in GN No. 29 apply to the proposed project (See Table 2-1):

Table 2-1: Listed Activities potentially triggered by the NMF Project

Activity	Project component
1. Energy Generation, Transmission and Storage Activities	
1. The construction of facilities for - (b) the transmission and supply of electricity;	The project involves the construction of a substation with capacity of 500kVA and powerline connecting the on-site substation to the tie-in station in Arandis.
2. Waste management, Treatment, Handling and Disposal Activities	
2.1 The construction of facilities for waste sites, treatment of waste and disposal of waste.	The project involves the construction of a general and hazardous waste treatment and disposal facility.
2.3 The import, processing, use and recycling, temporary storage, transit or export of waste.	
3. Mining and Quarrying Activities	
3.2 Other forms of mining or extraction of any natural resources whether regulated by law or not.	The project will require the extraction of cover material and material to be used for construction purposes (e.g. borrow pits on site for construction).
3.3 Resource extraction, manipulation, conservation and related activities	
5. Land Use and Development Activities	
5.1 The rezoning of land from – (d) use for nature conservation or zoned open space to any other land use.	The site is located within the #Gaingu Communal Conservancy and once developed it will no longer be available for use for conservation purposes.
8. Water Resource Developments	
8.1 The abstraction of ground or surface water for industrial or commercial purposes.	As an alternate to piped water supply, the project may involve the abstraction of groundwater to be used for industrial purposes.
8.2 The abstraction of groundwater at a volume exceeding the threshold authorised in terms of a law relating to water resources.	
8.4 Construction of canals and channels including the diversion of the normal flow of water in a riverbed and water transfer schemes between water catchments and impoundments	Portions of the project footprint are located within drainage lines. An upstream cut-off drain and dissipation infrastructure is required to divert stormwater around the facility.
8.6 Construction of industrial and domestic wastewater treatment plants and related pipeline systems.	The project involves the construction of a package sewage plant. All sewage will be treated on site.

Activity	Project component
8.8 Construction and other activities in water courses within flood lines.	Portions of the project footprint are located within drainage lines. An upstream cut-off drain and dissipation infrastructure is required to divert stormwater around the facility.
9 Hazardous Substance Treatment, Handling and Storage	
9.1 The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974.	The project involves the treatment, handling and storage of hazardous substances/waste.
9.2 Any process or activity which requires a permit, licence or other form of authorisation, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence or authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste.	
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.	The project includes fuel storage (20 kL diesel storage tank) and facilities for storage of chemicals to be used in waste treatment. Cumulatively these may exceed 30 cubic metres.
10. Infrastructure	
10.1 The construction of- (a) oil, water, gas and petrochemical and other bulk supply pipelines;	The project involves the construction of a bulk water supply line to convey water to the site from a tie-in connected to a pipeline from the Rossing reservoir.
10.1 The construction of- ((b) public roads;	The project involves the construction of an alternative access road which will travel around the Arandis town to join the existing Trekkopje Road.
10.2 The route determination of roads and design of associated physical infrastructure where - (a) it is a public road;	

2.2.5 Other Relevant Namibian Legislation

Table 2-2 below provides a summary of other relevant environmental and social legislation considered in the preparation of this EA Report.

Table 2-2: Other applicable Namibia legislation

Sector	Law	Key Provisions and relevance to the Project
Transport	*Road Traffic and Transport Act, 1999 (No. 22 of 1999)*	This Act provides for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, and the control and regulation of road transport across Namibia's borders. Vehicles supplying goods and services to the project during construction and operation, including the delivery of wastes, will have to comply with the requirements of the Act.
	Road Traffic and Transport Regulations 2001	Chapter 6: Part 4 provides the regulations for the Transportation of Dangerous Goods. Parties undertaking the transport of hazardous waste must comply with the specified regulations.
Pollution / Waste	*Pollution Control and Waste Management Bill (3rd Draft September 2003)*	This Bill promotes sustainable development and provides for the prevention and regulation of the discharge of pollutants to the air, water and land; regulation of noise, dust and odour pollutions; and the establishment of a system of waste planning and management. General and hazardous (such as vehicle and machine lubricants, paints and solvents) waste will be generated during construction. General and hazardous waste will be treated and disposed of at the NMF.
	Atmospheric Pollution Prevention Ordinance (Ordinance 11 of 1976)	This Act provides for the prevention of the pollution of the atmosphere. Construction activities, creating dust near third parties, needs to be controlled in terms of the requirements of the Act.
Environmental / Conservation / Land	*National Heritage Act, 2004 (No. 27 of 2004)*	This Act provides for, *inter alia*, the protection and conservation of places and objects of heritage significance. A National Heritage Council has been established to identify, conserve, manage, and protect places and objects of heritage significance. Permits are required for the removal, damage, alteration or excavation of heritage sites or remains. Any person who discovers an archaeological site should notify the National Heritage Council. These aspects could be relevant during the construction activities of the proposed project and will require to be assessed.
	National Monuments Act 28 of 1969	This Act establishes a National Monuments Council and provides for the preservation of certain property as National Monuments and the maintenance of certain burial grounds.

Sector	Law	Key Provisions and relevance to the Project
	Nature Conservation Ordinance, 1975 (No. 4 of 1975)	This Ordinance consolidates and amends the laws relating to the conservation of nature; the establishment of game parks and nature reserves; and the control of problem animals. The Ordinance is expected to be replaced by the Wildlife and Protected Areas Management Act in the near future (latest draft 2018).
	The Nature Conservation Amendment Act, 1996 (No. 5 of 1996) and amended by Act No. 5 of 2017	The Act enables communities to apply to Government to be registered as a conservancy. The study area for the NMF Project site overlaps the #Gaingu Conservancy (refer to Section 5).
	Communal Land Reform Act, 2002 (No. 5 of 2002)	This Act provides for the allocation and administration of all communal land and makes provision for the prevention of land degradation and for mitigating the impacts of, amongst others, water provision on the natural environment. The Act gives certain rights to communal farmers and traditional authorities and makes provision for regulations to address issues pertinent to conservation and sustainable management of water and water courses, of woods and to the combatting and prevention of soil erosion. The NMF Project site is located on communal land owned by the Namibian Government, and the !Oe-≠Gân Traditional Authority enjoys a "right of use".
	Soil Conservation Act (Act 76 of 1969)	The Act makes provision for the prevention and control of soil erosion and the protection, improvement and conservation of soil, vegetation and water supply sources and resources, through directives declared by the Minister. Care is to be taken in identifying any potential impacts on soil, vegetation, water supply sources and resources by firstly trying to avoid these impacts. Where they cannot be avoided, - mitigation measures should be implemented to reduce the significance of the impact(s).
Hazardous Substances	*Hazardous Substances Ordinance, 1974 (No. 14 of 1974)*	These provide for the control of toxic substances which may cause injury, ill health or death of human beings. Various chemicals would be used and stored (paint, solvents) and hydrocarbons used during the construction and operational activities of all project components.
Labour	*Labour Act, 2007 (No. 11 of 2007) and its amendment: No. 2 of 2012*	These Acts stipulate, amongst other things, sound labour relations, employment equity, fair employment practices, training, minimum basic conditions of service, workplace health and safety and retrenchment. Compliance is enforced and monitored by the Ministry of Labour through the office of the Labour Commissioner.
	Social Security Act, 1994 (No. 34 of 199, as amended	
	Employees Compensation Act, 1995 (No. 5 of 1995)	
	Regulations relating to the health and safety of	These Regulations establish health and safety regulations for the workplace.

Sector	Law	Key Provisions and relevance to the Project
	employees at work (GN 156 of 1997)	
	Affirmative Action (Employment) Act, 1998 (No. 29 of 1998)	This Act aims to achieve equal opportunity in employment by redressing, through appropriate affirmative action plans, the conditions of disadvantage in employment experienced by persons in designated groups arising from past discriminatory laws and practices.
Electricity	*Electricity Act, 2007 (No. 4 of 2007)*	This Act provides the regulatory framework for the generation, trading, transmission, supply, distribution, import and export of electricity.
Health	*Public and Environmental Health Act 1 of 2015*	The Act aims to promote public health and wellbeing; prevent injuries, diseases and disabilities; protect individuals and communities from public health risks; encourage community participation in order to create a healthy environment; and to provide for early detection of diseases and public health risks. To this end, the Act contains several provisions relevant for environmental protection. The Act addresses integrated waste management in Part 9 and stipulates among others that in order to prevent environmental pollution and public health risks, local authorities must ensure that all waste generated is collected, disposed of and recycled in accordance with the requirements of all laws governing the management of the different waste streams. The Act came into operation in 2020.
Water Resources	*Water Resources Management Act No. 11 of 2013*	The Act provides for the management, protection, development, use and conservation of water resources, and the regulation and monitoring of water services among others. The objective of the Act includes to ensure that the water resources of Namibia are managed, developed, used, conserved and protected in a manner consistent with, or conducive to, specific fundamental principles including, among others, equitable access to safe and sufficient drinking water; the maintenance of the water resource quality for ecosystems; and the promotion of the sustainable development of water resources based on an integrated water resources management plan which incorporates social, technical, economic, and environmental issues. In terms of the Act a non-transferable licence is required for the abstraction and the use of water for industrial purposes. The Project includes the abstraction of groundwater as a water supply option for the Project.

2.2.6 Other Relevant Namibian Policies

The scope of this report is designed to comply with the requirements of the EMA and the EIA Regulations. It is however noted that several other policies, plans and statutes are potentially applicable to the implementation of the NMF Project, including (but not limited to):

- Electricity Act, 2007;
- Labour Act, 2007;

- Local Authorities Act, 1992;
- Namibia's Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1994);
- National Development Plan 5;
- National Integrated Resource Plan (NIRP 2016);
- National Forest Policy (1992);
- National Agricultural Policy (2015);
- National Land Policy, the National Resettlement Policy, the Agricultural (Commercial) Land Reform Act (1995);
- Land Tax and Communal Land Reform Act (2002);
- National Industrial Policy (2012);
- Policy for the Conservation of Biotic Diversity and Habitat Protection (1994);
- National Policy on Human Wildlife Conflict management (2009);
- Namibia's Climate Change Policy;
- The Namibia Vision 2030; and
- The Harambee Prosperity Plan (2021 -2025)

2.2.7 International Conventions

Relevant international conventions to which Namibia is a signatory are summarised below:

- Convention on Biological Diversity, 1992;
- United Nations Framework Convention on Climate Change, 1992;
- The Convention on International Trade in Endangered Species (CITES) of 1973;
- Convention to Combat Desertification 1994;
- National Rangeland Management Policy and Strategy of 2012;
- National Biodiversity Strategy and Action Plan 1 and 2 (draft);
- Vienna Convention for the protection of the ozone layer (1985);
- Montreal Protocol on substances that deplete the ozone layer (1987);
- United Nations Convention on Biological Diversity (UNCBD); and
- United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) 2007.

2.3 International Law and Standards

A broad range of Multilateral Environmental Agreements (MEAs) are pertinent to pollution control and waste. Namibia is a party to various prominent relevant conventions, including the following:

- The Stockholm Convention on Persistent Organic Pollutants (2001),
- The United Nations Framework Convention on Climate Change (1992) and
- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989).

With regard to transboundary pollution the legal and policy framework of the Southern African Development Community (SADC), to which Namibia is a party, also contains some relevant provisions. The SADC Protocol on Health contains a provision on environmental health, which seeks for cooperation among member states in addressing regional environmental health issues and other concerns, including toxic waste, waste management, port health services, pollution of air, land and water, and the degradation of natural resources (Ruppel-Schlichting, 2022).

3.0 Environmental Impact Assessment Approach and Methodology

This chapter provides the details of the EIA Project Team, describes the EIA process and methodology, and outlines the EIA assumptions and limitations.

3.1 Details of the EIA Project Team

SLR has been appointed as the independent EAP to undertake the required EIA process for the NMF Project proposed by Namwaste. SLR has no vested interest in the proposed Project other than fair remuneration for the work completed as part of the EIA process. The details of the team including EAPs and specialists undertaking the EIA process are provided in Table 3-1.

Table 3-1: Overview of the EIA Team

Details			
EIA Team			
Name of the practitioner	Natalie Kohler	Matthew Hemming	Stephanie Strauss
Role	Project director	Technical review	Project manager and EAP
Contact	+264 61 231 287		+264 61 231 287
Postal address.:	PO Box 86386, Windhoek		
E-mail address	namwaste@slrconsulting.com		
Environmental and Social Specialists			
Aspect	**Consultant**	**Name**	
Air Quality	SLR	Lisa Ramsay	
Visual	Graham A Young Landscape Architect	Graham Young	
Heritage	RC Heritage Services	Alma Nankela	
Terrestrial Biodiversity	Henriette Potgieter	Henriette Potgieter	
Soils and Agriculture	The Biodiversity Company	Andrew Husted	
Socio-economic	SLR	Duncan Keal	
Traffic	Burmeister and Partners	Perez Goseb	
Hydrology	SLR	Meeressa Pillay	
Hydrogeology	SLR	Nansunga Kambinda	

Curriculum Vitae of the EIA Team are included in Appendix A.

Natalie Kohler

SLR Consulting – Principal Environmental and Social Advisor

Project director

Natalie has over 16 years consulting experience in mainly Africa and Europe and has led and managed teams across multiple sectors as part of a broad range of projects, including ESIA, strategic environmental assessments, feasibility studies and waste management. Natalie has also been involved in a range of environmental compliance (regulatory and corporate standards assessments) and due diligence (DD) audits, as well as assessments in terms of the South African, best practice and International Finance Corporation (IFC) standards. Natalie has completed numerous projects in Southern Africa (South Africa, Botswana, Mozambique, Namibia), Central Africa (DRC, Zambia), East Africa (Uganda, Tanzania, Kenya, Ethiopia), West Africa (Cameroon, Ghana) and North Africa (Egypt) as well as Europe and the Middle East (UAE), in a variety of sectors including mining, oil and gas, energy/power, infrastructure industrial, waste and agriculture. These projects were conducted in line with, where applicable, corporate standards, national environmental legislations, and/or international requirements.

Matthew Hemming

SLR Consulting – Technical Director

Technical review

Matthew has over 17 years' experience as an Environmental Assessment Practitioner within the environmental consulting field. Matthew is well versed in the authorisation and compliance requirements of all South African environmental legislation. He has managed a wide range of licensing projects including environmental authorisations, water use license and waste management license applications, mainly in the oil and gas exploration, waste management, mining, industry and electricity generation sectors. His role included project management and coordination; specialist and engineering team management; environmental impact assessment; and coordination, facilitation and undertaking of stakeholder engagement processes, including for contentious projects. Over the past few years Matthew's focus has been on assisting clients in the waste management and oil and gas field sectors. He has had involvement in site screening processes for a number of waste and onshore gas projects.

Stephanie Strauss

SLR Consulting – Associate Environmental Consultant

Project manager and Environmental Assessment Practitioner

Stephanie is an Associate Environmental Consultant with SLR and has nine years of experience as an Environmental Assessment Practitioner within the environmental consulting field in Namibia. Stephanie has been involved in several EIAs for projects in various sectors. Stephanie has worked on a variety of authorisation and auditing processes within various sectors. Key projects experience includes Environmental Assessments for urban development projects, road rehabilitation, telecommunication, waste management, and infrastructure development, mining and exploration projects. She has conducted numerous public participation and stakeholder engagement activities relevant to the projects. Stephanie also has experience in environmental compliance monitoring and auditing for projects.

Werner Petrick

SLR Associate

Technical Advisor

Werner is an SLR Associate with over 24 years of experience in engineering and environmental management, principally in Namibia. Werner's experience is based on work conducted as a consultant as well as working for industry. His key projects are related to mining and power generation. Sectors of his experience includes exploration or production phases of large mining projects, power generation including renewable power initiatives and hybrid power plants, transmission lines, water supply & sanitation, petrochemical industry, linear infrastructure including roads and rail, port related projects, chemical handling and storage, large irrigation projects and other. Werner has worked on many assessments for large and complex projects in Namibia.

3.2 Environmental Impact Assessment Process

3.2.1 Overview

The EIA process consists of a series of steps to ensure compliance with the objectives and the EIA Regulations, commencing formally with the Scoping phase and completing with the Impact Assessment phase. The EIA process involves an open, participatory approach to ensure that impacts are identified, and that decision-making takes place in an informed, transparent and accountable manner.

The EIA process for the NMF Project has been undertaken in three phases:

- Project Initiation/Screening phase (completed);
- Scoping phase (completed); and
- Impact Assessment phase (current, *FEIR submitted*).

A summary of the approach, key steps and corresponding activities in each phase of the EIA process are outlined in the following Sections.

3.2.2 Screening, project initiation and application phase

The Screening phase for the NMF Project has been completed. This phase of the study included the following tasks:

- Project inception and initiation meetings held between SLR and the Namwaste team;
- A site visit undertaken by SLR on 8 and 9 March 2023;
- Early identification of environmental and social aspects and potential impacts associated with the proposed Project activities at alternative sites;
- Technical investigations;
- Identification of key stakeholders to be involved in the EIA process; and
- Confirming the following:
    - The list of activities, according to the EIA Regulations, that may not be undertaken without an ECC;
    - The approach to stakeholder engagement; and
    - The Scoping phase requirements.
- Compiling a Technical Feasibility Report (SLR, August 2023) outlining the above.

Based on the outcome of the Screening phase, SLR compiled the "Application for Environmental Clearance" and submitted this as both a hard copy (with revenue stamp) and electronically via the MEFT portal.

3.2.3 Scoping Phase

The Scoping phase for the NMF Project has been completed. It resulted in the MEFT's acceptance of the Scoping Report in March 2024.

3.2.3.1 Public Participation

As part of the Scoping phase, SLR undertook a public participation process to inform potential I&APs of the proposed Project, notify them of the EIA process, provide an initial understanding of the environmental and social baseline and project risks, and to invite registrations in the I&AP database and receive initial representations.

The Scoping phase public participation included the placement of site notices and public newspaper notices, the distribution of written notices (including an Executive Summary of the Scoping Report) to I&APs, hosting of a public meeting and focus group meetings with key stakeholders. Registered I&APs were invited to comment on the draft Scoping Report which was made available for review from 15 November 2023 to 15 December 2023. Relevant details and evidence of this process were included in the Scoping Report (SLR, January 2024).

3.2.3.2 Scoping Outcomes

The Scoping phase (November 2023 – January 2024) accomplished the following tasks:

- A draft Scoping Report was compiled documenting the following:
    - Relevant policies and legislation applicable to the proposed project was identified and key gaps within the environmental and social legislation were determined;
    - Baseline environmental and social information;
    - Key environmental and social issues to be addressed in the Impact Assessment phase;
    - The level of assessment to be undertaken (i.e. terms of reference for specialist studies), including the methodology to be applied, the expertise required, as well as the extent of further consultation during the Impact Assessment phase;
- All written comments received on the draft Scoping Report were collated and responded to in a Comments and Responses Report, and the Scoping Report was updated to address the I&AP comments.
- The final Scoping Report was submitted to the MEFT on 15 January 2024 for review.
- The Scoping Report was accepted by the MEFT on 5 March 2024 (Appendix C). This enables the EIA process to proceed to the Impact Assessment phase in terms of Section 35(1)(b) of the EMA.

3.2.4 Impact Assessment phase

On approval of the Scoping Report, and thus the proposed terms of reference for further (specialist) investigations, SLR initiated the Impact Assessment phase of the EIA process.

3.2.4.1 Specialist Studies

The specialist studies undertaken confirmed the potential impacts identified, as well as any additional impacts and determined the significance of these impacts on the environment. The following specialist assessments were conducted:

- Soils and agriculture impact assessment;
- Air quality impact assessment;
- Visual impact assessment;
- Traffic impact assessment;
- Hydrological impact assessment;
- Hydrogeological impact assessment;
- Terrestrial biodiversity and ecological impact assessment;
- Socio-economic impact assessment; and
- Heritage impact assessment.

The reports from the specialist assessments are attached to this EIA Report in Appendices D to M.

3.2.4.2 Compilation of EIA Report

This EIA Report has been prepared in compliance with Section 15(2) of the EIA Regulations (see Table 3-2) and incorporates the findings of the specialist studies and the assessment of the potential impacts identified.

Table 3-2: Requirements of an EIA Report in terms of the EIA Regulations

Section 15(2)	Content of EA Report and EMP	Completed (Y/N or N/A)	Section in this report
(a)	The curriculum vitae of the EAP who compiled the report;	Yes	Section 3.1
(b)	A detailed description of the proposed listed activity;	Yes	Section 5.0
(c)	A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;	Yes	Section 6.0
(d)	A description of the need and desirability of the proposed listed activity and identified potential alternatives to the proposed listed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;	Yes	Section 4.0
(e)	An indication of the methodology used in determining the significance of potential effects;	Yes	Section 7.0
(f)	A description and comparative assessment of all alternatives identified during the assessment process;	Yes	Section 5.8
(g)	A description of all environmental issues that were identified during the assessment process, an assessment of the significance of each issue and an indication of the extent to	Yes	Section 7.0

Section 15(2)	Content of EA Report and EMP	Completed (Y/N or N/A)	Section in this report
	which the issue could be addressed by the adoption of mitigation measures;		
(h)	An assessment of each identified potentially significant effect, including:	Yes	Section 7.0
	(aa) cumulative effects;		
	(bb) the nature of the effects;		
	(cc) the extent and duration of the effects;		
	(dd) the probability of the effects occurring;		
	(ee) the degree to which the effects can be reversed;		
	(ff) the degree to which the effects may cause irreplaceable loss of resources; and		
	(gg) the degree to which the effects can be mitigated;		
(i)	A description of any assumptions, uncertainties and gaps in knowledge;	Yes	Section 3.2.5
(j)	An opinion as to whether the proposed listed activity must or may not be authorised, and if the opinion is that it must be authorised, any conditions that must be made in respect of that authorisation; and	Yes	Section 8.3.1
(k)	A non-technical summary of the information.	Yes	Executive Summary

3.2.4.3 Compilation of Environmental Management Plan

Regulation 8(j) of the EIA Regulations, promulgated in 2012, requires that an Environmental Management Plan (EMP) be included as part of the EIA process. A ‘management plan’ must include –

> *"A description of the manner in which the applicant intends to modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation remedy the cause of pollution or degradation and migration of pollutants."(Section 8(j)(cc))*

A *final EMP is included as Appendix N* and provides management measures to be undertaken to address the environmental impacts identified in the EIA Report and ensure that the impacts on the environment are avoided or limited, where they cannot be avoided completely.

3.2.4.4 Public Participation

The Public Participation Process (PPP) for the Impact Assessment phase aimed to present the findings of the impact assessment that was undertaken for the impacts that were identified during the Scoping phase to the stakeholders that may be affected by, or are interested in, the proposed NMF. Building from there, the PPP provided opportunities to I&APs to be informed of the issues in relation to the project and to register their views and concerns.

3.2.4.4.1 Stakeholders

Stakeholders registered on the Project’s I&AP database to date are provided in Table 3-3.

Table 3-3: NMF Project Stakeholders

No.	Stakeholder
1.	Ministry of Environment, Forestry and Tourism (MEFT)
2.	MEFT: Department of Environmental Affairs
3.	MEFT: Division of Environmental Assessment, Waste Management and Pollution Control, and Inspections (EAWMPCI)
4.	Ministry of Mines and Energy (MME):
5.	MME: Energy Directorate
6.	Ministry of Agriculture, Water and Land Reform
7.	Ministry of Regional and Local Government, Urban and Rural Development
8.	Ministry of Industrialisation, Trade and SME (Small and Medium Enterprise) Development
9.	Ministry of Works and Transport
10.	MWT: Department of Transport
11.	Ministry of Health and Social services
12.	National Radiation Protection Authority
13.	NamWater
14.	NamPower
15.	Electricity Control Board: Head Office
16.	ErongoRed
17.	National Heritage Council of Namibia
18.	Namibia Roads Authority
19.	Namibia Chamber of Environment
20.	Arandis Town Council
21.	#Gaingu Conservancy
22.	Oe-≠Gân Traditional Authority
23.	Orano Mining
24.	Namibia Scientific Society
25.	Earthlife Namibia
26.	Namibia Nature Foundation
27.	National Botanical Research Institute
28.	Chaneni Investment (Pty) Ltd
29.	Langer Heinrich Uranium
30.	*Sinomine Tsumeb Smelter*

3.2.4.4.2 Opportunity to comment

The draft EIA Report *was* distributed for a 21-day comment period from **09 August 2024 to 02 September 2024** to provide I&APs with an opportunity to comment on any aspect of the proposed Project and the findings of the EIA process. A draft EMP was made available to I&APS during the EIA review period.

Copies of the draft EIA Report *were* available electronically on the SLR website (https://www.slrconsulting.com/en/public-documents/) and in hard copy at the following location:

- Arandis Library.

The link to download the draft EIA Report (main report with appendices) *was* distributed via email to all authorities and I&APs (with e-mail addresses) that are registered on the Project's public consultation database (Appendix B).

Hard copies of the draft EIA report *were* provided to the:

- #Gaingu Conservancy; and
- Oe-≠Gân Traditional Authority.

Bulk text messages were sent to I&APs notifying them of the availability of the draft EIA Report for review.

During the review period of the draft EIA Report, focus group meetings and a public meeting were held with key stakeholders / I&APs. These meetings were undertaken as follows:

- *21 August 2024 – Meeting with the Oe-≠Gân Traditional Authority (Usakos)*
- *22 August 2024 – Meeting with the Gaingu Conservancy (Spitzkoppe)*
- *22 August 2024 – Public meeting (Arandis)*
- *23 August 2024 – Meeting with Orano Uranium Mine (Swakopmund)*

Minutes of these meetings are included in *Appendix B.* All comments received during the review period *have been* collated into a Comments and Response Report included in this *FEIR.*

Namwaste held a range of consultations with the Arandis Town Council during the course of project development and the EIA process. The section below provides a summary of the consultation undertaken by the proponent with the Arandis Town Council (see Appendix B for proof of consultation):

- *18 July 2023: Letter to the TC to request consent for the construction of the site.*
- *6 September 2023: Initial presentation of the project to the TC, including the alternative road.*
- *13 September 2023: Letter to ATC to ask for feedback about the alternative road.*
- *7 December 2023: Public meeting the present the scoping report.*
- *14 December: Letter from ATC with some comments on the scoping report to decline the proposal of the project.*
- *11 January 2024: Letter form SLR requiring some additional information or confirmation about the town's boundaries.*
- *30 January 2024: Meeting with Mr. Norris and Mr. Strauss.*
- *15 February: Meeting with Mr. Norris*
- *29 February 2024:*
  - *Technical meeting with ATC (and our consultants, B&P) about the routings of the road, the power line and the water pipe.*
  - *Visit of the possible connection points for water and electricity*.
- *15 March 2024: Meeting with Mr. Norris.*

- *22 April 2024: Request for a consent letter.*
- *29 April 2024: Meeting with Mr. Norris*
- *8 May 2024: Technical meeting with Om'Khumo.*
- *16 May 2024: Meeting with the Governor of Erongo Region.*
- *3 June 2024: Meeting with the Mayor and some Councillors.*
- *9 July 2024: Meeting with the Mayor and the full Council and Mr. Norris.*
- *12 July 2024: Technical meeting with all ATC and RAD's consultants.*
- *15 July 2024: Written request for a consent letter.*
- *22 July 2024: Technical meeting with ATC and RAD's consultants to discuss road solutions.*

To date, consent for supporting project infrastructure within Arandis Townlands has not been obtained from the ATC despite the above consultation process.

3.2.5 Assumptions and limitations

While every effort has been made to compile a robust assessment of the environmental and social risks associated with the proposed Project, there remain certain assumptions, uncertainties and limitations which are applicable to the assessment in general as well as to each of the individual specialist assessments. In addition to the specific assumptions and limitations relevant to each specialist assessment (refer to Appendix D to Appendix M), the EIA includes for the following:

- SLR assumes that all relevant project information has been provided and that it was correct and valid at the time it was provided;
- It is assumed that the Project site identified for the proposed Project represents a technically feasible site for the construction and operation of a Waste Management Facility based on the design presented by a registered, professional civil engineer;
- The assessment is limited to consideration of the Project site, components and listed activities as detailed in the EIA Report. Should any additional infrastructure be proposed in future this may require additional assessment and/or separate application process(es); and
- No significant changes to the project description or surrounding environment between the completion of the EIA process and implementation of the proposed Project that could substantially influence findings and recommendations with respect to mitigation and management will occur.

4.0 Project Need and Desirability

Namibia has entered a period of economic growth in recent years. In 2023, the country's economy grew by 4.2%, mainly driven by the mining sector and investments in oil exploration (The World Bank, 2024). As activities in the mining, offshore oil and gas, and green hydrogen sectors continue to increase in response to global market conditions, further growth is expected in years to come. Development related to these industries is likely to result in population growth (naturally and through in-migration from other counties), increasing levels of urbanisation in towns linked to development nodes and improved economic status for those engaged with the developments.

It is generally accepted that increased economic activity and production, as well as increased population, urbanisation and improved economic status, lead to increased waste production. The increasing volumes of waste will necessitate greater inputs and efforts into waste management services and infrastructure.

The management of waste from growing industrial sectors such as the mining and offshore oil and gas sectors is of particular concern in light of the existing shortage of suitable facilities for the treatment and disposal of general and hazardous waste in Namibia, as evidenced by the waste stockpiles which exist on many of the mines and other industrial sites in the country.

According to the MEFT (2017) waste disposal is one of the major concerns within the solid waste management system in Namibia and the country is currently serviced by only two hazardous landfill sites which accept waste from industrial sources for disposal. The Kupferberg facility in Windhoek reportedly has 2 years airspace remaining, and the facility in Walvis Bay is not an engineered disposal facility. The anticipated increase in waste generation due to increased economic activity further exacerbates the pressing need for suitable facilities to manage general and hazardous waste from industry.

The Namibian Pollution Control and Waste Management Policy (2003) recommends the use of environmentally safe measures and best practice to reduce, reclaim, recycle and dispose of hazardous waste. The treatment, recovery (where feasible) and disposal of waste to engineered, sanitary landfills are best practice and is socially and environmentally just. Doing so protects human health, living conditions, the environment and ensures that ecosystems services are not compromised.

The proposed NMF would service the mining, oil and gas, meat processing, construction and other industrial and business sectors, allowing for treatment and disposal of waste from clients across the country. The majority of the waste which would be treated and/or disposed at the facility would be hazardous, and as such would support the objective to implement feasible options for hazardous waste management in Namibia as outlined in the National Solid Waste Management Strategy (MEFT, 2017). The NMF would offer the opportunity for disposal of general waste from surrounding communities, such as the nearby town of Arandis.

The location of the NMF was selected to minimise risk to environmental and social receptors. The EIA process has considered potential social, economic and biophysical impacts that could result through the implementation of the proposed NMF. Section 7.0 of this EIA Report sets out the project issues and impacts that have been assessed. Measures to avoid, minimise and/or remedy potential impacts on and/or degradation of the environment that may occur as a result of the proposed NMF are presented in the EMP Report (Appendix N).

The development of the proposed NMF would generate approximately 50 employment opportunities during the initial construction period and approximately 20-25 construction jobs every 2 years for a period of 6 months during the construction of new disposal cells. Furthermore, during operation, 20-25 permanent employment opportunities are expected to be created on average, comprising of both skilled and unskilled jobs. The local communities would be given due consideration related to employment opportunities. In addition, training and skills development would be offered to employees.

The Namibian Vision 2030 policy aims to develop wealth and prosperity among the population while taking cognisance of the importance of protecting biodiversity in this process (Namibia Vision 2030, 2004). This aligns with the Séché Environnement Group's approach to the preservation of biodiversity, which has been one of the Group's core values since its inception over 40 years ago. A dedicated team of ecologists drive sustainable development by linking the landscape, biodiversity and environment into all activities of the Group. The development of this approach has evolved over time and Séché is now implementing biodiversity preservation and restoration programmes across operations internationally in alignment to its voluntary commitments to Act4Nature which are audited annually.

Accordingly, Namwaste would implement programmes to restore, preserve and enhance biodiversity around the proposed NMF, in consultation with the local community and the #Gaingu Conservancy. Biodiversity preservation and restoration would be incorporated into the design and ongoing development and management of the NMF.

5.0 Project Description

This chapter introduces the applicant, provides an overview of the NMF project, its location, and provides a detailed description of the various components and supporting infrastructure.

5.1 Details of the Applicant

The application for an ECC has been lodged by Namwaste (Pty) Ltd, contact details are provided in Table 5-1. Namwaste is a subsidiary of the Rent-A-Drum Group, which is majority owned by the Séché Environnement Group. Refer to Section 1.1 for details.

Table 5-1: Applicant details

Details	
Company	Namwaste (Pty) Ltd
Relevant representatives	Thierry Provendier
Tel:	+26461 244 097
Postal address	PO Box 30735, Pionierspark, Windhoek
Email	namwaste@rent-a-drum.com.na

5.2 Project Overview

Namwaste proposes to develop the NMF as a new general and hazardous waste treatment and disposal facility in the Erongo region, which will address the pressing shortage of solutions for industrial general and hazardous waste management in Namibia and contribute to the protection of the environment, whilst also creating employment opportunities and fostering economic growth.

5.2.1 Business cases

Namwaste (Pty) Ltd is considering two business cases for the NMF, which are considered and assessed in the EIA as follows:

- Business case 1 entails the facility receiving approximately 60 000 tonnes of waste per year, where approximately 50% of the waste received would be arsenic waste; and
- Business case 2 entails the facility receiving approximately 30 000 tonnes of waste per year and no arsenic waste would be received.

The site footprint would remain the same for both business cases, thus the lifetime of the site would increase for Business Case 2 due to lower tonnages being received. The cells would remain as in Business Case 1 but would all be used for the disposal of general and other hazardous waste (i.e. not for disposal of arsenic waste). For Business Case 2, no warehouse for the offloading of arsenic waste would be required, no cement would be required to cover the arsenic dust big bags and no sand would be required to fill the gaps between the big bags. The cells would not contain a hydraulic barrier and each sub-phase would be developed with only one leachate containment facility. The risk associated with the management of arsenic waste would be removed.

The impacts related to both Business cases have been assessed in the EIA.

5.2.2 Industries to be served and types of waste to be accepted

The NMF will service the mining, oil and gas, meat processing, construction and other industrial and business sectors and will accept general and hazardous waste, allowing for treatment and disposal of waste from clients across the country. The majority of the waste which will be treated and/or disposed at the facility will be hazardous in nature, but general waste and a very small quantity of municipal solid waste from nearby communities will also be accepted. Examples of typical waste streams which will be accepted for treatment include general waste, hazardous waste, arsenic waste (business case 1 only), dry residues remaining after waste from the oil and gas sector has been treated, contaminated soil, liquids, sludges, chemicals, hydrocarbon contaminated waste, asbestos waste and non-infectious abattoir waste.

5.3 Project Location

A potentially suitable site for the development of the NMF was identified based on the outcome of stakeholder consultation, a screening study (Environmental Compliance Consultancy, 2022) and a Technical Feasibility Study (SLR, 2023). The Project site is located ~50 km north-east of Swakopmund, ~15 km north-west of Arandis, along the Trekkopje Road (Orano Uranium Mine access road) in the Erongo Region, as shown in Figure 5-1. The Project site is approximately 1 500 ha in extent and the corner coordinates of the site are indicated in Table 5-2 below.

Table 5-2: Coordinates of Project site

Corner	Latitude	Longitude
1	22°16'50.92"S	14°52'4.75"E
2	22°15'14.49"S	14°55'12.35"E
3	22°16'14.30"S	14°56'6.64"E
4	22°18'3.10"S	14°52'48.81"E

As part of the site identification process, a Technical Feasibility Study (SLR, 2023) was undertaken to identify any potential fatal flaws and to identify the most suitable sections of the site for the development of a general and hazardous waste treatment and disposal facility. The study identified four potential areas within the site as most suitable for the development of the facility (PA1 – PA4), as shown in Figure 5-3 below. Based on the findings of the Technical Feasibility Study (discussed in detail in Section 5.8.2), Namwaste has refined a proposed footprint (based on PA4) of approximately 177 hectares for the NMF as shown in red hatching on Figure 5-4. The coordinates of the proposed footprint NMF are shown in Table 5-3.

Table 5-3: Coordinates of the proposed NMF footprint

Corner	Latitude	Longitude
1	22°17'48.71"S	14°53'1.28"E
2	22°16'54.46"S	14°53'42.23"E
3	22°16'47.45"S	14°54'15.04"E
4	22°17'6.38"S	14°54'27.31"E
5	22°17'52.41"S	14°53'3.63"E

The NMF Project footprint is not underlain by any formal land parcel and is defined as 'communal ground', located in the #Gaingu Conservancy. The land is owned by the Namibian Government, and the !Oe-≠Gân Traditional Authority enjoys a "right of use".

Supporting infrastructure (water supply pipeline, electrical supply pipeline and access road) will be developed as part of the NMF Project. The water supply pipeline and electrical supply powerline will travel from the NMF Project site along the Trekkopje Road until Arandis. Within Arandis the infrastructure (water supply, electrical supply and access road) will be developed to the east of the town as shown in Figure 5-2.

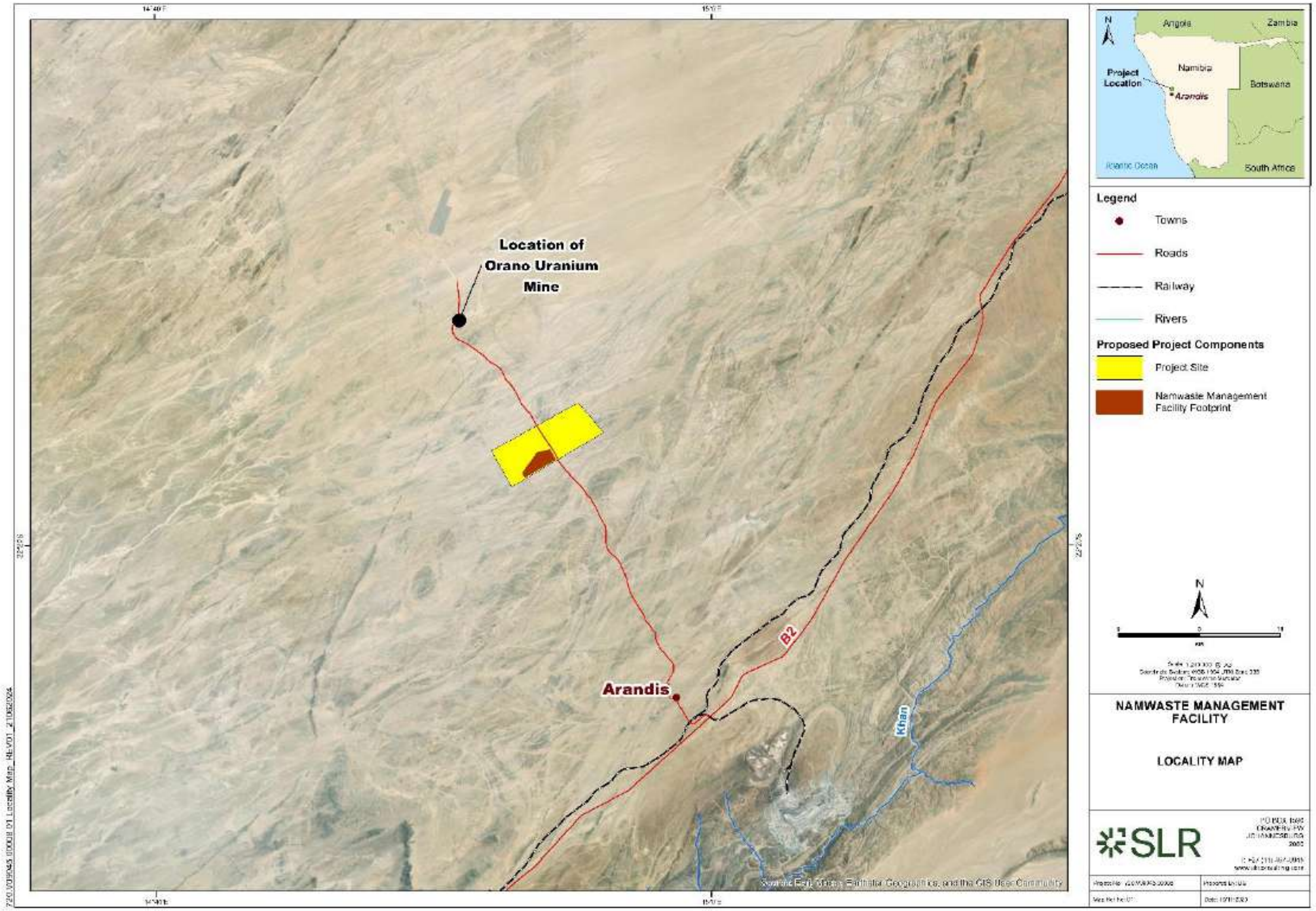

Figure 5-1: Locality of Project site

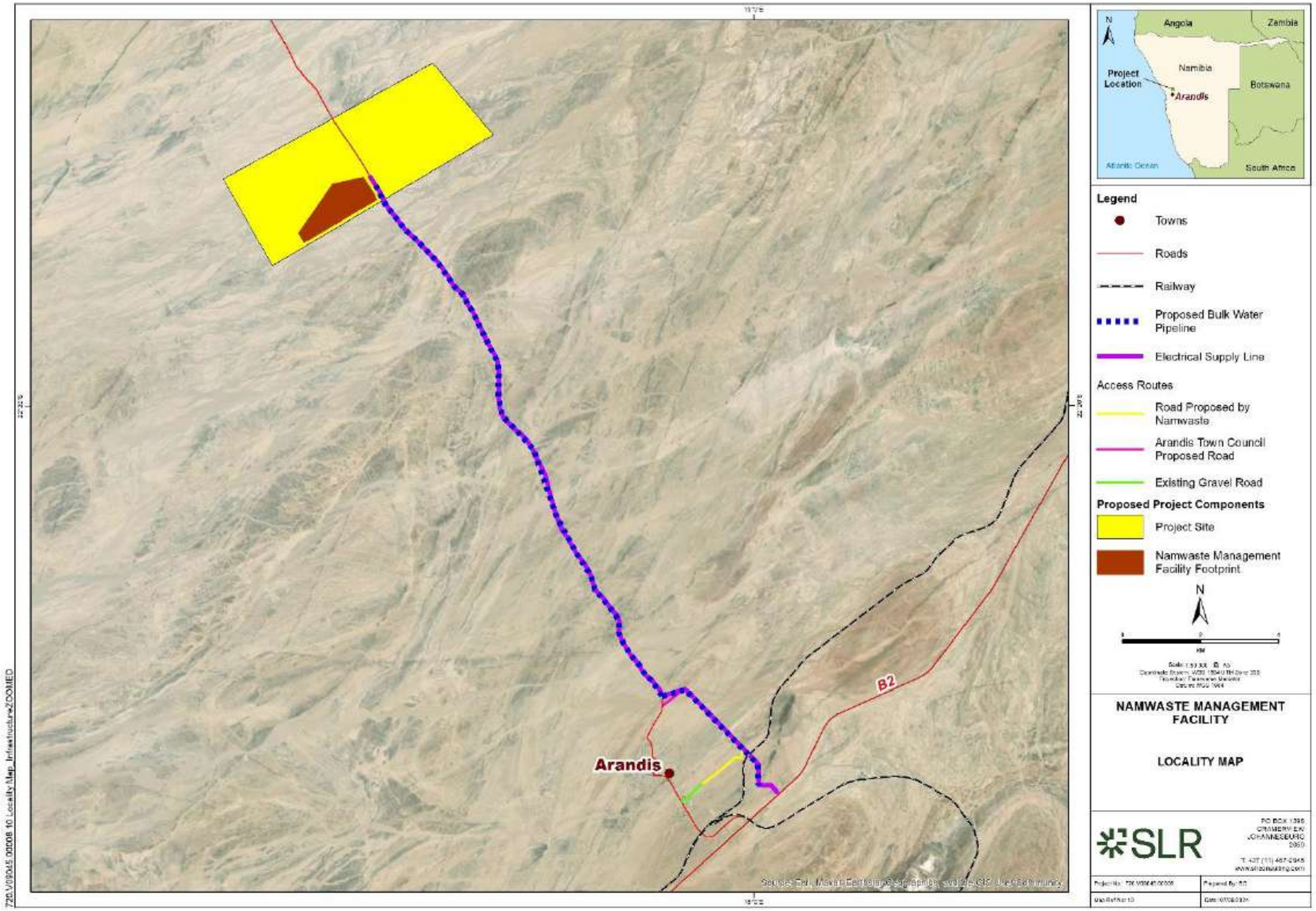

Figure 5-2: Locality of Supporting Infrastructure

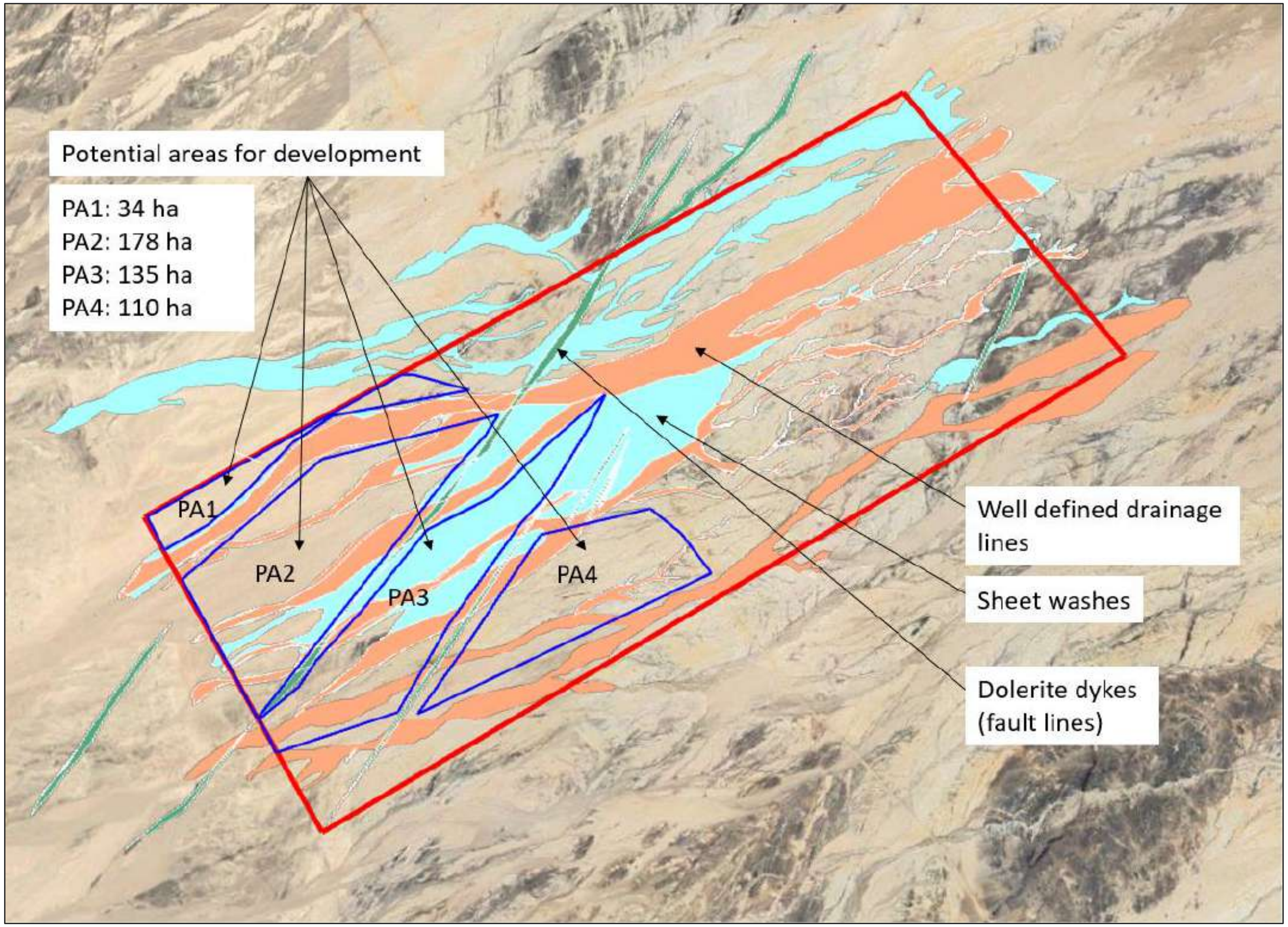

Figure 5-3: Potential areas most suitable for the development of a general and hazardous waste treatment and disposal facility

(Source Technical Feasibility Study (SLR, 2023))

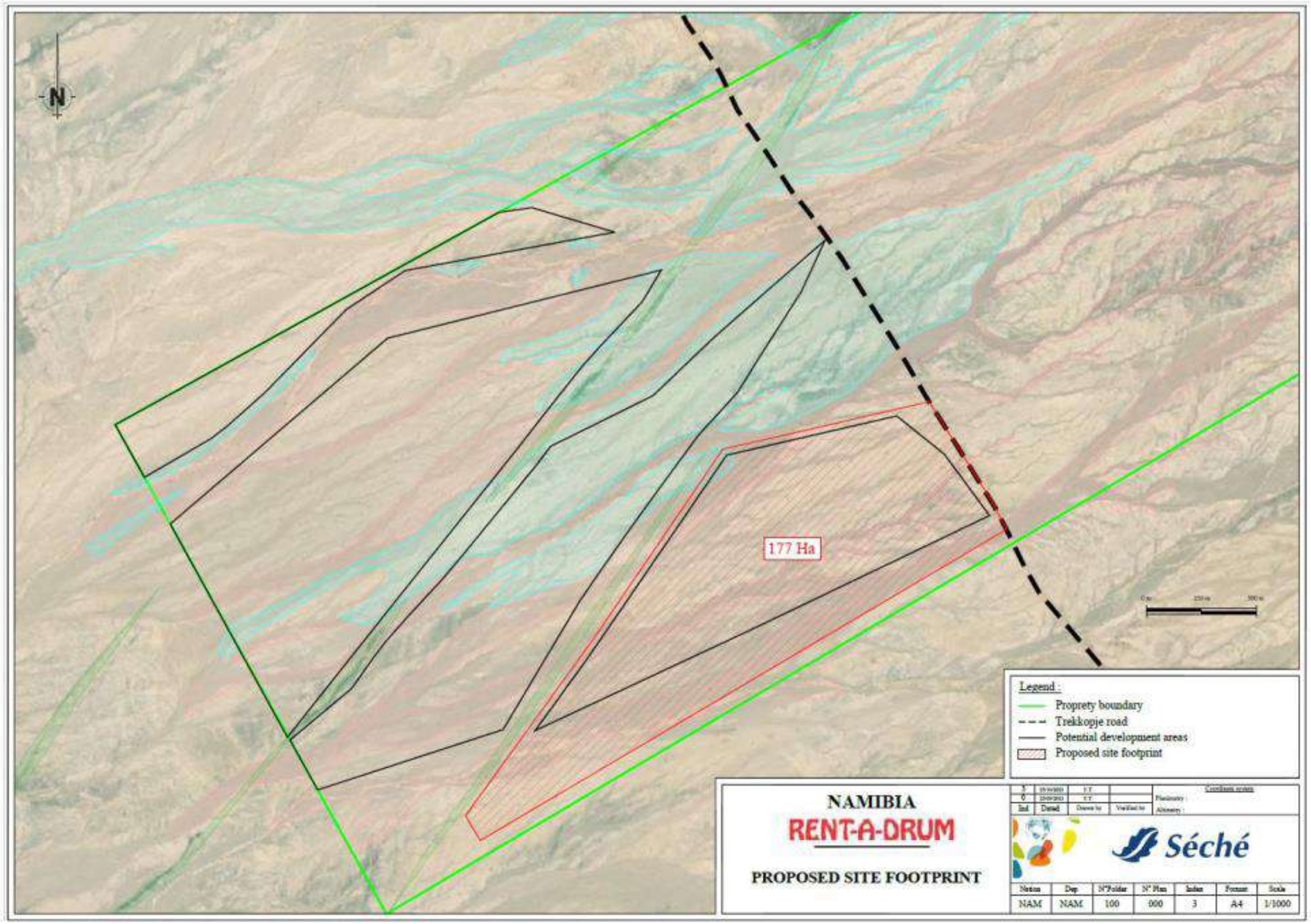

Figure 5-4: Proposed NMF footprint

5.4 Project Components

The proposed NMF will include waste treatment and disposal facilities as well as all required ancillary infrastructure in order to facilitate management of general and hazardous waste in terms of applicable regulations and market requirements. The main project components of the NMF are listed below:

- Landfill, developed in phases for disposal of:
  - General and hazardous solid and (pre-treated) liquid waste;
  - Arsenic waste.
- General and hazardous waste treatment facilities:
  - Warehouse with a concrete slab for off-loading of arsenic waste in bulk bags;
  - Waste treatment facility (a series of concreted, lined, bunded, treatment bays under roof used to blend treatment additives into wastes streams that require treatment prior to disposal) with silos for storage of additives to be used in treatment (e.g., lime, cement, ferrous sulphate, ash and soil);
  - Landfill leachate collection and containment in suitable containment facilities;
  - Stormwater/ run-off management infrastructure for collection and containment of any contaminated water in suitable containment facilities;
  - Upstream cut-off drain to divert clean stormwater off site;
  - Laboratory to test and verify the make-up of incoming and/or treated waste as required;
- Ancillary Infrastructure:
  - Access road (~8 m wide) from the entrance of the industrial area of Arandis to Trekkopje Road (~5 km);
  - Access control facilities including perimeter fencing;
  - Weighbridges and control room;
  - Internal roads;
  - Yard for trucks and skips, fuel storage facilities (20 kL diesel storage tank);
  - Plant/vehicle washing bay and vehicle maintenance area with contaminated runoff control;
  - Workshop;
  - Electrical supply via underground cable and overhead lines (33kV) and substation (500kVA) connected to nearest supply in Arandis (overhead line approximately 16 km);
  - Bulk water supply pipeline (approximately 20 km long) to convey water to the site. The pipeline will connect to the existing pipeline from the Rossing Reservoir towards Arandis Town. Daily water consumption is estimated to be 150 m^3 per day;
  - On-site water storage at NMF (2 x 30 m^3 JOJO type tanks);
  - Boreholes for abstraction of water (50 m^3 per day);
  - Borehole water monitoring network;
  - Office block;

  - Parking area;
  - Staff dining and ablution facilities; and
  - Package sewage plant (all sewage generated on the site will be treated on site).

The listed activities in terms of the EIA regulations that are triggered by the proposed Project are outlined in Table 2-1, Section 2.2.4.

Namwaste developed a concept level layout and design for the NMF which was presented in the Scoping Report for assessment during this EIA. The conceptual design and layout were informed by technical feasibility studies undertaken which considered a range of legislative, technical, financial and environmental considerations.

The conceptual details have been subject to adjustment and updates to optimise the facility against ongoing technical feasibility studies and in response to the outputs of the specialist studies and impact assessment undertaken in the EIA phase. The final design and layout of the NMF are presented in the EIA Report. A detailed description of the key project components is provided in the sub-sections below.

5.4.1 Waste Treatment Facility

The waste treatment facility will allow for the treatment of waste prior to disposal thereof to landfill. The facility will have a roofed, impermeable and bunded operational area of approximately 3 500 m^2 and will be able to treat up to 500 tonnes of waste per day. The average tonnage to be treated per day will be approximately 100 tonnes.

The treatment will involve a variety of processes, which will take place in a series of specially constructed lined and bunded treatment bays. The processes are aimed at achieving:

- pH modification / correction and chemical stabilisation of leachable contaminant concentrations;
- Micro-encapsulation through treatment with agents with cementitious properties;
- Moisture correction through chemical reaction with materials with absorbent properties;
- Contaminant toxicity reduction through addition of suitable agents/chemicals.

All treatment methods and procedures will be predetermined by the internal Technical Services Department and will be implemented by on-site staff as directed by the Technical Services Acceptance Sheet (TSAS).

The treatment facility will consist of a pre-treatment storage area, two waste treatment areas and a post-treatment storage area.

The details of the two waste treatment areas are as follows:

- Treatment Area 1:
  - Incoming waste which requires pre-treatment will be off-loaded into appropriately lined concrete bays. The required treatment agents will be added to the bays as per the predetermined treatment method on the TSAS. An excavator will then be used to mix the contents of the bays. Once treatment has taken place, a sample will be taken and analyzed to confirm that the treatment has been effective. If the treatment has not been successful, the waste will be retreated.

- Treatment Area 2:
  - Incoming waste will be deposited in the pre-treatment storage area. A front-end loader (FEL) will be used to feed the waste into a hopper, which will feed the waste onto a conveyer. The conveyer will feed a waste mixer. Treatment agents will be added to the waste mixer from storage silos as per the predetermined treatment method on the TSAS. Once treatment has taken place, a sample will be taken and analyzed to confirm that the treatment has been effective. If the treatment has not been successful, the waste will be retreated.

After treatment, the treated waste will either be collected by third parties as recovered material for their processes or will be sent to the on-site disposal facility.

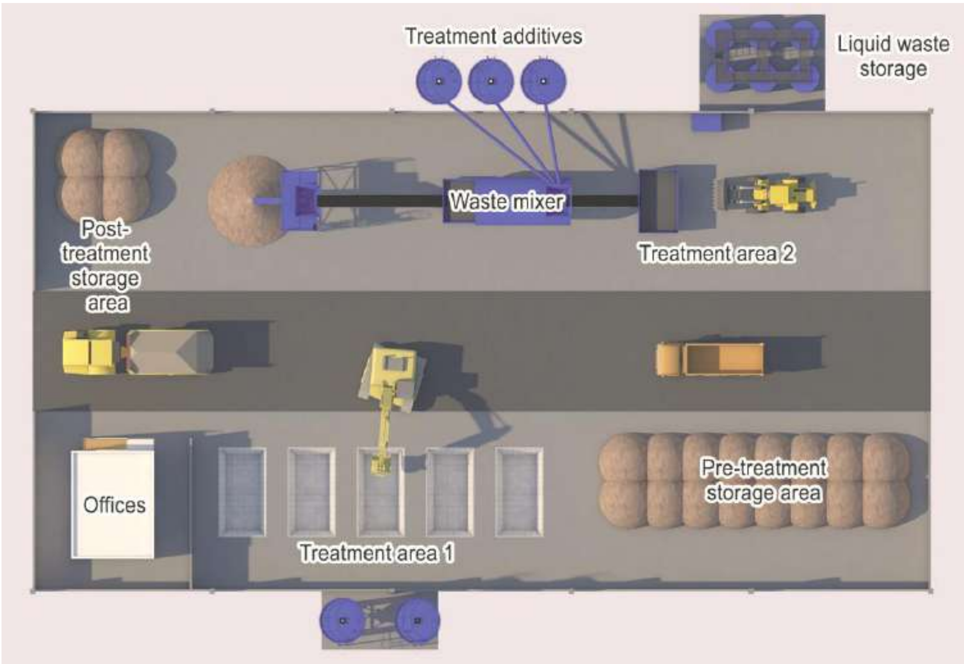

Figure 5-5: Conceptual layout of the waste treatment facility

5.4.2 Waste Disposal Facility and ancillary infrastructure

The waste disposal facility will receive approximately 600 tonnes of waste per day (including treatment additives). The facility will accept mainly hazardous waste, but general waste will also be accepted for disposal. The facility will have a containment barrier equivalent in performance to the South African Class A containment barrier standard in line with the *National Norms and Standards for Disposal of Waste to Landfill (GN 636, 2013).* The standard design of a Class A containment barrier as per GN 636 is shown in Figure 5-6 below. The maximum outflow rate of the containment barrier will be 10^{-9}m/s. Listed below are the typical elements making up the Class A containment barrier system:

- Leachate filter and collection layer
- Primary composite liner
- Leakage detection layer
- Secondary composite liner

- Subsoil drainage system (if required)

(a) Class A Landfill:

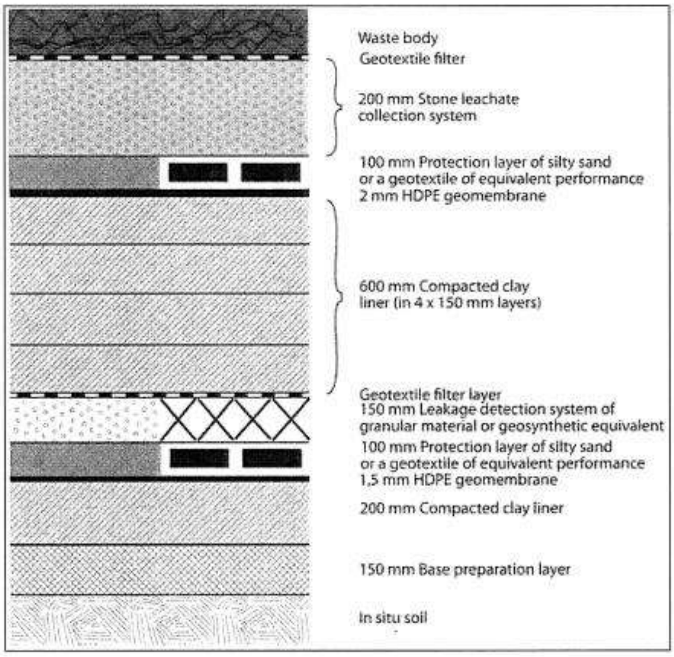

Figure 5-6: Standard containment barrier design of a Class A containment barrier in terms of the Norms & Standards for the Disposal of Waste to Landfill (GN 636 of 2013)

The waste disposal facility will provide an estimated 24 million m^3 of airspace for an estimated period of 62 years (at Business case 1 disposal rates), subject to market fluctuations. The facility will thus offer a long-term sustainable solution which will have capacity to support Namibia's economic growth. Should alternative technologies to landfill disposal become available in future, the footprint currently allocated to cell development could be used for development of the infrastructure required for the new technology.

5.4.2.1 Design and Capacity

The facility will be developed systematically and will comprise of two phases: Phase 1 and Phase 2. Phase 1 and Phase 2 have an approximate lifespan of 40 years and 22 years respectively using an initial deposition rate of 60 000m^3/year and an annual increase in waste volumes of 5%. Phase 1 will be spilt further into Phase 1A and 1B, with 1A being constructed first and having an approximately lifespan of 30 years. The construction of Phase 1B will only commence when Phase 1A is nearing its end of life and Phase 2 will only commence once Phase 1B is nearing its end of life.

Cells (areas that are excavated and lined with an appropriate containment barrier to receive waste) with volumes of approximately 160 000 m^3 per sub-cell will be constructed sequentially to make up phases (Phase 1 and 2) and sub-phases (Phase 1A, Phase 1B, Phase 2A, Phase 2B and Phase 2C) as indicated in the Cell Development Plan (Figure 5-7) and Phase 1A Cell Development Plan (Figure 5-8). Cells will be excavated to a maximum depth of approximately 3 m below natural ground level and the final height of the landform will be approximately 22.5 m from natural ground level (NGL). Waste to be disposed at the waste disposal facility will be directed to the active cell while the next cell is prepared by excavating, shaping and constructing the containment barrier to receive waste.

For Business Case 1, each cell will consist of two sub-cells, separated by a berm (hydraulic barrier). The first sub-cell will be used for the disposal of arsenic waste and the second sub-cell will be used for the disposal of general and other hazardous waste. Each sub-cell will have its own leachate management system as explained in Section 5.4.3. Two distinct landfilling methods will be implemented in the arsenic waste disposal sub-cell and the sub-cell used for disposal of general and other hazardous waste as explained in the following sub-sections. In Business case 2, the cells would not be subdivided with the hydraulic barrier and there would be a single leachate management system.

On completion of each phase, the side slopes will be shaped and intermediate capping will be placed as temporary cover until final closure. Phases will be capped and rehabilitated once complete. A typical capping system is shown in Figure 5-9. The capping system will be designed in the context of the desert environment and may not include a hydroseeded layer.

The first waste cells (arsenic and general/hazardous) will be constructed on the eastern portion of the Phase 1A footprint, with the future cells progressing to the west as airspace is required.

The Pollution Control Dams (PCD) for Phase 1A will be positioned to the west of Phase 1A, within the Phase 1B footprint, as per Figure 5-8. When the Phase 1B is required for landfilling, the PCDs will be decommissioned and reconstructed at the western boundary of Phase 1B as shown in Figure 5-10.

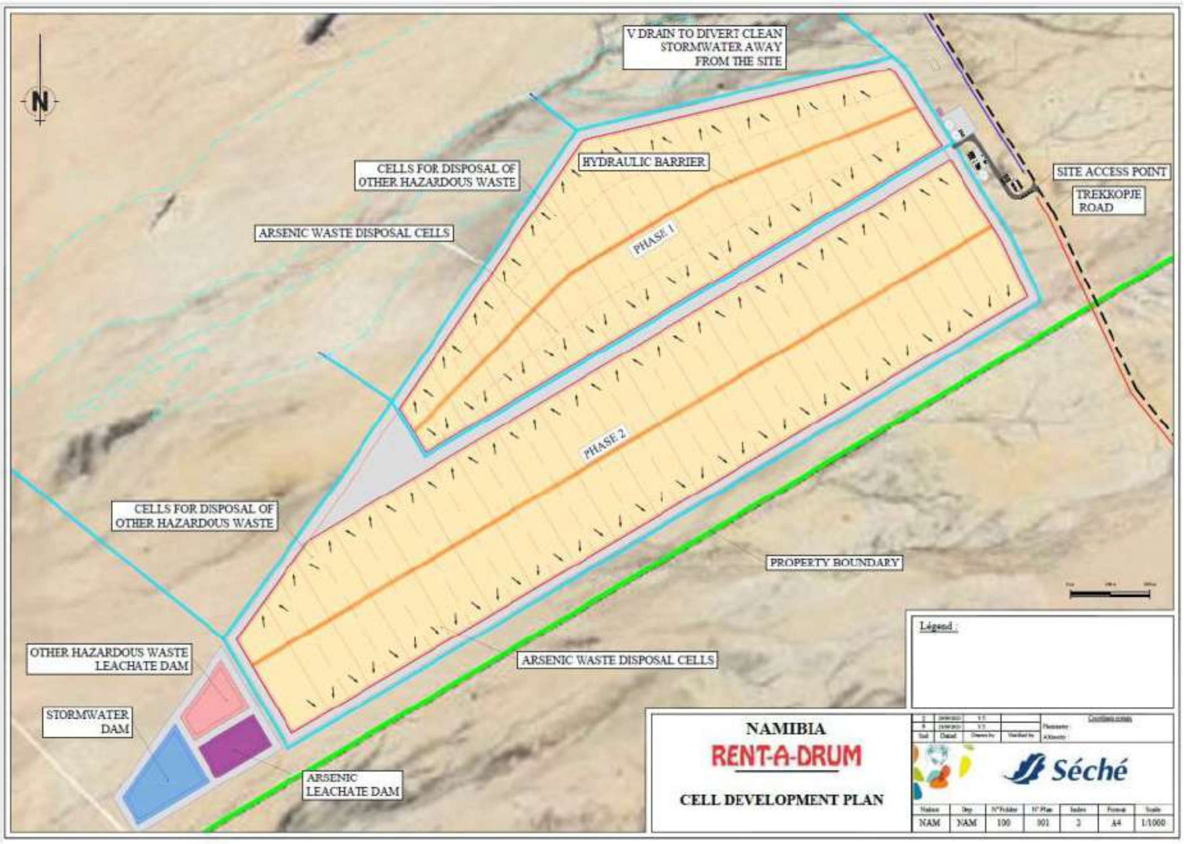

Figure 5-7: Cell development plan

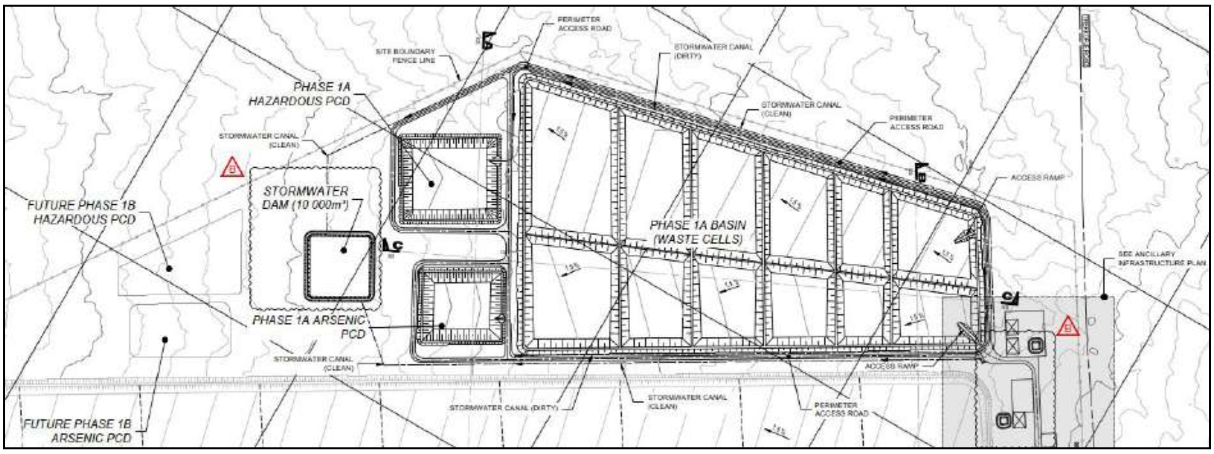

Figure 5-8: Phase 1A cell development plan for Business Case 1

Figure 5-9: Typical capping system

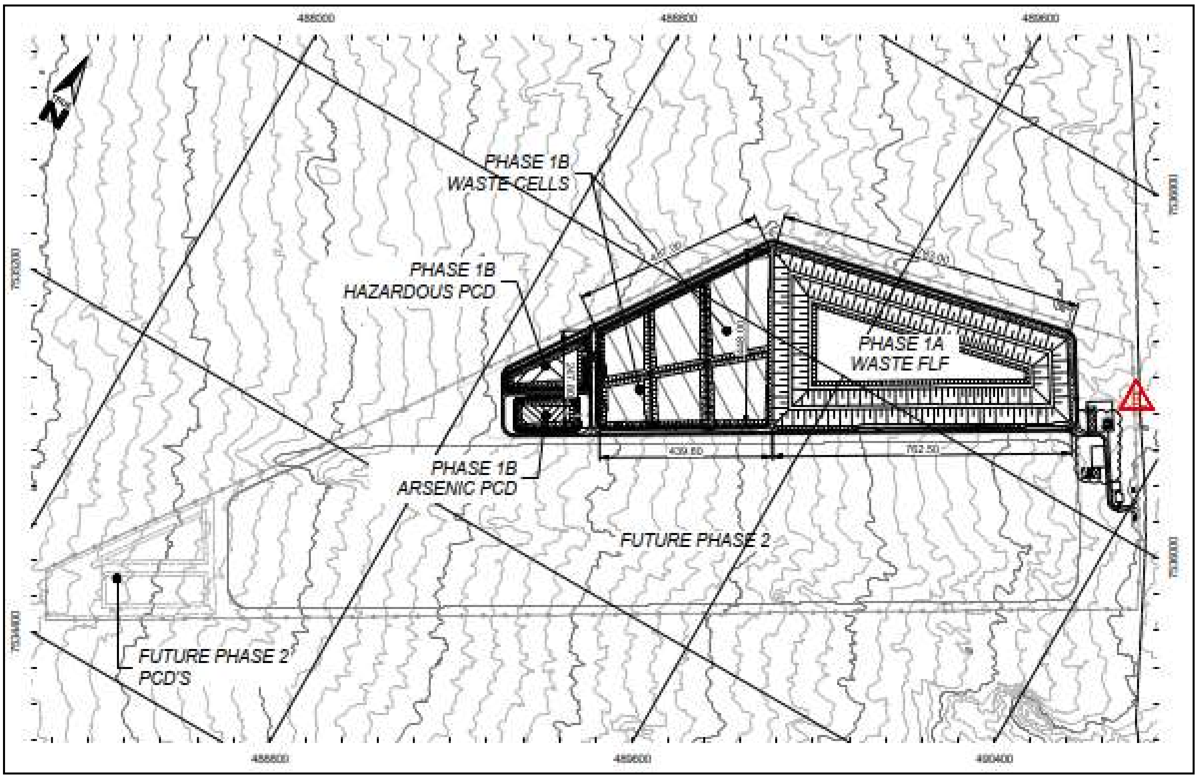

Figure 5-10: Final Phase 1 - General conceptual site layout

5.4.2.2 Landfilling method to be applied in arsenic waste disposal sub-cells

Assuming Business Case 1, the arsenic waste will be pre-packaged into waterproof big bags, such as UN13H3/Y big bags, shown in Figure 5-11 below, at the point of generation. These big bags have been designed for handling solid hazardous products (such as asbestos containing waste). The bags will be sealed as shown in Figure 5-12 and reinforced with the use of adhesive tape. In addition, this step will include labelling each bag to identify its contents to allow for the bag to be traced. The sealed bags will be secured on pallets and will be transported to the NMF on trucks.

Figure 5-11: Example of an UN13H3/Y big bag

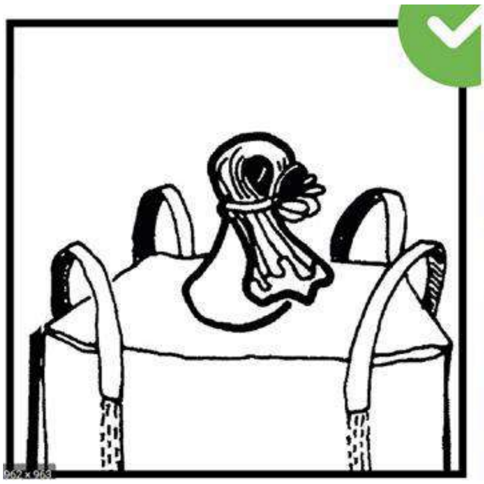

Figure 5-12: Big bag sealing method

Upon arrival at the NMF, the pallets containing the big bags will be offloaded in a warehouse with a concrete slab. A lowbed truck will be used to transport the big bags to the active arsenic waste disposal sub-cell. The big bags will then be packed in double layers, as shown in Figure 5-13 below. The gaps between the bags will then be filled with sand (sourced from cell excavations) during disposal (Figure 5-14).

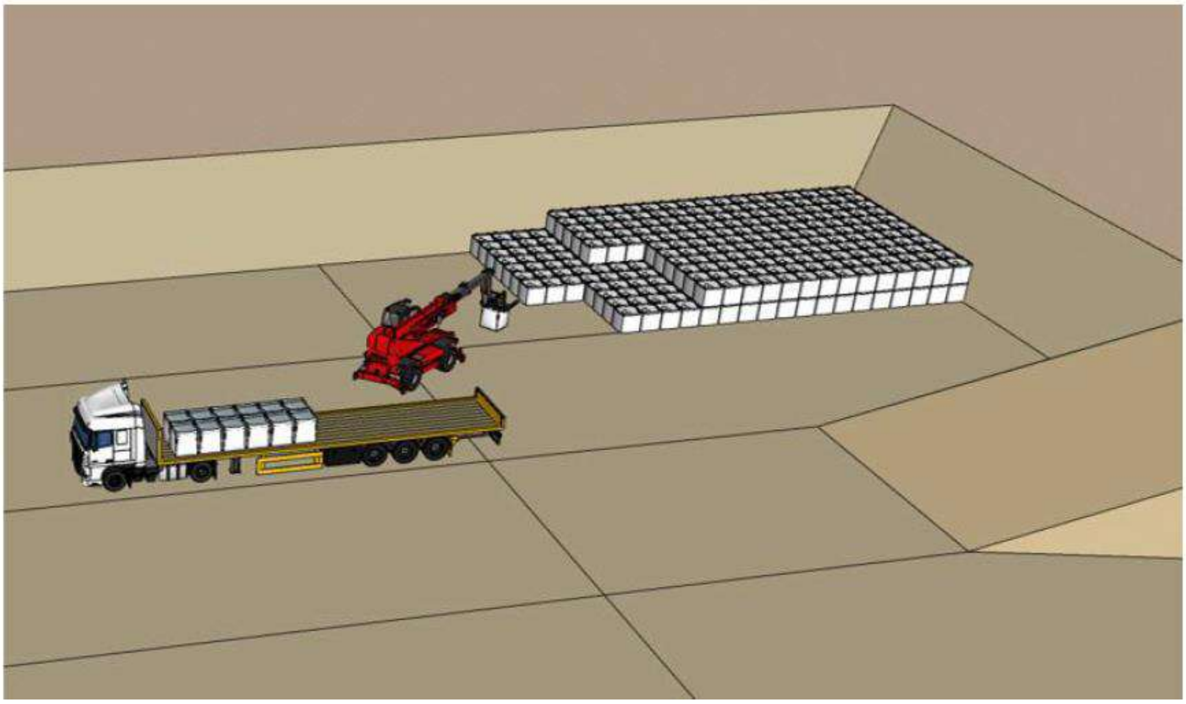

Figure 5-13: Placement of big bags in double layers.

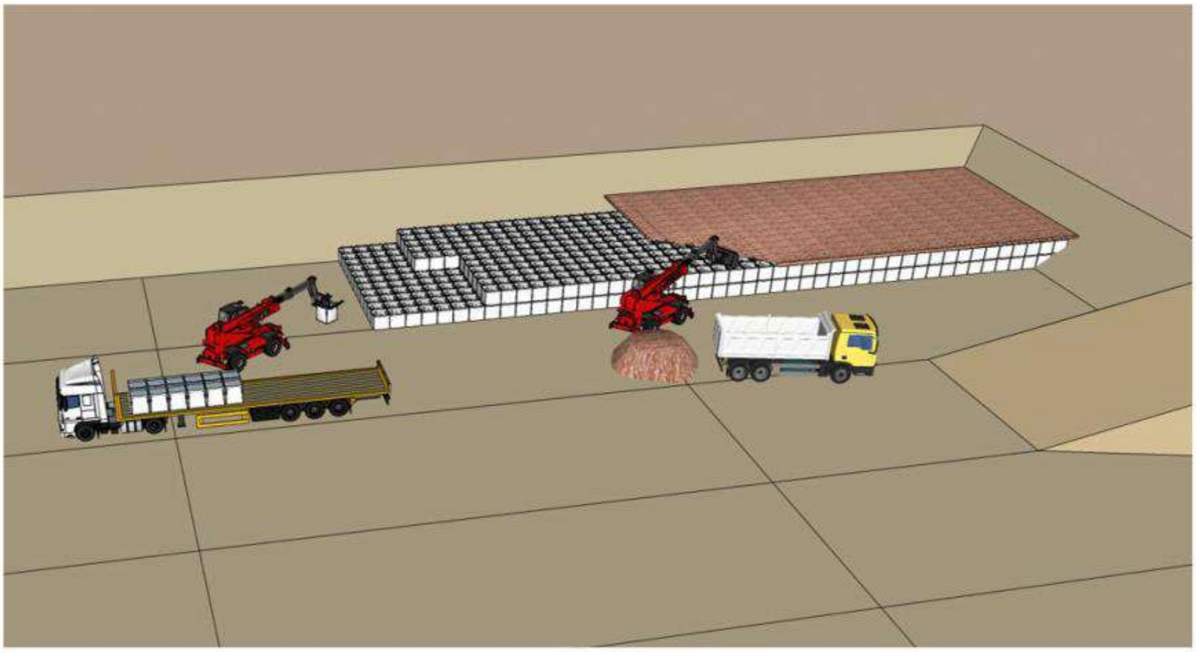

Figure 5-14: Filling of gaps between the big bags using sand.

Cement will be used as intermediate cover between each double layer of bags (Figure 5-15). This will provide a solid surface on which equipment can drive to place subsequent layers of bags without risking damage to the bags which have already been placed in the cell. The cement layer will also further reduce permeability of the cell.

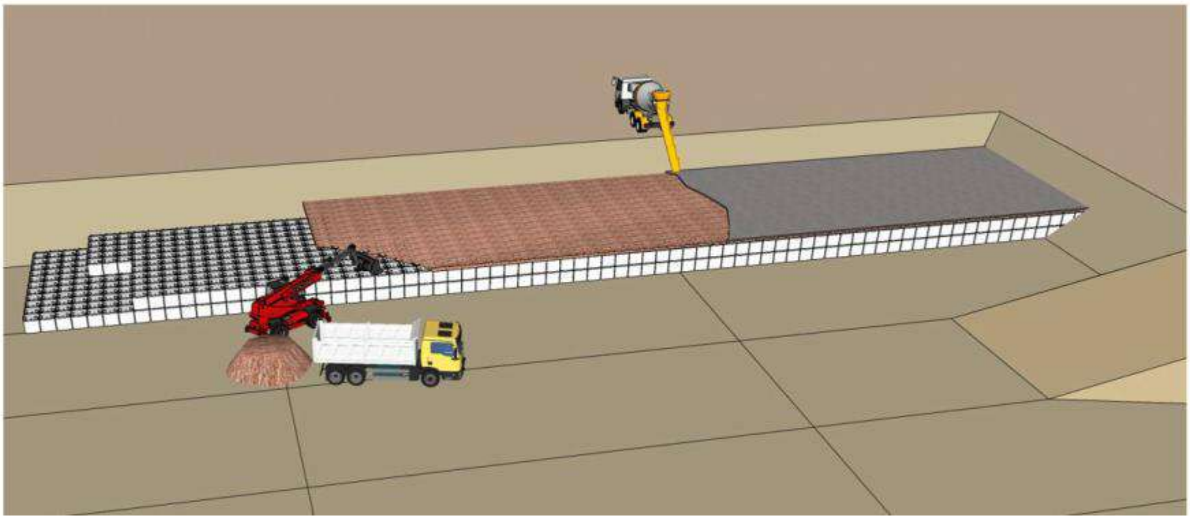

Figure 5-15: Intermediate cover using a cementitious material.

Once a sub-cell has been filled, a geomembrane will be placed over the top of the cell and welded to the geomembrane of the containment barrier, effectively sealing the cell and further reducing its permeability. The containment of the arsenic waste in big bags will prevent direct contact between the raw waste and the cementitious material, preventing any chemical reactions from taking place. The disposal of the waste in a low permeability cell and in an arid environment would ultimately mitigate the potential risk of groundwater contamination.

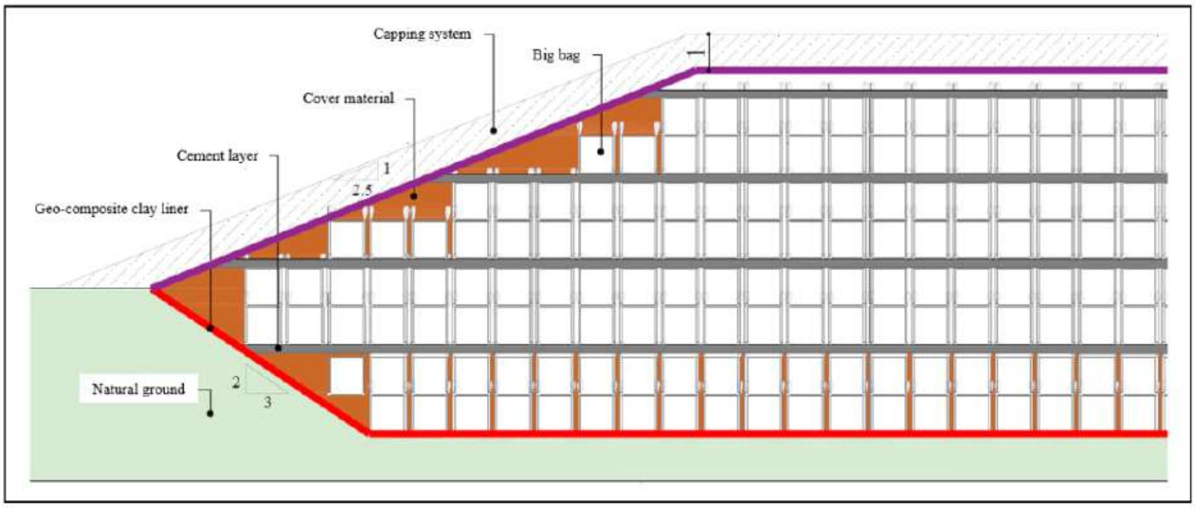

Figure 5-16: Completed arsenic cell with containment barrier and capping system.

5.4.2.3 Landfilling methods to be applied in sub-cells for disposal of general and other hazardous waste

General and hazardous wastes will be accepted under both Business Case 1 and 2. Depending on the nature of the waste, the waste may require pre-treatment prior to disposal. In such cases the waste will be received at the waste treatment facility. If no pre-treatment is required, the waste will be disposed directly into the active sub-cell for the disposal of general and other hazardous waste.

Waste received on the landfill will be deposited in horizontal layers approximately 0.5m thick and will be compacted continuously. Where necessary, cover material (soil from excavations on the disposal footprint) will be applied at a thickness of around 100 – 150 mm to prevent dispersion of the waste through wind, breeding of vectors and rodents and malodours. Intermediate cover shall be placed at a thickness of 300 mm on cells which will be capped once phases are complete.

The waste disposal facility requires the following ancillary infrastructure:

- Leachate collection and containment system - appropriately lined leachate containment ponds;
- Stormwater/ run-off management infrastructure for collection and containment of any contaminated and potentially contaminated water, such as from capped cells, in dams;
- V-drain around the upstream side of the site to keep uncontaminated stormwater off site; and
- Link roads between cells (8 m wide with reserve).

The operational detail of the above ancillary infrastructure is discussed in more detail in the sections below.

5.4.2.4 Radioactive waste

Namwaste has elected not to include the disposal of radioactive waste at the NMF in the current application.

5.4.3 Leachate collection and containment systems

It is not anticipated that large quantities of leachate will be generated by the facility due to its location in a hyper-arid area. However, provision will be made for leachate management. Each sub-cell will have its own leachate drainage network, to ensure that leachate potentially containing arsenic is handled separately from leachate generated in the general and other hazardous waste cells. Each sub-phase of cells will therefore be designed with two leachate containment facilities, one for the containment of leachate from the arsenic waste disposal sub-cells and the other for the containment of leachate from the sub-cells used for disposal of general and other hazardous waste (Figure 5-17). Under Business Case 2, there would be a single leachate drainage network and containment facility per cell. The leachate containment facilities will be sized with capacity sufficient for 1:50 year storm events.

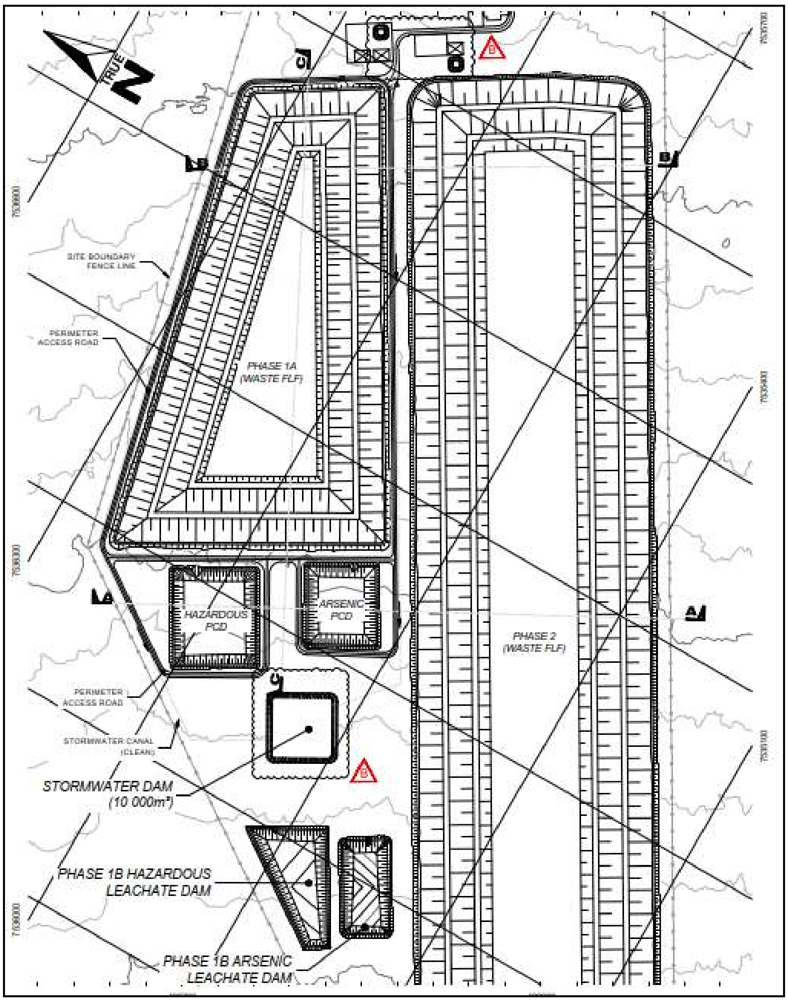

Figure 5-17: Phase 1 Arsenic and Hazardous Waste Leachate Collection and Detection

Once sub-phases are complete, the associated leachate containment facilities will be decommissioned, and the leachate will be directed to the new leachate containment facilities of the next sub-phase.

The conceptual design allows for transfer HDPE manholes to be constructed to allow the collection and monitoring of the leakage detection system and the leachate collection system. The leak detection manhole will outlet into the leachate collection manhole which will then outlet into the lined canal. The HDPE manholes will be positioned to reduce the need for pumping so that the system can function under gravity.

5.4.4 Stormwater management infrastructure

An upstream cut-off drain will be constructed on the upstream boundary of the NMF to divert clean water away from the site.

Due to the site being located in a hyper arid area, no significant runoff from the active waste disposal area is expected. All contaminated and potentially contaminated runoff from the remainder of the operational site footprint (internal roads etc.) will be directed to the PCDs by v-drains. The v-drains will be concreted in line with the phased development of the landfill.

The stormwater management system has been designed to accommodate events up to at least the 1:100-year event, in line with the South African GN704 (Government Notice 704 of 1999, in terms of the National Water Act (NWA), Act 36 of 1998).

Separation of dirty and clean water will be achieved by having the dirty stormwater collected in a series of lined canals and conveyed around the toe of the cell basins to the proposed PCDs. The clean stormwater canal system will flow along the perimeter fence and discharge into a Stormwater dam. The two systems are separated by an access road which slopes at 2% slope to the dirty canal traversing around the footprint of the facility as shown in Figure 5-18 below.

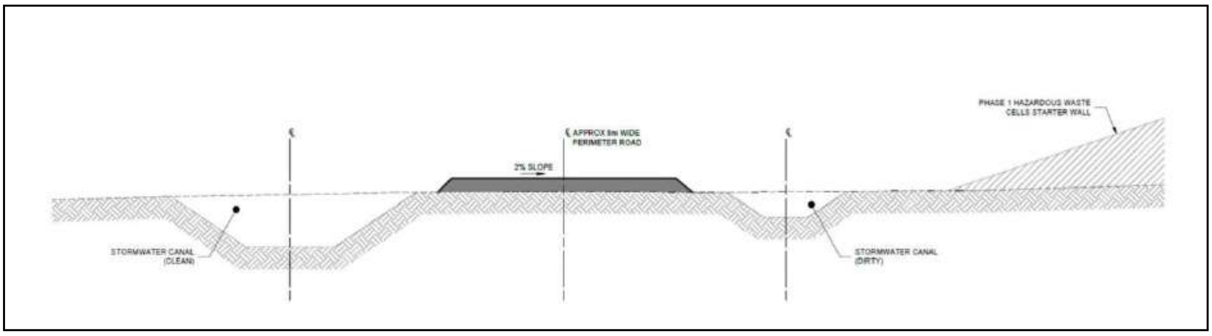

Figure 5-18: Contaminated and Clean Stormwater Canals Configuration

The following water management measures will be implemented on the site:

- Installation of a network of background (upstream) and detection (downstream) boreholes for groundwater quality monitoring purposes in line with authorisation requirements as determined by the Competent Authority.
- Monitoring of surface and ground water quality in line with authorisation requirements as determined by the Competent Authority.
- Immediate removal of all waste spillages along roads within the site followed by appropriate treatment or disposal.
- Spill kits will be available on site to contain and rehabilitate spillages on site.
- All contaminated soil at any spills, will be collected, treated if required, and then disposed of responsibly.
- Diesel, fuel, and oil will be stored in tanks kept within bund walls to contain spills. The volume within the bund walls must be able to contain at least 110% of the maximum contents of the tanks. Where more than one container or tank is stored, the bund must be capable of storing at least 110% of the largest tank or 25% of the total storage capacity, whichever is greater.
- Wash bays and workshop run-off will be contained on site and will be accommodated in the site's potentially contaminated water management system or will alternatively be treated in the waste treatment facility prior to disposal to landfill.

5.4.5 Site Access

5.4.5.1 Within the NMF

An approximately 8m wide, surfaced road will be developed for access in and around the facility. The paved surfaces of the access road and platforms will be finished to a 2% crossfall for drainage and stormwater will be diverted towards the contaminated water system.

5.4.5.2 From Arandis to the NMF

Due to the nature of the waste which will be transported to the facility and the nature of the vehicles which will be transporting the waste, Namwaste has proposed to develop an alternative access road to bypass the town of Arandis and link to the existing Trekkopje Road. _Namwaste investigated potential alternative access routes to the site through an investigation undertaken by Du Toit Planning (Appendix N). Based on the investigation_ two possible options (Options A (in yellow) and B (in purple)) were identified as shown in Figure 5-19 below.

The Arandis Town Council (ATC) aims to develop an industrial area to the south-east of the Arandis CBD as well as residential areas to the east of the existing urban environment (Stubenrauch Planning Consultants, 2011). As part of this future development plan, the Town Council is proposing to develop an alternative access point to the Arandis Industrial Area off the B2 highway and to extend the road to link to the existing Trekkopje Road. The proposed route is shown in purple (Option B) in Figure 5-19 below. If constructed, it will be approximately 4.58 km long and includes a level crossing over the railway line.

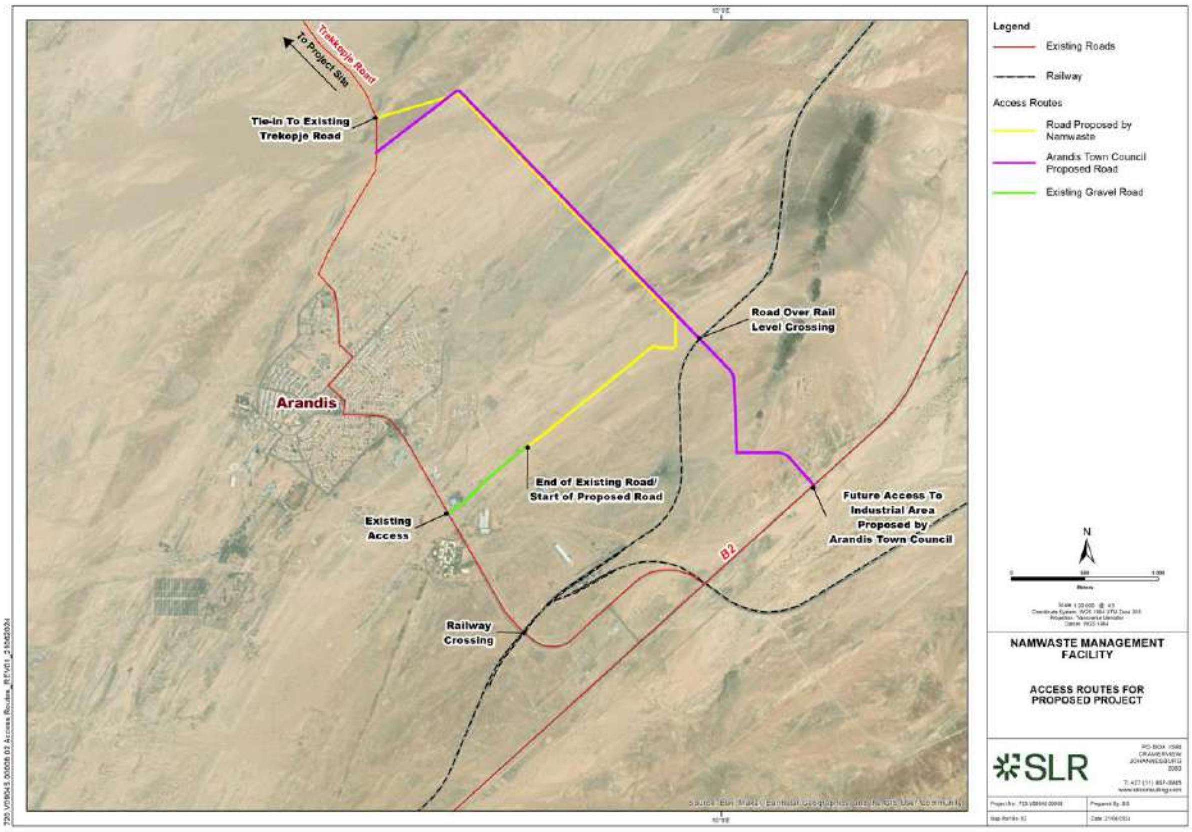

Figure 5-19: Proposed road

As per information provided to Namwaste by the Arandis Town Council's consulting engineer, the budget for the ATC project for the development of Option B has reportedly been approved and construction could commence in 2025. Should the construction timelines of this project align with Namwaste's need for an access road to the proposed facility and should the level crossing be equipped with an appropriate safety system, including anti-collision barriers, Namwaste will be able to use this road. However, to manage the risk of the road proposed by the Town Council not being constructed in time for operations to commence at the NMF, Namwaste is proposing to develop a part of the road proposed by the Town Council, with an alternative access point as shown as Option A (shown in yellow) in Figure 5-19 above. The road will be approximately 4.97 km long and 8 m wide. The road will be an engineered gravel road, which may include the application of lime to further stabilise the road.

5.4.6 Water Supply Infrastructure

The NMF will require approximately 150 m^3 of water per day during operations.

A bulk water supply pipeline will be constructed to convey water to the site from the NamWater Reservoir, the connection point has been identified next to the B2 road from the existing bulk water pipeline from the reservoir to Arandis town as shown in Figure 5-20. The pipeline will be approximately 20km long.

The minimum flow rate and diameter will be regarded as 15 l/s for a 150mmØ (inner diameter) pipeline respectively. The pipeline will be constructed above-ground, however short sections of the pipeline may need to be underground.

The water will be pumped into two (2) JOJO type tanks on-site storages, with 30 m^3 capacity each at the NMF. The on-site storage facilities and water pump station will be located near the receiving end of the water pipeline, marked as 'water station' Figure 5-21.

The water will be used for dust suppression, waste treatment and vehicle washing. The water will also be used in the offices and ablutions. During the initial stages of the project, water trucks may be used to transport water from Orano Uranium Mine to the site, for construction and phase 1 operations. It is presumed that trucks with a capacity of 10 m^3 will be used, resulting in 15 return trips per day to supply the daily volume of water required (150 m^3).

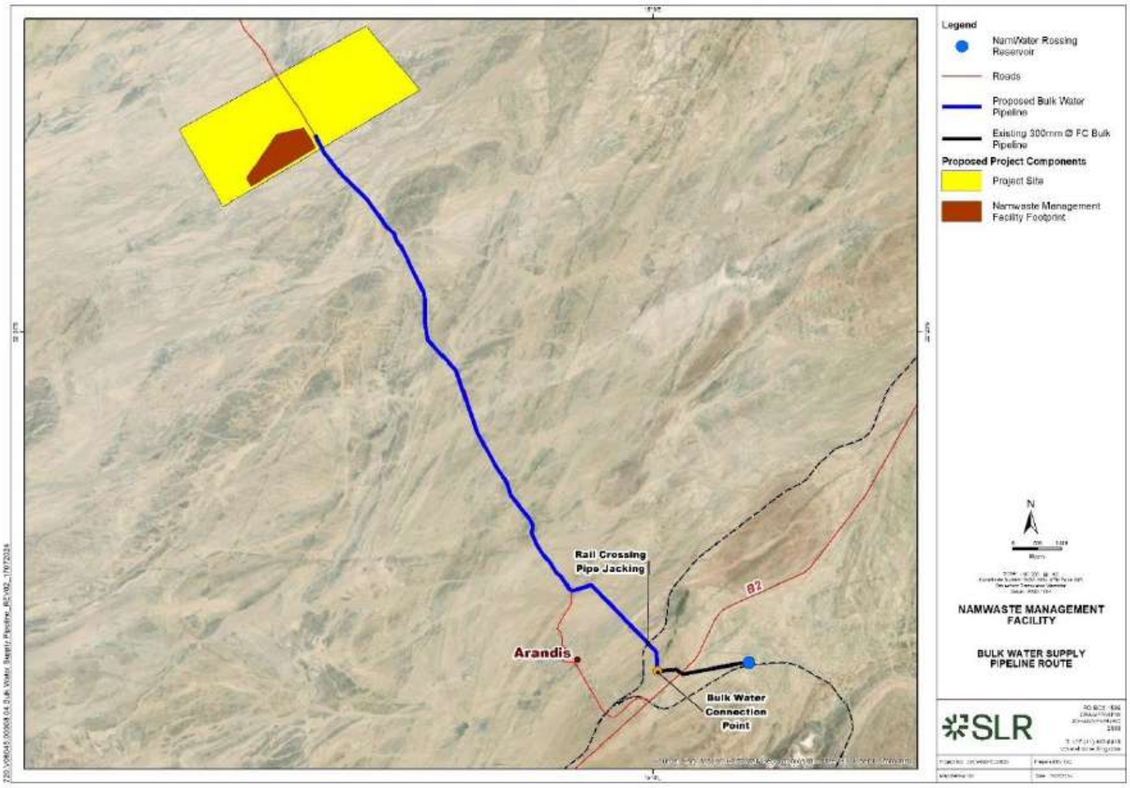

Figure 5-20: Conceptual bulk water supply pipeline route

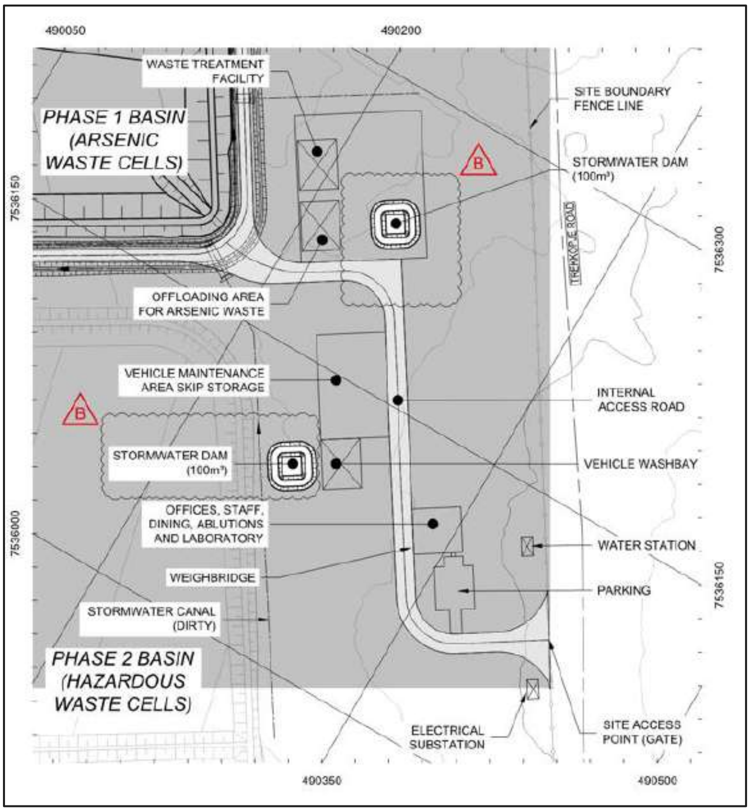

Figure 5-21: Conceptual bulk water pump station and on-site water storage

Namwaste is also considering sourcing groundwater from the site as an additional source of water. As part of the Hydrogeological Assessment (SLR, 2024) undertaken for the NMF one borehole (WW206578) was deemed the most feasible existing borehole in terms of a backup water supply option, with a tested yield of 1 L/s. The abstraction from this borehole, over a 40-year period was simulated to assess drawdown impacts. The hydraulic head of 484 mamsl at the start of pumping, is expected to reduce to 380 mamsl after 40 years. The gradual curve seen in Figure 5-22 indicates that the aquifer would be able to be pumped at the proposed rate, without the risk of dewatering critical fractures. From year 40 to year 100, recovery is slow, but the water level should recover to 480 mamsl (i.e., 99 % of the original static water level). This borehole is not likely to be used by Namwaste for abstraction purposes due to its distance from the development footprint, Namwaste will thus investigate the option of drilling a borehole(s) for abstraction within the project development footprint.

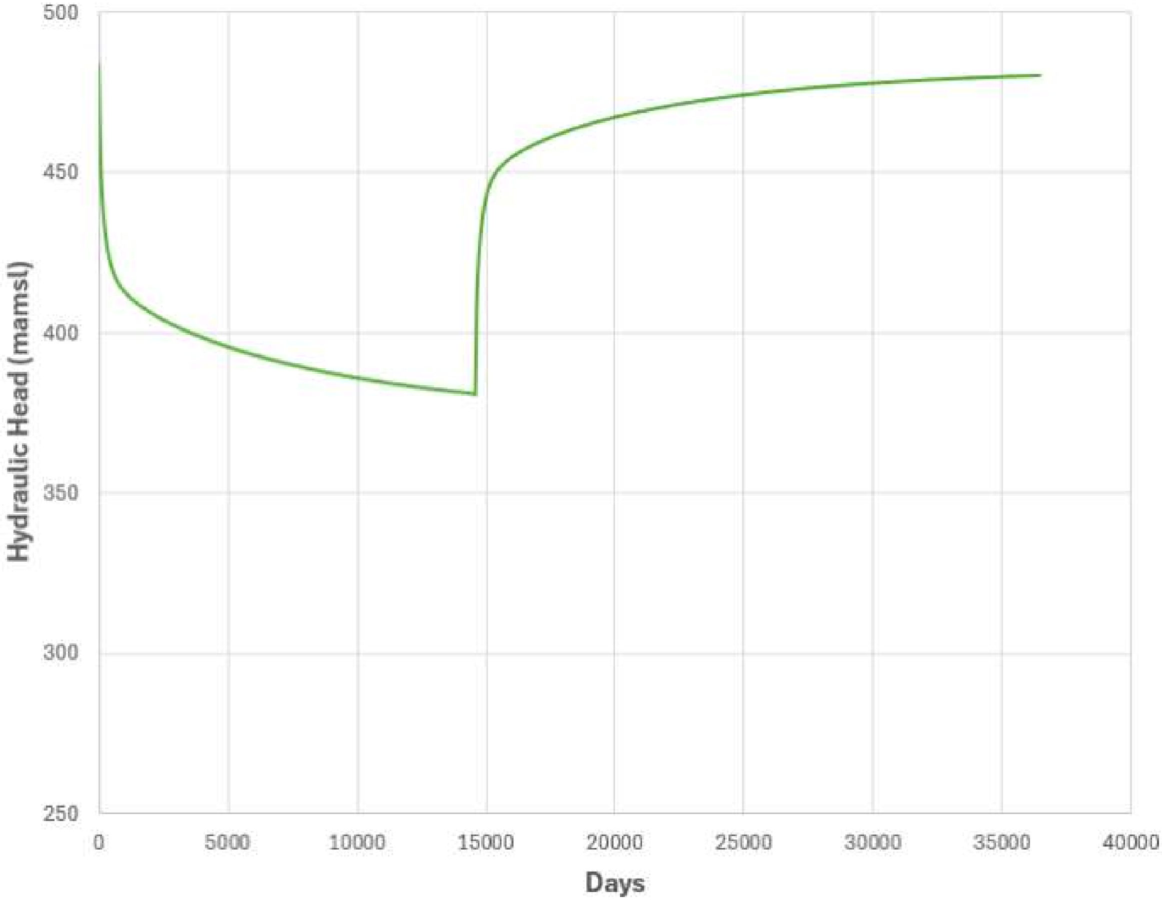

Figure 5-22: Hydraulic head of borehole WW206578 showing pumping for 40 years

5.4.7 Electrical Supply Infrastructure

A miniature substation/pole mounted transformer with a capacity of approximately 500 kVA will be installed at the site. The location of this within the NMF is indicated in Figure 5-23.

Electrical supply to the transformer will be provided by creating a tee-off point from the existing 33kV overhead powerline along the B2. An underground cable will run from the tee-off point to a point close to the existing Orano security checkpoint. From there an overhead powerline (33kv overhead powerline with 11m MV poles spaced between 80 and 120 meters apart) will follow Trekkopje Road to the miniature substation/pole mounted transformer to be installed at the project site. The length of the underground cable is approximately 4.5 km, and the length of the overhead powerline is approximately 16 km. The conceptual routing for the electrical supply line is shown in Figure 5-23 below.

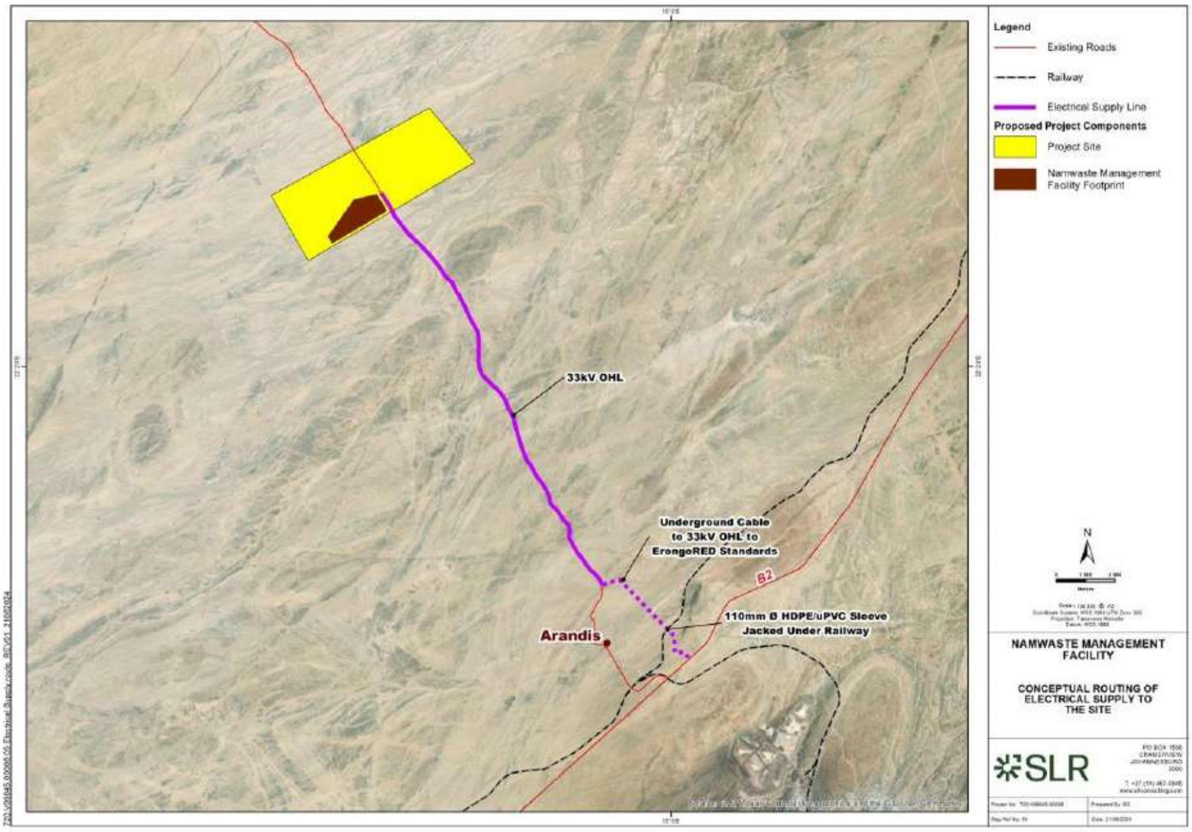

Figure 5-23: Conceptual routing of electrical supply to the site

5.5 Construction Phase Activities

The NMF facilities and infrastructure will be established by NamWaste or construction contractors. The main contractor will likely operate from a temporary construction camp which will be located on the NMF site, within the footprint of planned infrastructure.

Development of the facilities and infrastructure at the NMF will require activities typical of most construction, including: vegetation clearance, soil stripping, bulk earth works and levelling to achieve the required elevations. Topsoil will be preserved from all stripping activities and stockpiled for use.

The common, shared infrastructure will be developed as and when required to ensure accessibility and functionality of the site. This is likely to include internal roads, electricity and water services, as well as drainage. Once the site for each facility has been prepared, the infrastructure will be constructed and or installed as per the required design specifications.

The initial construction is anticipated to be completed within 12 to 18 months. However, certain components of the facilities are phased, and the later phases will only be developed as and when required. For example, construction of the waste disposal facility will be implemented in phases with each waste cell being developed as the demand for waste disposal capacity requires. It is anticipated that a new cell will be developed every 2 years (with a construction duration of approximately 6-8 months). This will require site preparation activities such as: soil stripping, bulk earth works and levelling to the required elevations. Topsoil will be preserved from all stripping activities and stockpiled for use.

The construction of the access road to bypass Arandis, electrical supply line, bulk water supply pipeline, site perimeter fences, offices, staff dining and ablution facilities, waste treatment facility, first cell, leachate containment facilities and stormwater dam for Phase 1A, and stormwater management infrastructure is planned to commence in the first quarter of 2025 and will continue into the fourth quarter of 2026. Cell excavation and construction will be an on-going activity throughout the lifespan of the facility.

The design philosophy for the cells and the dams is to undertake a cut to fill operation but this will be dependent on the nature of the in-situ material. Any surplus cut material that cannot be used for the construction can be stockpiled and used for daily cover or treatment of the waste.

It is anticipated that operations will commence in the second half of 2025 for an estimated period of 62 years, subject to market fluctuations. Table 5-4 summarises the overall construction duration for the NMF.

Table 5-4: Construction duration

Description	Area (m^2)	Earthworks volume (m^3)	Estimated construction time (months)
Phase 1 Waste Cells	432 720	819 550	8 (per waste cell)
Phase 2 Waste Cells	869 299	1 234 411	8 (per waste cell)

5.5.1 Construction phase access routes, water and electrical supply

During construction, water trucks will be used to bring water from Orano Uranium Mine to the site. It is presumed that the trucks with a capacity of 10 m^3 will be used, resulting in 15 return trips per day to supply the daily volume of water required (150 m^3).

The Project site currently does not have an electricity supply. A diesel generator will be the source of electricity for site establishment offices and construction requirements.

Construction vehicles will likely be routed through Arandis as the proposed bypass access route would likely not have been constructed yet.

5.6 Operations and Maintenance Phase

5.6.1 Operating hours, access control and security

The facility will be operational on weekdays (excluding public holidays), for 12 hours per day on average. Emergency spills and clean-ups may necessitate short periods of time during which the facility will be required to operate 24 hours per day.

5.6.1.1 Access Control

It is envisaged that the existing security checkpoint, currently managed by the Orano Uranium Mine, will be shared between Orano Uranium Mine and Namwaste. The checkpoint is located approximately 1.2 km from the edge of Arandis on the Trekkopje Road. The project site is approximately 16 km from the existing security checkpoint. An additional security checkpoint will be located at the facility entrance, which will be used to control the movement of vehicles in and out of the facility at all times. A security system will be implemented with guards on duty 24 hours per day.

The facility will have perimeter fencing which will be completed in phases. During the first phase, a security fence with a 4 280 m perimeter surrounding the Phase 1A cell development area as depicted in Figure 5-24 (perimeter displayed in purple) will be constructed. The remainder of the site will be fenced in phases aligned to the phased development of the site.

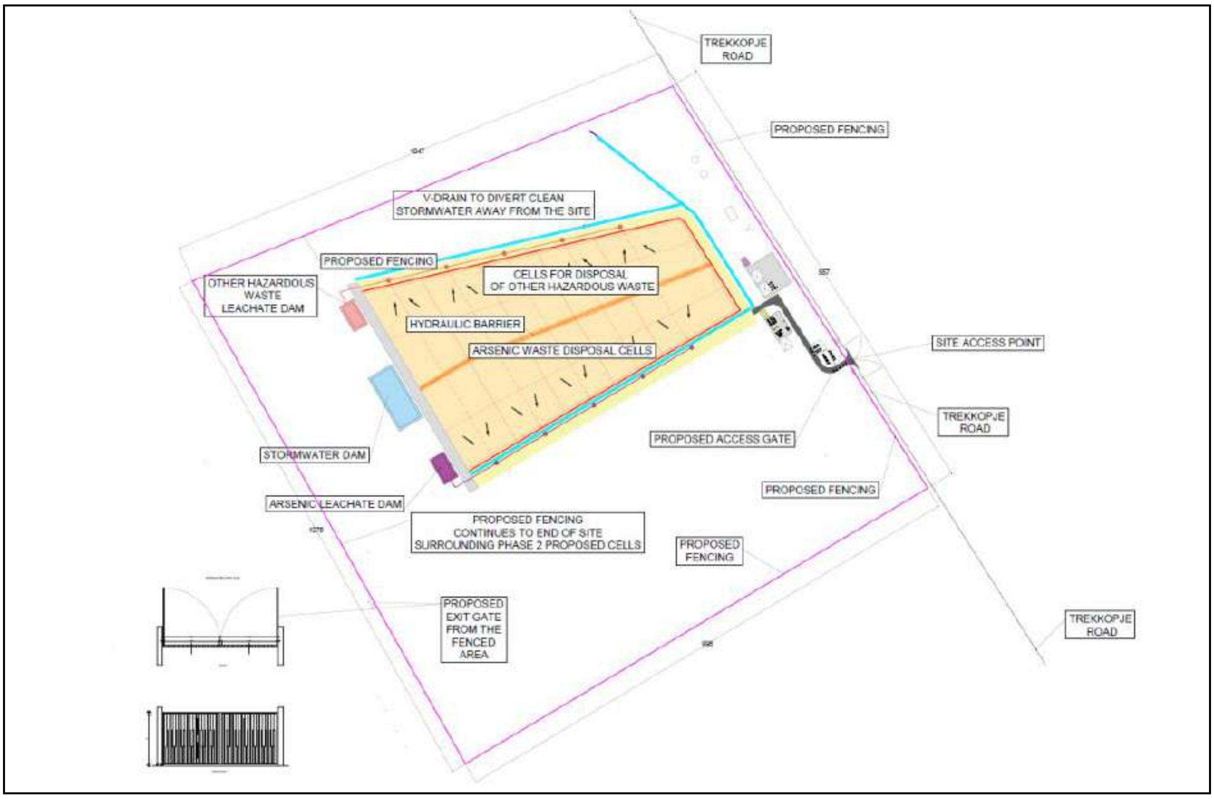

Figure 5-24: Phase 1 perimeter fencing

5.6.2 Waste transportation and acceptance procedure

5.6.2.1 Waste transport

Waste will be collected and transported to the site by Namwaste vehicles and customer vehicles. The waste acceptance procedure is detailed in Section 5.6.2.2 below.

The vehicles which will be used for transportation of waste and estimates of the number of these vehicles which will visit the site per day are provided in Table 5-5 below. Typical waste streams and volumes to be managed at the NMF is shown in Table 5-6 below. Prior to waste vehicles leaving the site, they will be washed to avoid cross-contamination.

Table 5-5: Types of vehicles to be used for the transportation of waste

Vehicle Type	Waste stream	Number of vehicles visiting the site per day
Tipper truck - 30 tons	General and hazardous solid waste (excluding arsenic waste)	2

Vehicle Type	Waste stream	Number of vehicles visiting the site per day
Tanker truck – 30 tons	General and hazardous liquid waste	1
Skips truck – 10 tons	General and hazardous solid waste (excluding arsenic waste)	5
Tautline truck – 30 tons	Arsenic waste	5

Table 5-6: Typical waste streams (and volumes) to be managed at the NMF

Waste streams	Minimum quantities per annum (m^3)
Arsenic waste	30 000
General Hazardous waste	10 000
Contaminated Soil	3 000
Grease	2 000
Sludge and slops	10 000
Chemicals	3 000
Hydrocarbon contaminated waste	1 000
General waste	1 000

5.6.2.2 Waste acceptance procedure

Verification analysis

The Technical Services Department and Facility Manager will be responsible for ensuring that all waste loads which are sent to the facility can be treated and/or disposed at the facility in a legal manner. A TSAS will be prepared for each waste load before it can be booked for treatment or disposal at the facility which will describe the processes to be followed on site and will contain an overview of major hazards and precautions to be taken.

Operation of the weighbridge system

One 18-m steel-deck weighbridge will be installed at the entrance to the facility. This system will be used to record the mass of all waste loads delivered to the facility. Every vehicle carrying waste destined for treatment and/or disposal at the facility will be subjected to weighing before entering the facility and upon leaving the facility. To ensure that no data is lost as a result of damage to the weighbridge computer system, the weighbridge system will make daily backup files of all electronic data automatically, which will be stored on the server at the Head Office.

Identification of disguised and illegal waste and rejection of waste

All arriving waste loads will be inspected by the Lab Technician and/or be subjected to verification analysis as described above for conformance to the TSAS which should accompany the load before it enters the facility. Arriving waste loads should be further evaluated in respect of wastes that are prohibited or restricted. Should there be no notable discrepancies or deviations from the aforementioned criteria, the load should be accepted for processing. If the load deviates from the aforementioned TSAS descriptors or a load is received in the absence of the appropriate booking or without the relevant documentation, this concern will be communicated to the Facility Manager. Such communication should at least include:

- a copy of the subject TSAS;
- a reference photograph of the waste of concern; and
- a non-conformance report with a written description of the subject deviations / concerns leading to potential rejection. Decisions on how to proceed with the management of the waste thereafter will be done in agreement between all concerned parties (i.e. Commercial Division, Facility Manager and the Technical Services Division). If the load is ultimately rejected from the facility –
    - The arrangements for any off-site management of the waste must be finalised as soon as is reasonably possible;
    - The arrangements proposed for the onward management of any rejected load must be communicated with the customer of concern;
    - Customers must approve any proposal for the onward management of their rejected waste; and
    - Customers must be provided with a reasonable indication of the factors that influenced the rejection of the load, as well as of the potential cost implications of any onward disposal / management thereof.

5.7 Decommissioning Phase

The waste disposal facility has been designed for a 62-year operational life (under Business Case 1), subject to market fluctuations. The waste treatment facility will be maintained/upgraded and used for the duration of the disposal facility's life. Decommissioning of the facilities, which are not required for post-closure long-term management and monitoring of the site, will require the dismantling of the equipment, the sale and final disposal of all components, the decontamination of any contaminated areas and the rehabilitation of the site to a condition suitable for an end land use.

The life of the disposal site is directly related to the rate of airspace utilisation. Once the site is near to its final levels a closure plan will be developed. The end land use will be determined through a consultative process.

The closure plan will include details regarding the post-closure, long-term management and monitoring of the site.

5.8 Project Alternatives

This section has been compiled in compliance with Section 8(g) of the EIA Regulations. The aim of this Section is to detail and compare the environmental and social impacts and risks of the project alternatives for the purpose of selecting the preferred alternative(s).

5.8.1 Layout and design

The layout of the NMF and the design of the various facilities as currently presented is a conceptual plan and has been subject to adjustments in order to optimise the facility. The current layout has been informed by the findings of the Technical Feasibility Study (SLR, 2023) and in response to the outputs of the specialist studies and impact assessment undertaken in the ESIA phase. The conceptual design and layout of the NMF are presented in this EIA Report. A detailed description of the key project components is provided in the sub-section 5.4.

The proposed project footprint considered proximity to the existing Trekkopje road to avoid impacts related to establishment of a long access route. As a result, the site access point and facilities such as offices, parking, workshops, etc., are placed immediately off Trekkopje road which requires a short access route to the site.

Technical, financial and environmental considerations, as identified during the course of this assessment, has informed the conceptual layout and design based on the recommendations as provided by the environmental specialist studies which have been undertaken. Where risks were identified the designs will be improved to provide adequate mitigation. Planning and design considerations are further outlined within the EMP (Appendix N).

5.8.2 Alternative Sites

As part of the pre-feasibility studies, Namwaste undertook a screening study to assess at a “high-level” two target areas suitable for the development of the Project. A high-level, desktop screening (Environmental Compliance Consultancy, August 2022) of a number of initial target areas against various criteria including environmental and social aspects, amongst others, was previously commissioned by the proponent. A site options assessment was conducted for the following six sites in the Erongo region:

- Stone Africa quarry, parcels 120 and 123, northwest of Rössing, east of the Dorob National Park;
- Second site option at Stone Africa quarry;
- Twin Hills northwest portion of the lease, outside of mine facilities;
- Trekkopje /Orano Uranium Mine south of the mining rights;
- Uis Tin Mine within the mined opencast footprint of ML 134; and
- Farm Vergenoeg.

The desk-based assessment (Environmental Compliance Consultancy, 2022), which included a site screening exercise and the appraisal of options, was guided by the following key considerations:

- The relevant waste licence application form.
- The ‘Minimum Requirements’ (DWAF, 1998) for the site selection of a landfill.
- Spatial criteria including economic, social, environmental and public acceptance, considering the following:
  - Proximity to railways, highways and main roads.
  - Presence of dolomite and potentially sensitive seismic zones.
  - Presence of an aquifer.
  - Presence of wetlands, dams, pans and water courses.
  - Dominant soil type.
  - Protected and ecologically sensitive areas.
  - Townlands, high population density, mineral reserves, and infrastructure.

Based on these findings, two preferred target areas were selected for further consideration as potential locations for the Project. The preferred targets which were identified were named the Trekkopje and Vergenoeg target areas. Each area was approximately 2 000 ha in extent, both located in the Erongo region, between 50 and 80 km inland from Swakopmund, shown in Figure 5-25. These targets were subject to further investigation and screening via a Technical Feasibility Study (SLR, 2023)

The Technical Feasibility Study involved the screening and assessment of two ~2 000 ha target areas to identify ~500 ha parcels of land (one on each target area) which could potentially be feasible for development as a general and hazardous waste management facility and be taken into the Scoping phase of the EIA application process. The Technical Feasibility Study included engineering, geotechnical and hydrogeological inputs, as well as further consideration of environmental and social aspects.

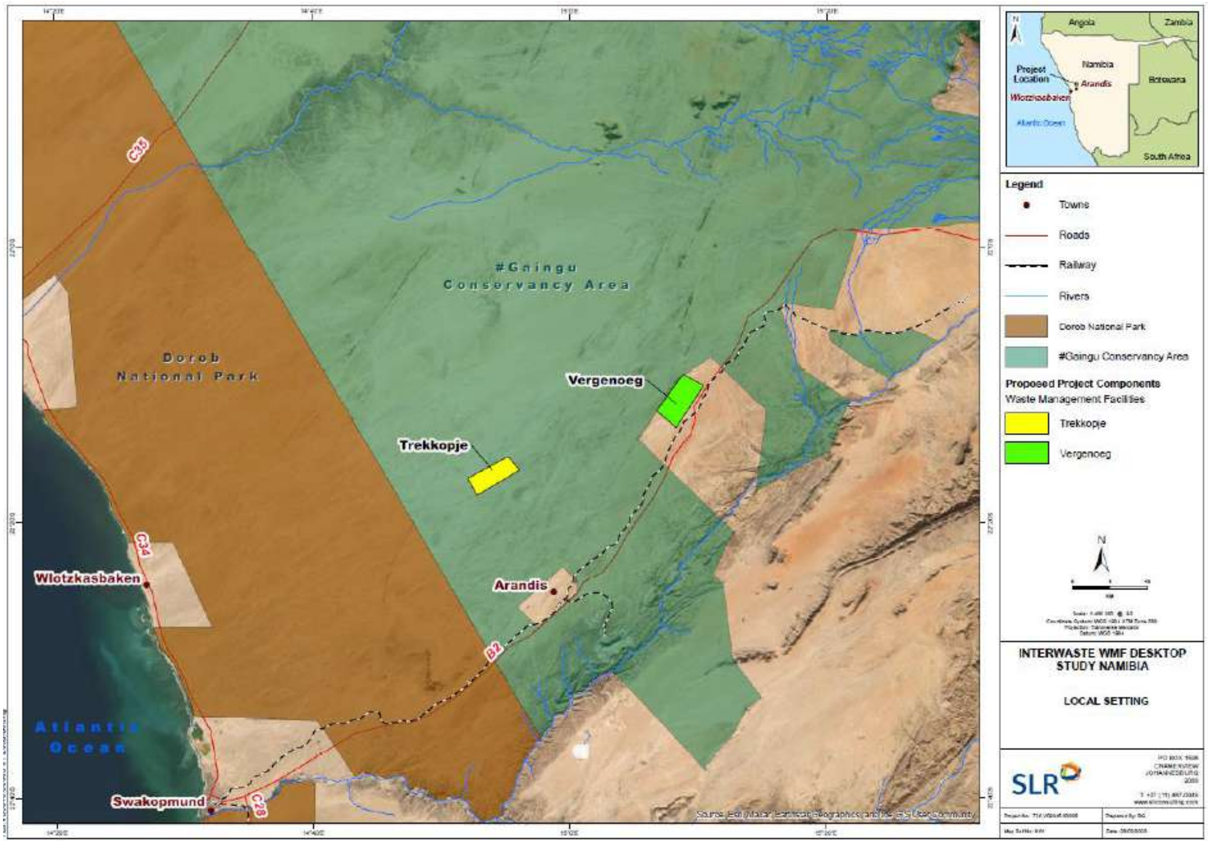

Figure 5-25: Locality of two target areas considered.

The two target areas assessed in the Technical Feasibility Study are summarised the table below:

Table 5-7: Summary of target areas assessed.

Target area name	Location	Land ownership	Mining/exploration
Trekkopje	Located ~50 km north-east of Swakopmund, ~15 km north-west of Arandis, along the Trekkopje Road, ~ 8	Communal land – owned by the Namibian Government, and the !Oe-≠Gân Traditional Authority enjoys a "right of use"	No ML over the target area but there is an application for EPL 8801 (base and rare metals, dimension stone, industrial minerals,

Target area name	Location	Land ownership	Mining/exploration
	km south-east of the mine		nuclear fuel minerals and precious metals) pending ECC
Vergenoeg	75 km north-east of Swakopmund, ~20 km from the Trekkopje target area, adjacent to the B2 road (to the north of the road)	Private property (Vergenoeg Farm No 92)	No ML but there is an EPL for base and rare metals and EPL application for nuclear fuel minerals.

The following section summarises the key findings of the Technical Feasibility Study and the aspects considered during the comparison of the two target areas resulting in the identification of the most feasible option.

5.8.2.1 Geotechnical

The following are key findings relating to the Trekkopje target in terms of geotechnical considerations:

- Apart from sporadic outcrop of schist, gneiss, dolerite, quartz vein, calc silicates and quartzite, the site is covered by a mantle of aeolian sand with a secondary alluvial influence evident as coarse gravel and cobble deposition. Calcrete development is also evident.
- Generally shallow TLB refusal at depths of between 1 and 2 m.
- Bedrock is weathered and highly fractured within the depths of test pit excavation. The ERT surveys infer these conditions to extend to depths of about 10 m, with a high degree of variability.
- There is a paucity of naturally occurring clayey materials across the site. Gravel materials occur in abundance.
- According to Kadiri *et al* (2023), the area has a low seismic hazard potential.

The geotechnical assessment of the Vergenoeg target was limited to a desk study level only as the site could not be accessed for reconnaissance and investigation purposes. It was noted that areas on the site, particularly the far north and southern portion, are underlain by calcareous rock types, which negatively influences the feasibility of the site for development as a waste management facility.

5.8.2.2 Geohydrology

Consideration of information that distinguishes the two targets is tabulated in Table 5-8. Flaws and sensitivities relating to the Vergenoeg and Trekkopje targets are summarised in Table 5-9 and Table 5-10 respectively.

Table 5-8: Target area characterisation

Trekkopje Target	Vergenoeg Target
• Dykes cross-cut the site in a northeast-southwest orientation compartmentalising the site. They are part of the fractured aquifer and locally control groundwater flow. • Marbles and other geological formations outcrop more on the eastern side of the site while the west has limited outcrops as sediments in the washes become relatively thicker and more widespread. • The site is outside main strategic river catchments that are important for water supply for domestic, agriculture and/or other commercial uses. • Surface water and groundwater flows westwards with no immediate downstream receptors (such as boreholes, settlements or farms).	• No dykes were identified within the site from satellite imagery. • It is expected that hard rock formations are more exposed at surface due to lack of sediment cover. • The site is underlain by Karibib Formation lithologies, whose marble aquifers are strategic aquifers in the east of the site where groundwater is relatively fresh. • The site borders the Swakop-Khan River catchment divide with a small portion of the site falling within the catchment. • Groundwater flow from the site is towards the catchment although it is expected to be predominantly westward towards Arandis.

Table 5-9: Flaws and sensitivities at Vergenoeg Target

Flawed areas	Sensitivities	Preferred areas within the site
Exposed outcrop with faults presents preferential pathways for contaminants. The site boarders the Swakop-Khan River catchment divide with a small portion of the site falling within the catchment. Therefore, groundwater flow from the site is towards the catchment; although it is expected to be predominantly westwards towards the town of Arandis. Existing boreholes within farmland indicate use of groundwater for other purposes despite the perceived brackish nature of the aquifer. Knight Piesold (2022) accorded that the waste disposal site will need to be located away from the geological contact points where boreholes are located. The presence of the Karibib marble on the site.	Presence of surface drains and washes that recharge the aquifers and sustain sensitive ecosystems. The site is underlain by Karibib Formation lithologies, whose marbles are locally good yielding aquifers to the east of the site where groundwater is relatively fresh. Location within farmland and proximity to the Swakop-Khan River Catchment means that the area may pose risk to surrounding areas.	No preferred site identified

Table 5-10: Flaws and sensitivities at Trekkopje

Flawed areas on each site	Sensitivities of each site	Preferred areas of each site
Exposed outcrop on the eastern side with potential fractures/faults presents preferential pathway for contaminants. Dykes that cut across the site are part of the fractured aquifer. Presence of major surface drains and washes that recharge the fractured aquifer and shallow sediments that sustain sensitive ecosystems.	Active surface drains that recharge local aquifers and shallow sediments sustain sensitive ecosystems.	Four areas (PA1-PA4), to the west of the site/mine access road, were identified as shown in Figure 5-26.

5.8.2.3 Radiation

The baseline radiation doses elaborated for the Vergenoeg and Trekkopje targets are typical exposure doses for members of the public residing in Namibia's Erongo Region. No specific radiation-related risks were identified at the Vergenoeg or the Trekkopje targets. From a radiological risk perspective, neither Vergenoeg nor Trekkopje targets show fatal radiologically relevant flaws.

5.8.2.4 Engineering

Trekkopje Target

Based on the available information and assessment conducted in terms of engineering considerations, it can be concluded that:

- There were no fatal flaws identified that would render the target unsuitable for the construction of a WMF.
- The topography/slopes on the east of the target are less suitable and the area to the west of the Trekkopje Road contains the least risk when it comes to the slopes and stability of the facility.
- The western portion of the target area contains some risk due to the presence of fault line/dyke(s); caution would be required during the design and construction phases. The landfill may also be constructed in two phases to avoid the major fault line/dyke(s).
- As sensitive ecological areas (drainages and outcrops) are present at the target site, the placement of the WMF would have a negative effect on these sensitive areas. This will need to be dealt with during the detailed design and permitting of the WMF to ensure minimal negative effect to the receiving environment.

The area to the west of the target area likely presents the least risk for the construction of the proposed WMF.

Vergenoeg Target

Based on the available information and assessment conducted in terms of engineering considerations, it can be concluded that:

- Areas on the target, particularly the southern portion, is underlain by calcareous rock types which increase the risk of constructing a landfill and should be avoided.
- Exposed outcrops with faults were identified on the target, extra caution would be required during the design and construction phases. The landfill may also be constructed in two phases to avoid the fault/dyke.

- As sensitive ecological areas (drainages and outcrops) are present at the target area, the placement of the WMF would have a negative effect on these sensitive areas.
- The target area is close to the general public (via B2 road) and will likely require screening.
- There are potentially strategic aquifers in the east of the target area where groundwater may be relatively fresh and need to be avoided.
- Further studies are required to delineate sensitive features, as well as determine their sensitivity before a preferred area for the development of the WMF can be identified.

5.8.2.5 Environmental (biodiversity), Archaeology and Land use

In the Technical Feasibility Study, the pros and cons for both target areas were identified. The Trekkopje target is further away from human receptors (i.e., more remote to third parties) than is the case for the Vergenoeg target. There might also be less significant archaeological sites on the Trekkopje target than at Vergenoeg. The Trekkopje target is noted to be located within a Biodiversity Yellow flag Area according to the Strategic Environmental Assessment (SEA) undertaken for the central Namib Uranium Rush as well as within the #Gaingu Conservancy, which may favour the Vergenoeg target. Although neither of these categorisations translate to inherent sensitivities. The Trekkopje target is favoured, in part as access to the site enabled a better depth of information than for Vergenoeg.

No specific biodiversity or heritage features were noted as significantly differentiating any portion of the targets from others. That said, the more sensitive biodiversity habitats are aligned to the active/prominent surface drainages and the outcrop areas. Areas where these features occur at a smaller/less prominent scale, and/or a lower density, should be favoured over other areas. Any development footprint should aim to avoid “more significant” drainage lines as far as possible. Flow in impacted drainage lines would need to be diverted, which would need to be addressed in the design and stormwater management planning.

The preferred areas on the Trekkopje target, from a biodiversity perspective, concur with the hydrogeological recommendation as shown in Figure 5-26.

5.8.2.6 Conclusion

Overall, the Trekkopje target area was recommended as preferred over the Vergenoeg target area. Within the Trekkopje target area, four preferred areas (PA1-PA4) were delineated to be assessed in detail during the next phase of the WMF planning and design as well as EIA process (see Figure 5-26).

Further specialist studies were recommended to inform the design and limit risks which included the following:

- Terrestrial biodiversity;
- Archaeology;
- Hydrogeology; and
- Surface water.

Namwaste has refined a proposed footprint (based on PA4) of approximately 177 hectares for the NMF as shown in red hatching on Figure 5-4.

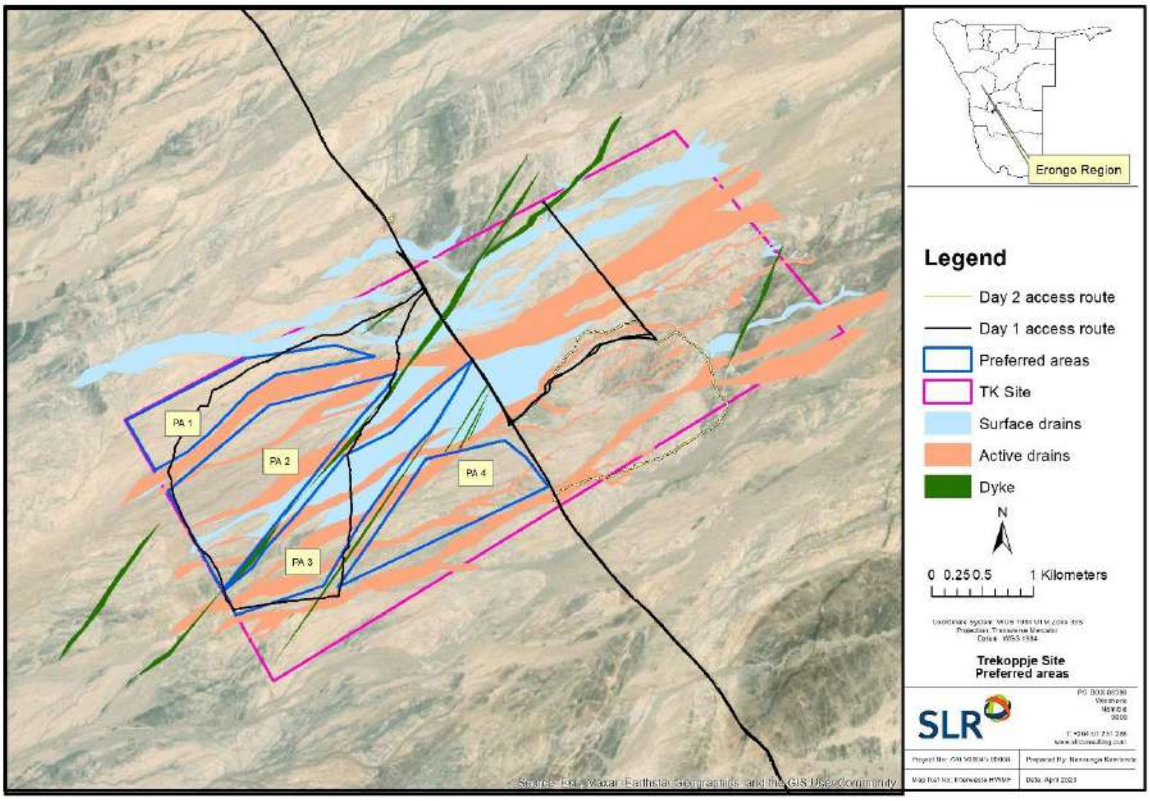

Figure 5-26: Preferred areas within the Trekkopje target

5.8.3 The option of not implementing the activity 'NO-GO' Alternative

The 'No-Go' alternative is the option of not constructing the NMF and associated infrastructure and where the *status quo* of the current status and/or activities on the project site would prevail. This alternative would result in no additional impact on the receiving environment.

Should the 'No-Go' alternative be considered, there would be no impact on the existing environmental baseline but no benefits to the local and regional economies, as well as no contribution toward greater hazardous waste management in Namibia.

6.0 Description of the Baseline Environment and Specialist Findings

This chapter introduces the baseline conditions of the Project site, as it is currently understood. It additionally outlines the specialist findings on the various aspects.

6.1 Climate

Namibia is one of the most arid countries in sub-Saharan Africa and is characterized by high climatic variability through persistent droughts, unpredictable and variable rainfall patterns, and high variability in temperatures and water scarcity.

The Project site is located in the Namib Desert at a location which receives low annual rainfall (approximately 50 mmpa) and annual fog deposition of approximately 10 mm. The main rainfall season is between January and March, while most fog occurs during September. High solar radiation, low humidity, and high temperature lead to very high evaporation rates and a substantive annual water deficit (approximately 1 630 mm). Due to the erratic nature of rainfall in the region, there is a potential for episodic flash floods following rainfall of high intensity.

The dominant winds are SSW and NNE, the latter occasionally reaching storm speeds during winter (warm east winds, or Bergwind). Episodic dust storms, associated with synoptic conditions and strong easterly winds, can occur facilitating long-range transport of particulates. The wind field is described as follows:

- Calm conditions (wind speeds <0.5 m/s) occurred 1.86% of the time.
- Wind speeds ranged from light (0.5 – 1.6 m/s) to fresh breeze (defined as 8.0 – 10.8 m/s).
- Peak wind speed (10.46 m/s) occurred from the east-northeast during the night (18h00 – 00h00) in spring.
- Higher average wind speeds (3.86 m/s) occurred from the north-northeast. Wind speeds were higher on average during spring (4 m/s) and during the morning (06h00-12h00) hours (3.3 m/s).
- Diurnal circulations show prevailing northeasterlies during the early morning and morning hours. Westerly and southwesterly components prevail in the afternoon and at night.
- Seasonal variation shows westerly and southwesterly components prevailing during spring and summer months. Northeasterly components strengthen during autumn and prevail during winter. Highest directional variability is observed during autumn.

The range of temperatures are wide, with average maximums exceeding 34°C (December) and average minimums being under 5°C (July). Combined, these factors result in a water-stressed environment with adapted vegetation growth. Aridity index (ratio between rainfall and potential evapotranspiration): 0.04 – 0.06 (arid).

Since the 1960s, increased mean, maximum, and minimum temperatures have been observed, and warming in Namibia has been higher than the global average. Future reductions in total precipitation are anticipated.

6.2 Topography

The Project site has a relatively gently rolling terrain, sloping (gently) from approximately 580 m above sea level at the north-eastern boundary, down to approximately 490 m at the south-western boundary (Figure 6-1).

Plains and various shallow washes and low ridges characterise the site area. Quartz gravel covers most of the plains, and sand dominates in washes. A few relatively small outcrops were found across the Project site.

Various ephemeral washes (drainage lines) traverse the region in an east to west alignment and drain toward the coast. A number of these drainage lines are relatively well defined (i.e., bigger / more significant than others). The drainage lines on the Project site appear to be more significant (i.e., bigger, more drainages and better defined / more prominent across larger areas) on the north-eastern part of the site (i.e., north-east of the Trekkopje Road). Despite the low difference in elevation, sporadic flash floods of a high intensity have the potential to cause extensive fluvial erosion.

6.3 Geology

6.3.1 Regional Geology

The Project site is located within the Southern Central Zone of the Damara Orogeny where, on a regional perspective, Swakop Group lithologies are mostly predominant (Table 6-1). These lithologies form secondary aquifers, classified to be of low to very low groundwater potential (Lohe, Amster & Swartz, 2020). The Southern Central Zone is regionally faulted, folded, and intruded by granitoid complexes and dyke swarms, shown in Figure 6-3. These are likely to influence groundwater potential and quality.

In terms of regional stratigraphy, Figure 6-2 shows differentiated formations and members of the Swakop Group that predominates in the Central Zone (Miller, 2008). Table 6-1 details the lithology that are deposited in the area (adopted after SLR, 2012). According to Kadiri *et al* (2023), the area has a low seismic hazard potential.

Table 6-1: Regional geology of the study area

Group	Subgroup	Formation	Lithology
Swakop	Khomas	Kuiseb	Pelitic and semi-pelitic schist and gneiss, migmatite, calc-silicate rock, quartzite. Tinkas member: Pelitic and semi-pelitic schist, calc-silicate rock, marble, para-amphibolite.
		Tinkas	Mica schist, metagreywacke, calc-silicate rock, quartzite, marble, amphibolite
		Karibib	Marble, calc-silicate rock, pelitic and semipelitic schist and gneiss, biotite amphibolite schist, quartz schist, migmatite.
		Arandis	Mica schist, para-amphibolite, meta-sediments, marble (impure), calc-silicate rocks
		Chuos	Diamictite, clac-silicate rock, pebbly schist, quartzite, ferruginous quartzite, migmatite
	Discordance		
	Ugab	Rössing	Marble, pelitic schist and gneiss, biotite-horneblende schist, migmatite, calc-silicate rock, quartzite, meta-conglomerate

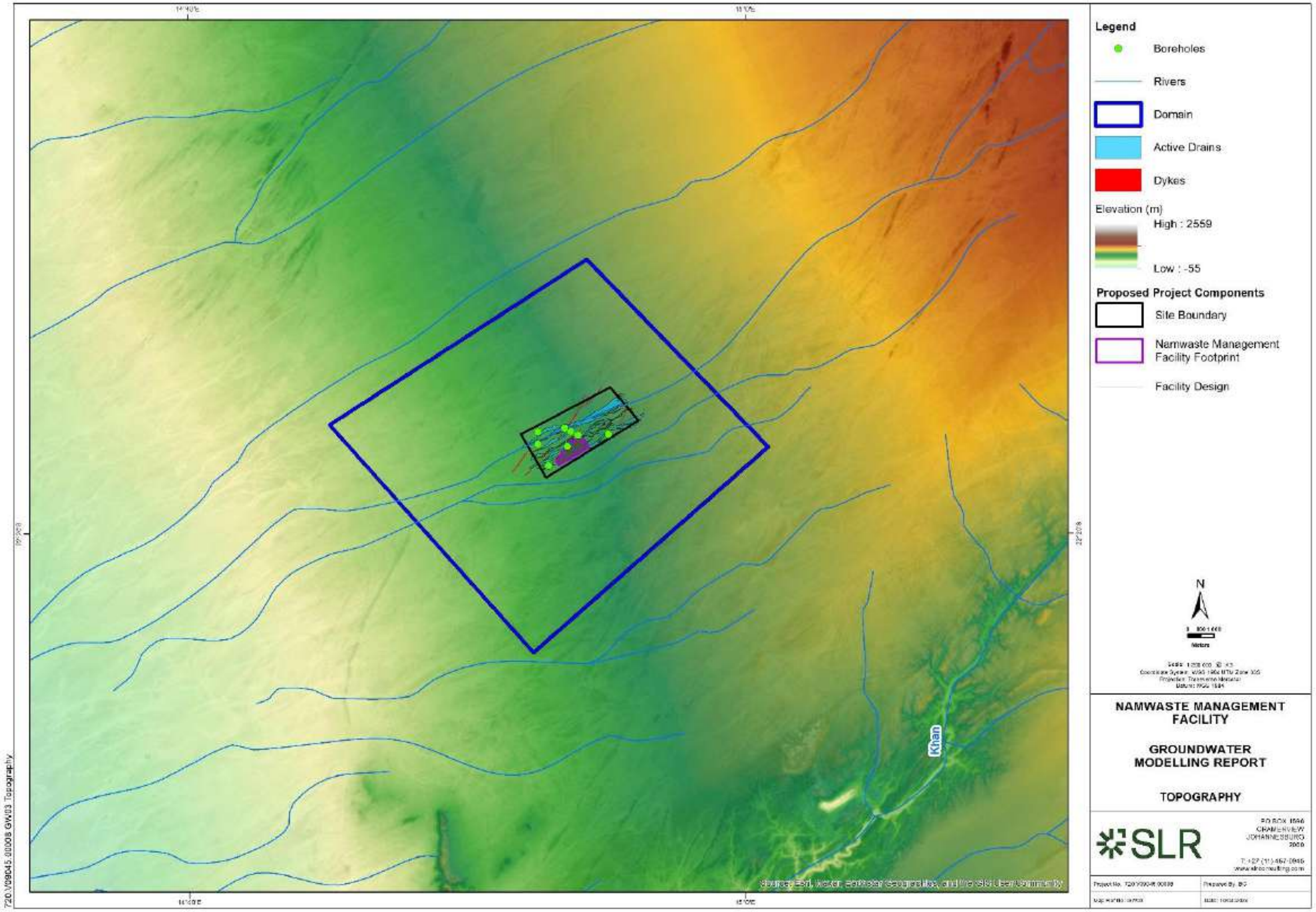

Figure 6-1: Map showing the general topography and drainage of the site and surrounds

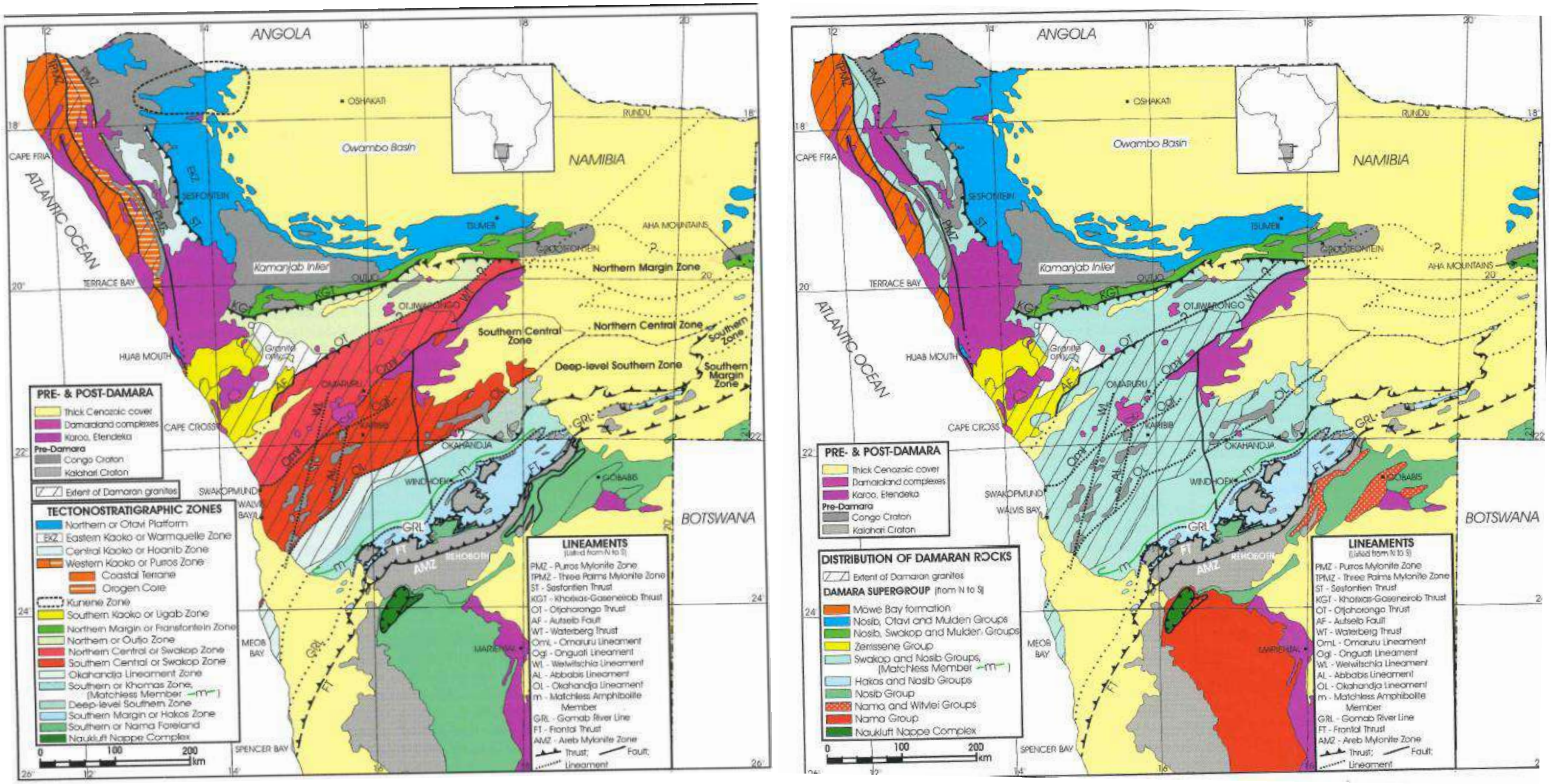

Figure 6-2: Tectonic stratigraphic zone and distribution of Damaran rocks

Source: Miller, 2008

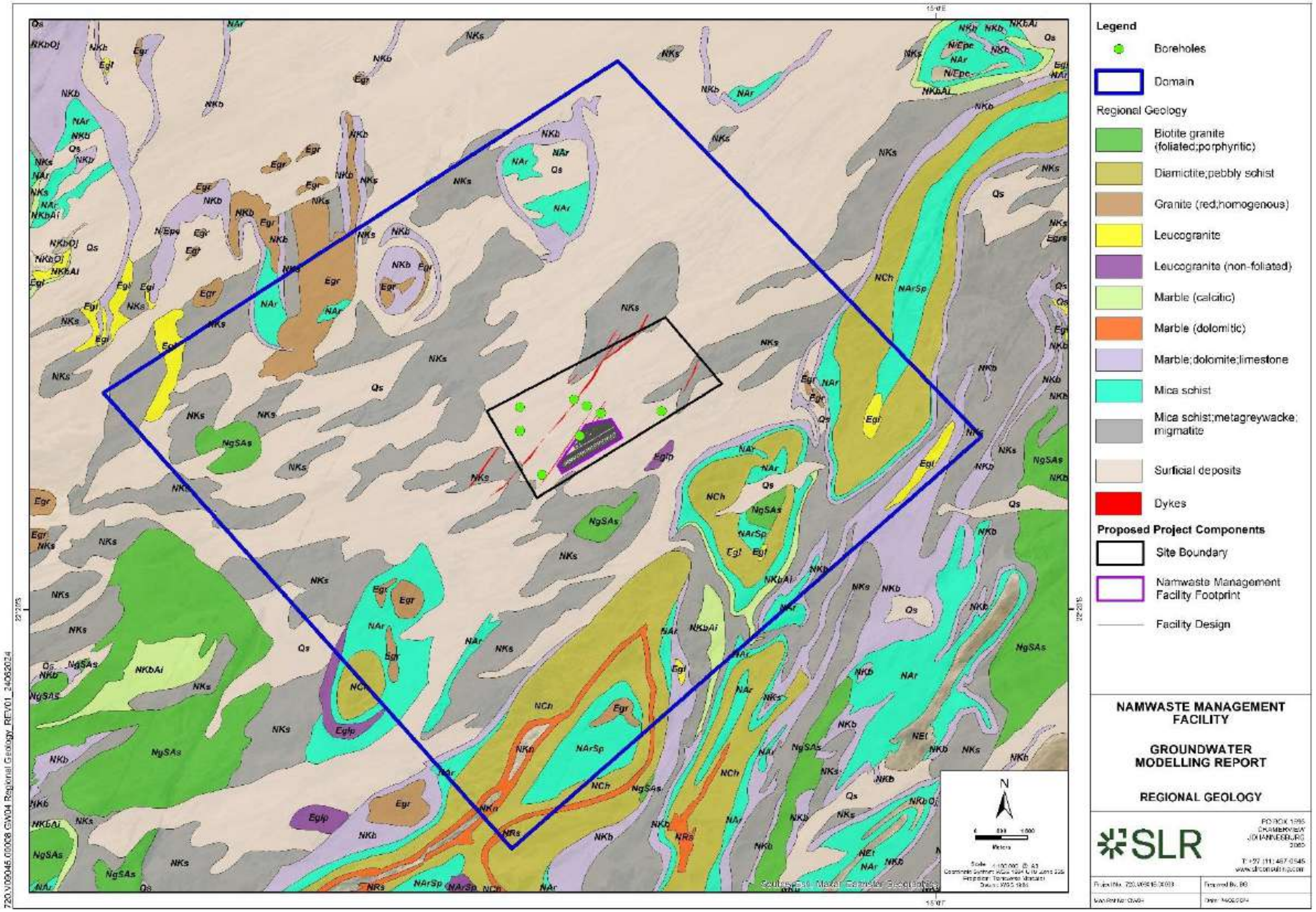

Figure 6-3: Regional Geology with site and associated model features superimposed

6.3.2 Local Geology

In terms of the local geology of the Project site, it is noted that:

- The 1:1 Mio Geology Map of Namibia and 1:250 000 Geology Map available from the Geological Survey of Namibia indicated that local geology is characterised by surficial deposits underlain by Kuiseb Formation mica schist, minor quartzite, graphitic schist. marble as well as calcretised quaternary sediments. From the Hydrogeological Screening Report SLR (2023), it is known that:
  - The Southern Central Zone is regionally faulted. Folded, intruded by granitoid complexes and dyke swarms. Unconsolidated to semi-consolidated calcretised sediments, weathered mica (biotite) schists, marble, dolerite, pegmatite, quartzite are located/identified during the site visit.
  - Marbles and other geological formation outcrop more on the eastern side of the site while the west has limited outcrops as sediments in the washes become relatively thicker and more widespread.
  - Dolerite dykes crosscut the site in a northeast-southwest orientation compartmentalising the site. They are part of the fractured aquifer and locally control groundwater flow observed in slight differences in groundwater levels from new boreholes drilled at the site.
  - Although dolerite dykes appear to outcrop, they are buried in other places. This was confirmed by their interception at depth during drilling and Electrical Resistivity Tomography (ERT) survey results.
  - Very thick over burden was not intercepted during drilling. ERT survey indicated a possible buried paleo-channel of about 25 m thick. ERT surveys also indicated weathering and rock hardness that underlay shallow calcretised overburden up to 10 m thick in some cases where after less weathered rock was characterised. Thick conductive weathered rock zone extended to depths of about 12 m below surface.
  - Both ERT and EM surveys determined local faulting and fracturing at lithological contacts orienting northeast - southwest.

6.4 Soils

A Soil and Agricultural Impact Assessment was undertaken by The Biodiversity Company (Appendix D). The assessment aimed to provide information to inform on the potential impacts that the proposed activity has on the soil and agricultural potential within the proposed Project footprint.

Four representative soil forms were identified within the NMF footprint and project buffer area (50 m) which include the Koiingnaas, Namib, Glenrosa and Mispah forms. The proposed NMF footprint is dominated by the Namib soil form, with the Koiingnaas soil form being the least dominant soil form within a 50 m buffer area around the site (see Figure 6-4). The activities are proposed within predominately freely drained, highly sandy soils. No hydromorphic soils are associated with the Project footprint. The different soil forms identified within the proposed Project footprint, as well as the current land uses, are illustrated in Photo Plate 6-1 and Photo Plate 6-2, respectively.

The most sensitive soil forms identified within the proposed Project footprint, include, the Namib and Koiingnaas soil form. The Namib soil form consists of an orthic topsoil on top of a regic sand horizon below. The Koiingnaas soils consists of a topsoil on top of a soft carbonate horizon underlain with a gypsic horizon below. The soils are characterised with high permeability which promotes water infiltration, root penetration and gas exchange. Furthermore, these soils have high calcium carbonates with the profile or as surface crust due to the effect of salinization where the evapo-transpiration demands exceeds precipitation resulting in surface salts accumulation. Other less sensitive soil forms that were identified within the Project footprint include Glenrosa and Mispah soil forms. The Glenrosa soil form consists of an orthic topsoil on top of a lithic horizon below. The Mispah soil form consists of an orthic topsoil on top of a hard rock substratum layer below. These soils are considered to have a lower suitability for crop production and growth due to their restrictive limitations which include impermeable subsoil horizons either solid or fractured parent material.

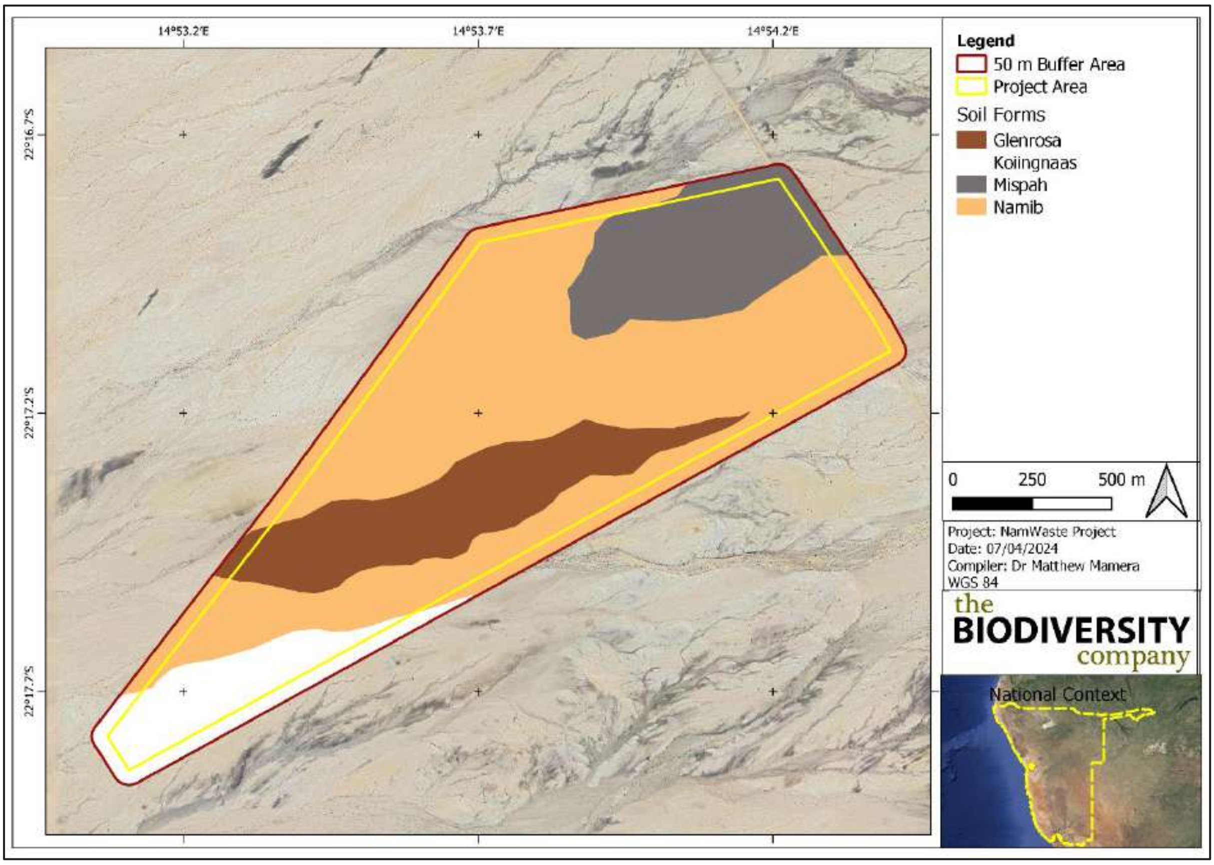

Figure 6-4 Soil forms found within the proposed NMF footprint

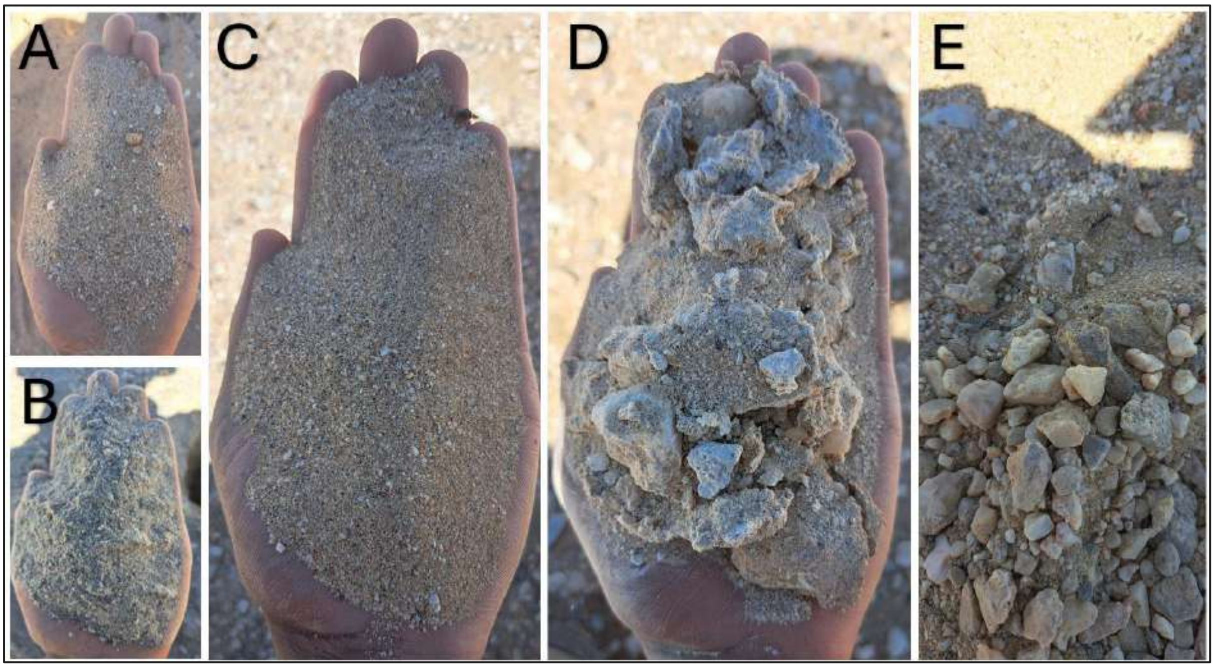

Photo Plate 6-1: Diagnostic soil forms identified on site: A) Mispah soil form; B&C) Namib soil form; D) Koiingnaas soil form; and E) Glenrosa soil form

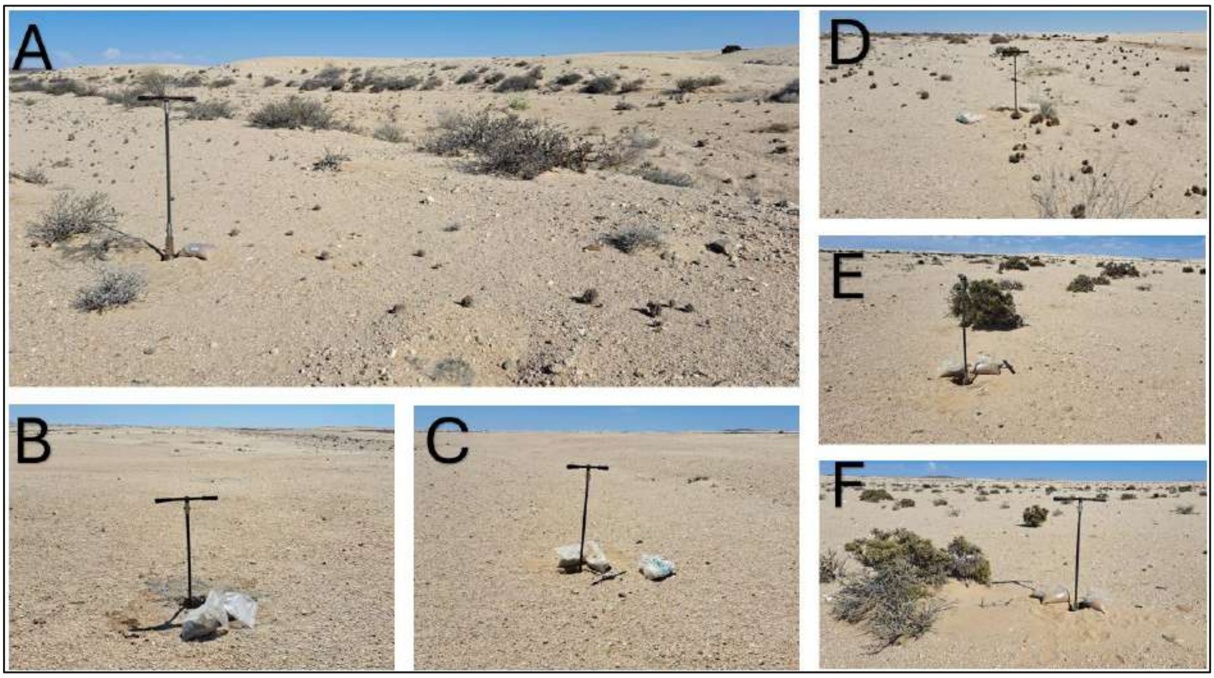

Photo Plate 6-2: Different landscapes identified within the 50 m buffer area; A) Drainage lines; B-F) Sandy plains and Herbaceous shrub veld

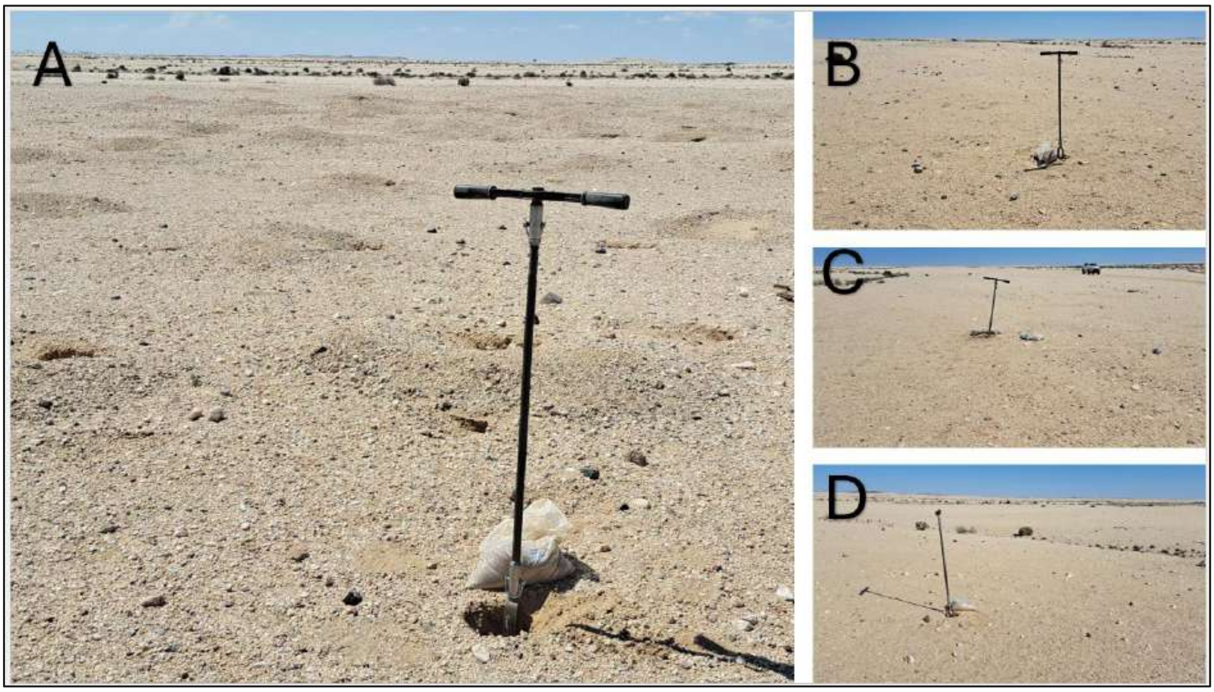

Photo Plate 6-3: Different land uses identified within the 50 m buffer area; A-D) Saprolithic Crop and Sandy plains

6.5 Agricultural Potential

The Biodiversity Company considered the agricultural potential of the Project footprint in their Soil and Agricultural Impact Assessment (Appendix D).

Agricultural potential is determined by a combination of soil, terrain, and climate features. Land capability classes reflect the most intensive long-term use of land under rain-fed conditions.

The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

6.5.1 Climate Capability

The climatic capability has been determined by means of the Smith (2006) methodology, of which the first step includes determining the climate capability of the region by means of the Mean Annual Precipitation (MAP) and annual Class A pan (potential evaporation) (see Table 6-2).

Table 6-2 Climate capability (step 1; Scotney et al., 1987)

Central Sandy Bushveld region				
Climatic Capability Class	**Limitation Rating**	**Description**	**MAP: Class A pan Class**	**Applicability to site**
C1	None to Slight	Local climate is favourable for good yields for a wide range of adapted crops throughout the year.	0.75-1.00	
C2	Slight	Local climate is favourable for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperature increase risk and decrease yields relative to C1.	0.50-0.75	
C3	Slight to Moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.	0.47-0.50	
C4	Moderate	Moderately restricted growing season due to the occurrence of low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.	0.44-0.47	
C5	Moderate to Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk of some yield loss.	0.41-0.44	
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops that frequently experience yield loss.	0.38-0.41	
C7	Severe to Very Severe	Severely restricted choice of crops due to heat and moisture stress.	0.34-0.38	
C8	Very Severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.	0.30-0.34	✓

According to Smith (2006), the climatic capability of a region is only refined past the first step if the climatic capability is determined to be between climatic capability 1 and 6. Given the fact that the climatic capability (i.e. Central Namib vegetation, MAP 100 mm and MAPE of 2240 mm with a MAP: A pan Class of 0.05) has been determined to be "C8" for the Project footprint, no further steps were taken to refine the climate capability.

6.5.2 Land Capability

The land capability was determined by using the guidelines described in "The farming handbook" (Smith, 2006). The delineated soil forms (WRB Soil groups) were clipped into the four different slope classes (0-5%, 5-10%,10-15% and 15-20) to determine the land capability of each soil form. Accordingly, the most sensitive soil forms associated with the Project footprint are restricted to land capability 6 (i.e. Koiingnaas and Nambi soil forms; Calcisols or Gypsic soil groups) and the other soils to 8 land capability (i.e. Glenrosa and Mispah soil forms; Leptosols soil groups) classes.

Table 6-3 Land capability for the soils within the project area

Land Capability Class	Definition of Class	Conservation Need	Use-Suitability	Land Capability Group	Sensitivity
6	Limitation preclude cultivation. Suitable for perennial vegetation.	Protection measures for establishment, e.g., sod-seeding	Veld, pasture, and afforestation	Non-arable	Low
8	Extremely severe limitation. Not suitable for grazing or afforestation	Total protection from agriculture	Wildlife	Non-arable	Low

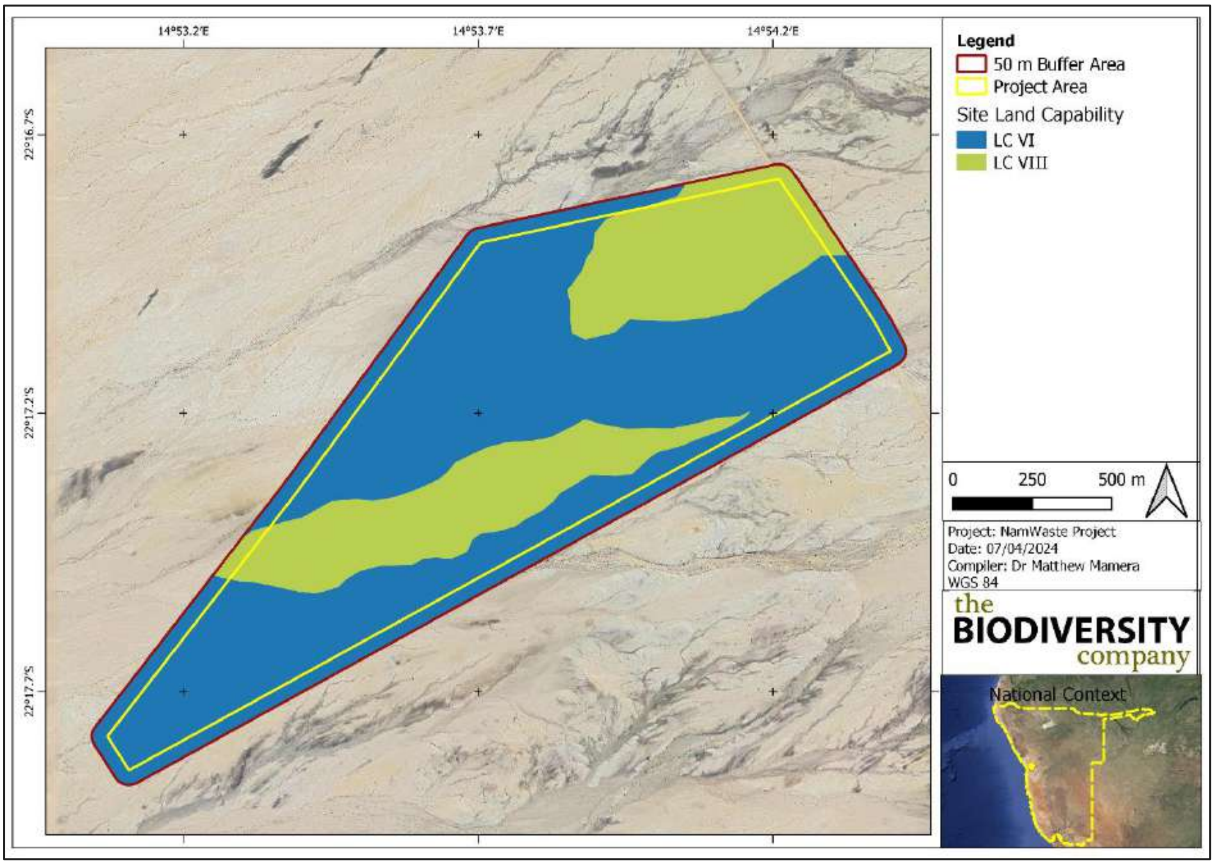

Figure 6-5 Land capability of the dominant soil forms identified in the proposed NMF footprint

6.5.3 Land Potential

The methodology used for the calculations of the relevant land potential levels are illustrated in Table 6-4 and Table 6-6. From the two land capability classes, the land potential levels have been determined by means of the Guy and Smith (1998) methodology. The land capability class VI was then reduced to a land potential level 7, land capability class VIII to land potential level 8 due to climatic limitations. The categorized land potentials for the site identified soil forms are illustrated in Table 6-5 below.

Table 6-4 Land potential from climate capability vs land capability (Guy and Smith, 1998)

Land Capability Class	Climatic Capability Class							
	C1	C2	C3	C4	C5	C6	C7	C8
LC1	L1	L1	L2	L2	L3	L3	L4	L4
LC2	L1	L2	L2	L3	L3	L4	L4	L5
LC3	L2	L2	L2	L2	L4	L4	L5	L6
LC4	L2	L3	L3	L4	L4	L5	L5	L6
LC5	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
LC6	L4	L4	L5	L5	L5	L6	L6	**L7***
LC7	L5	L5	L6	L6	L7	L7	L7	L8
LC8	L6	L6	L7	L7	L8	L8	L8	**L8***

*Land potential level applicable to the climate and land capability

Table 6-5 Land potential categories for the soil forms identified in the NMF footprint

Soil Form/Family	Land Potential
Koiingnaas and Nambi soil forms; Calcisols or Gypsic soil groups	7
Glenrosa and Mispah soil forms; Leptosols soil groups	8

Table 6-6 Land potential for the soils within the NMF footprint (Guy and Smith, 1998)

Land Potential	Description of Land Potential Class	Sensitivity
7	Low potential. Severe limitations due to soil, slope, temperatures or rainfall. Non-arable.	Low
8	Very Low potential. Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable.	Low
Disturbed	N/A	None

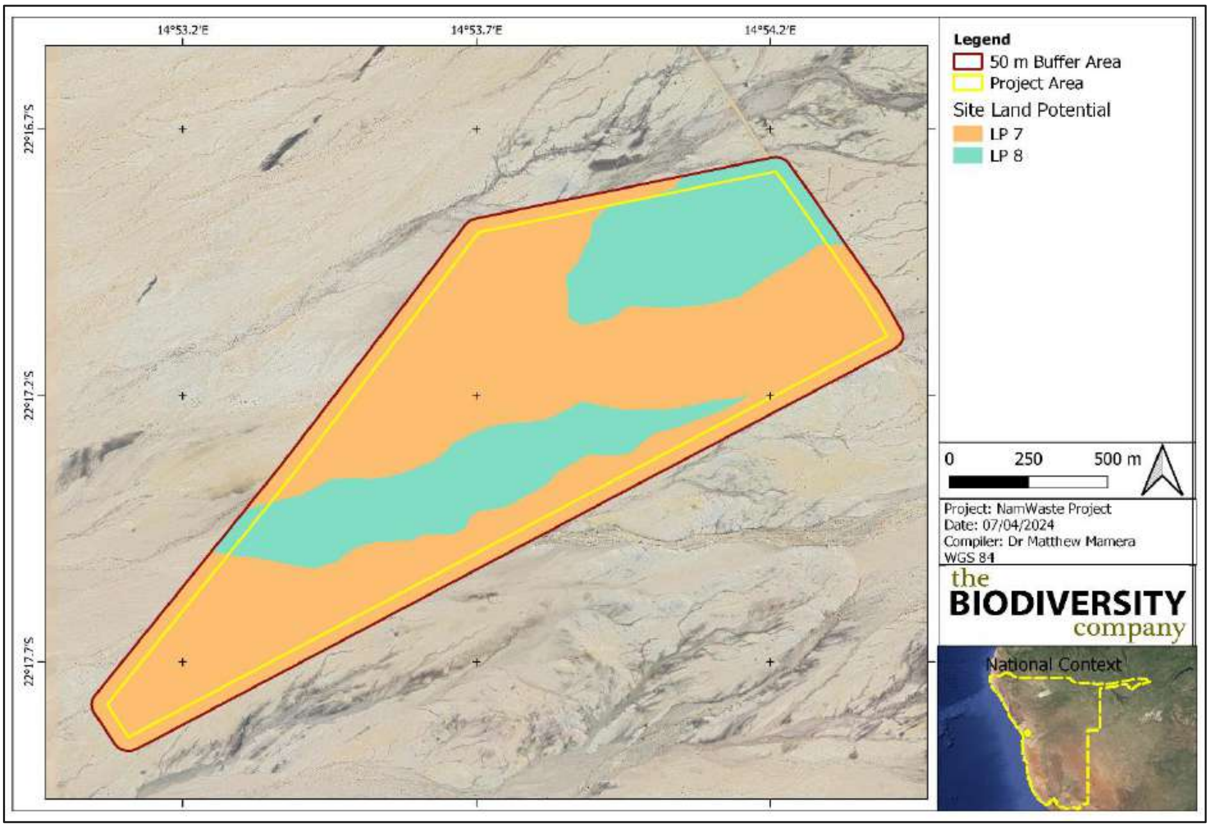

Figure 6-6 Land potential of the dominant soil forms identified in the proposed NMF footprint

6.5.4 Erosion Potential

The erosion potential of the identified soil forms has been calculated by means of the Smith (2006) methodology. In some cases, none of the parameters are applicable, in which case the step was skipped.

6.5.4.1 Koiingnaas

Table 6-7 illustrates the values relevant to the erosion potential of the Koiingnaas soil forms. The final erosion potential score has been calculated at 1.0, which indicates a "Very High" potential for erosion.

Table 6-7 Erosion potential calculation for the Koiingnaas soil forms

Step 1- Initial Value, Texture of Topsoil		
Light (0-15% Clay)	Medium (15-35% Clay)	Heavy (>35% Clay)
3.5	4.0 4.5 5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)		
Slightly Restricted	Moderately Restricted	Heavily Restricted
-0.5	-1.0	-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)		
Dystrophic Soils, Medium and Heavy Textures	Mesotrophic Soils	Eutrophic or Calcareous Soils, Medium and Heavy Textures
+0.5	0	-0.5

Step 4- Organic Matter	
Organic Topsoil	**Humic Topsoil**
+0.5	+0.5
Step 5- Topsoil Limitations	
Surface Crusting	**Excessive Sand/High Shrink/Self-Mulching**
-0.5	**-0.5**
Step 6- Effective Soil Depth	
Very Shallow (<250 mm)	**Shallow (<250-500 mm)**
-1.0	**-0.5**

6.5.4.2 Namib

Table 6-8 illustrates the values relevant to the erosion potential of the Namib soil forms. The final erosion potential score has been calculated at 1.5, which indicates a “Very High” potential for erosion.

Table 6-8: Erosion potential calculation for the Namib soil form

Step 1- Initial Value, Texture of Topsoil		
Light (0-15% Clay)	**Medium (15-35% Clay)**	**Heavy (>35% Clay)**
3.5	4.0 4.5 5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)		
Slightly Restricted	**Moderately Restricted**	**Heavily Restricted**
-0.5	**-1.0**	-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)		
Dystrophic Soils, Medium and Heavy Textures	**Mesotrophic Soils**	**Eutrophic or Calcareous Soils, Medium and Heavy Textures**
+0.5	0	**-0.5**
Step 4- Organic Matter		
Organic Topsoil	**Humic Topsoil**	
+0.5	+0.5	
Step 5- Topsoil Limitations		
Surface Crusting	**Excessive Sand/High Shrink/Self-Mulching**	
-0.5	**-0.5**	
Step 6- Effective Soil Depth		
Very Shallow (<250 mm)	**Shallow (<250-500 mm)**	
-1.0	-0.5	

6.5.4.3 Glenrosa

Table 6-9 illustrates the values relevant to the erosion potential of the Glenrosa soil forms. The final erosion potential score has been calculated at 1.0, which indicates a “Very High” potential for erosion.

Table 6-9: Erosion potential calculation for the Glenrosa soil form

Step 1- Initial Value, Texture of Topsoil		
Light (0-15% Clay)	Medium (15-35% Clay)	Heavy (>35% Clay)
3.5 4.0	4.5 5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)		
Slightly Restricted	Moderately Restricted	Heavily Restricted
-0.5	-1.0	-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)		
Dystrophic Soils, Medium and Heavy Textures	Mesotrophic Soils	Eutrophic or Calcareous Soils, Medium and Heavy Textures
+0.5	0	-0.5
Step 4- Organic Matter		
Organic Topsoil	Humic Topsoil	
+0.5	+0.5	
Step 5- Topsoil Limitations		
Surface Crusting	Excessive Sand/High Shrink/Self-Mulching	
-0.5	-0.5	
Step 6- Effective Soil Depth		
Very Shallow (<250 mm)	Shallow (<250-500 mm)	
-1.0	-0.5	

6.5.4.4 Mispah

Table 6-10 illustrates the values relevant to the erosion potential of the Mispah soil forms. The final erosion potential score has been calculated at 0.5, which indicates a “Very High” potential for erosion.

Table 6-10: Erosion potential calculation for the Mispah soil form

Step 1- Initial Value, Texture of Topsoil		
Light (0-15% Clay)	Medium (15-35% Clay)	Heavy (>35% Clay)
3.5 4.0	4.5 5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)		
Slightly Restricted	Moderately Restricted	Heavily Restricted
-0.5	-1.0	-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)		
Dystrophic Soils, Medium and Heavy Textures	Mesotrophic Soils	Eutrophic or Calcareous Soils, Medium and Heavy Textures
+0.5	0	-0.5
Step 4- Organic Matter		
Organic Topsoil	Humic Topsoil	
+0.5	+0.5	
Step 5- Topsoil Limitations		

Surface Crusting	Excessive Sand/High Shrink/Self-Mulching
-0.5	-0.5
Step 6- Effective Soil Depth	
Very Shallow (<250 mm)	Shallow (<250-500 mm)
-1.0	-0.5

6.5.5 Site Ecological Importance (SEI)

The following land potential levels have been determined:

- Land potential level 7 (this land potential level is characterised by low potential. Severe limitations due to soil, slope, temperatures, or rainfall. Non-arable); and
- Land potential level 8 (this land potential level is characterised by Very Low potential. Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable).

The climate, soil forms and land capability features were used to determine the overall ecological importance of the soil resources. The area along drainage lines and washes generally tend to support vegetation and habitats due to transported dissolved nutrients and periodical water supply. These areas usually are characterised with a "Medium" sensitivity. The proposed Project footprint associated with plains which are dominant in the current Project area was assigned a "Low" sensitivity (Figure 6-7).

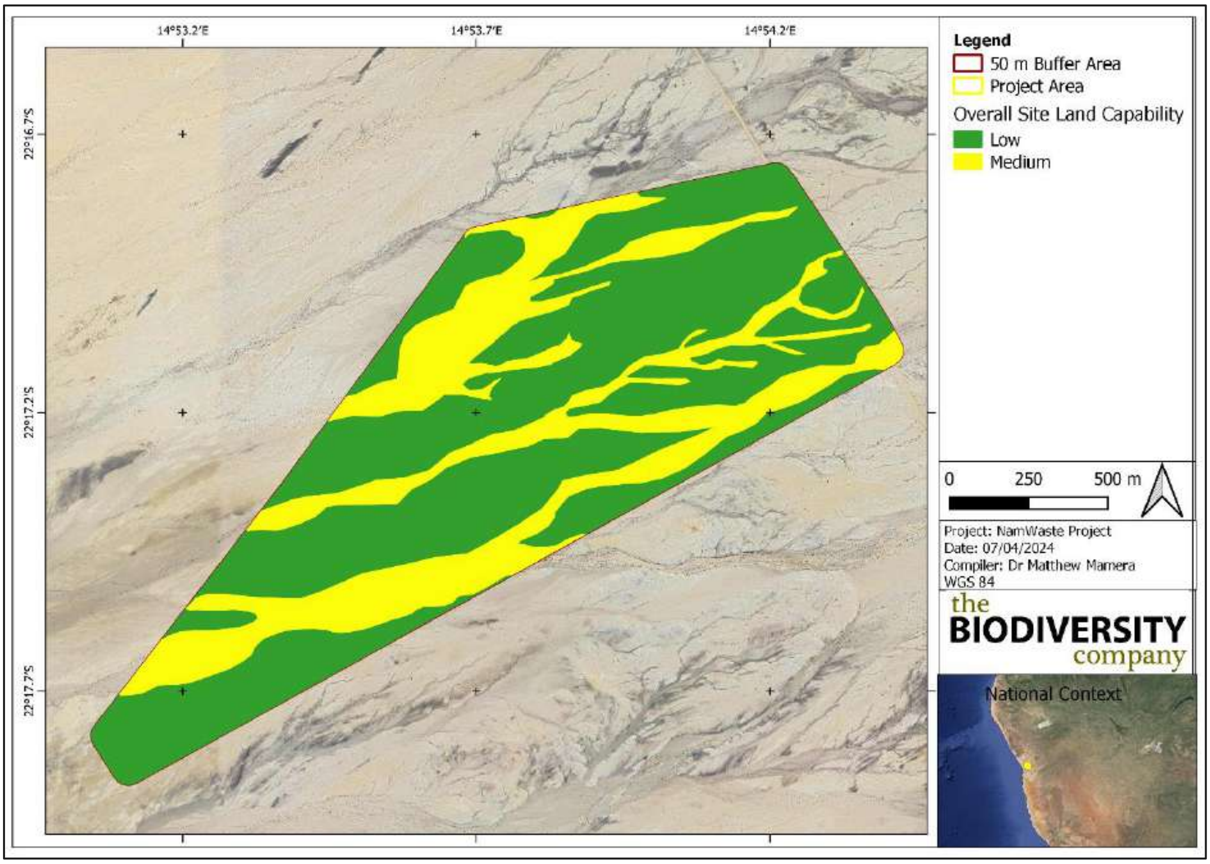

Figure 6-7: Overall Ecological Importance for the proposed NMF footprint

The proposed Project footprint falls within "Very Low to Low" and areas along drainage lines have a "Medium" land capability sensitivity (see Figure 6-7). The land capability and land potential of the resources for agricultural and cropping practices in the buffer area are both characterised as "Low to medium." The following land capability category is applicable:

- Land Capability 1 to 5 (Very low Sensitivity to Low Sensitivity).

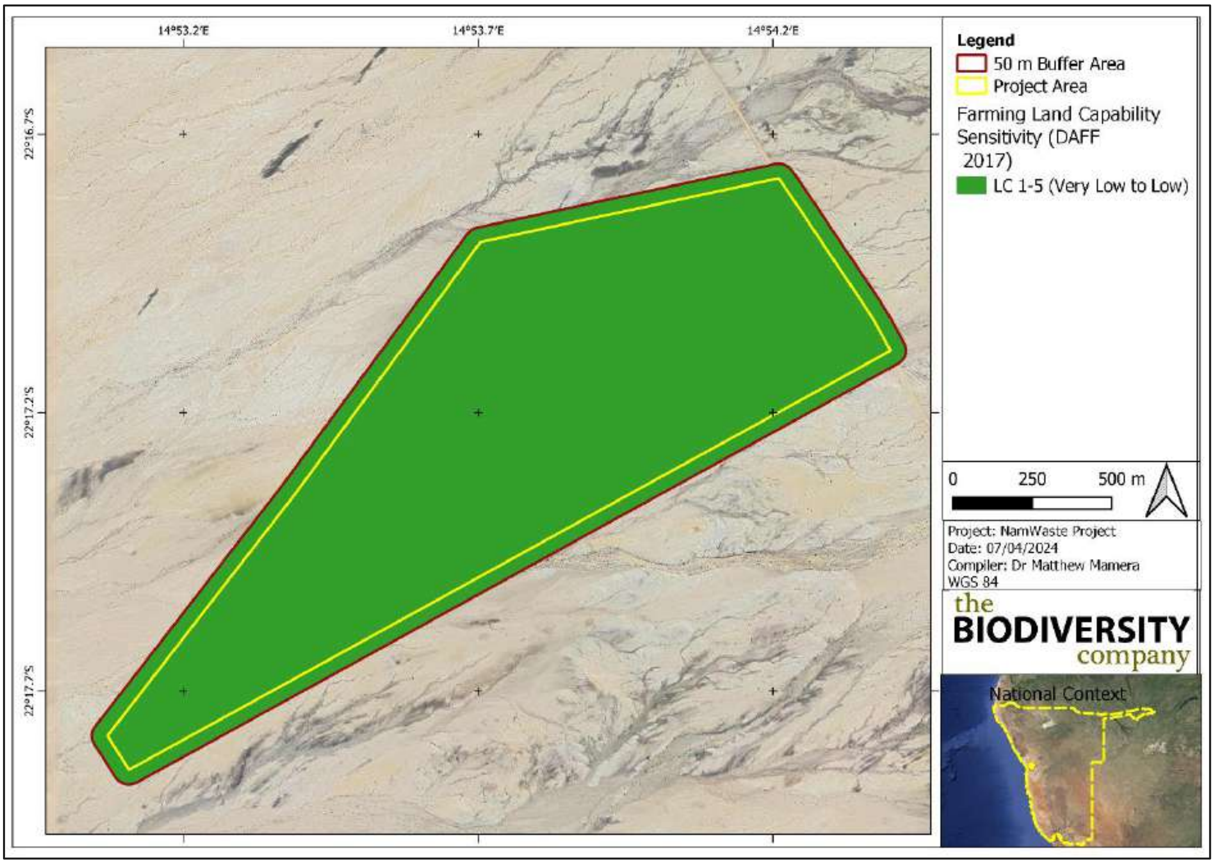

Figure 6-8: Land Capability Sensitivity for the proposed NMF footprint following the DAFF, (2017) approach

The soil characteristics within the Project footprint have limited agricultural capability and potential. There are no crop boundary areas which were identified within the Project footprint.

By field work observation, it is evident that there is no active agriculture or crops present within the proposed Project footprint. Moreover, there is no working irrigation infrastructure, such as centre pivots or drip irrigation present within the Project footprint and irrigated agriculture is currently not practised in the area. However, the naturally occurring plants grow in drainage lines, providing important habitats for animals, specifically in the washes which can be sensitive for the biodiversity and terrestrial ecology.

Considering the soil properties, agricultural potential as well as the current land use of the proposed development area, the area has a low agricultural sensitivity. Based on the confirmed sensitivities, the overall sensitivity of the proposed Project footprint is categorized as "Low" (see Figure 6-7).

6.6 Land Use

6.6.1 General

The area is primarily wilderness with no defined or regular human activity. Land use in the proposed Project site is nominally conservation (under control of the #Gaingu Conservancy) although there is no evidence or information on any current or active conservation usage. Exploration activities in the past have left some disturbance in the form of tracks and small pits, etc.

6.6.2 Mining and exploration

Mining activities account for a significant portion of land-use in the Erongo Region, with the main commodities mined being uranium and gold. Salt mining also occurs along the coast at Walvis Bay and Swakopmund.

The Orano Uranium Mine, owned by Orano Mining Namibia (Pty) Ltd (Orano), is located ~ 6.5 km north-west of the Project site. In July 2013, Orano placed the Orano Uranium Mine under care and maintenance. Since then, the already constructed facilities have been kept in operating condition so that the 80% completed mine infrastructure can be started up as soon as there is an upswing in the uranium market. The access road to the Orano Uranium Mine runs adjacent to the Project site. Orano has an access control point between the town of Arandis and the mine site, which is permanently manned by security personnel and access is only allowed through arrangement with Orano.

The Rössing Uranium mine (operational mine) is located approximately 20 km south-east of the Project site.

According to the Namibia Mines and Energy Cadastre Portal, there are no current Mining Licences (ML) over the Project site.

Chaneni Investment (Pty) Ltd has made an application for an EPL (Ref: 8801), to explore for base and rare metals, dimension stone, industrial minerals, nuclear fuel minerals and precious metals. The EPL application area overlaps with the NMF site as shown in Figure 6-9. Registration of the EPL is pending the issuing of an ECC. *The EIA and EMP documents for the EPL application, as accessed on the MEFT portal, do not provide a clear indication of where exploration activity is proposed. SLR contacted the EPL applicant, but they declined to discuss the NMF or share any information on their EPL application (see consultation record in Appendix B). Thus, it has not been determined if there is potential for any direct conflict in physical activity of the two parties.*

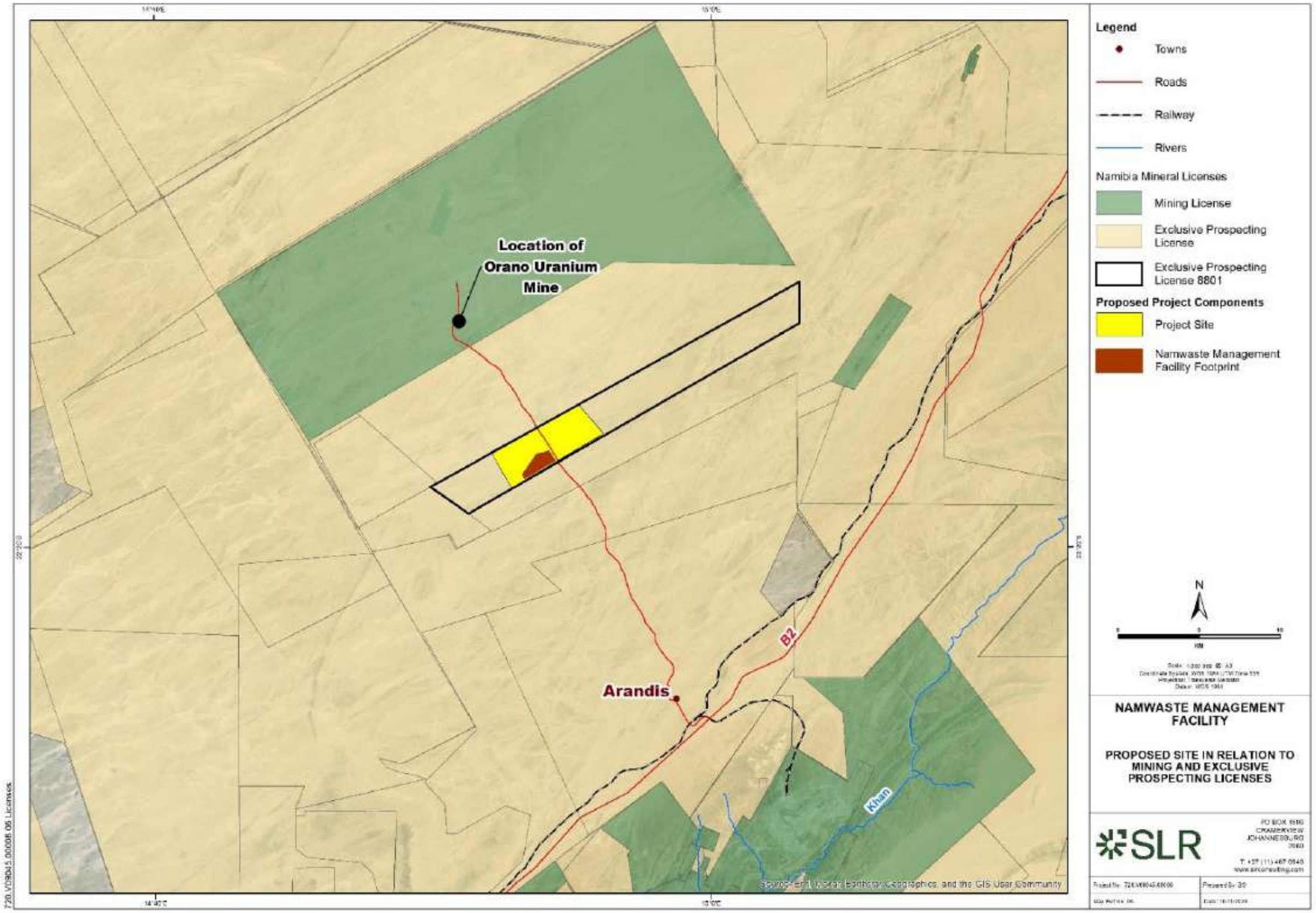

Figure 6-9: Mineral Licences in relation to the Project site

6.6.3 Parks and Communal areas

The Dorob National Park boundary lies ~ 10 km to the west of the Project site and the northern boundary of the Namib Naukluft National Park (NNNP) is ~ 30 km to the south. The Project site lies within the #Gaingu Conservancy (see Figure 6-10).

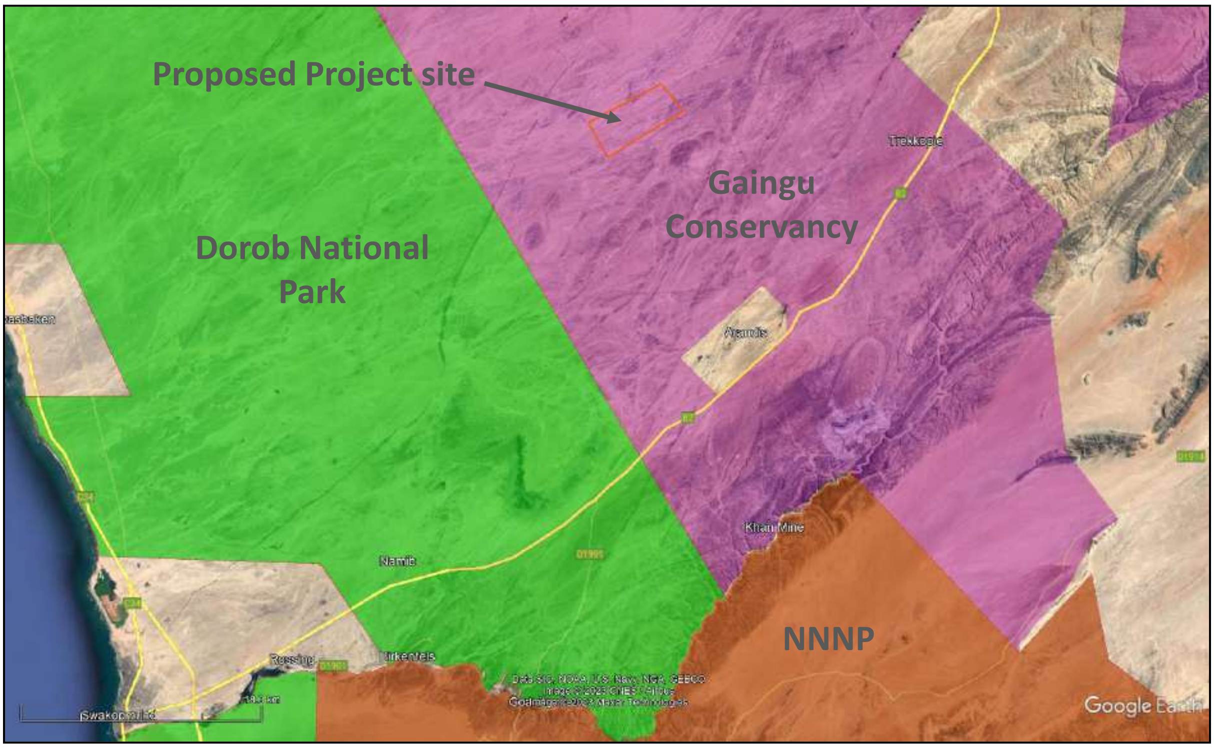

Figure 6-10: Project site in relation to National Parks (Green shading & Brown shading) and the #Gaingu Conservancy (Pink shading)

The #Gaingu Conservancy is named after the Khoekhoegowab name for 'Spitzkoppe Mountain'. The conservancy was registered in 2004 and covers an area of ~ 7 800 km^2. The Conservancy is home to the following key enterprises: the Spitzkoppe Community Camp (community rest camp, location ~52 km north-east of the proposed project site); trophy hunting and semi-precious stone market along the access road to the Spitzkoppe Community Camp (NACSO, 2023). The conservancy has not made direct use of the Project site. *The #Gaingu Conservancy was consulted during the EIA process (see Section 1.2 of the CRR, Appendix B).*

6.6.4 Communities / Residential areas and other infrastructure

The Project site has no known human receptors on or in its immediate vicinity. The nearest establishments are at the Orano Uranium Mine (~ 7 km to the north-west) and the town of Arandis (~15 km south). There are no other known buildings, public roads or railways closer than this.

The main urban areas in the Erongo Region include the towns of Arandis, Swakopmund, Walvis Bay, Henties Bay, Usakos, and Karibib, as well as a few smaller settlements. The main towns, except Arandis, Karibib and Usakos are located along the coast and are popular holiday and tourist destinations throughout the year.

The town of Arandis, with associated infrastructure (i.e. powerline, informal general landfill site, railway lines, etc.) is located ~15 km south of the Project site. Arandis has a total population of approximately 8 000 residents (Namibia-info, 2023). The Arandis Railway Station is a crossing loop on the Trans-Namib Railway between Swakopmund and Usakos.

According to the Arandis Town Council Structure Plan, the Town Council intends to extend the town boundaries in future as per Figure 6-11. Should the townlands be extended as outlined in the structure plan the NMF will be located approximately 10 km from Arandis. In terms of future development the Arandis Town Council is considering extending the townlands boundary to beyond the NMF site to include Orano mine. The ATC is yet to submit an application for the planned future extension of the town boundary.

The Namibian Institute of Mining and Technology (NIMT) is reputed to be the best vocational training centre in the country and it accepted 1130 students into full time and special positions in its March 2020 intake. It has four campuses, two of which are in Arandis. In 2020, the Arandis campus provided training in: petrol and diesel mechanics, fitting and turning, general electrical, instrumentation, air-conditioning and refrigeration, boiler making and welding, carpentry and joinery, plumbing and sheet metal work, and clothing production (NIMT, 2020).

Between Rössing and Arandis is the B2 National Road, linking the Central Coastal Towns with Windhoek and further east (including Botswana). Refer to **Figure 6-12** for the closest receptors.

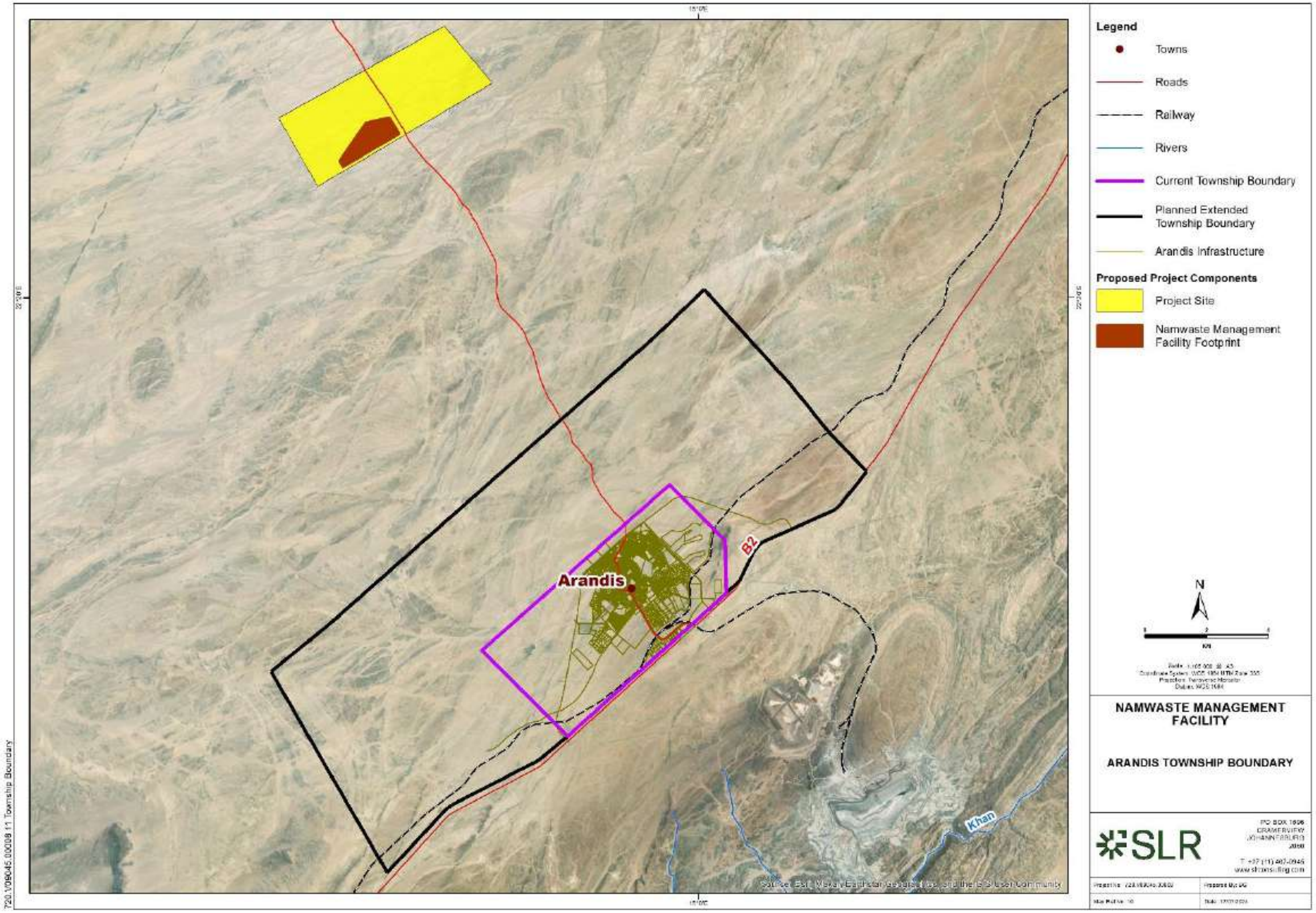

Figure 6-11: Proposed Townlands Boundary Extension for Arandis

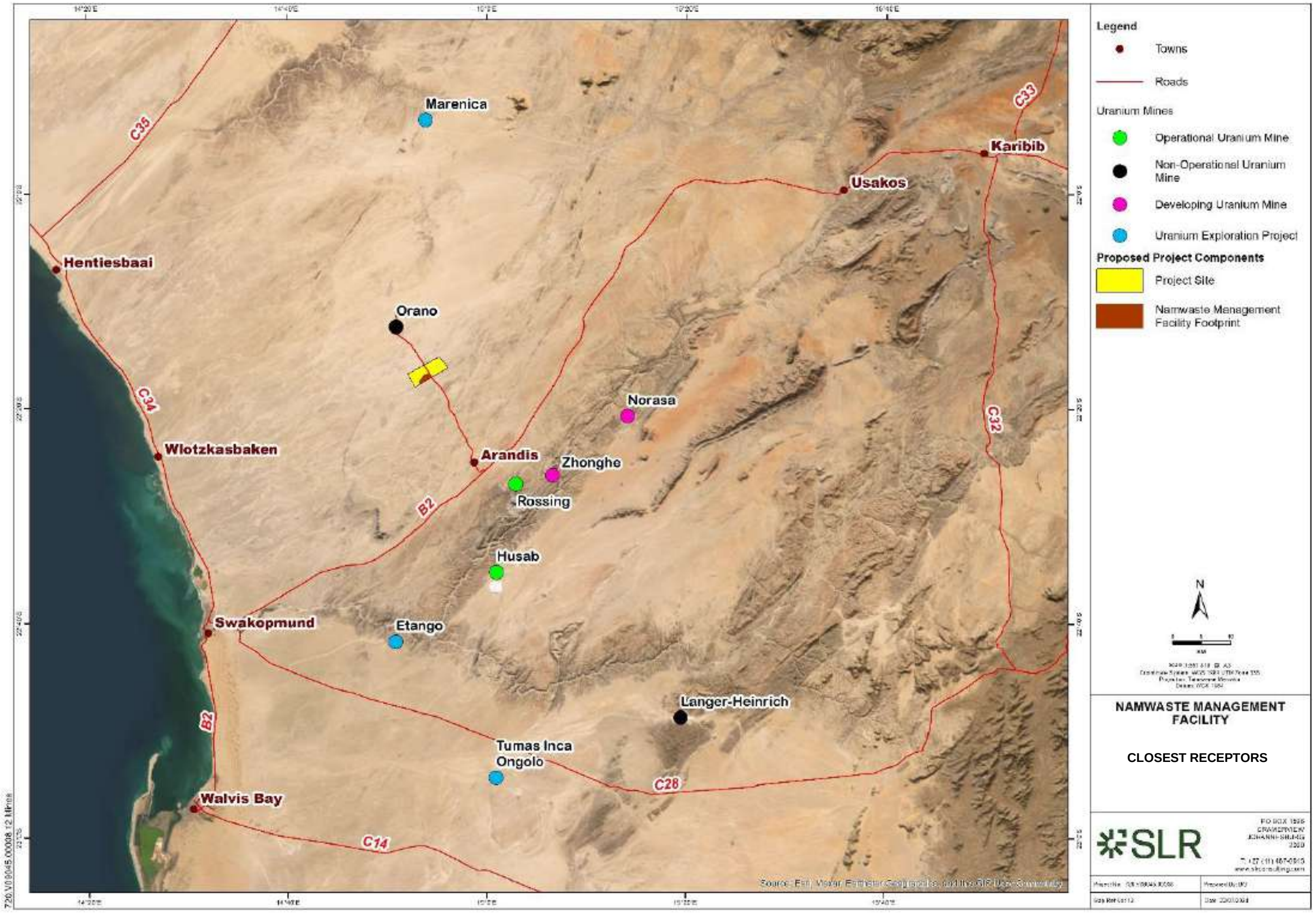

Figure 6-12: Closest Receptors

6.7 Visual

A Visual Impact Assessment (VIA) was undertaken by Graham A Young Landscape Architects (Appendix F). The study focused on the physical aspects of the proposed Project, within its local context.

6.7.1 Landscape Character

The site of the proposed NMF is located in the Central Namib Desert, a gravel plain between the true Namib desert and the escarpment. The broader landscape is characterized by rolling flat topography, gently sloping and subtly changing from the northeast to the southwest, with the Spitzkoppe (north of the proposed site) and Rössing mountains (south of the proposed site) standing as beacons in the landscape.

The site gives the impression of being a pristine desert landscape, which however, has been compromised with vehicle tracks leaving stark imprints on the desert surface. The plain, called the 'Namib Unconformity Surface' by geologists, holds the remnants of ancient geological processes (estimated from 65 million years ago) characterized by quartz gravel, gypsum-rich layers of gypcrete and calcium rich layers of calcrete (Seely & Pallett 2008:57). Vehicle tracks not only damage the surface and expose the fine sand making it susceptible to soil erosion and compaction, but also cause "visual and physical scars" on the desert surface that may still be visible many decades later.

In addition to the visually intrusive nature of vehicle tracks, the natural desert characteristics of the landscape for the supporting infrastructure (e.g. new road, overhead powerline) has been compromised with existing infrastructural activities (e.g. powerlines) as indicated Figure 6-13.

Figure 6-13: Landscape Character Views

6.7.2 Visual Resource

The value of the visual resource and its associated scenic quality are primarily derived from the combination of landscape types described above overlaid onto an open flat to gently rolling topography. These are the primary features that give the area its general characteristics and a sense of place. The sensitivity of the study area's landscape, from a visual perspective, is rated from moderate high to low for the various landscape character types illustrated in Figure 6-14. The value of a visual resource is dependent on its:

- Character (does it contribute to the area's sense of place and distinctiveness?);
- Quality – in what condition is the existing landscape;
- Value – is the landscape valued by people, local community, visitors, and is the landscape recognised, locally, regionally, or nationally and
- Capacity – what scope is there for change (either negative or positive) in the existing landscape character?

The Project site occurs within a landscape type rated *moderate.* The landscape surrounding the site, is also rated *moderate* with the rocky outcrops, with the bulk water line and the electricity powerline passing areas rated *moderate to high*. Table 6-11 summarises the various local landscape character types and their consequent sensitivities as defined in Figure 6-14 below.

Table 6-11: Value of the Visual Resource (after: LiEMA 2013)

Moderate to High Rocky Outcrops	**Low Moderate to Moderate** Ephemeral, shallow water courses, and flat to rolling gravel plains.	**Low** Urban settlement and mine infrastructure
This landscape type is considered to have a *moderate* to *high* value because it is a: Distinct landscape that exhibits a positive character with valued features that combine to give the experience of unity, richness, and harmony. Landscape Sensitivity: It is sensitive to change in general and will be detrimentally affected if change is inappropriately dealt with.	This landscape type is considered to have a *moderate* value because it is a: Common landscape that exhibits some positive character, but which has evidence of degradation and erosion of features resulting in areas of mixed character. Landscape Sensitivity: It is potentially sensitive to change in general and change may be detrimental if inappropriately dealt with.	This landscape type is considered to have a *low* value because it is a: Minimal landscape generally negative in character with few, if any, valued features. Landscape Sensitivity: It is not sensitive to change in general and scope for positive enhancement frequently occurs.

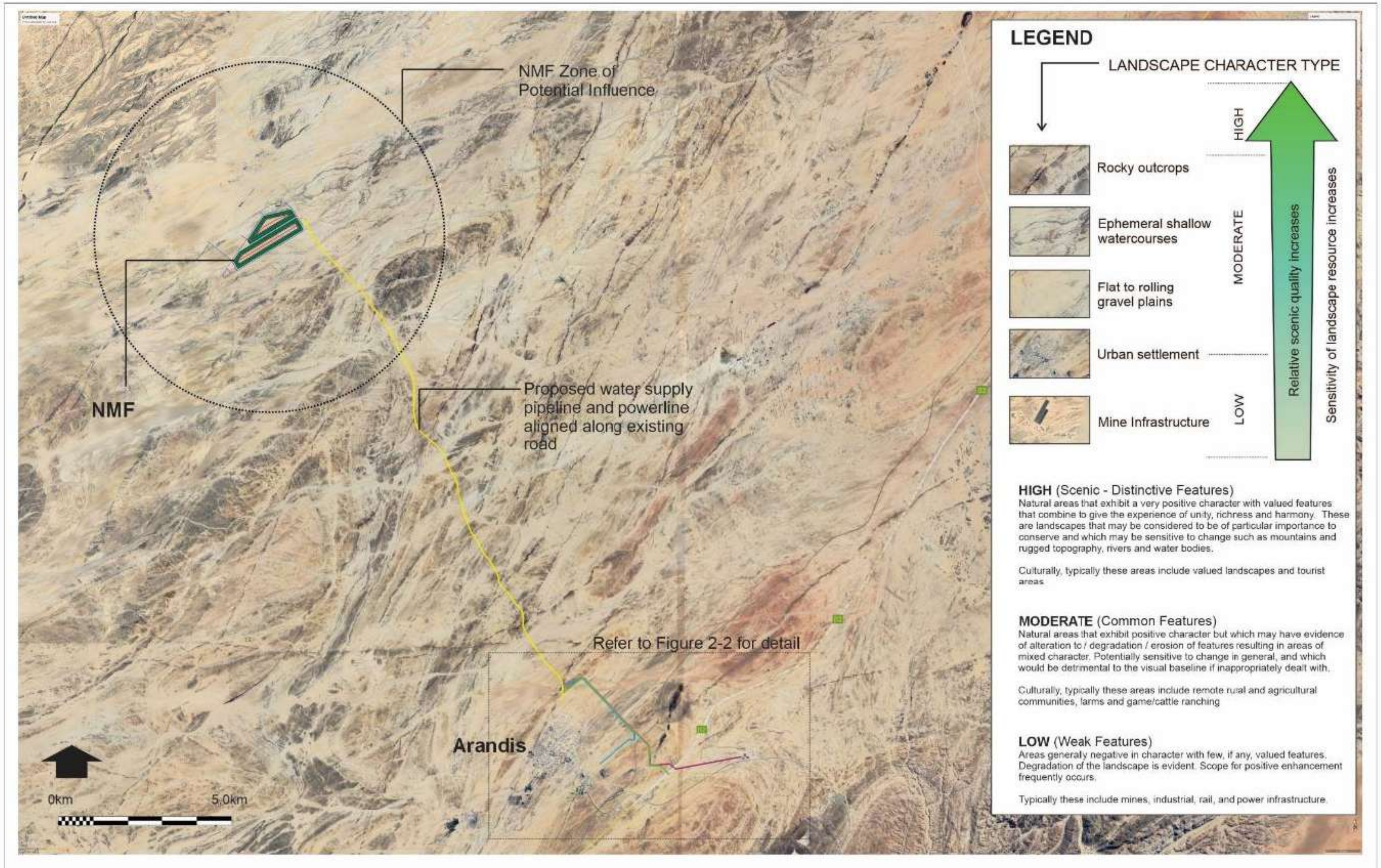

Figure 6-14: Landscape Character and Sensitivities

6.7.3 Sense of Place

According to Lynch (1992), a sense of place is the extent to which a person can recognize or recall a place as being distinct from other places - as having a vivid, or unique, or at least particular, character of its own. The sense of place for the study area derives from a combination of the local landscape types described above, their relative 'intactness', and their impact on the senses.

The activities and land-uses in the Project area are common within the sub-region. However, the desert, with its openness and huge expanses of rolling gravel plains, interspersed with rocky outcrops, exerts a moderately strong sense of place. Yet, within the context of the sub-region, it is regarded as a common landscape which is being impacted by mining, infrastructure and urbanization activities. Although the Project area occurs within the #Gaingu Conservancy, there are no nearby tourist destinations i.e. Spitzkoppe is 60 km to the north east and the coast is approximately 55 km west of the NMF site.

Nevertheless, new development needs to be carefully managed such that the combination of development activities associated with the Project are not at complete odds with the nature of the landscape.

6.7.4 Sensitive Viewers and Locations

During the public review comment process of the Scoping Phase only one visual issue was raised in which the respondent wanted to know "How high will the landfill be? Will it be visible from the B2?". The viewshed in Figure 6-15 below, indicates that landfill will not be visible from the B2.

Figure 6-16 identifies receptor locations where people would most likely be sensitive to negative changes in the landscape caused by the physical presence of the Project. There are two main areas of concern:

- The public roads including the B2 and the main access road to Arandis; and
- the residential areas associated with the town of Arandis.

It is evident in Figure 6-16 that these areas are at the far southern section of the study area and are far enough away from the proposed NMF that it would not be visible from these locations.

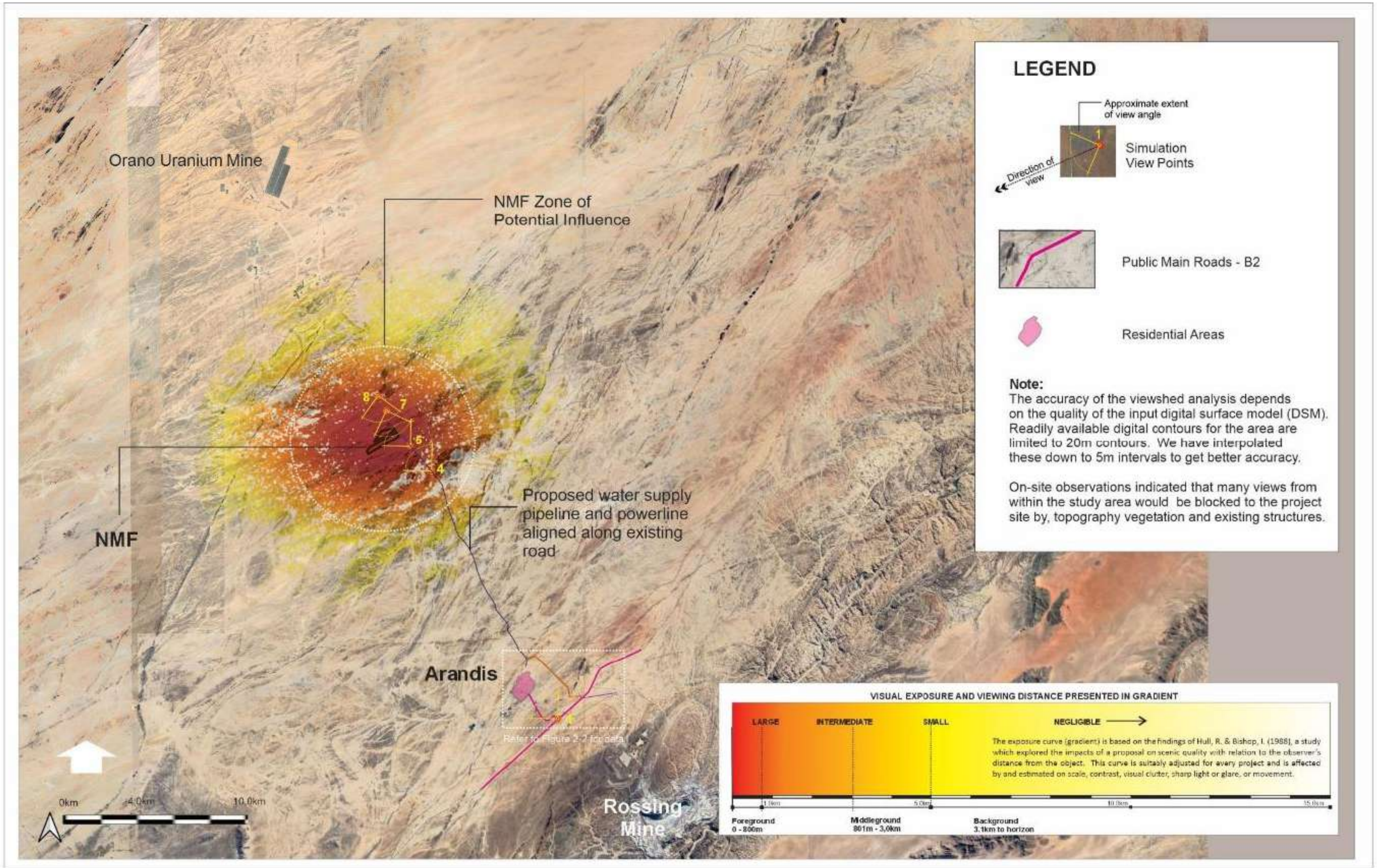

Figure 6-15: Viewshed Analysis

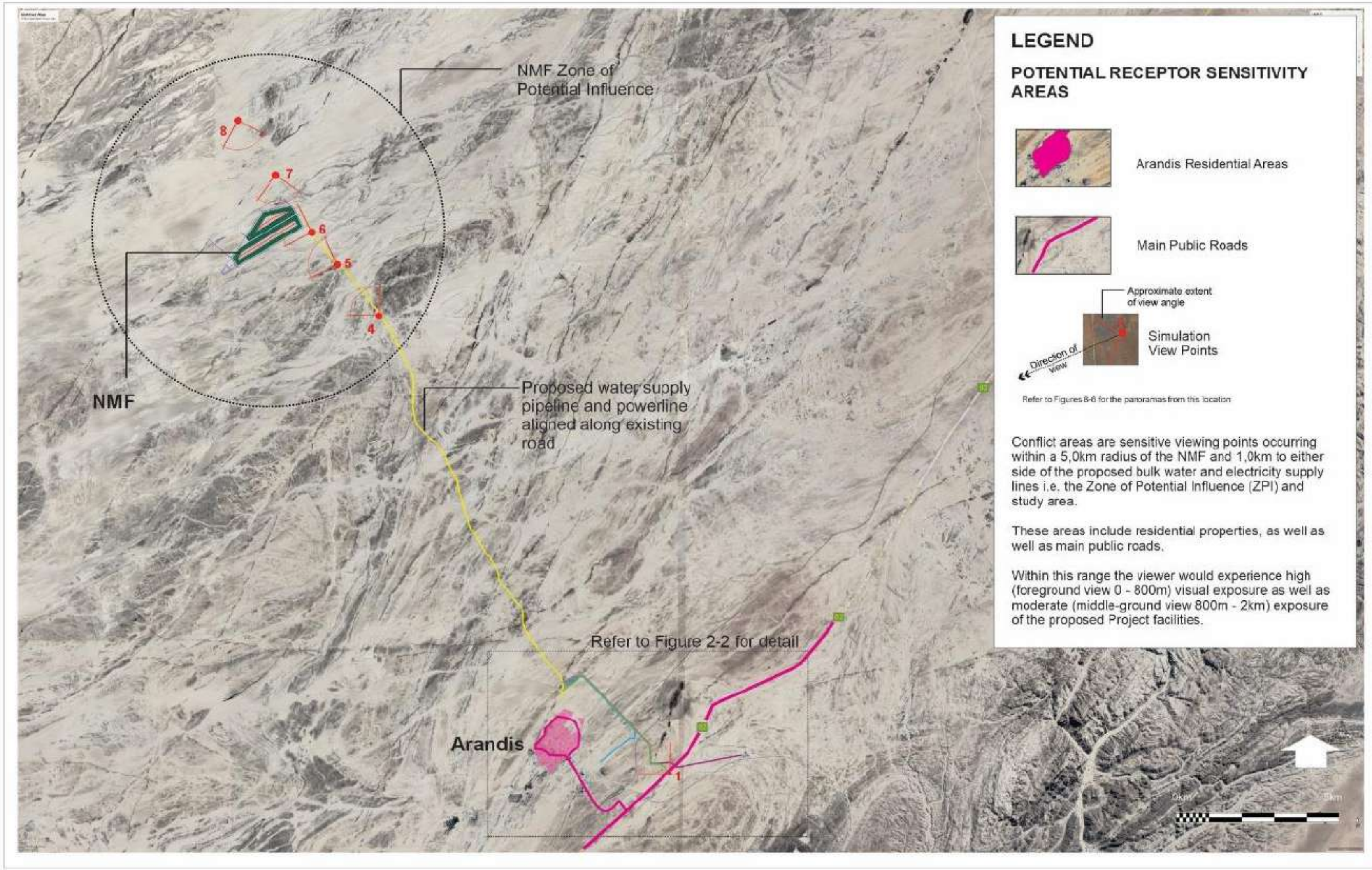

Figure 6-16: Receptor Sensitivity

6.7.5 Visual Exposure

Visual exposure is determined by qualifying the visibility of an object, with a distance rating to indicate the degree of intrusion and visual acuity. As distance between the viewer and the object increases, the visual perception of the object reduces exponentially as, generally, changes in form, line, colour, and texture in the landscape become less perceptible with increasing distance.

Sensitive receptor locations are outside the viewshed of the NMF, and the proposed infrastructure in Arandis occurs in a landscape context where they are most likely not to be readily noticed due to the clutter of urban and industrial activities in the town. The 33kV powerline (with pole structures) is proposed to be routed to the east and south of the town. However, it would be visible from distances greater than 1,0km and therefore exposure and intrusion would be low.

6.7.6 Visibility

The only Project activities that would be visible to the public are the proposed power line, bulk water line and the new access road at Arandis. These activities would not appear out of place in an urban/industrial context. And, as Arandis is mostly a mining town, sensitivities to this type of development would most likely be low.

There are no significant tourist destinations within the study area and access to the Project site will be controlled at a checkpoint, currently managed by the Orano Uranium Mine, approximately 1,2km from the edge of Arandis on the Trekkopje Road.

6.7.7 Night Lighting

I&APs consistently raise the impact of night lighting, specifically when they can be seen from tourist or residential sites and when the impact would continue for the Project's life. The negative effect of night lighting against a relatively dark sky (although the glow from Arandis and the nearby Rossing Mine contribute to light pollution within the study area) would not be particularly detrimental to people visiting the area as the potential glow from the NMF would be negligible due to the proposed operational schedule i.e. operating mostly in daylight hours.

Security lighting could however add to the cumulative effect of lights originating at Orano Mine, Arandis and Rossing Mine, if inappropriately dealt with. Therefore, appropriate management measures, as included in the EMP (Appendix O), should therefore be implemented to limit the spillage of light beyond the Project's site boundaries.

6.8 Hydrology

A Hydrology Impact Assessment was undertaken by SLR (Appendix H). The study aimed to provide an understanding of the baseline hydrology which is required to inform stormwater management and design, water balances and impact assessments related to proposed infrastructure, operations and the receiving environment.

6.8.1 Regional Hydrology

The proposed NMF is located in the Omaruru Delta, which lies between the Omaruru and Swakop catchments. The region is characterised by several non-perennial drainage lines that flow in a south-westerly direction and join the Atlantic Ocean, 45 km south-west of the project site. Figure 6-17 presents the regional hydrology.

6.8.2 Local Hydrology

The Project site is drained by several well-defined drainage lines, that flow in the westerly direction to join the non-perennial rivers downstream of the project site. The site is also characterized by a number of small, shallow clustered drainage lines, the soil of which becomes saturated during rainfall, resulting in sheet flow over the entire site surface and localised flooding. These drainage lines are active and are the source of recharge to aquifers.

On the 27th of March 2024, a site visit was undertaken by SLR. During the site visit, it was observed that the site is situated on a relatively flat surface drained by several minor, shallow, yet well-defined channels. The Project site is bounded by a main channel on the right and a much flatter channel on the left (facing downstream). There are scattered shrubs within the main channels and shallow-depth mineral soils. The site's local hydrology is presented in Figure 6-17.

The NMF footprint and its ancillary infrastructure will be traversed by some of these flatter channel drainage lines. The photos in Photo Plate 6-4 were taken during the site visit in the area marked "X" in Figure 6-18. The photos provide a visual reference to the arid conditions.

<table>
<tr><td>
Photo 1</td><td>West side of the Trekkopje Mine Road in the direction of a drainage line
</td></tr>
<tr><td>
Photo 2</td><td>East side of the Trekkopje Mine Road
</td></tr>
</table>

<table>
<tr><td>
Photo 3</td><td>East side of the Trekkopje Mine Road in the direction of a drainage line
</td></tr>
<tr><td>
Photo 4</td><td>West side of the Trekkopje Mine Road
</td></tr>
</table>

Photo Plate 6-4: Hydrology Site Photos

Figure 6-17: Regional Hydrology

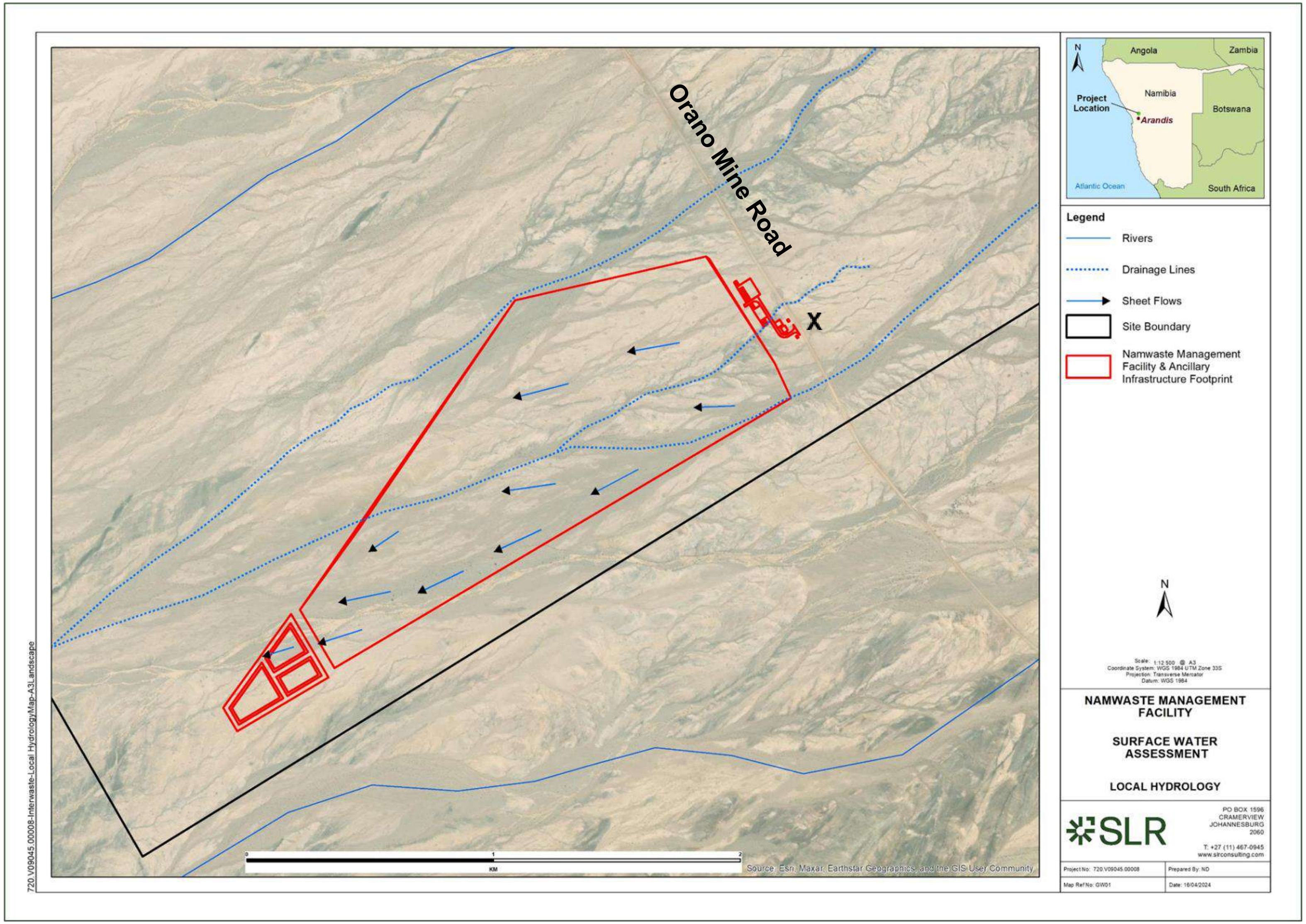

Figure 6-18: Local Hydrology

6.8.3 Catchment Delineation and Characterisation

Catchments for drainage lines traversing the Project site were delineated and are shown in Figure 6-19. Each catchment was characterised by its hydraulic and physical parameters. These catchment parameters together with the rainfall intensities were used in the estimation of design flood peaks. Table 6-12 presents the catchment parameters.

Table 6-12: Catchment Parameters

Catchment Name	Catchment Area (km^2)	Watercourse Length (km)	Height @ 85% (m)	Height @ 10% (m)	Height Difference (m)	Slope (m/m)	*TC (Minutes)
S1	234.52	56.89	1083	568	515	0.012	489.58
S2	4.64	7.15	578	502	76	0.014	93.24
S3	74.09	35.95	923	541	382	0.014	323.26

*TC-Time of Concentration

6.8.4 Hydraulic Flood Modelling

The 1:50-year and 1:100-year floodlines for the drainage lines have been modelled to understand and manage the risks of flooding to the proposed NMF and supporting infrastructure.

6.8.4.1 Methods and Approach

The following section presents the approach, and the methods used in the development of a hydraulic model for determination of the flood lines.

The Hydrological Engineering Centre River Analysis System (HEC-RAS) developed by the US Army Corps of Engineers, was used to model the flood elevation profile for the 1:50-year and 1:100-year flood events, as well as ArcGIS and Google Earth.

A Digital Elevation Model (DEM) was created using 50 cm contour data (as supplied by Namwaste). The DEM was used to extract elevation data for the river profile together with the river cross-sections. The topographical data was also used to determine the placement positions for the cross-sections across the drainage lines profile, such that the watercourse could be accurately modelled. The topographic dataset depicts that the NMF site is traversed by non-perennial drainage lines.

Manning’s roughness factor “n” is used to describe the flow-resistant characteristics of a specific surface. The river flow channels and floodplains are similar in nature, consisting of sandy soils. Therefore, Manning’s roughness factors were determined for the river flow channel and the floodplains as 0.025 to represent these conditions.

After the analysis and preparation of input data, the HEC-RAS model was developed according to the following steps:

- Creating the project file in HEC-RAS.
- Spatial referencing of the project.
- Adding a DEM
- Generation of the geometry of the project which involves the main river channel, riverbanks, flow paths and cross sections.
- Adding manning’s roughness factors to the river cross sections.

- Adding the 1:50-year and 1:100-year flood peak values calculated in Appendix J.
- Running of Steady-state HEC-RAS model.
- Generation of the 50-year and 100-year flood inundation area.
- Exporting generated floodlines from HEC-RAS as shapefiles and plotting them into ArcGIS.

Key assumptions and limitations of the model can be found in Appendix J.

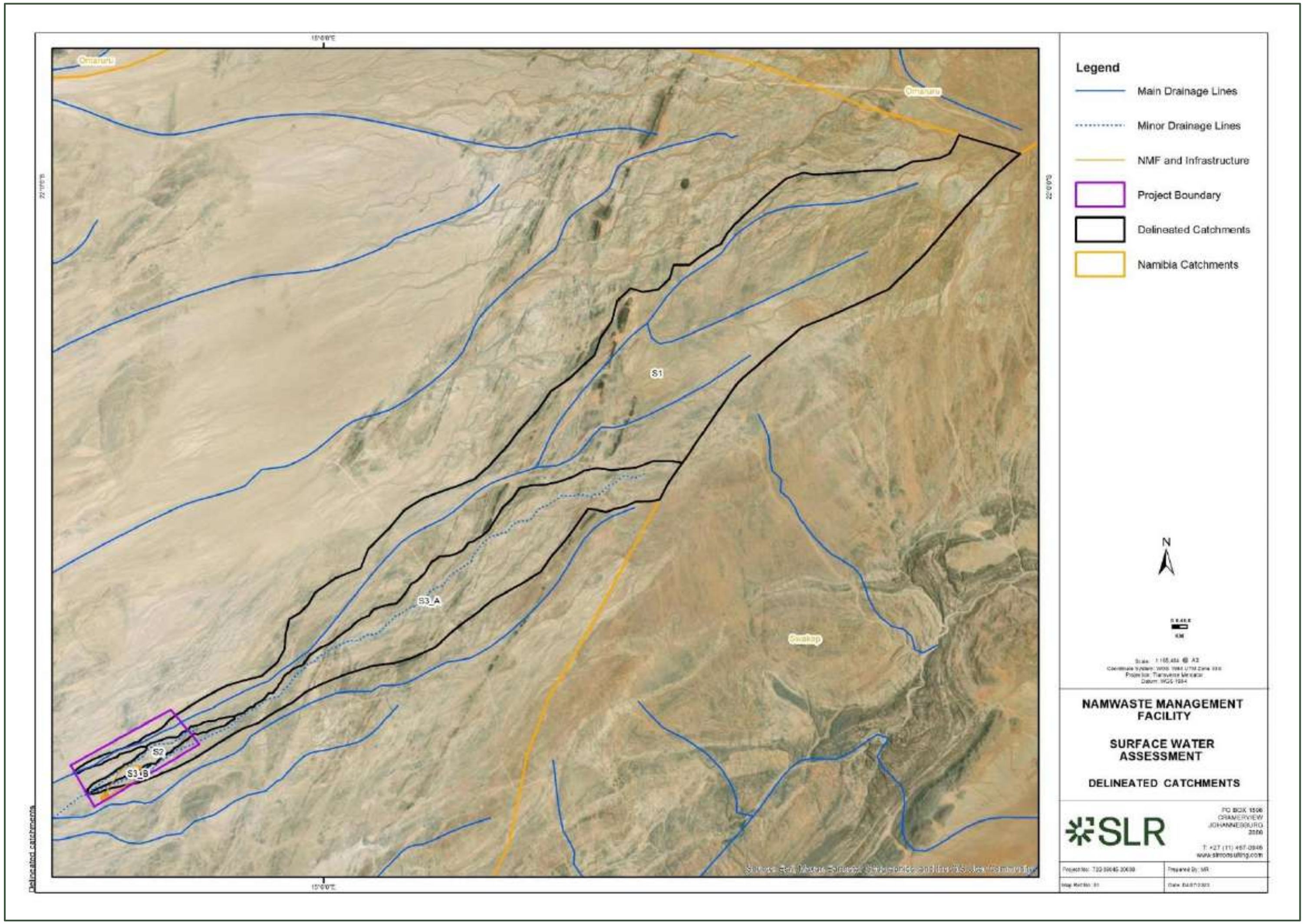

Figure 6-19: Delineated Catchments

6.8.4.2 Flood Modelling Findings

Floodlines for major and minor well defined drainage lines were delineated to evaluate risks associated with the flooding of infrastructure. Refer to Figure 6-20 to Figure 6-23 for the estimated 1:50 and 1:100 flood inundation areas.

A small area at the north-western corner of the NMF Phase 1 Waste Disposal Area would be exposed to flooding during 1:50 and 1:100 flood events. The NMF Phase 2 Waste Disposal Area falls within the 1:50 and 1:100-year floodlines of minor drainage lines. The following infrastructure within the Plant Area also fall within these floodlines:

- Workshop and stores
- Vehicle wash bay
- Fuel storage tanks
- The access road
- Proposed bulk water pipe

Additional ancillary infrastructure within the Plant Area may not be within the estimated inundated areas but may, however, be impacted by surface/ pluvial floods. This is due to the proposed infrastructure falling within the clustered drainage lines that are capable of generating sheet flow during intense storms, which result in localised flooding.

Due to limited DEM coverage, floodlines through the Phase 2 dams (arsenic leachate, stormwater dam and hazardous waste leachate dams) could not be delineated. However, from the aerial image (Google image) there are well defined drainage lines that pass through them, as shown in Figure 6-20. The dams are therefore susceptible to localised flooding due to sheet flows.

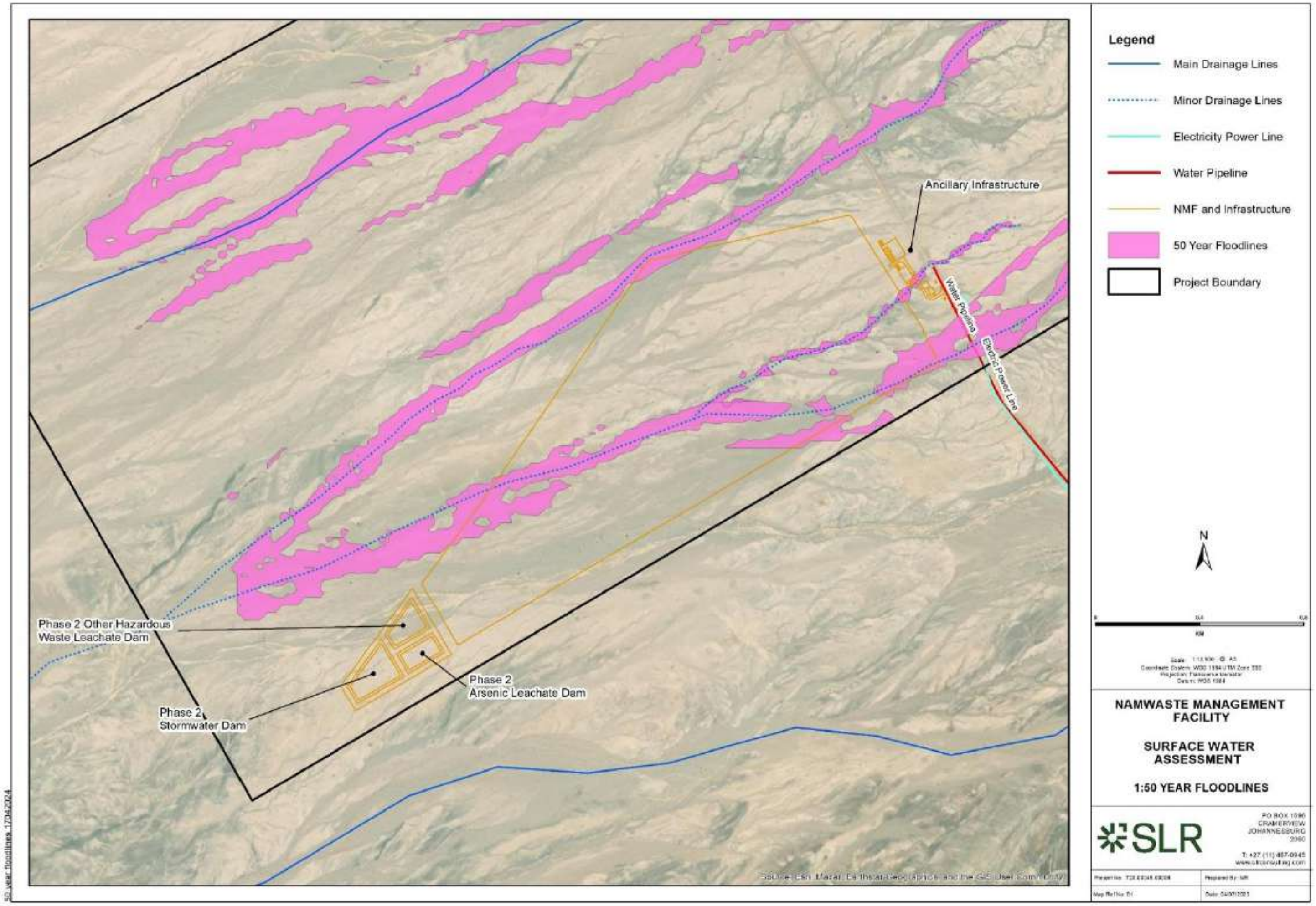

Figure 6-20: NMF 1:50-Year Floodlines

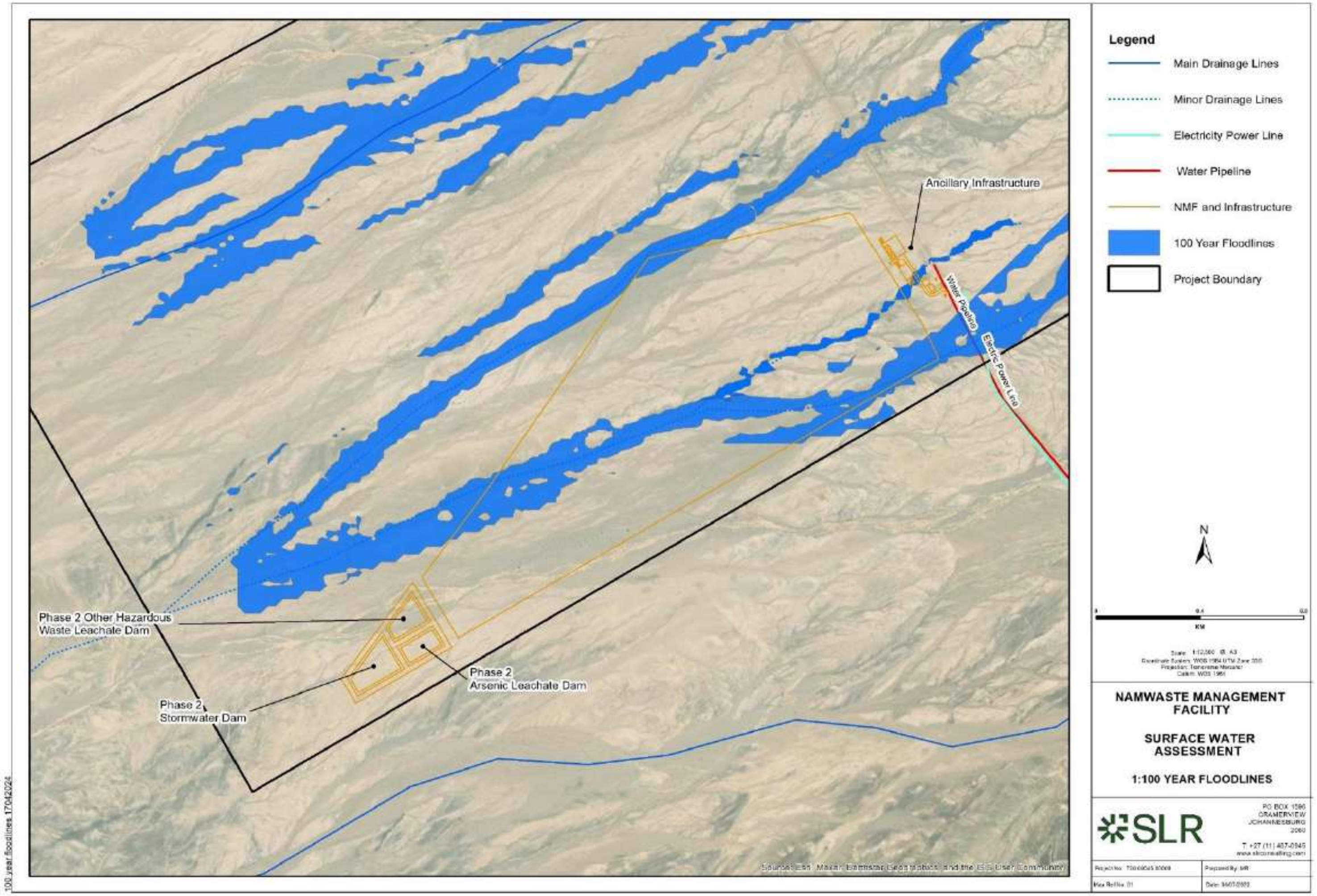

Figure 6-21: NMF 1:100-Year Floodlines

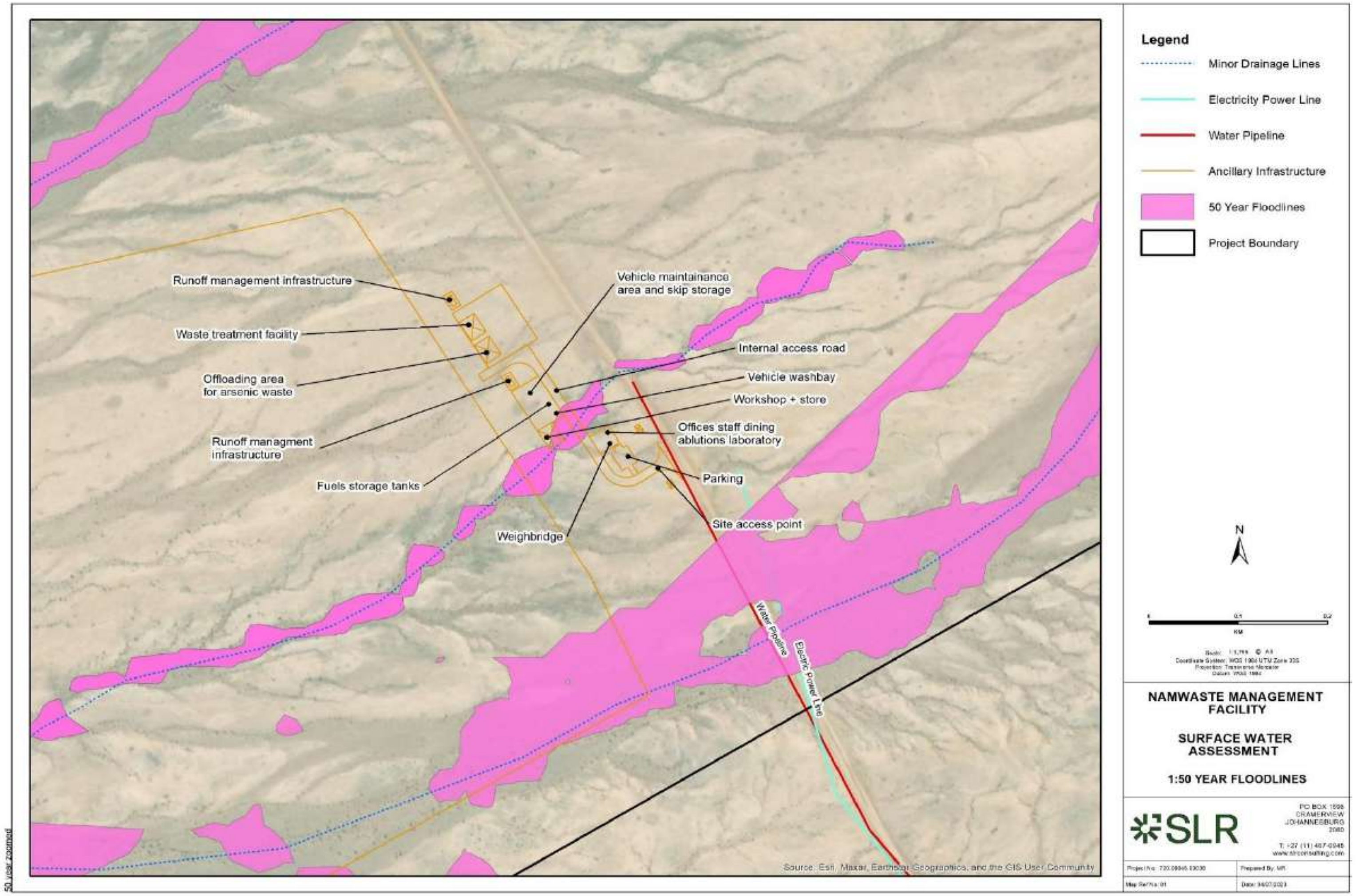

Figure 6-22: Infrastructure within 1:50-Year

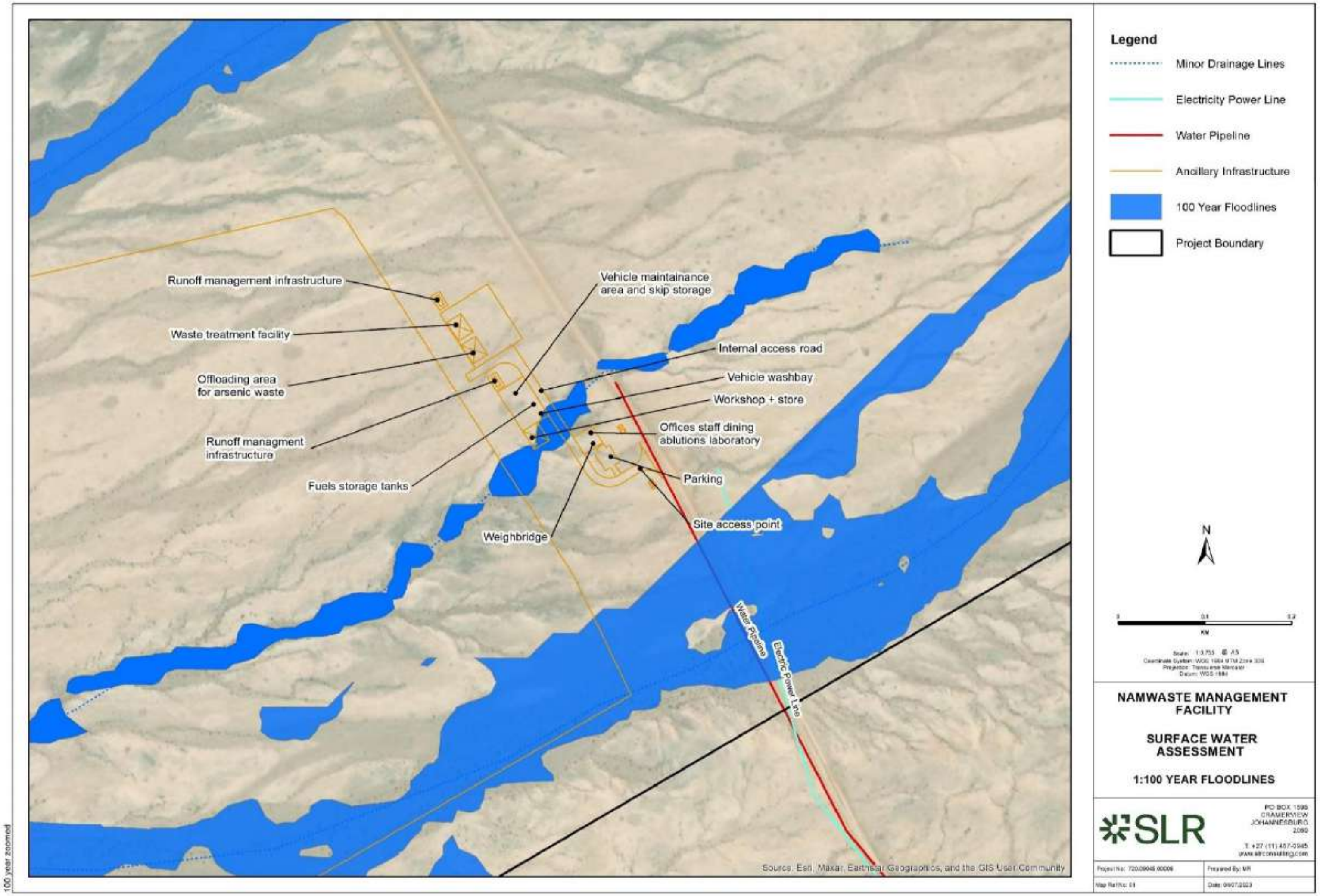

Figure 6-23: Infrastructure within 1:100-Year Floodlines

6.8.5 Site Wide Water Balance

A conceptual site wide water balance model (WBM), based on the conceptual design of the facility, has been developed to understand rainfall-response flows generated on site, as well as the operational water circuit at the NMF.

Two independent models were developed to represent different stages within the NMF lifecycle, specifically considering worst-case footprints from an impacted water generation perspective. The two stages are:

- Phase 1A: Representing the fully developed Phase 1A footprint with the cover preparation in varying stages between active waste disposal, temporary cover and permanent cap.
- Fully developed footprint: Phase 1 complete. Phase 2 footprint fully developed and the cover preparation in varying stages between active waste disposal, temporary cover and permanent cap.

The model is thus a quasi-dynamic model, as it does not consider changes in flows associated with varying waste disposal rates, or storage, but does look at the dynamic response associated with likely rainfall patterns over representative average, wet and dry years.

The WBM was developed using the GoldSim modelling package (version 14.0) and applying a daily timestep calculation (though accounting for rainfall on a monthly timestep, given that no representative daily timestep rainfall data could be sourced). GoldSim is a software program developed by the GoldSim Technology Group which can analyse complex time-dependent systems and can assess stochastic systems resulting in probabilistic outcome ranges.

6.8.6 Water Management System

The conceptual water management system for the NMF, which will be refined during the detailed design stage, comprises of the following:

- Runoff and leachate generated from the active and temporarily capped landfill cells (Phase 1A,1B, 2A and 2B), as well as runoff from the plant area and roads will be collected, conveyed and stored in PCD's located near the waste disposal sites. Run-off and containment infrastructure will be separated as per the division of waste (i.e.: general and hazardous (1) and arsenic (2)). Since there is no anticipated plan to re-use this water, it will be held and reduced via evaporation.
- It is anticipated that the active Waste Disposal Area will have a footprint of 5,000 m^2. Temporary capping will take place every year, following which, permanent capping will be done after 10-year periods. Due to the capping sequencing, the maximum flowrates of impacted water that are expected to be generated, will coincide with the maximum expected impacted footprints, as follows: active G&H/arsenic = 5,000m^2, temporarily capped G&H/arsenic = 50,000m^2.
- Clean runoff generated from the capped and rehabilitated cells will be collected and stored in a stormwater dam on site.
- Potable water will be sourced from the existing supply network to Arandis and transported to the plant via a bulk pipeline. The water will be used for dust suppression, construction purposes, ablutions, waste processing and vehicle washing.
- Impacted water generated from the waste treatment facility and arsenic offloading area will be collected and stored in a PCD at the plant. Additionally, runoff from the vehicle maintenance and washbay area will be collected and stored in a separate

PCD. Overflow from these two PCDs will be diverted to the arsenic and general & hazardous PCDs at the waste disposal areas, respectively.

- Black water from the ablutions will be treated at a package WWTW onsite. The solid fraction will be disposed of in the landfill and the liquid stream will be released to the environment if proved compliant with the applicable effluent standards.
- Rainwater will be harvested from the plant area roofs and stored in tanks and used to offset dust suppression demands.

Two snapshots in time over the life of the facility, have been selected to assess the effectiveness of the proposed water management philosophy on the site. This comprises of the following:

- Phase 1A footprint and facilities: An assessment of the initial phase of the development including waste disposal area, plant area and storage infrastructure. Detailed conceptual design and layout information is currently available for this Phase.
- Fully developed footprint and facilities (Phase1 & 2): An assessment of the entire development including all waste disposal phases, plant area and auxiliary infrastructure. High-level conceptual design and layout information is currently available for the full development.

Detailed schematics of the conceptual water management systems for both scenarios, indicating inflows, outflows and transfers among the various structures, are depicted in Figure 6-24 and Figure 6-25.

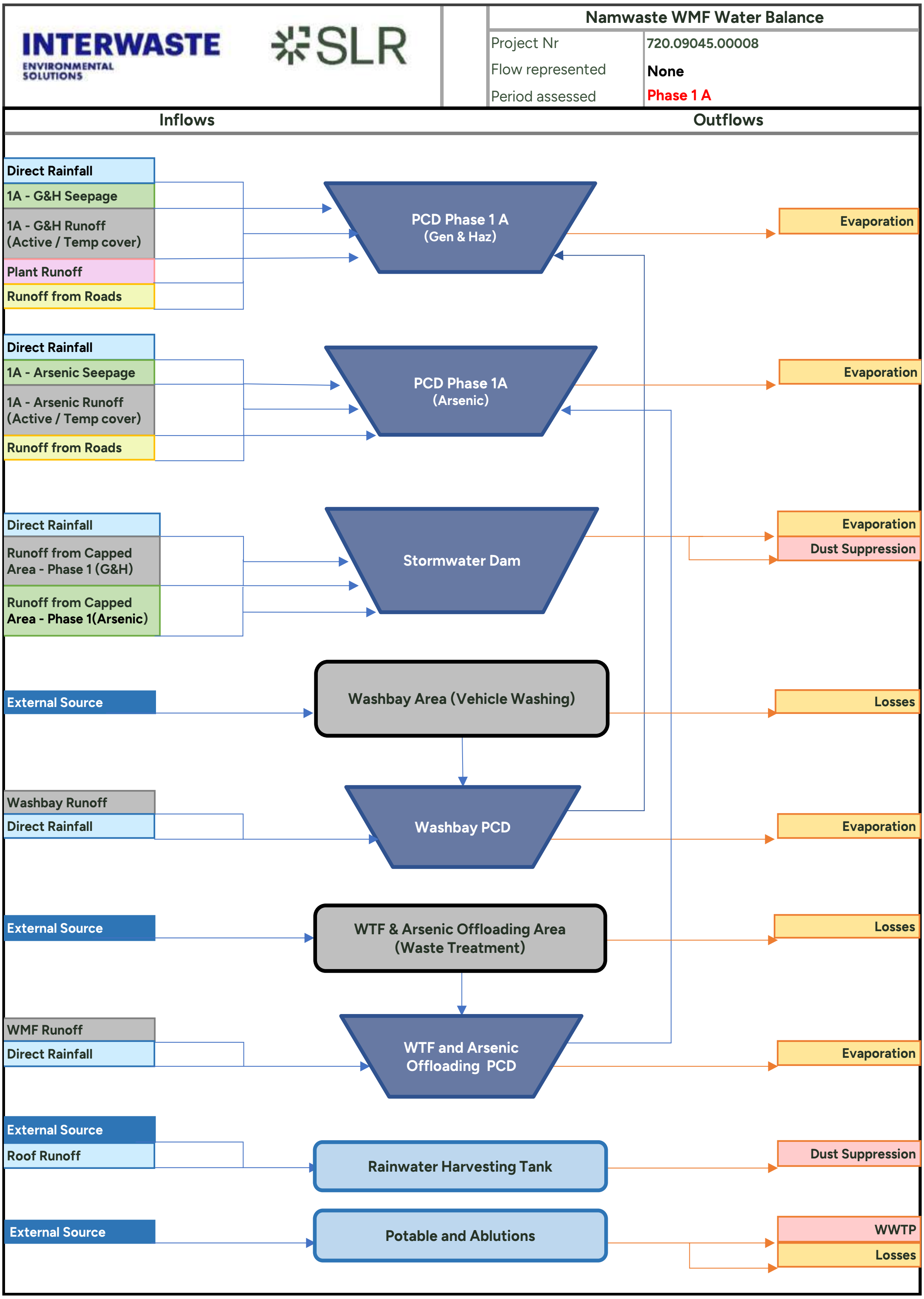

Figure 6-24: Water Reticulation Diagram – Phase 1A

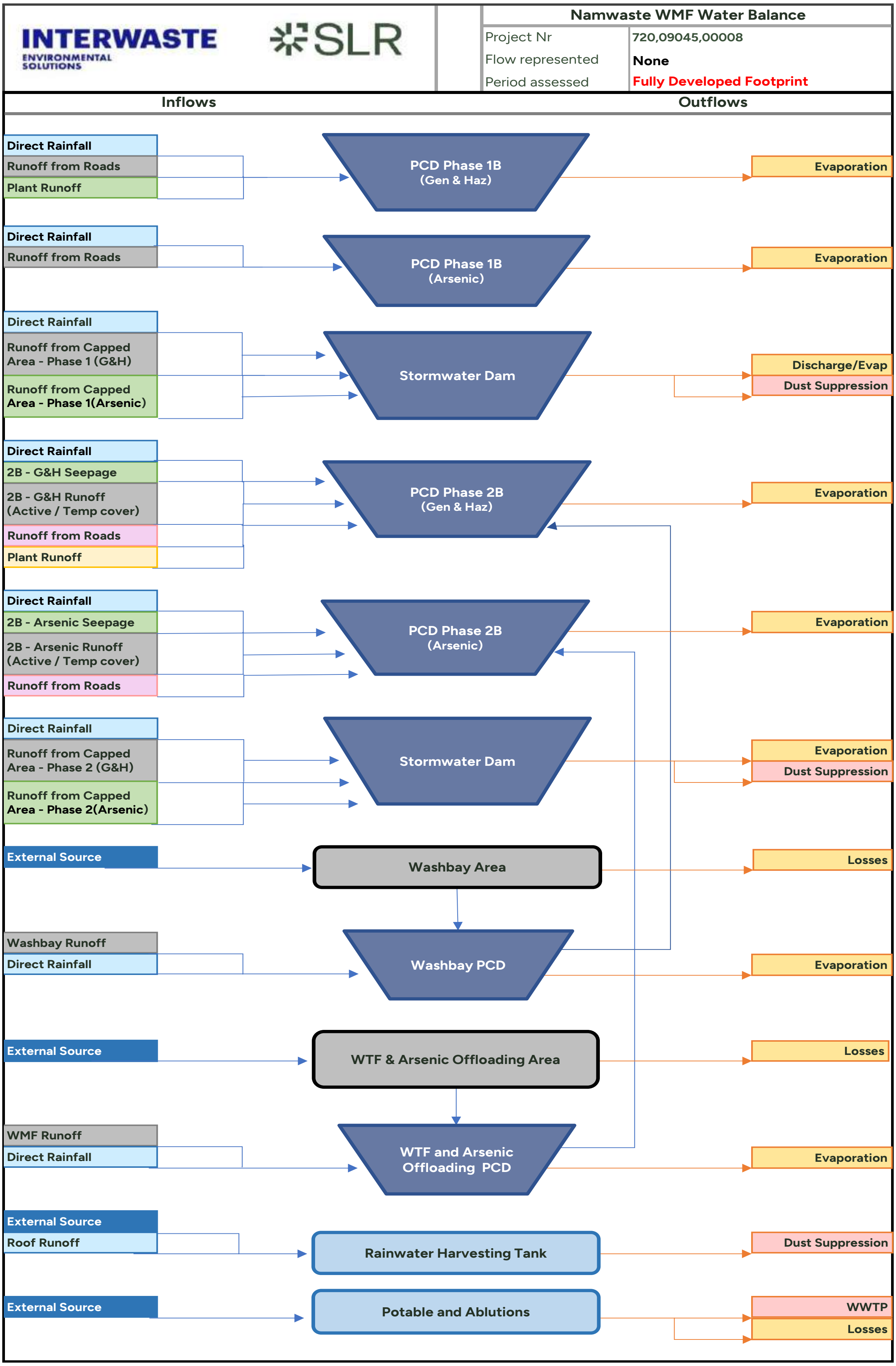

Figure 6-25: Water Reticulation Diagram – Fully Developed Footprint

6.8.7 Total Demand (Raw Water)

A total raw water demand of 140 m^3/d was estimated for Phase 1A of the development, 120 m^3/d of which is attributed to dust suppression. Figure 6-26 shows the modelling results, indicating that the full demand is required from an external source continuously during a dry year. That requirement is expected to drop to 126 m^3/d during the wet season of a wet year and increases again to almost 137 m^3/d within a few months.

Figure 6-26: Total External Raw Water Demand (Phase 1A)

For the fully developed footprint, similar to the Phase 1A requirements, the full 140 m^3/d of water is required from the external source continuously during a dry year, as shown in Figure 6-27. This is expected to drop to the minimum 57 m^3/d in February of a wet year, before increasing again after a few months.

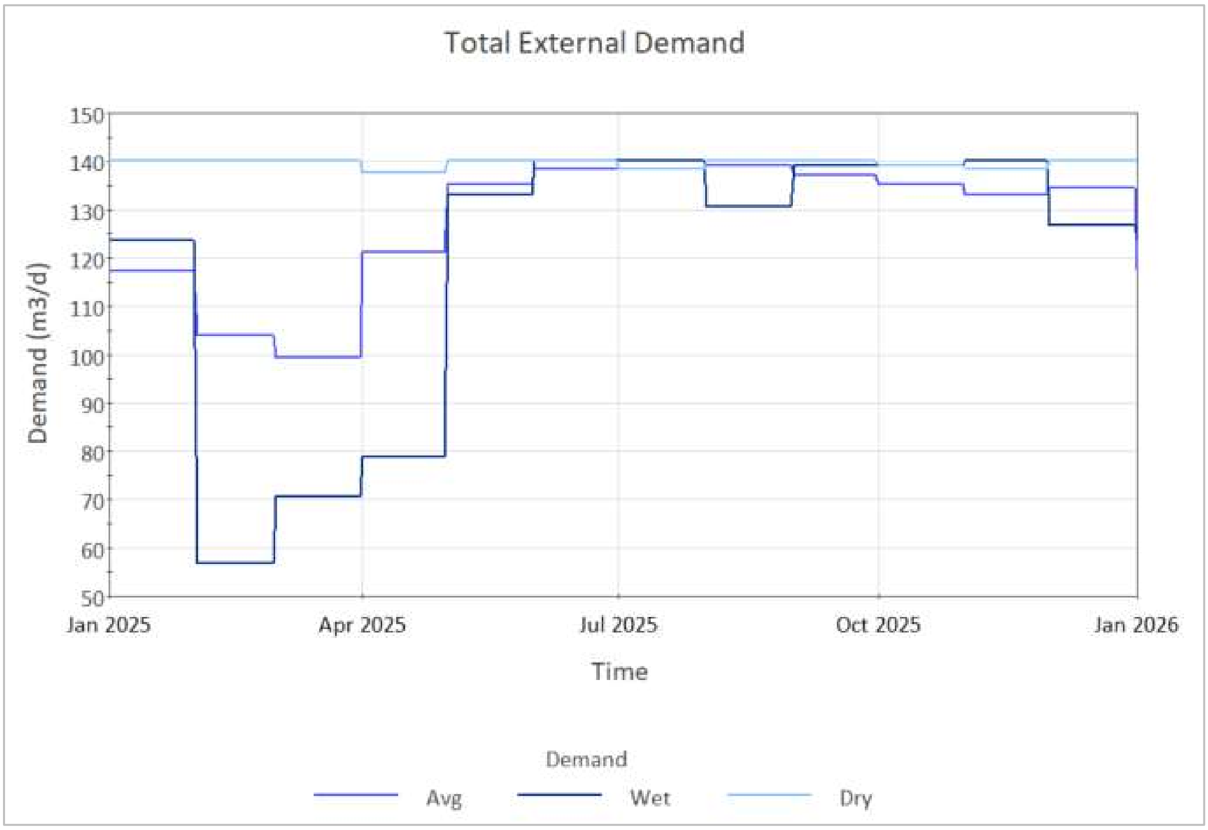

Figure 6-27: Total External Raw Water Demand (Fully Developed Footprint)

6.8.8 Total Demand (Potable Water)

An additional 3,650 m^3/year will need to be obtained from an external source for potable purposes. It is expected that 2,920 m^3/year will be discharged to the onsite Wastewater Treatment Plant (WWTP), while approximately 730 m^3/year may be attributed to losses in the system.

6.9 Hydrogeology

A Hydrogeological Impact Assessment was undertaken by SLR (Appendix J). The study aimed to determine the current groundwater baseline of the Project area and to identify potentially critical impacts of the development proposal on local groundwater resources through modelling.

The proposed Project site is not underlain by any strategic geohydrological aquifer utilised for domestic or industrial purposes. As shown in Section 6.9.4, groundwater is saline and not suitable for human consumption. A fractured aquifer underlays the Project site. During borehole drilling groundwater was struck within the fractured basement aquifer only, mainly in the pegmatite and quartzite/schist contact while no water strike was made in dolerite dykes which have a slight influence on groundwater flow locally.

Two-dimension cross-sections of intercepted geological formations were developed as a means of conceptualising the formations, geological features and groundwater levels. This was supported by lithological logs and ERT survey results. The orientation of cross-section lines are shown in Figure 6-28 while Figure 6-29, Figure 6-30 and Figure 6-31 show an idealised schematic of lithologies beneath the surface.

The following is noted from the idealised cross-sections:

1. Varying thickness of unconsolidated sediments, which overlay a weathered zone of the fractured aquifer.
2. Slight displacement of the water table, associated with dolerite dykes and respective water strikes in the boreholes, and
3. A north-east-southwest oriented fault passes through the western edge of Preferred Area 4.

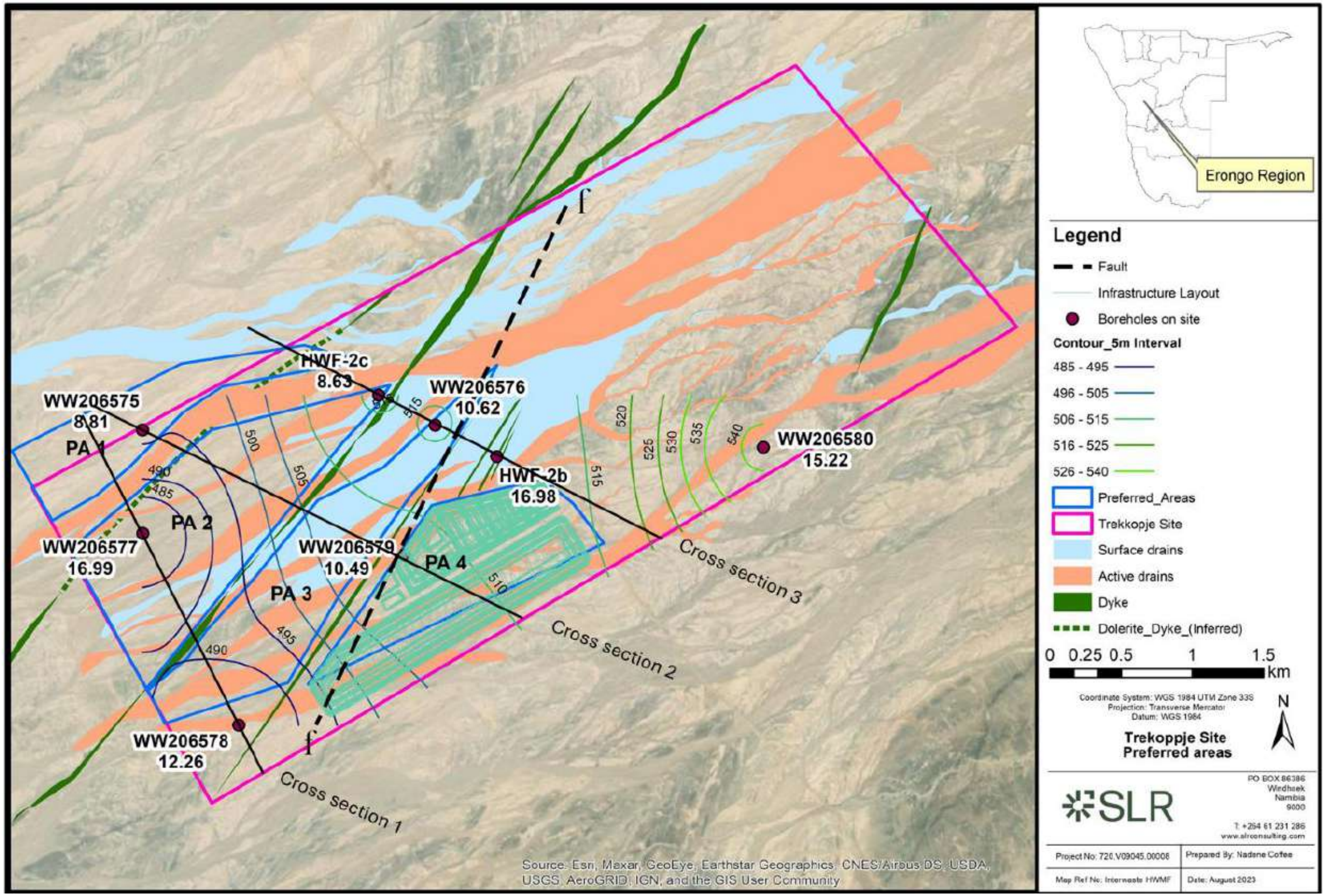

Figure 6-28: Map showing the orientation of the three (3) cross sections.

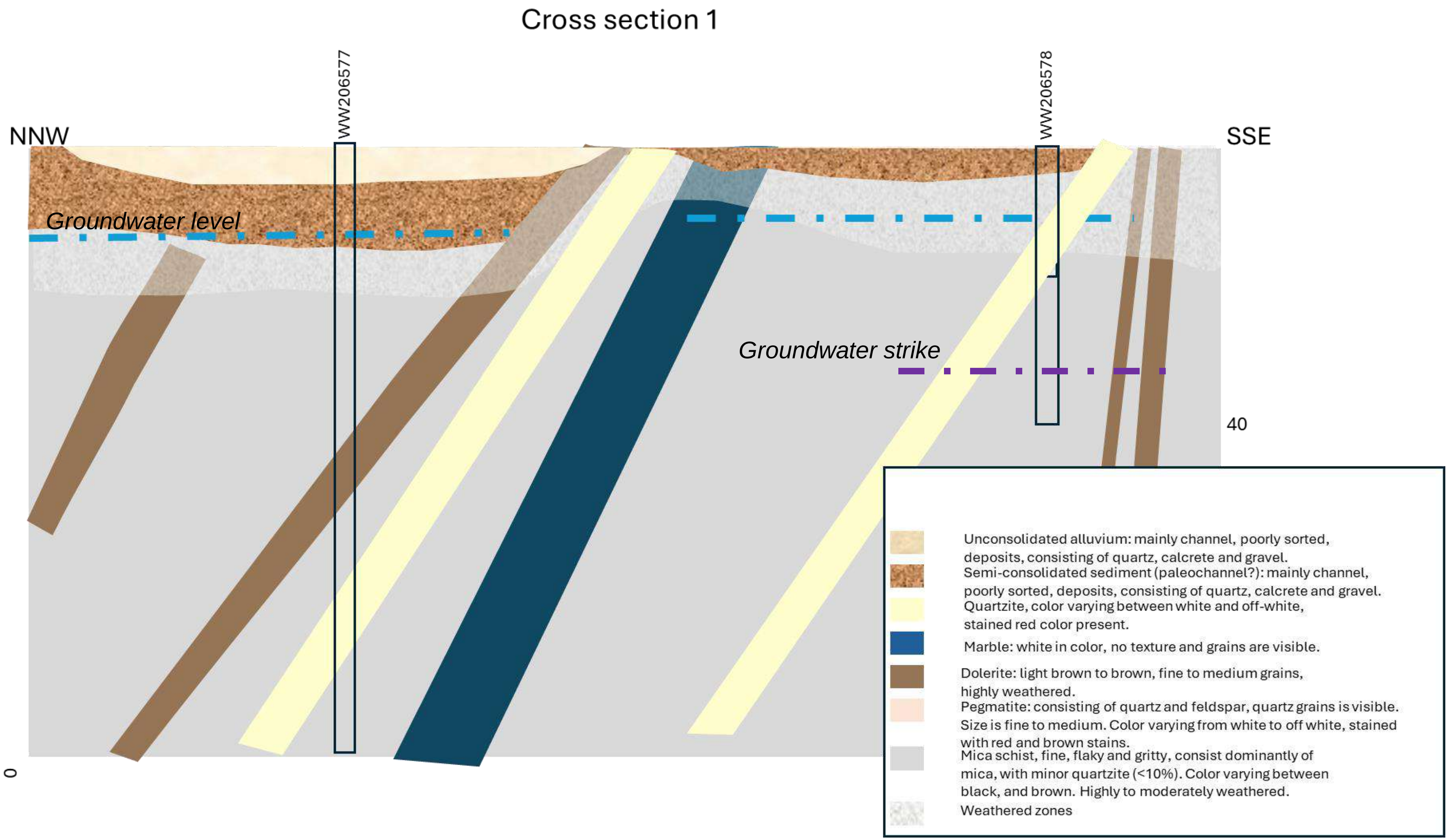

Figure 6-29: Cross section 1 across boreholes WW206577 and WW206578

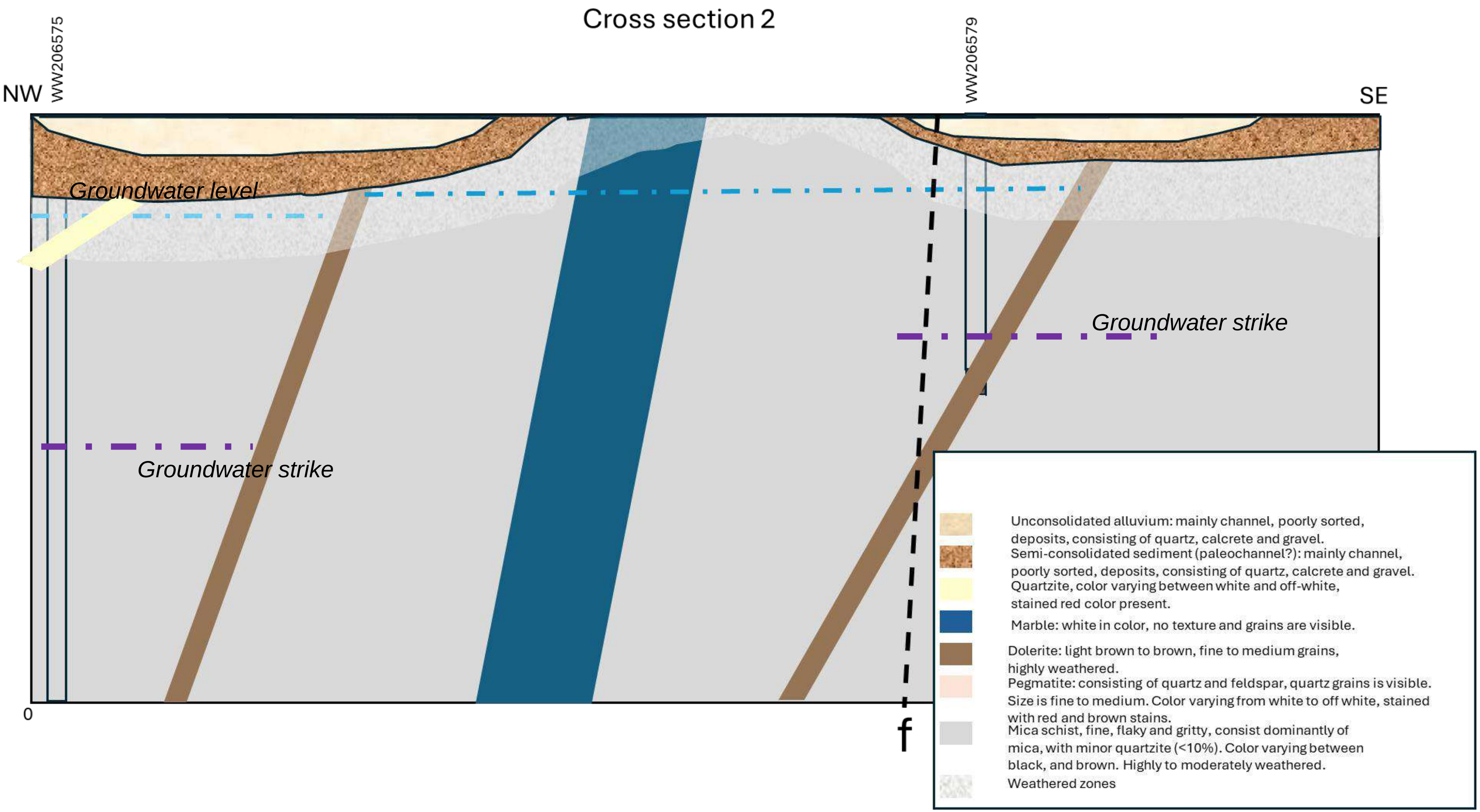

Figure 6-30: Cross section 2 across boreholes WW206575 and WW206579

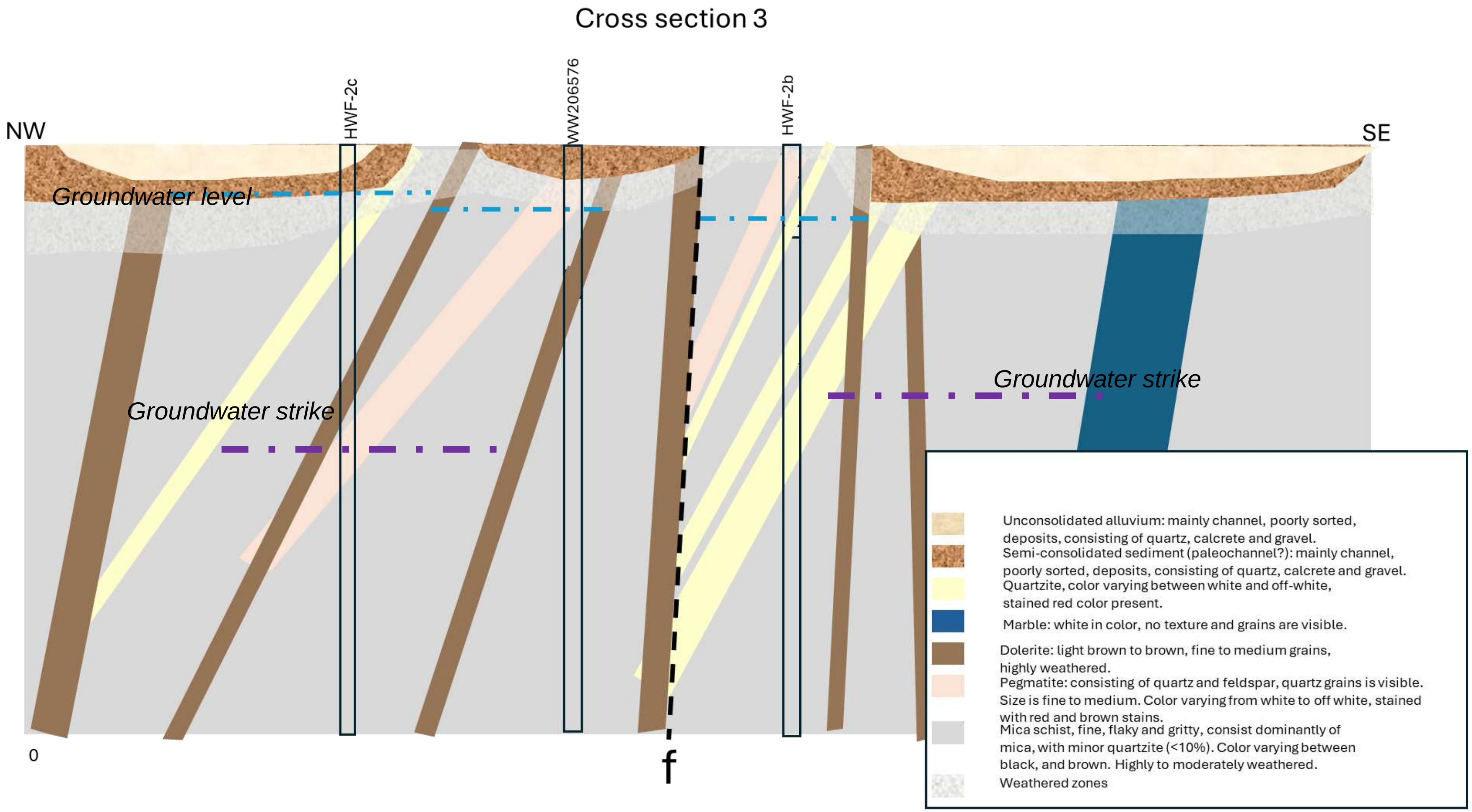

Figure 6-31: Cross section 3 across boreholes HWF-2c and WW206576 and HWF-2b.

6.9.1 Hydraulic Characteristics and groundwater abstraction

The hydraulic properties are key to understanding the ease at which water flows within the aquifer and thus the implications for contaminant transport. In this regard, new boreholes were drilled, and test pumped to determine hydraulic properties of the fractured aquifer defined on the Project site (SLR 2023) (Figure 6-32). Hydraulic properties are summarised in Table 6-13 and detailed in the screening report by SLR (2023). It is noted that:

- groundwater potential is relatively low with improved yields at local levels when targeting fractures within the aquifer prevails. There is potential to utilise local groundwater for varying purposes, however it is dependent on water quality required; and
- transmissivity of groundwater is generally low but can be significant within weathered and fractured zones of the aquifer.

Table 6-13: Hydraulic characteristics of the fractured aquifer

WW	Easting	Northing	Depth	RWL*	Yield	Water strike	Transmi ssivity	
		UTM	(m bgl)	(m bsu)	(m^3/h)	(m^3/h)	m^2/day	m/day
206575	487178	7536490	100	8.81	0.5	32	1.85	0.0078
206577	487180	7535763	100	16.99	1	No strike	No data	
206578	487854	7534413	41	12.26	3.2	22	36.1	1.29
206579	489019	7535611	100	10.49	1	89	4.23	0.0476
206580	489236	7536524	100	15.22	1	38	1.92	0.0227
206576	489236	7536524	100	10.62	1.5	No strike	0.0015	0.000173
HWF-2c	488838	7536734	100	8.63	1	44	2.92	0.0321
HWF-2b	489668	7536303	100	16.98	0.5	33	0.918	0.0112

6.9.2 Groundwater Levels and Flow

A groundwater monitoring program was initiated at the Project site with the aim of developing a geohydrological baseline as well as meeting requirements under the Department of Water Affairs (DWA) Drilling Permit No.11706 issued in 2023.

Figure 6-32 shows that groundwater levels range from 8.63 m bgl in HWF-2c to 16.99 m bgl in HWF-2b and indicates that the hydraulic gradient deepens westward in similar orientation of surface flow. Similarly, groundwater flow (black dotted arrows in Figure 6-32) is from the eastern side of the Project site where more out-cropping marble and other geological formations were observed, while in the west the quaternary deposits develop washes that are generally flat with no immediate downstream receptors (such as boreholes, settlements or farms).

Dolerite dykes' impact on groundwater levels and flow locally is observed through slight differences in water levels within compartments formed by the dykes.

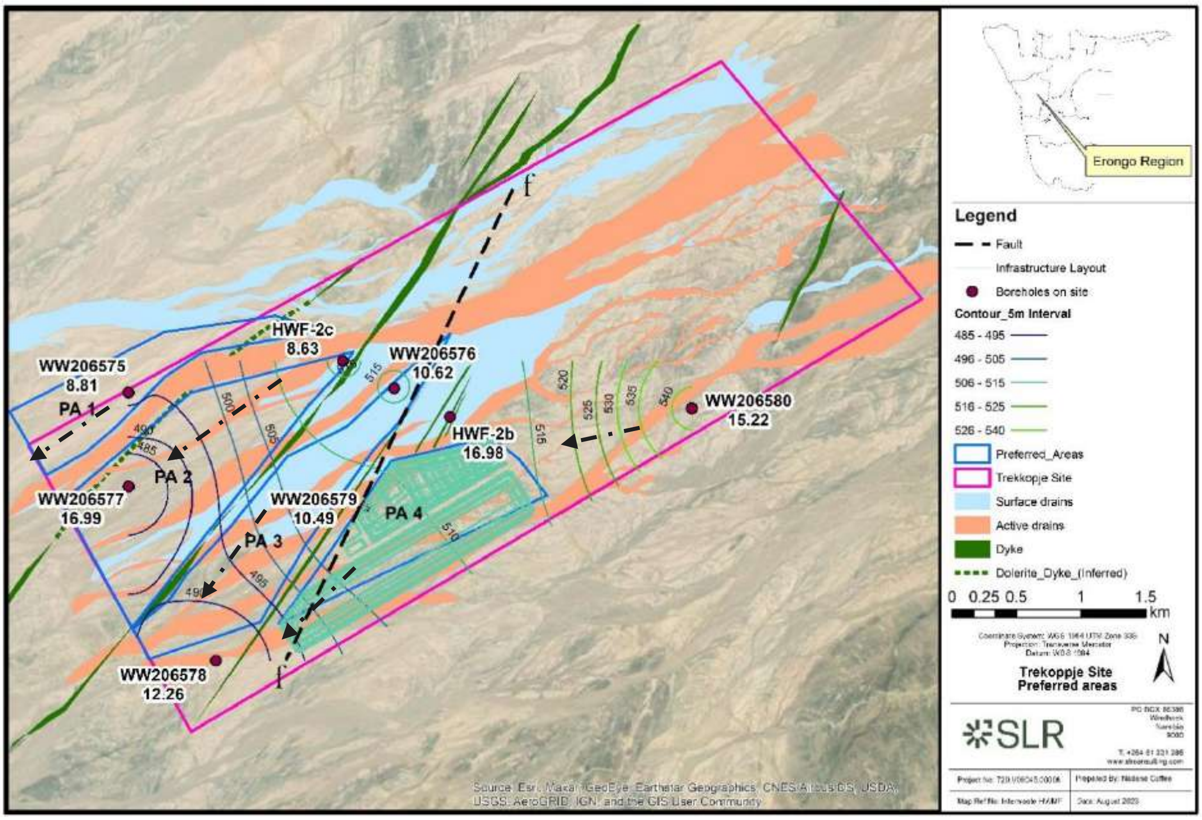

Figure 6-32: Groundwater levels and flow direction at the Proposed Site

Table 6-14 presents groundwater level measurements for each borehole between July and December 2023. The data is graphically illustrated in a time-series hydrograph in Figure 6-33, where no major fluctuation in levels was observed.

Table 6-14: Monthly GWL Measurements at HWMF. Proposed Site.

Date	WW206575	WW206576	WW206577	WW206578	WW206579	WW206580	HWF-2b	HWF-2c
Jul-23	8.81	10.62	16.99	12.26	10.49	15.22	16.98	8.63
Oct-23	8.79	10.78	16.84	12.25	10.47	15.27	16.98	8.65
Nov-23	8.79	10.82	16.85	12.28	10.47	15.28	17.00	8.66
Dec-23	8.72	10.80	16.84	12.27	10.44	15.27	16.98	8.64

Date	WW206575	WW206576	WW206577	WW206578	WW206579	WW206580	HWF-2b	HWF-2c
Jan-24	8.74	10.81	16.85	12.28	10.46	15.32	17	8.66
Feb-24	8.83	10.84	16.86	12.29	10.49	15.32	16.99	8.67
Mar-24	8.8	10.85	16.88	12.3	10.5	15.34	17.02	8.68
Apr-24	8.74	10.85	16.89	12.3	10.51	15.37	17.02	8.67
May-24	8.85	10.98	17.01	12.43	10.65	15.47	17.19	8.79

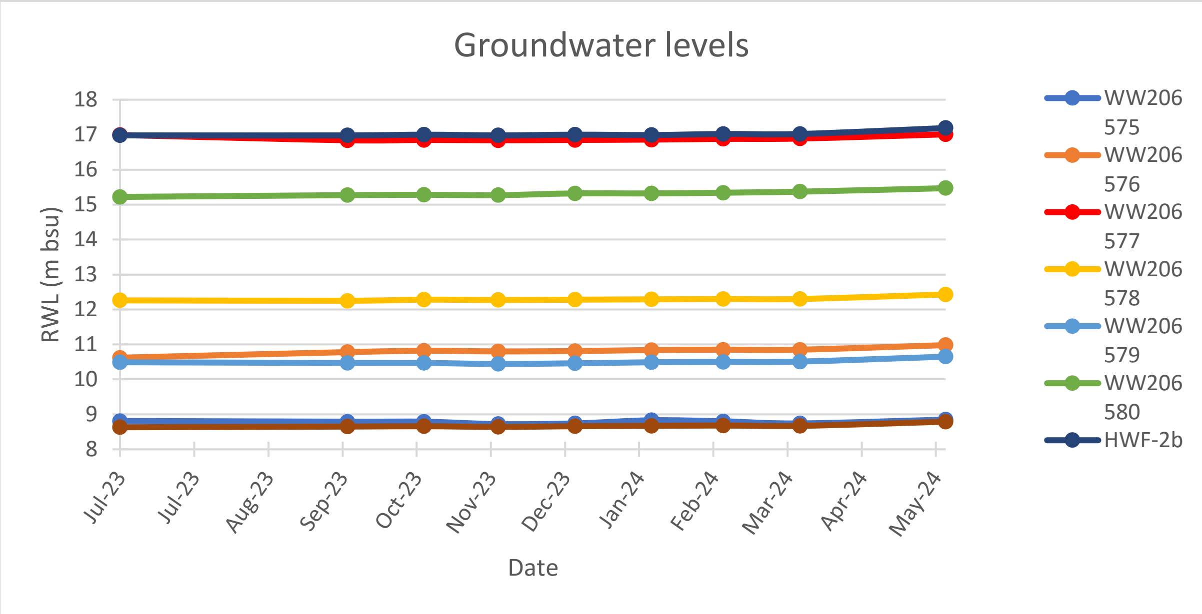

Figure 6-33: Groundwater level time series of monitoring boreholes at the Proposed Site.

6.9.3 Groundwater Recharge

Mean Annual Rainfall (MAR) for the area is estimated at 35-40 mm/a while annual A-pan evaporation is around 2700 mm with an average daily rate of 7 mm evaluated from the Rössing Uranium Mine rainfall record (SRK 2010).

Aquifers are generally recharged by percolation of rainfall below the water table through direct recharge or transmission losses during runoff events. SLR & BIWAC (2012), when developing a numerical model within a desert environment, stated that recharge may occur by infiltration of rainwater through the overburden (diffuse recharge) or via the drainage features (washes and rivers) or linear features (localised, indirect recharge) where surface water run-off is collected.

The same premise applies to the Project site as similar characteristics prevail in terms of overburden relates to fractured aquifers, their outcropping nature and how surface drains as well as washes are oriented. Active flow was observed in drains <20 m wide at the site (SLR 2023). This flow recharges aquifers through diffusion or transmission losses into sediments, weathered zones and fractures. In this regard, where the fractured aquifer outcrops, it is expected that direct recharge may occur while the active drains and washes contribute recharge through transmission losses from runoff that diffuses into the fractured aquifer.

In terms of recharge rates, historical information from investigations done in the Namibian desert environment, these are very low particularly on account that very low rainfall is received. To this effect, groundwater recharge is negligible and not expected to be above 1% of MAR.

Table 6-15 shows historical recharge rates applied in existing models developed in the Namibia desert environment.

Table 6-15: Recharge zones and rates from existing models in similar environments

Source	Recharge Zone	% MAP	MAP (mm/yr)
Investigation within Namibia*	All zones	0.01% to 10%	MAR
Swakop Uranium numerical groundwater model Update*	Namib Group (alluvial cover)	0.02	16.53
	Regional surface water drainage	0.5	
	Bedrock outcrops	0.5	
	Local surface water drainage (e.g. Husab River in mining license area)	1	
	All Karibib marble outcrops and sub-outcrops of Welwitschia Syncline	3	
Proposed-Areva numerical groundwater model**	North-eastern Basement units	0.07 and 0.2	30
	Western and southern basement units	0.02 and 0.05	
	Marble of the Karibib Formation	0.06	
	Paleo channel	0.9 and 0.5	

*SLR (2020. ** SLR & BIWAC (2012)

6.9.4 Groundwater Quality

Groundwater quality monitoring has also been undertaken as part of baseline development. Samples were collected in July 2023 and October 2023 and analysed by various accredited laboratories. Major ions were analysed by Analytical Laboratories Services in Namibia, total metals were analysed by DDScience in South Africa, while radionuclides were analysed by Hydroisotop GmbH in Germany. The results were compared with the drinking-water guidelines of the World Health Organization (WHO. 2011) and with the Namibian drinking-water guidelines (2013) as further described in the sections below.

6.9.4.1 Major Ions

Groundwater samples were collected during test pumping in July 2023, October 2023 and January 2024. From the analysis of the results the following was observed:

- The results confirm the saline nature of local groundwater, thus confirming the limitation of its use for potable purposes in its natural occurrence. The water is classified above the acceptable standards (high risk or water unsuitable for human consumption and livestock watering) according to the WRMA.
- Electrical conductivity and total dissolved solids that are an indicator of salinity, range between 3 020 and 5 330 mS/m and 20 292 and 36 284 mg/l respectively (see Figure 6-34).
- Hardness, chloride, sulphate, nitrate, sodium and calcium are all elevated above allowable limits for potable water while corrosivity ratio is also elevated and implies negative impact on certain materials.

Elevated concentrations are indicative of saline soils in hyper desert environment, low groundwater recharge and low aquifer transmissivities on the Project site.

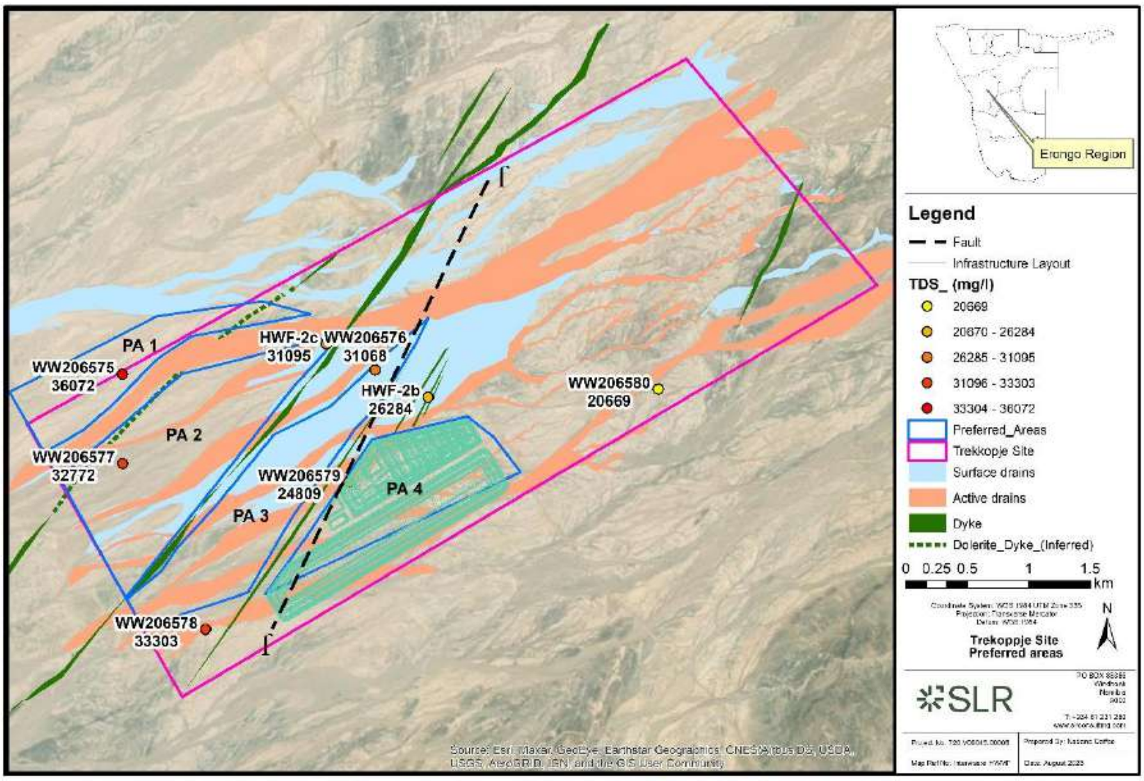

Figure 6-34: Total Dissolved Solids concentration in boreholes at the Proposed Site

6.9.4.2 Total metals

Groundwater samples were collected during test pumping in July 2023, October 2023 and January 2024. The results indicate that arsenic, lead and uranium concentrations are within general standards.

6.9.4.3 Radionuclides

Radionuclides were sampled and analysed in July 2023. Eight samples plus one (1) duplicate sample were collected. This section presents decay analysis for groundwater samples analysed for radionuclides. These radionuclides include ^{210}Pb, ^{228}Th, ^{230}Th, ^{232}Th, ^{210}Po, ^{226}Ra, ^{228}Ra, ^{234}U, ^{235}U and ^{238}U. Three most commonly occurring radionuclides in groundwater form the below three decay series (see Figure 6-35 below):

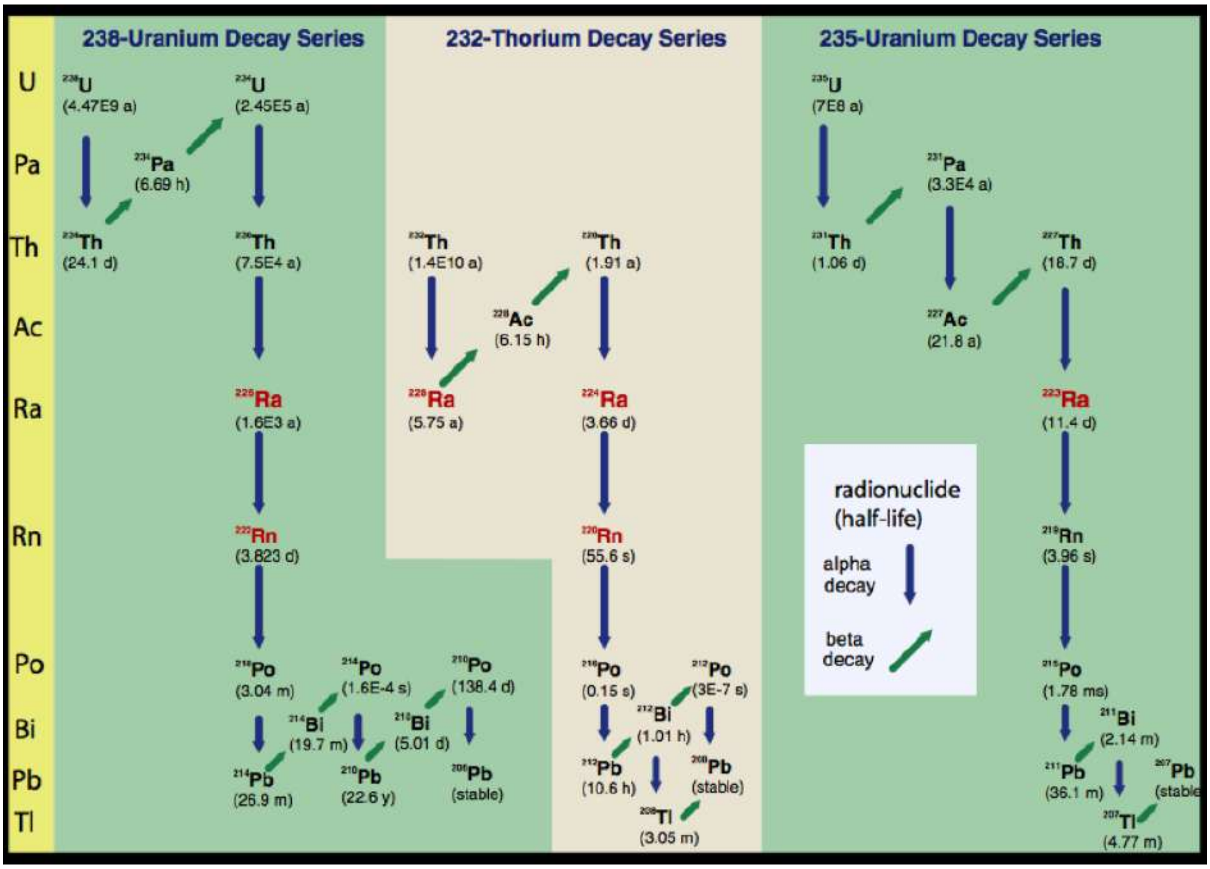

Figure 6-35: Decay series of analysed radionuclides and their half-life time.

Radionuclides results of the July 2023 sampling and chemical analysis shows that the quality of the water sampled met all the WHO (2011) drinking water guideline values except for ^{234}U and ^{228}Radium.

6.9.5 Classification of water types

The Piper diagram is often relied upon to classify water based on its chemistry shown in Figure 6-36. This is done through:

- plotting of cations and anion derived by computing the percentage equivalents for the main diagnostic cations of calcium, magnesium, and sodium as well as anions of chlorite, sulphide, bicarbonate that are plotted on adjacent trilinear fields; and
- extrapolating points from trilinear fields to a central diamond field to determine chemical character of water in relation to its environment.

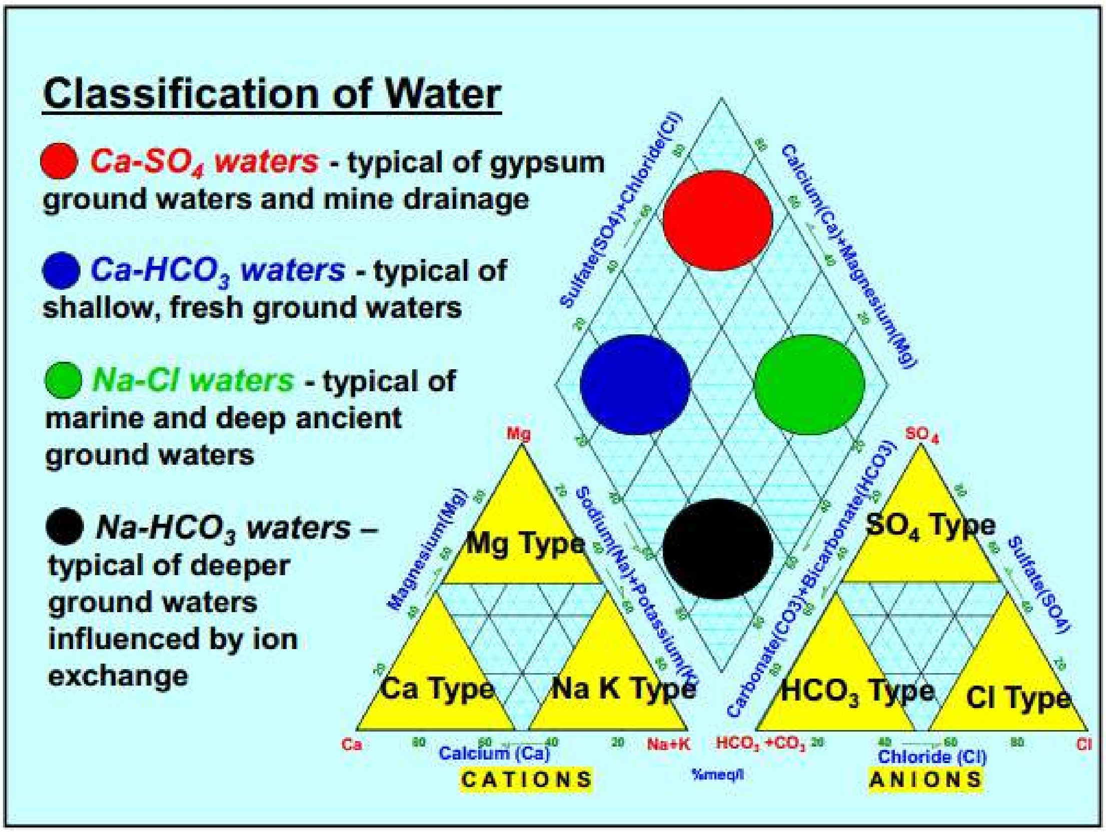

Figure 6-36: Piper diagram showing the classification of water types.

Groundwater at the Project site was sampled from the fractured aquifer. Groundwater Piper plot analyses was done for samples collected in July 2023 and represented on the Piper diagram in Figure 6-37. Following Piper plot classification, groundwater at the Project site is classified as Sodium-Chloride (Na-Cl) type.

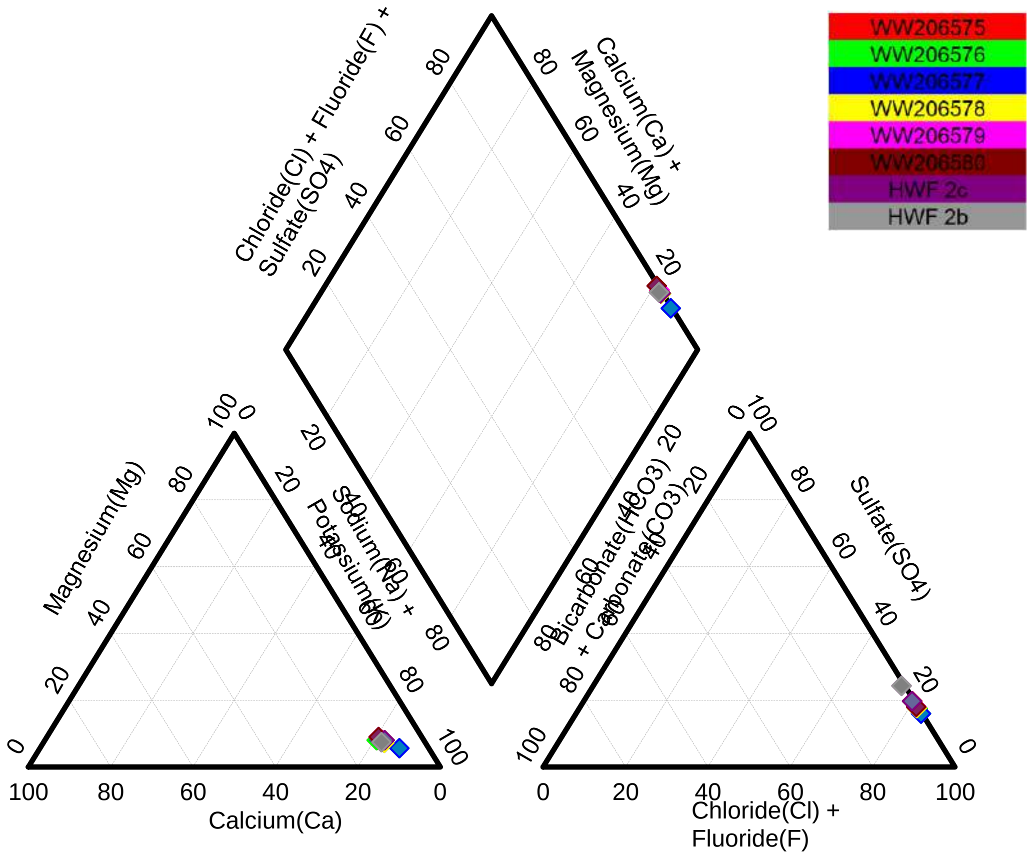

Figure 6-37: Piper plot of groundwater sampled at WMF Proposed Site. in July 2023.

6.9.6 Aquifer Characterisation and receptors

Aquifer characterisation and identification of receptors is summarised from the conceptual groundwater model report SLR (2024b) as follows:

- The proposed Project site is not underlain by any strategic geohydrological aquifer utilised for domestic or industrial purposes. Groundwater is saline and not suitable for human consumption;
- A fractured aquifer underlays the Project site. During borehole drilling, groundwater was intersected within the fractured basement aquifer only, mainly in the pegmatite and quartzite/schist contact while no water strike was made in dolerite dykes which have a slight influence on groundwater flow locally;
- Varying thickness of unconsolidated sediments exist, which overlay a weathered zone of the fractured aquifer;
- There is a slight displacement of the water table, associated with dolerite dykes and respective water strikes in the boreholes; and
- The fractured aquifer, and shallow sediments, in the washes as well as drains, are receptors of potential contamination from the NMF. The fractured aquifer and shallow sediments are generally recharged by percolation of rainfall and/or transmission losses during runoff events. Through this process, potential contamination could percolate

into the receptors through exposed sediments, weathered zones, fractured outcrops, fractures/faults that are preferential pathways for contaminants.

Hydraulic properties of the fractured aquifer are summarised in Table 6-16. It is noted that:

- groundwater potential is relatively low with improved yields at local levels when targeting fractures within the aquifer; and
- transmissivity of groundwater is generally low but can be significant within weathered and fractured zones of the aquifer.

Table 6-16: Hydraulic characteristics of the fractured aquifer

Borehole ID	Easting	Northing	Depth (m bgl)	Rest Water Level* (m bsu)	Yield (m^3/h)	Water strike (m^3/h)	Transmissivity	
							m^2/day	m/day
206575	487178	7536490	100	8.81	0.5	32	1.85	0.0078
206577	487180	7535763	100	16.99	1	No strike	No data	No data
206578	487854	7534413	41	12.26	3.2	22	36.1	1.29
206579	489019	7535611	100	10.49	1	89	4.23	0.0476
206580	489236	7536524	100	15.22	1	38	1.92	0.0227
206576	489236	7536524	100	10.62	1.5	No strike	0.0015	0.000173
HWF-2c	488838	7536734	100	8.63	1	44	2.92	0.0321
HWF-2b	489668	7536303	100	16.98	0.5	33	0.918	0.0112

6.9.7 Conceptual Groundwater Model

The hydrogeological understanding of the Project site is based on a hydrogeological conceptual model which considers site-specific data as well as background information and published literature (Table 6-17). The conceptual groundwater model was developed by SLR (2024b). The model is presented in (Figure 6-38) for ease of reference.

Table 6-17: Conceptual Model components

Sources	Description
Rainfall and evaporation	Mean Annual Rainfall (MAR) for the area is estimated at 35-40 mm/a while annual A-pan evaporation is around 2700 mm with an average daily rate of 7 mm evaluated from the Rössing Uranium Mine rainfall record (SRK 2010).
Surface runoff	West flowing drainages and washes were mapped on Site with evidence of active flow/runoff occurring during rainy season. Drains outside the site boundaries are expected to contribute inflow through the eastern boundary and lost along the western boundary.
Fractured Aquifers	Variably weathered fractured aquifer overlain by shallow unconsolidated sediments and compartmentalized by dolerite dykes. One fault has been defined. The aquifer has relatively

Sources	Description
Basement Aquifer	low groundwater potential with borehole yields ranging from 0.5- 3.2 m^3/h. Hydraulic conductivity and transmissivity are similarly low improving along fractures contacts and weathered zones. They range from 0.000173-1.2 m/day and 0.0015 – 36.1 m^2/day, respectively.
Groundwater levels and flow	Groundwater levels are relatively shallow ranging from 8.63 m bgl in HWF-2c to 16.99 m bgl. Groundwater flows towards the west. It is expected that base flow contributed to the site through its eastern boundary and lost along the western boundary.
Groundwater quality	Groundwater is Sodium-Chloride (Na-Cl) type and saline. Most parameters exceed drinking water standards. ^{234}U and ^{228}Ra are above WHO 2011 drinking water standards.
Recharge	Recharge is expected to be negligible below 0.1% of MAR.
Receptor 1	Shallow unconsolidated sediments
Receptor 2	Fractured aquifer outcropping and overlain by shallow sediments

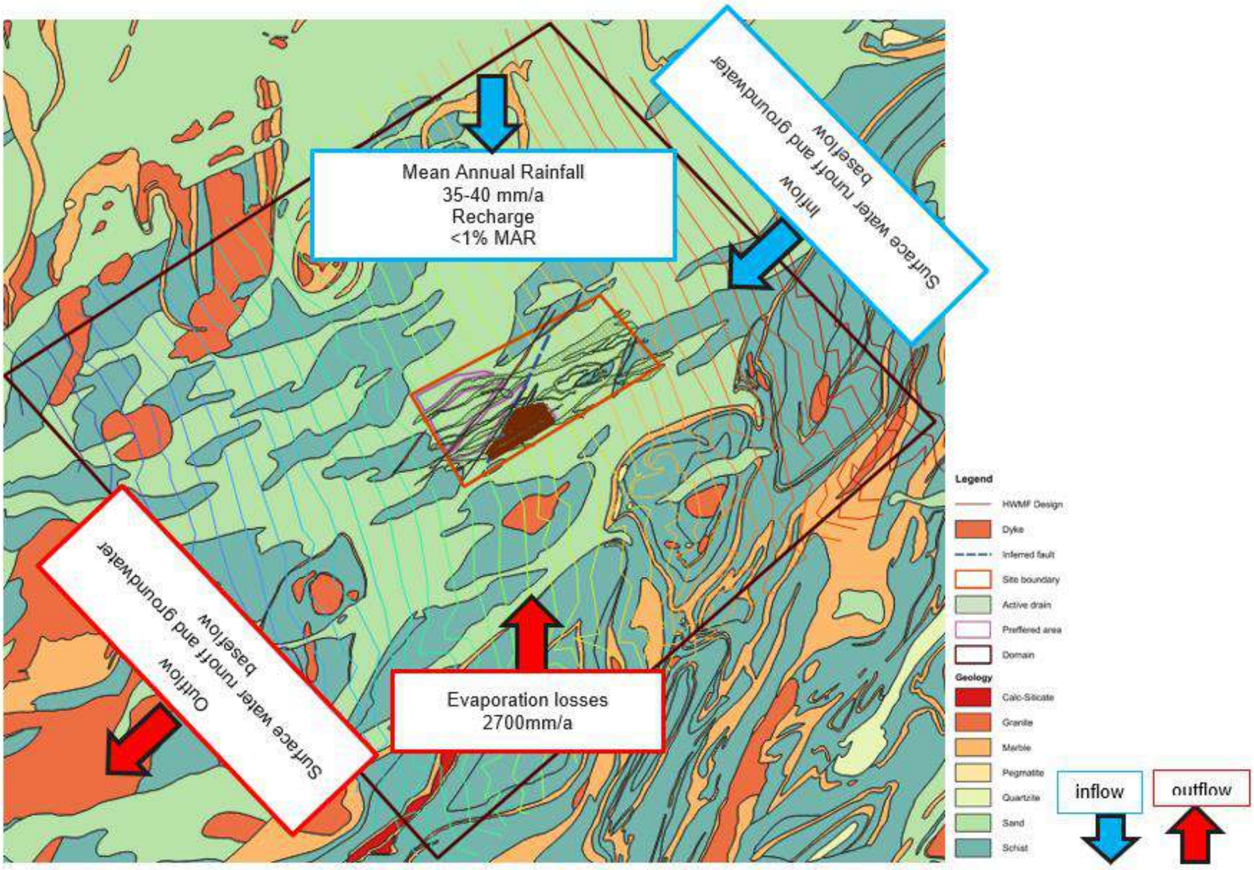

Figure 6-38: Conceptual Groundwater model for the NMF site (SLR, 2024b)

6.9.8 Numerical Groundwater Modelling

A numerical groundwater model was developed by SLR for the two business cases proposed for the NMF (Appendix I). The model aimed to predict contaminant flow to assess potential groundwater impacts resulting from the planned project activities over time.

The Finite Element Method (FEM) was selected for the purpose of the Project, using the FEFLOW (Finite Element subsurface FLOW and transport system v 8.1) modelling code developed by DHI-WASY (Diersch, 2014).

The conceptual model was mathematically represented by a mesh which encompasses a surface area of 330 km^2 and consists of 142 828 triangular mesh elements. The mesh density was increased in areas of interest i.e., facility footprint, dykes, boreholes, as well as the active drains which were explicitly included in the mesh construction. The model thickness is variable due to the changes in surface topography of the model. To represent the hydrogeology with depth the base elevation of the model was set at 150 mbgl. The model was split into 4 layers in total between surface and 150 mbgl

Numerical modelling was based on the Phase 1A and 1B concept design (Figure 5-10) provided by Jones and Wagener (2024) and consists of two groundwater models, each representing a business case. Business case 1 is characterized by the facility receiving 50 % arsenic waste and 50 % other hazardous waste, while business case 2 is representative of the facility only receiving other hazardous waste. A single model was constructed with the same background conditions, set up and calibrated, before the modelling could be separated into different models pertaining to specific scenarios.

The scenarios which both models consider are as follows:

- Scenario 1: Realistic mass transport scenario as designed with mitigation. The realistic scenario consists of applying a containment barrier of equivalent performance to a Class A containment barrier as per the South African National Norms and Standards for the Disposal of Waste to Landfill (GN 636, 2013), with a maximum outflow rate of 10^{-9} m/s in line with the South African Department of Water and Sanitation Guideline for Pollution Control Barrier System Design (DWS, 2021) in the absence of Namibian legislation and guidelines, with a reasonable expected number of defects and assumed permeabilities; and
- Scenario 2: Best case mass transport scenario as designed with mitigation. The best-case scenario is considered as a scenario where the containment barrier is fully impermeable (i.e., no contaminant will migrate outside the designated storage areas).

Based on the proposed design, the various components of the site were defined in the numerical model (Figure 6-40). These include with timeframes:

- Phase 1A (31 years)
  - Cells
  - Pollution Control Dams/ Leachate Dams
  - Stormwater dams (containment infrastructure)
- Phase 1B (9 years)
  - Cells
  - Pollution Control Dams/ Leachate Dams
  - Stormwater dams (containment infrastructure)

In the transient models, modulation functions were assigned to the respective Phase components to allow cells to be active for the specified amount of time per the Jones and Wagener (2024) design. Further, the models were set up to ensure cells were capped sequentially, after they were active, which reduced direct recharge over these cells for the remaining period. This was done within the time series applied to the cells.

Table 6-18: Timeframe of each feature, after Jones and Wagener (2024)

Cell	Service Life (years)
1 (Ph1A)	5
2 (Ph1A)	5
3 (Ph1A)	6
4 (Ph1A)	5
5 (Ph1A)	5
6 (Ph1A)	6
Ph1B	9
Total	**40**

The hydraulic parameters of the proposed containment barrier, with a reasonable number of defects, were confirmed by Jones and Wagener engineers to be equivalent to that of a Class A containment barrier as outlined in the South African National Norms and Standards for the Disposal of Waste to Landfill (GN 636, 2013) and detailed in Table 6-19. It was further confirmed a value lower than this would acceptably represent the fully impermeable containment barrier. As such, the fully impermeable containment barrier was indicated by a K value one order of magnitude lower. Namwaste provided the K value of the stormwater dams, as obtained from Jones & Wagener, that were added to the original design.

Table 6-19: Permeabilities representing the different site components.

Components	K (m/s)
Containment barrier with reasonable defects	1e-09
Fully impermeable containment barrier	1e-10
Stormwater dams	8.64e-08

The detail of the 3D Model is presented in Table 6-20 and the extent was delineated based on geographic and hydrogeological features.

Table 6-20: NMF model details

Modelling aspect	Detail for both modelling scenarios
Model code	Feflow
Slices and layers	5 Slices and 4 layers
Mesh	3D Finite Element Mesh (Triangular prisms)

Modelling aspect	Detail for both modelling scenarios
Mesh elements	142 828
Elements per layer	35 707
Mesh quality	5 % > 120°, 34.8 % > 90°
Domain area (m^2)	$3.30344e^8$
Domain volume (m^3)	$4.95516e^{10}$

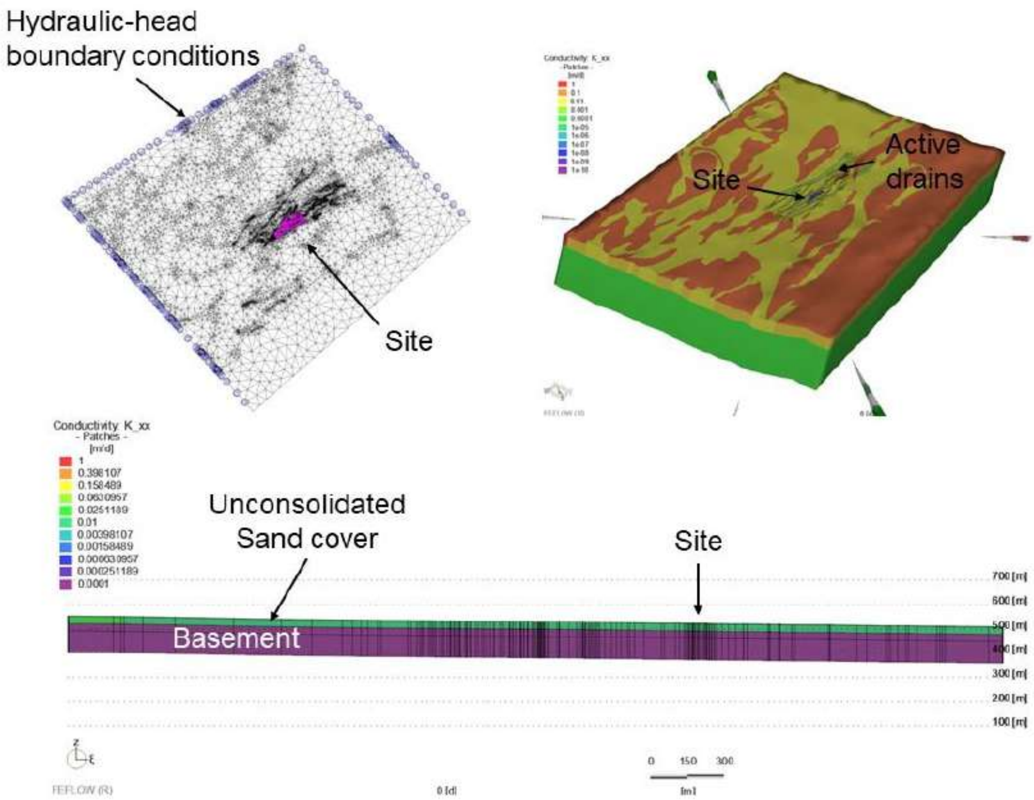

Figure 6-39: Namwaste Management Facility model set up

A three-dimensional steady state groundwater flow model representing the study area was constructed to represent pre-operation groundwater flow conditions. These conditions serve as the initial conditions for the transient simulations of groundwater flow and mass transport associated with the operation.

The three-dimensional groundwater flow equation on which Feflow modelling is based is expressed below:

$$\frac{\partial}{\partial x}\left(Kx\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(Ky\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(Kz\frac{\partial h}{\partial z}\right)\pm W=S\frac{\partial h}{\partial t}$$

Where:

h: Hydraulic Head (L)

Kx, Ky, Kz = Hydraulic conductivity (L/T)

S = storage coefficient

T = Time (T)

W = Source and sinks (L/T)

No source term modelling took place. Per best practices, source terms modelled through a geochemical study is used in the mass transport component in the numerical model. For the source term to be modelled, various geochemical analyses on the expected waste materials are needed, including but not limited to: X-Ray diffraction analyses (XRD), synthetic precipitation leaching procedure (SPLP), etc. The geochemical assessment provides the chemicals of concern, which are generally the highly reactive and dissolving constituents. Once these are known, they are used within the groundwater model.

However, due to the NMF being a green-field project, no waste samples are available for the geochemical analyses. Additionally, the hazardous waste is expected to come from various sites and therefore no single sample is expected to be completely representative of each waste type. Therefore, Namwaste advised that the two constituents to use for the models were Arsenic (As) to represent arsenic waste and Lead (Pb) to represent other waste. It was further advised that the Leachable Concentration Threshold (LCT) 3 concentrations for As (4 mg/L) and Pb (4 mg/L) be used for modelling purposes, in line with the South African National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN 635, 2013), in the absence of Namibian legislation guiding the assessment of waste for landfill disposal.In the absence of a geochemical assessment, SLR agreed that this approach would be reasonable given the nature of the hazardous waste facility.

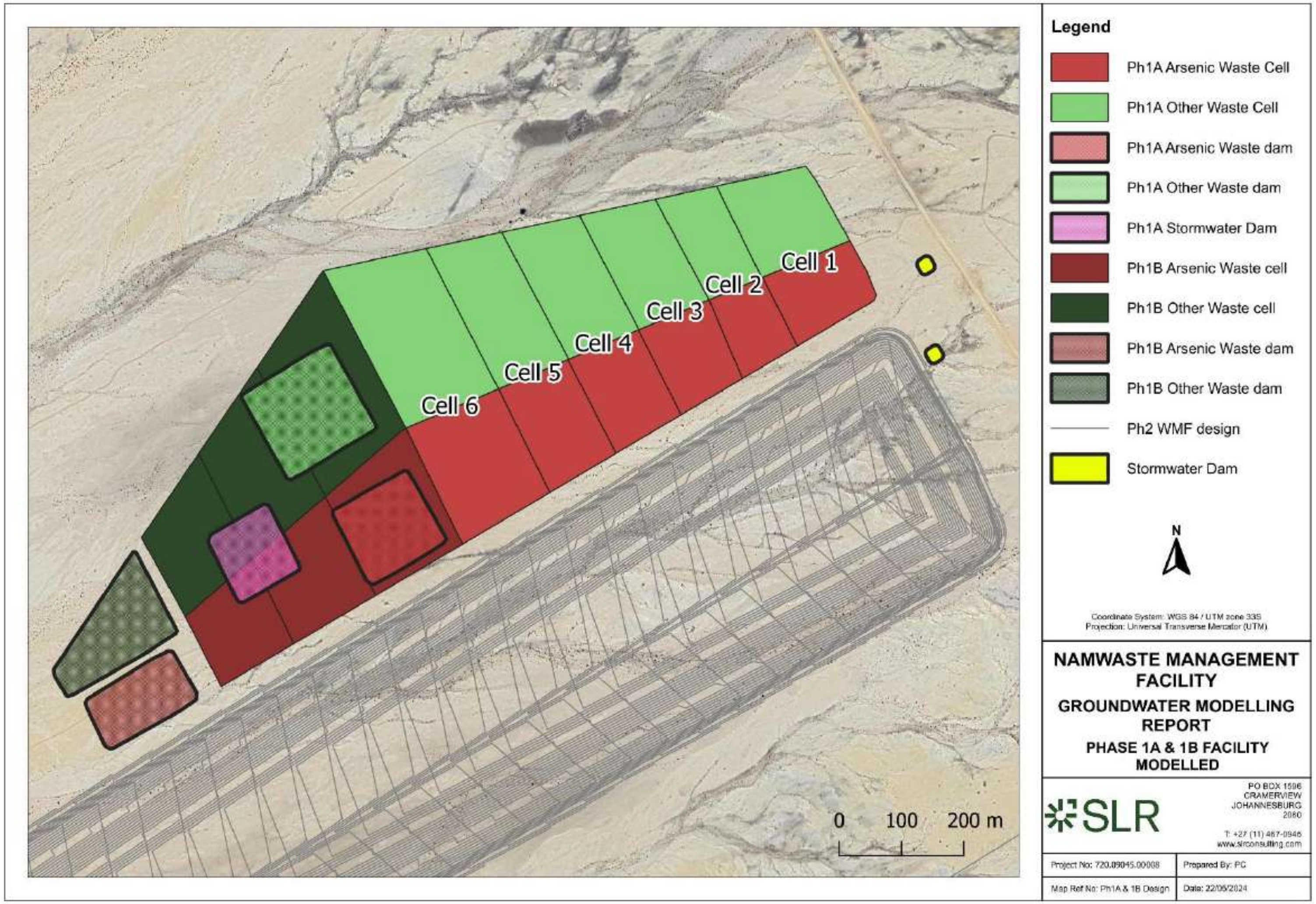

Figure 6-40: Phase 1A and 1B of the facility design separated into components for numerical modelling

6.9.8.1 Groundwater Model Simulations

The calibrated steady-state model was used to develop transient models to simulate the expected contaminant plume. Models were simulated for 100 years for each business case and scenario. The time series applied to the respective model, considered Phase 1A cells, and pollution control dams, stormwater dams and Phase 1B cells and pollution control dams.

Mass transport simulations were performed to determine the expected impact of seepage from the facility with the various containment barrier permeabilities and waste types. **It is important to note that the "plume" does not indicate a contaminant plume in reality since source term concentrations are not considered to be contamination. The "impact" is therefore only indicative of the path and distance that contaminants would flow, should there be any.**

6.9.8.2 Scenarios

Simulations were undertaken for scenarios as follows:

Scenario 1 (half arsenic waste and half other hazardous waste):

- Business Case 1:
  - 40 years (end of Phase 1B)
  - 62 years (end of Phase 2)
  - 100 years (60 years since the end of operations)
- Business Case 2:
  - 40 years (end of Phase 1B)
  - 62 years (end of Phase 2)
  - 100 years (60 years since the end of operations)

Scenario 2 (other hazardous waste only):

- Business Case 1:
  - 40 years (end of Phase 1B)
  - 62 years (end of Phase 2)
  - 100 years (60 years since the end of operations)
- Business Case 2:
  - 40 years (end of Phase 1B)
  - 62 years (end of Phase 2)
  - 100 years (60 years since the end of operations)

The results of the model are presented in the sections that follow.

6.9.8.3 Groundwater Model Results

Scenario 1 – Reasonable containment barrier defects

In Scenario 1 with the containment barrier anticipated to have a reasonable number of defects (K: $1.00e^{-09}$ m/s), in both business cases, plume migration is minimal. The leachate will be collected in leachate collection pipes which are sloped appropriately for the leachate to drain into the leachate dams.

Although defects are highly unlikely to occur due to the facility design and Construction Quality Assurance, should any defects occur leachate may flow out from the facility at the source/location of the defect. If enough seepage of leachate is generated from a major defect, this would flow out of the sides of the facility, as indicated by the model. Given the flat hydraulic gradient of the site, blockages to the drainage systems could also result in flow out of the sides of the facility. However, based on the restrictions on the moisture content of disposed wastes and the arid environment, the facility is not anticipated to generate large volumes of leachate.

The stormwater dams to the east of Phase 1A show slow progression of drainage to the southwest, like the active drains. The plumes are closely confined to the immediate vicinity of the facility boundary, and this is also owing to the very low rainfall in the area. Even after 100 years since the start of the facility, arsenic and lead in both cases do not reach any features that may act as conduits of flow. At the furthest point, the plume travels 61.5 m from the facility, and is representative of the lowest As/Pb concentration at this point (0 mg/L). Thus, downgradient impact is not expected.

Figure 6-41 to Figure 6-46 show the progression of the anticipated plumes for each of Business Case 1 and 2, at time steps of 40 years, 62 years and 100 years.

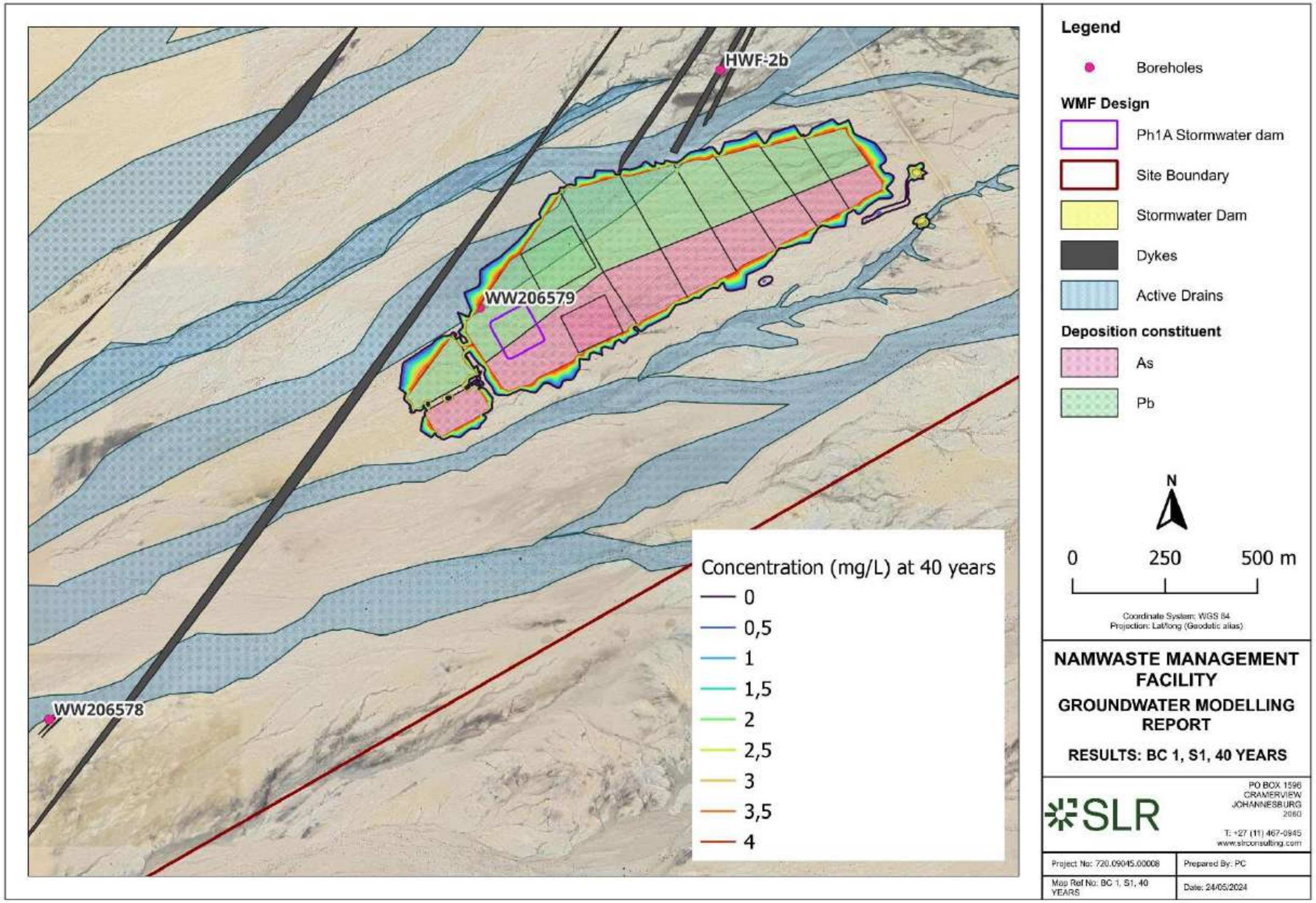

Figure 6-41: Business case 1 contaminant plume 40 years after start of operations

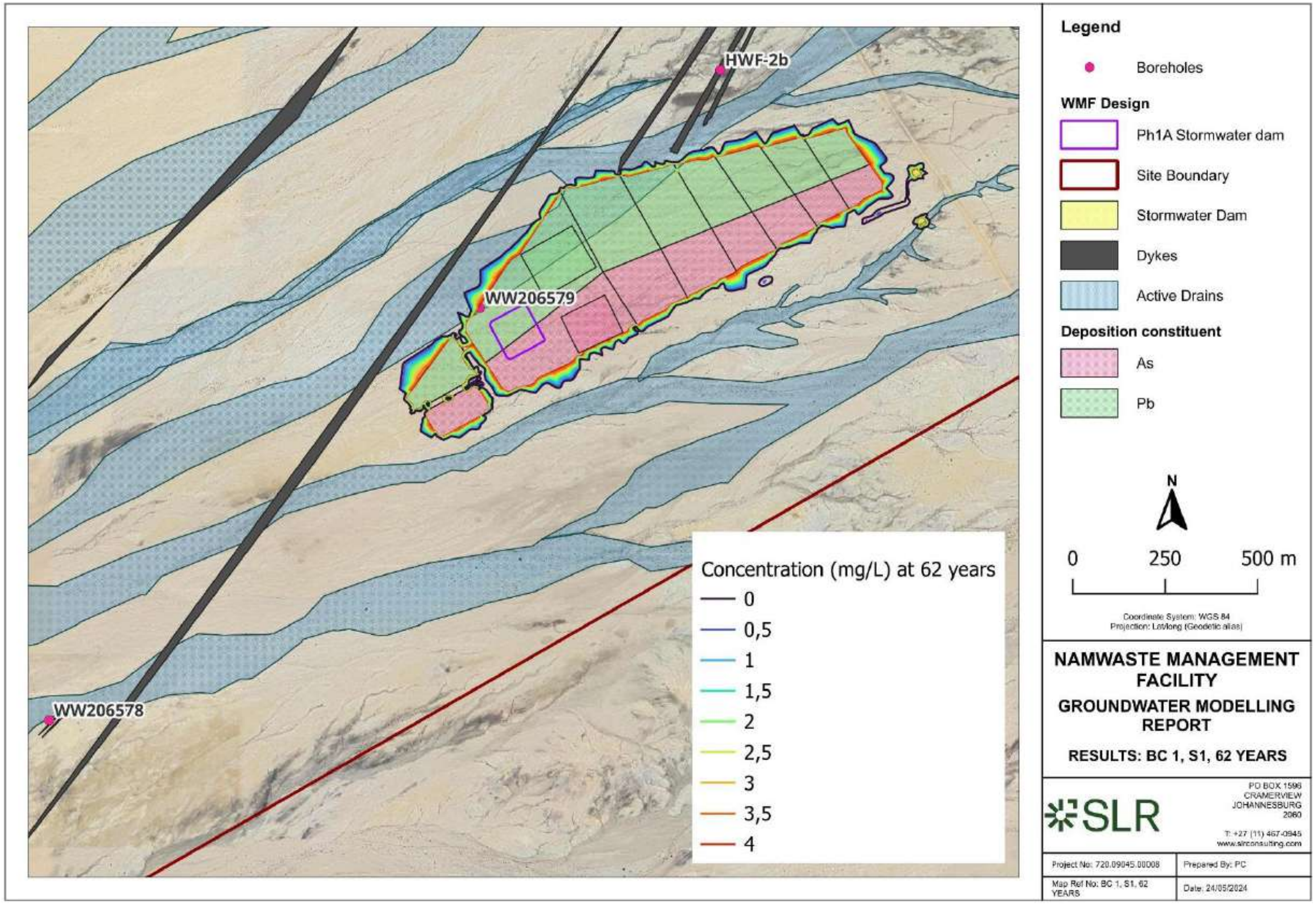

Figure 6-42: Business case 1 contaminant plume 62 years after start of operations

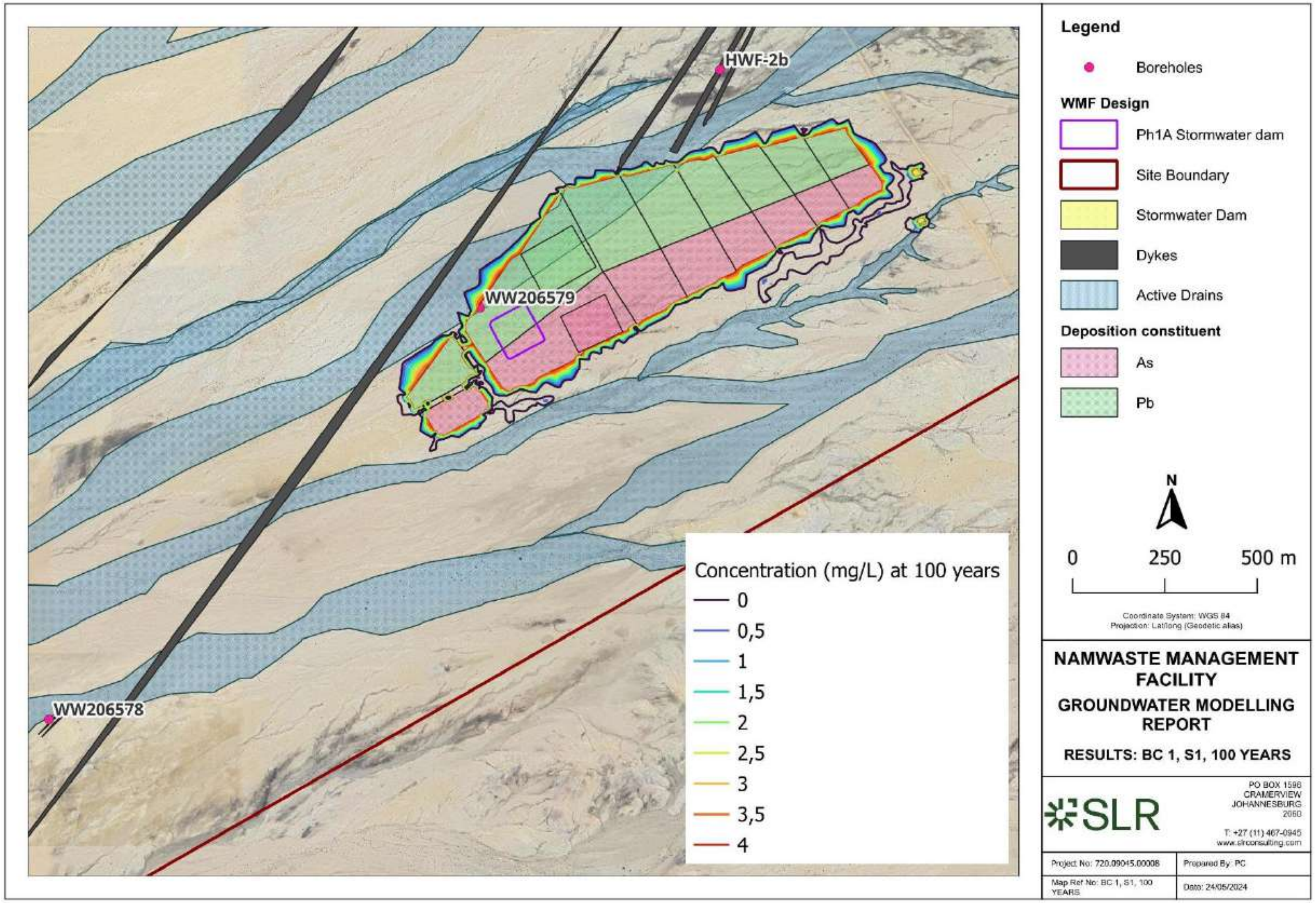

Figure 6-43: Business case 1 contaminant plume 100 years after start of operations

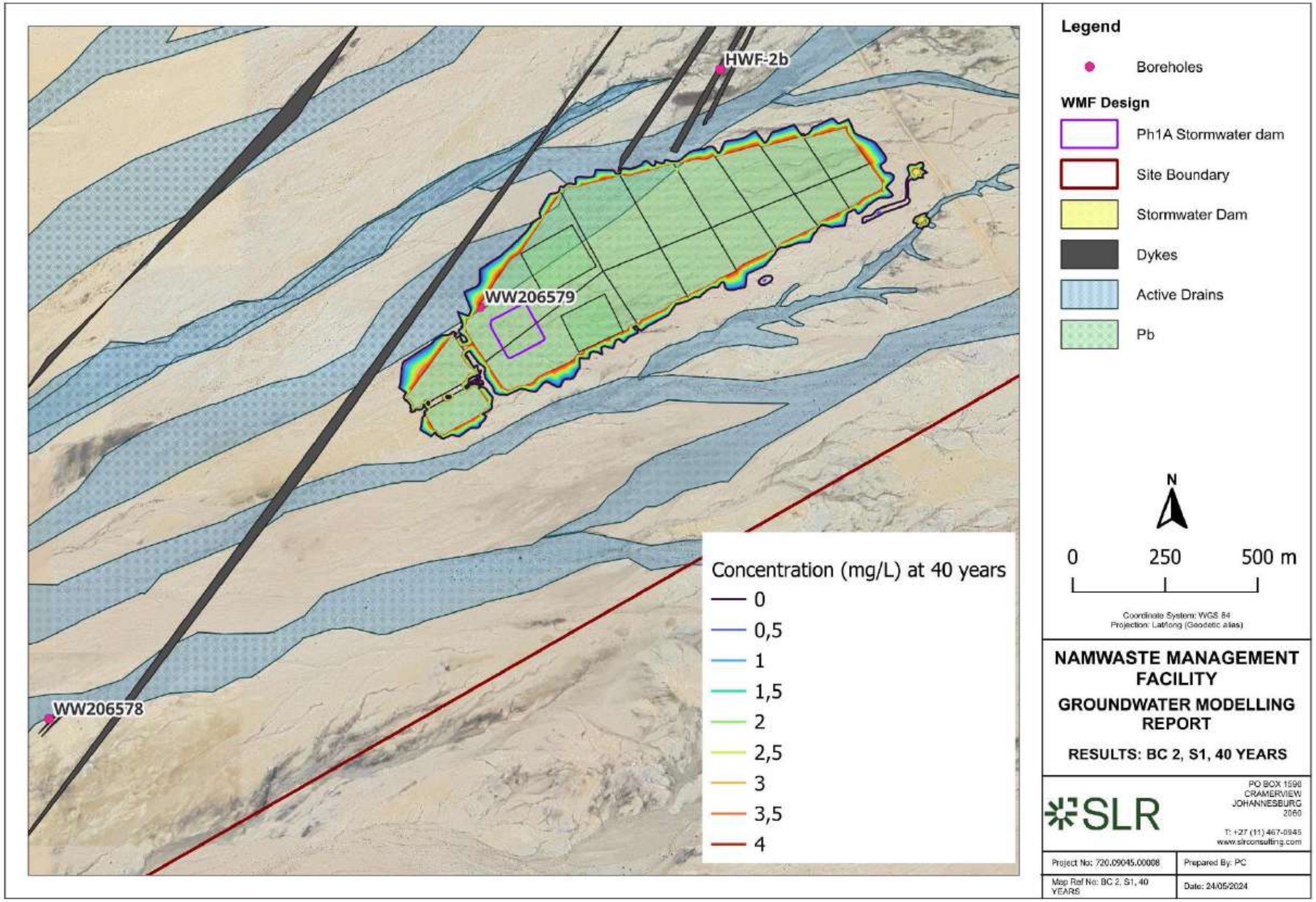

Figure 6-44: Business case 2 contaminant plume 40 years after start of operations

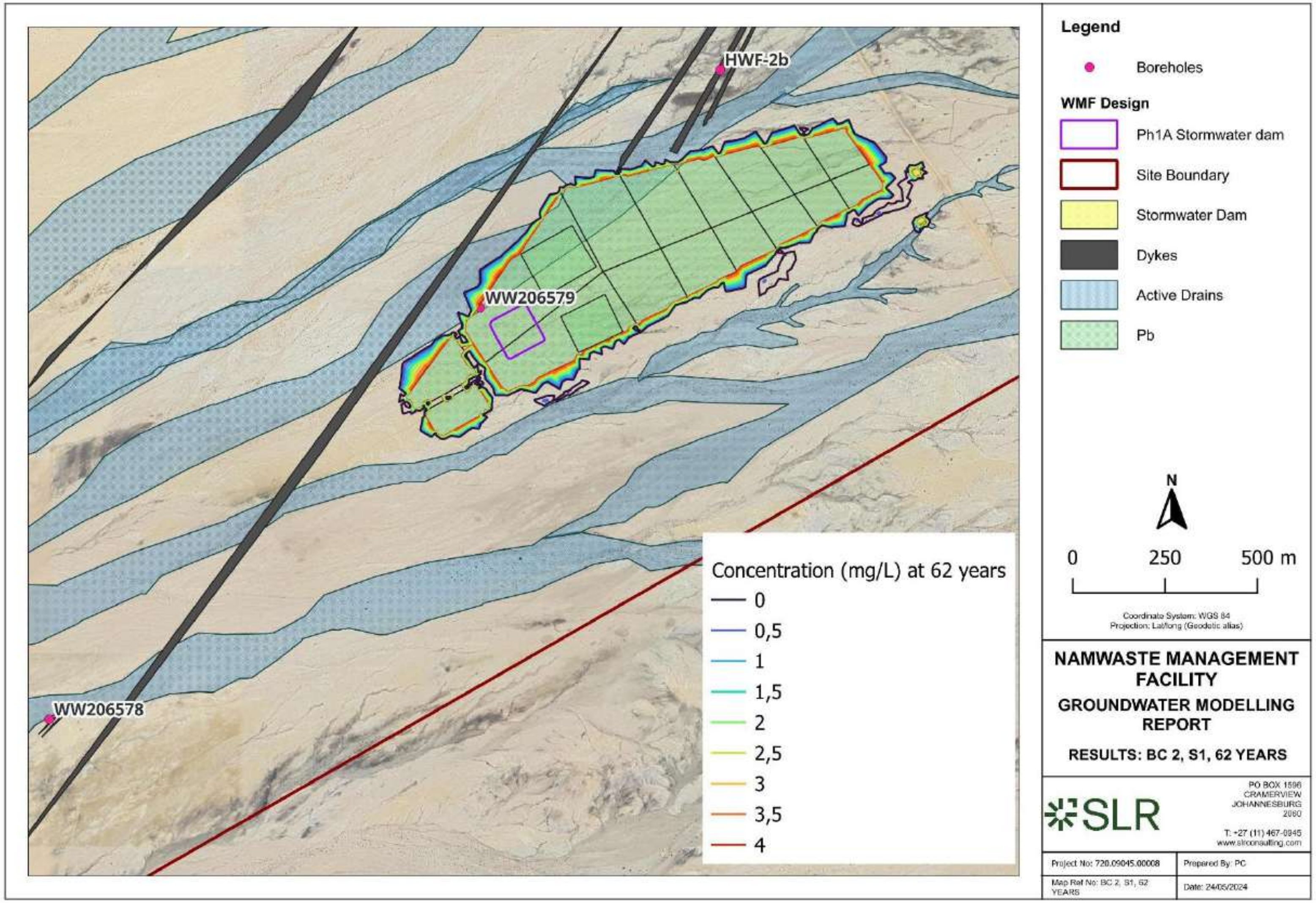

Figure 6-45: Business case 2 contaminant plume 62 years after start of operations

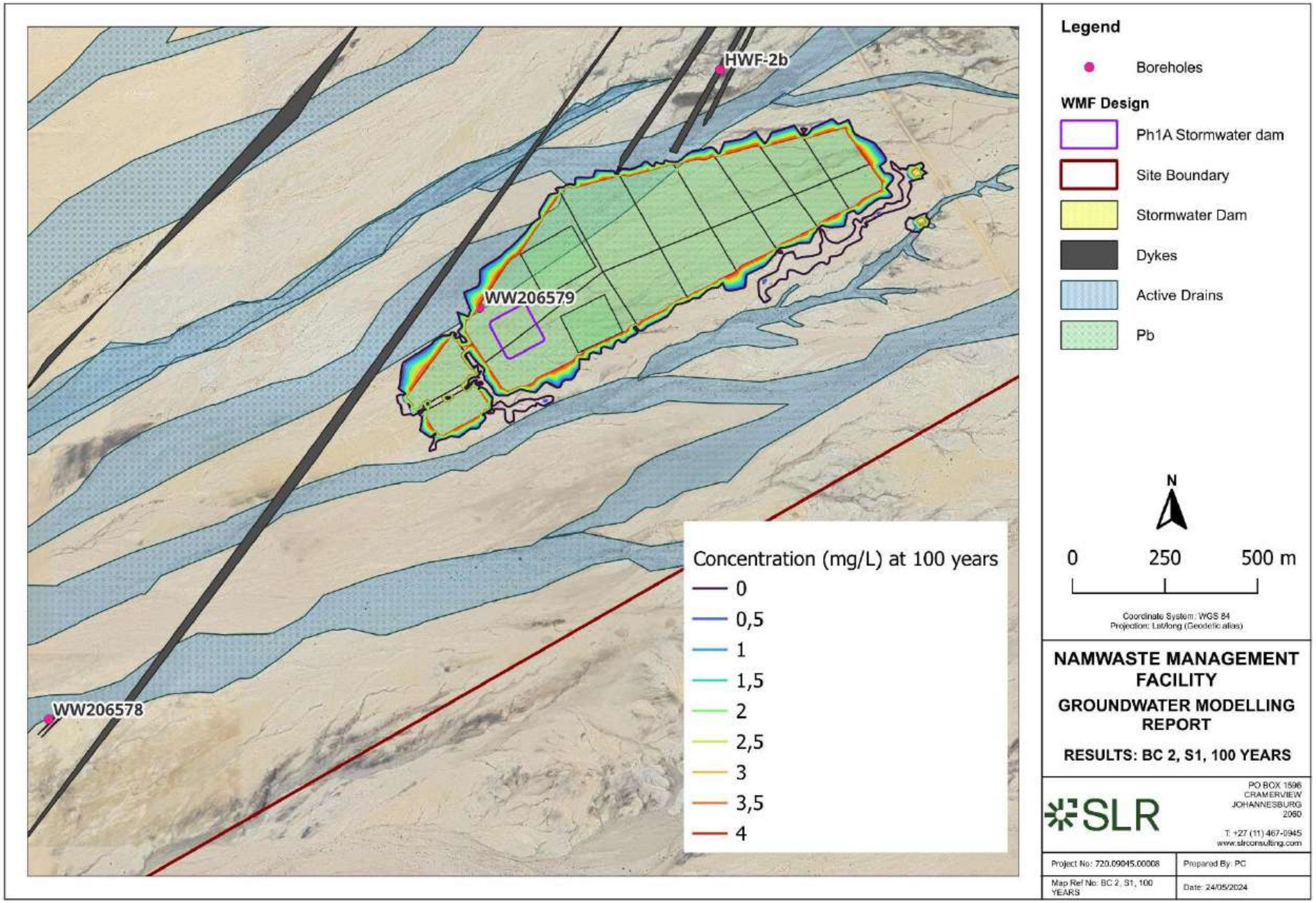

Figure 6-46: Business case 2 contaminant plume 100 years after start of operations

Scenario 2 – fully impermeable containment barrier

In Scenario 2 with the containment barrier anticipated to have minimal defects (K: $1.00e^{-10}$ m/s), in both business cases, plume migration is minimal. The leachate will be collected in leachate collection pipes which are sloped appropriately for the leachate to drain in the leachate dams.

Although defects are relatively unlikely to occur due to the facility design and Construction Quality Assurance, should any defects occur leachate may flow out from the facility at the source/location of the defect. If enough seepage of leachate is generated from a major defect, this would flow out of the sides of the facility, as indicated by the model. Given the flat hydraulic gradient of the site, blockages to the drainage systems could also result in flow out of the sides of the facility. However, based on the restrictions on the moisture content of disposed wastes and the arid environment, the facility is not anticipated to generate large volumes of leachate.

Like Scenario 1, the stormwater dams to the east of Phase 1A show slow progression of drainage to the southwest, in line with the active drains. The plumes are closely confined to the immediate vicinity of the facility boundary, and this is also owing to the very low rainfall in the area. Even after 100 years since the start of the facility, arsenic and lead in both cases do not reach any features that may act as conduits of flow. At the furthest point, the plume travels 61.5 m from the facility, and is representative of the lowest As/Pb concentration at this point (0 mg/L). Thus, downgradient impact is not expected.

Figure 6-47 to Figure 6-52 show the progression of the anticipated plumes for each of Business Case 1 and 2, at time steps 40 years, 62 years and 100 years.

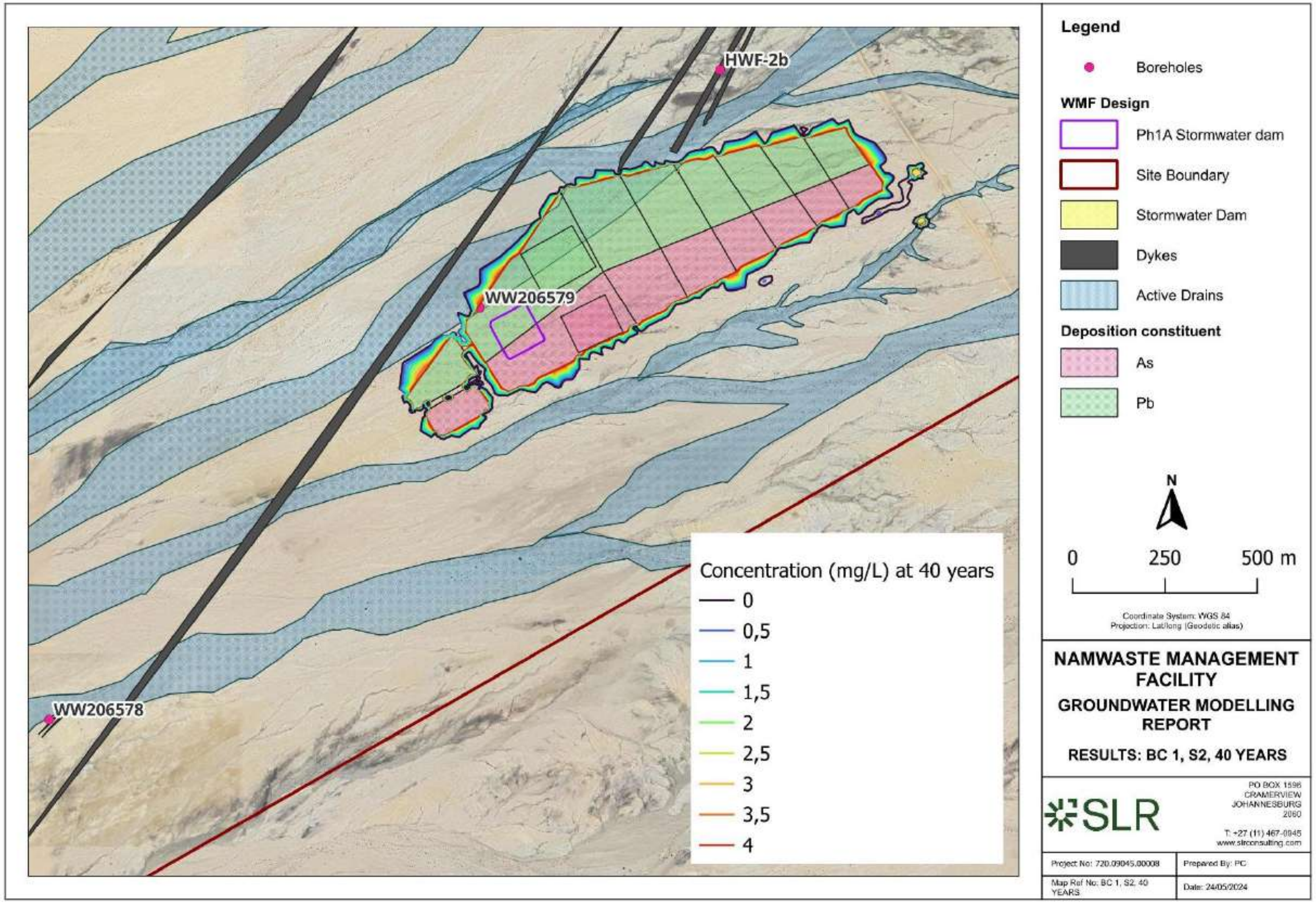

Figure 6-47: Business case 1 contaminant plume 40 years after start of operations

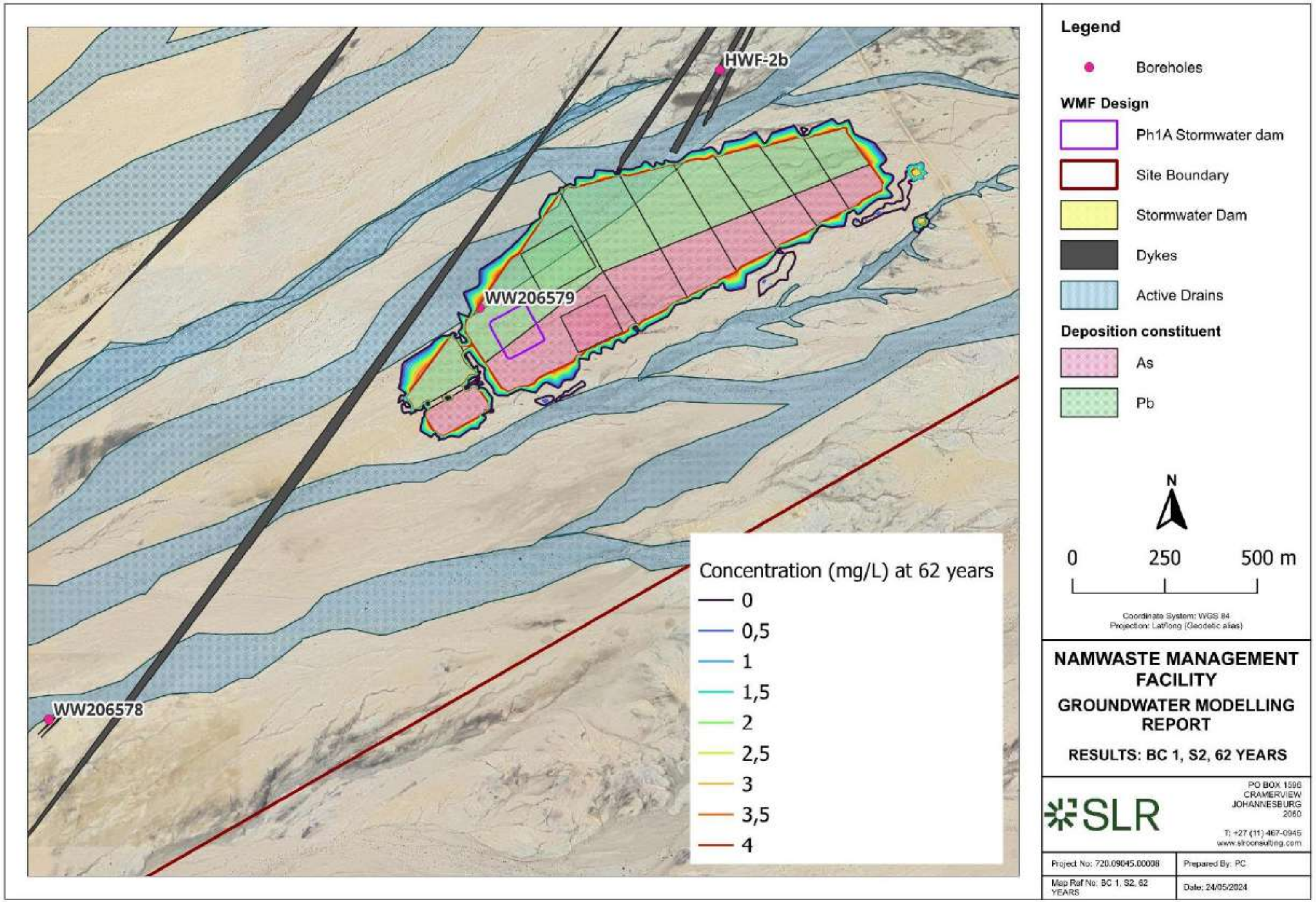

Figure 6-48: Business case 1 contaminant plume 62 years after start of operations

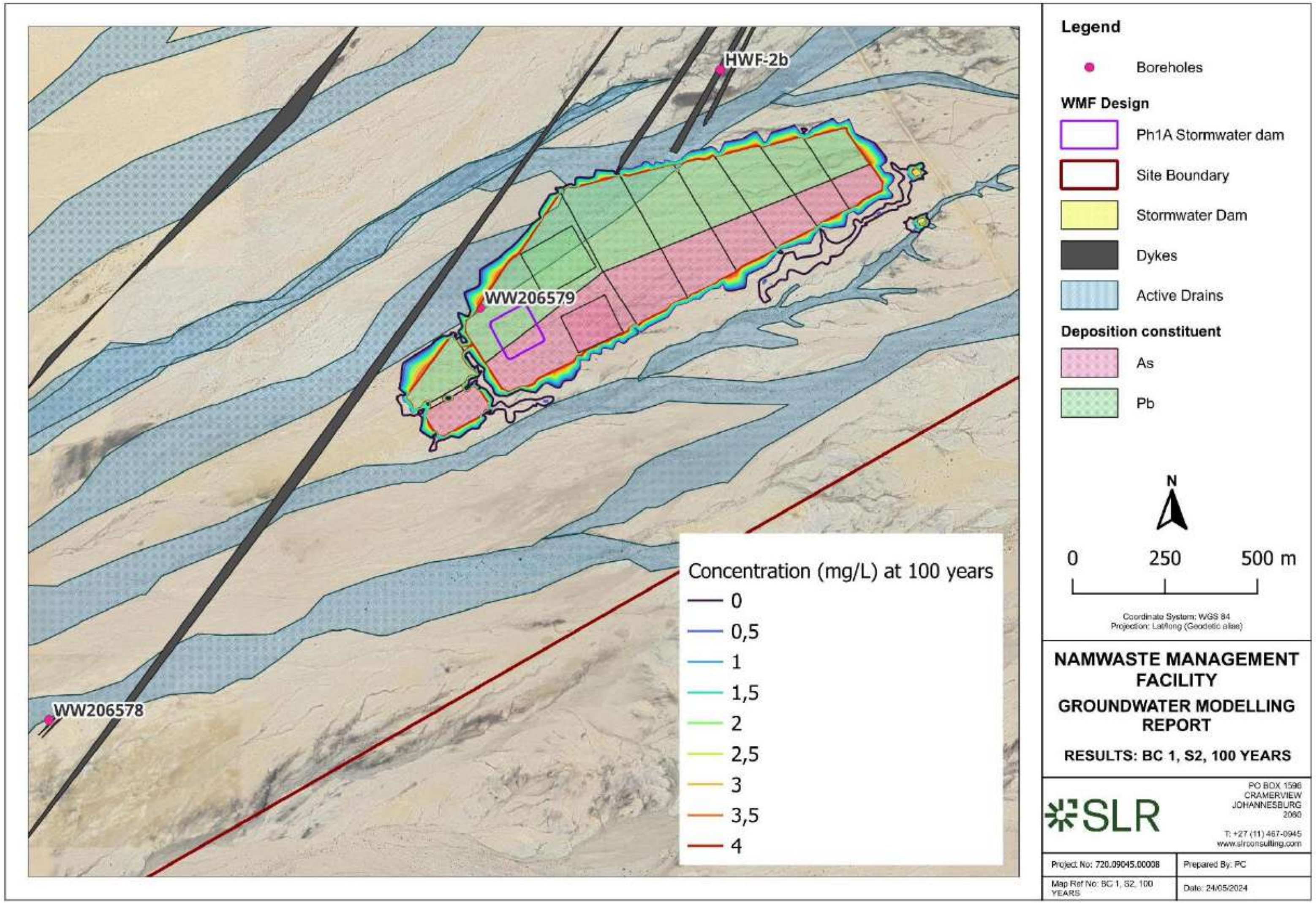

Figure 6-49: Business case 1 contaminant plume 100 years after start of operations

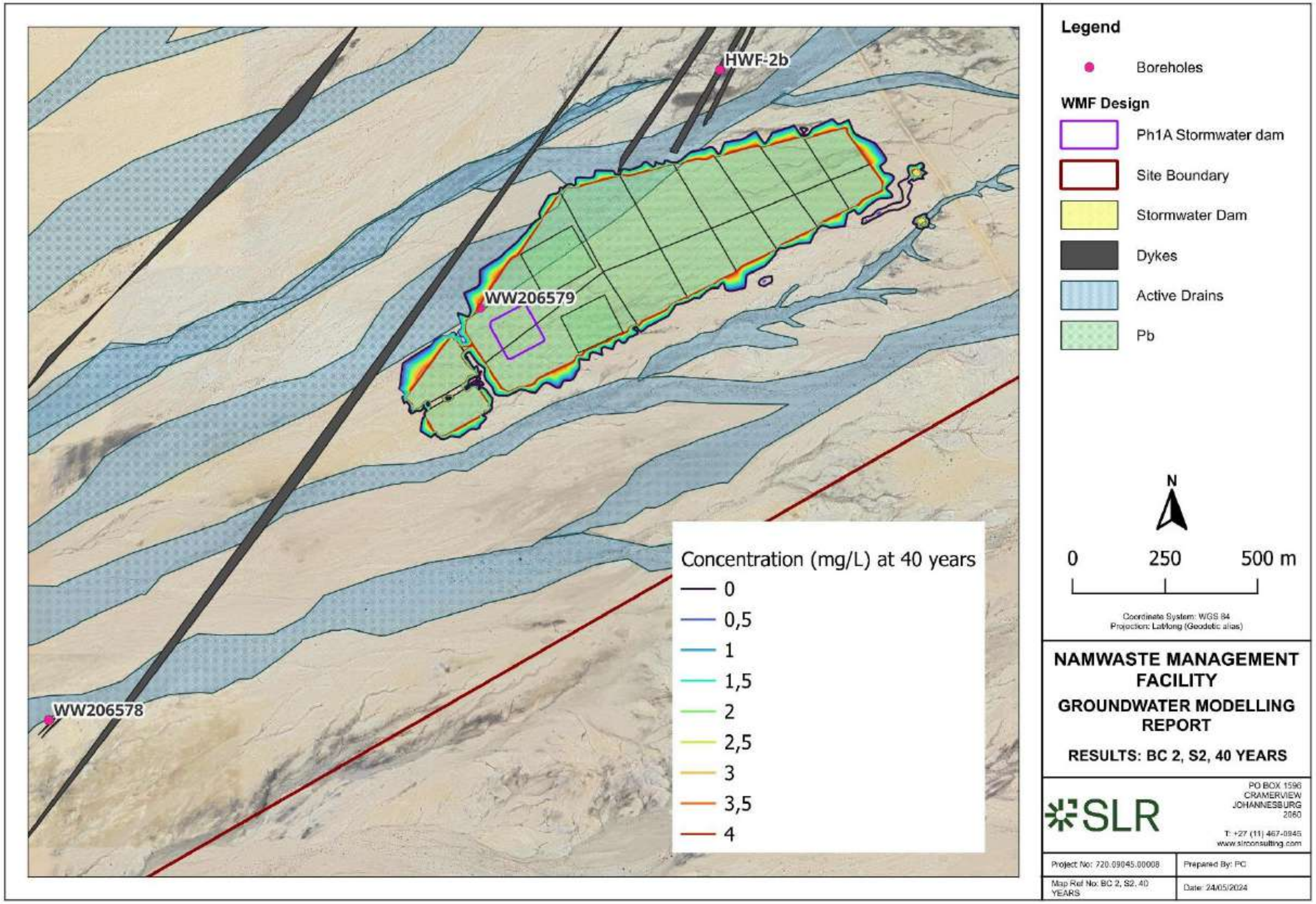

Figure 6-50: Business case 2 contaminant plume 40 years after start of operations

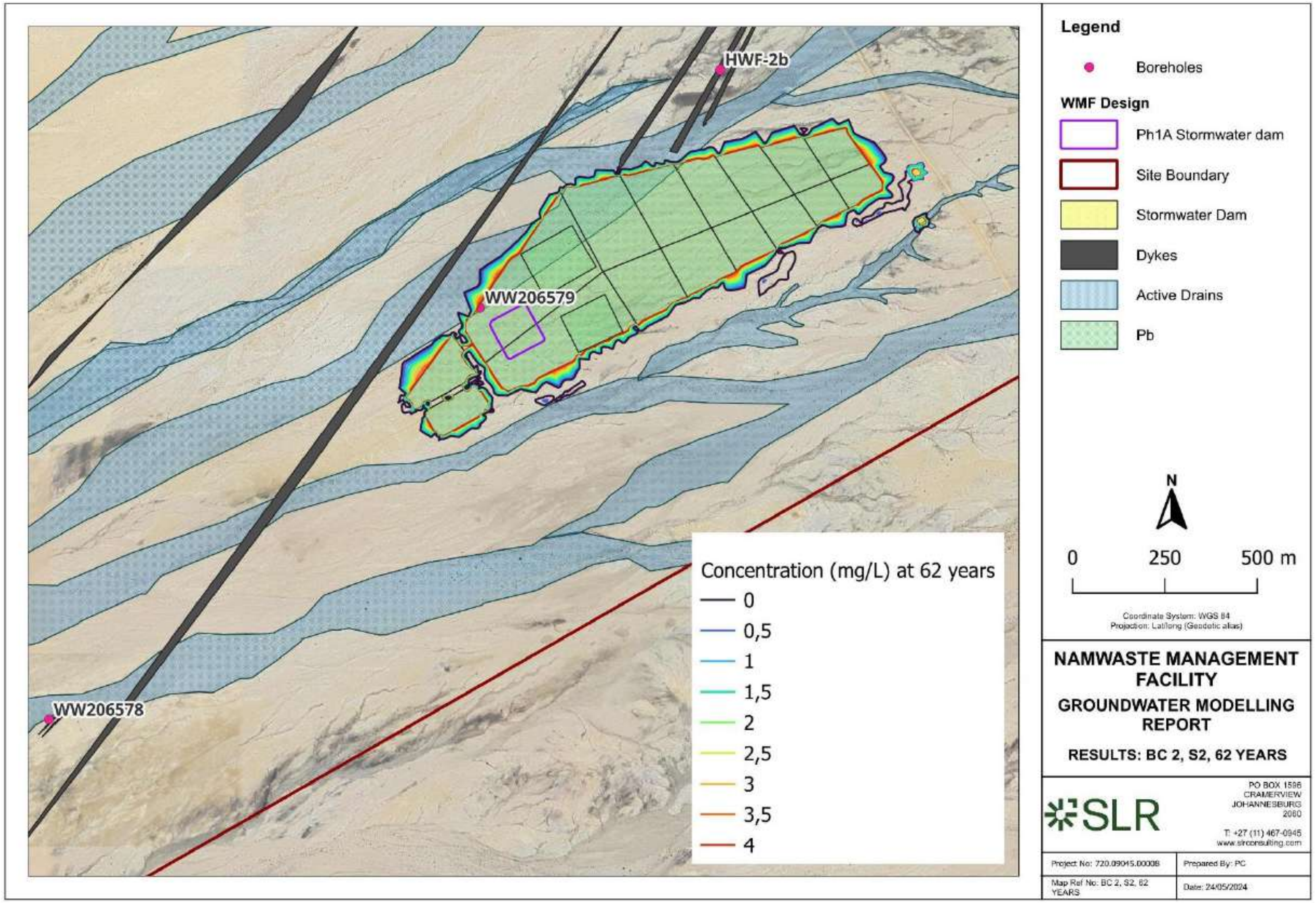

Figure 6-51: Business case 2 contaminant plume 62 years after start of operations

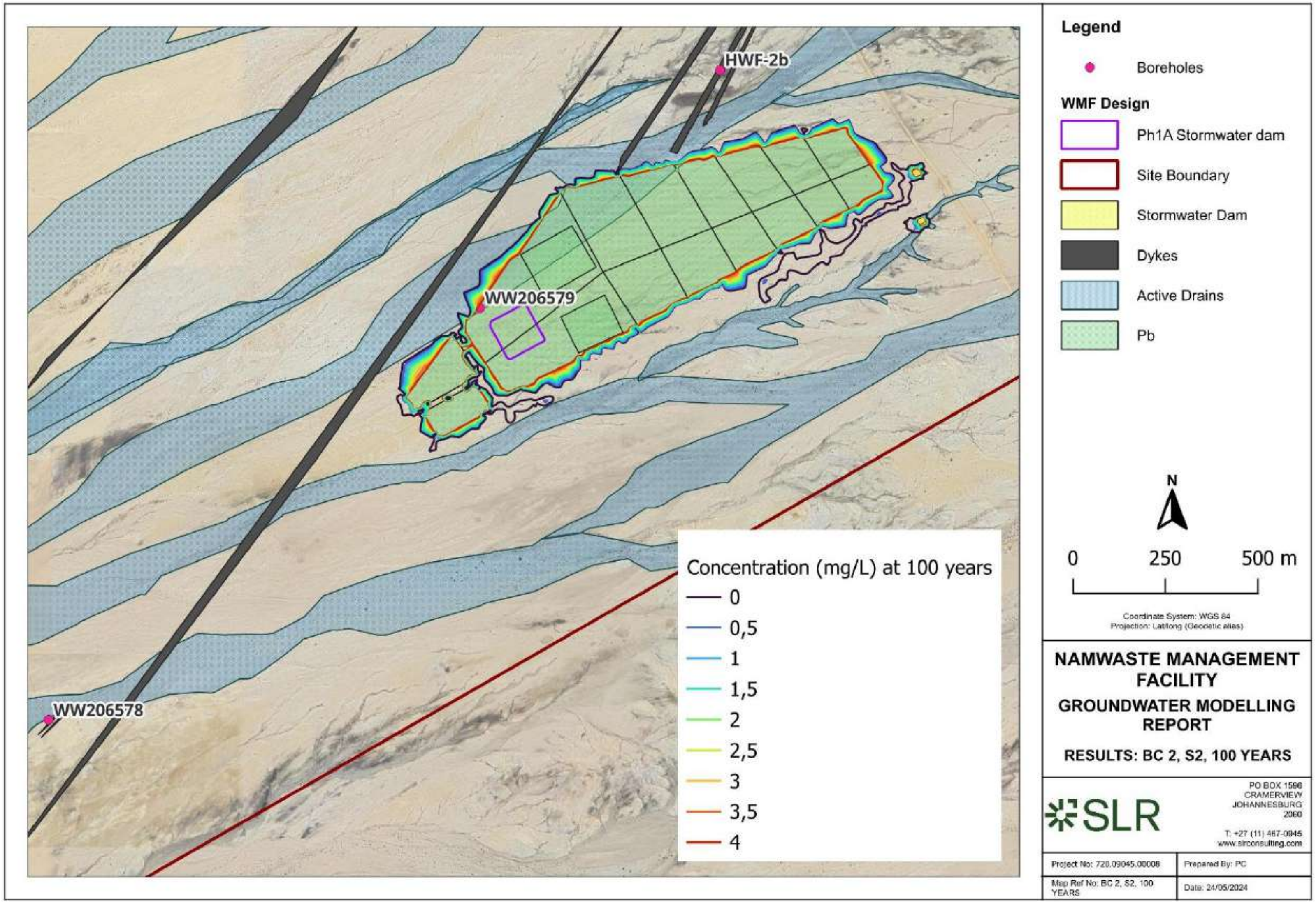

Figure 6-52: Business case 2 contaminant plume 100 years after start of operations

While the groundwater model (SLR, 2024c) showed that in both scenarios and business cases the potential contamination plume is not expected to move significantly away from the facility footprint, the model still has limitations that render it not 100 % accurate. The groundwater model provides a calculated prediction based on data provided. However, as with any model, it is a highly generalized version of the site setting and data limitations and assumptions may lead to a variation from reality. Based on the information at present, it is unclear if the dykes mapped north-west of the site would act as a conduit or barrier to flow. Thus, coupled with the relatively shallow groundwater level in the vicinity of the site (from 8.63 mbgl to 16.99 mbgl), there is still a possibility of groundwater contamination as a result of seepage from facility. Further, due to the erratic nature of rainfall in the region, there is a potential for episodic flash floods following rainfall of high intensity. This has the potential to transport contaminants from the above-mentioned areas/facilities into the active drains and then to the shallow alluvial aquifer system.

6.10 Biodiversity

A Terrestrial Biodiversity and Ecological Impact Assessment was undertaken by Henriette Potgieter (Appendix K). The study aimed to determine the current terrestrial ecological baseline of the Project site and to identify potentially critical impacts of the development proposal on biodiversity comprising of flora and fauna (including avifauna, reptiles, amphibians and mammals).

6.10.1 Fauna

6.10.1.1 Mammals

No mammals were observed during the site visit, but Springbok spoor and droppings were present, as well as burrows that may have been made by species such as Porcupine, rodent species and Ground Squirrel. During informal conversations with the Orano gate guards they reported sightings of Cheetah, Porcupine, Springbok, Cape Fox and Brown Hyaena.

The Terrestrial Biodiversity and Ecological study lists 35 mammal species that could possibly utilise the habitats in the study area. Of these, 7 are endemic but none of them are legally protected in Namibia: Angola hairy Bat, Namib Long-eared Bat, Namib round-eared Elephant Shrew, Setzer's hairy-footed Gerbil, Brush-tailed hairy-footed Gerbil, Pygmy Rock Mouse and Dassie Rat.

Bats and rodents represent more than 50% of the mammals that possibly occur in the area (18 species), but both are under-studied taxa in Namibia and the number may well be higher. Important habitats for these two taxa include the drainages with their associated vegetation and sandy substrate, and the rocky ridges along the power line/pipeline corridor with their crevices and boulders.

The Brown Hyaena is classified Near Threatened by the International Union for the Conservation of Nature (IUCN) and in Namibia. The Leopard is considered Vulnerable in Namibia, Near Threatened by the IUCN and is listed on Convention on International Trade in Endangered Species (CITES) 1. The Cape Fox and Aardwolf are Protected Game under the Nature Conservation Ordinance 4 of 1975 (NCO), and the Hartmann's Zebra is Protected Game and also listed on CITES 2. The Caracal is listed on CITES 2, bringing the total of protected mammal species expected to occur within the study area to 6.

The proposed access road near Arandis potentially poses an increased risk of collision and disturbance to mammals, but the proximity of the road to the town limits the probability and extent of the risk.

6.10.1.2 Reptiles

In the Namibian context the study area falls in an area with the second highest ranking of endemicity and in a medium ranking for reptile diversity (Mendelssohn, et al., 2002). The Global Biodiversity Information Facility (GBIF.org, 2024) lists 71 species recorded in the study area, but after screening for habitat suitability 41 species remain. The endemism rate for reptiles is high at almost 50%.

Important habitat niches for reptiles include the sandy substrate and vegetation of the drainages, as well as the rocky ridges where there is shade at some times of the day, ample shelter in crevices and vegetation, and more food resources than on the surrounding plains.

The national and international assessment of this taxon in Namibia has not been updated comprehensively in almost 20 years and it is likely that the situation, specifically regarding threatened species, has changed significantly. The 1989 discovery of the restricted range Husab Sand Lizard in the general area of the confluence of the Swakop and Khan Rivers. This lizard is an extreme habitat specialist of not only marble substrates, but specifically marble surrounded by other bare rock types, conditions that occur on the ridges south of the NMF where the power line-pipeline corridor will be placed (Cunningham, et al., 2012).

6.10.1.3 Amphibians

There is no permanent surface water in the study area, restricting species richness because most amphibians require water bodies for breeding. Ephemeral rock pools may occur in the ridges and koppies after rainfall events, possibly supporting 4 species that have distribution ranges that overlap with the study area. Hoesch's Pygmy Toad is endemic to Namibia and highly likely to occur in the rocky ridges in the power line-pipeline corridor, where it breeds in sandy-bottomed temporary pools for only a few nights after heavy rains.

The development is unlikely to increase the risk of extinction of any amphibian population or species.

6.10.2 Avifauna

A total of 75 bird species are likely to utilise resources in the study area and/or be impacted by the development (Potgieter, 2024). Collisions, electrocutions, and habitat loss are power line impacts that threaten Ludwig's Bustard, Rüppell's Korhaan, Namaqua Sandgrouse, Double-banded Sandgrouse, and raptors in the study area. The threat to raptors is cause for concern because this group is already at increased risk of extinction in Namibia. Augur Buzzard, Common Buzzard, Black-chested Snake Eagle, Martial Eagle, Lanner Falcon, Pale Chanting Goshawk, Greater Kestrel, Rock Kestrel, Yellow-billed Kite, and Lappet-faced Vulture are the 10 raptor species expected to occur in the study area.

Of the 75 possibly occurring species, 6 have been classified in various categories of risk: Ludwig's Bustard, Martial Eagle and Lappet-faced Vulture are Endangered in Namibia as well as globally, Lesser Flamingo is Near Threatened globally and Vulnerable in Namibia, and Greater Flamingo and Great White Pelican are Vulnerable in Namibia.

Near-endemic species and those with a limited distribution are more susceptible to risk: Rüppell's Korhaan and Gray's Lark, both specialists of the gravel plains, fall in this category.

Nomadic and migrant birds are at increased risk from power line collisions because they often fly at night or dusk when visibility is low, and often in flocks. Greater Flamingo, Lesser Flamingo and Great White Pelican move between the coast and Etosha National Park, Yellow-billed Kite is a migrant, and Namaqua Sandgrouse is a partial migrant. Migratory routes and flight paths vary in response to local resource availability, and the birds may not always use routes that cross the Project site. However, there is a cumulative risk to migrants and partial migrants because of an increasing number of power lines along the coast.

Familiar Chat, Tractrac Chat, Pied Crow and Speckled Pigeon are other birds that may nest on power line structures, potentially affecting the infrastructure.

6.10.3 Flora

A total of 275 plant species have been recorded in the study area (Potgieter, 2024), with 69 endemic or near-endemic species, and 17 protected by the Forestry Act 12 of 2001 or the Nature Conservation Ordinance 4 of 1975. International protection has been awarded to *Gossypium anomalum* (IUCN Near Threatened), *Adenia pechuelli* (CITES I) and to 6 species in CITES schedule II: *Aloe asperifolia, Aloe hereroensis, Aloe namibensis, Aloidendron dichotomum, Avonia albissima* and *Hoodia currori*.

The area has a medium ranking for plant endemism according to Mendelssohn (2002) but there are many restricted range species and plants that grow slowly, increasing the sensitivity of the study area.

Construction of the power line and pipeline poses a risk particularly to the species that grow on the rocky ridges, such as the endemic *Aloe namibensis, Commiphora saxicola, Commiphora virgata, Psilocaulon salicornioides* and *Hermannia complicata*, and the near-endemic *Adenolobus pechuelii. Commiphoras* grow slowly and if they are damaged, it is unlikely that they will recover in any meaningful way. Individuals and/or assemblages of these plant species need to be identified during the planning phase, cordoned off, and avoided during all phases. Careful planning of access roads to the pipeline/power line corridor is essential, during both the construction and operational phases.

Lithops species, *Commiphora* species and *Adenia pechuelii* are threatened in Namibia by habitat destruction and poaching. Relocation may be a viable measure for some plants, e.g. successful relocation of *Adenia pechuelii* has been reported (Kolberg, 2014).

6.10.3.1 Lichens

Lichens are present in the western parts of the gravel plains, albeit to a limited extent. Lichens play important ecological roles in the Namib Desert: primary production, food for invertebrates, bio-protection, erosion control, ecosystem engineering, thermoregulation, and soil creation (Lalley, 2005). Lichens form biological soil crusts, stabilising the fragile sandy soils, retaining moisture, reducing wind and water erosion, fixing atmospheric nitrogen, and contributing to soil organic matter and nutrient richness.

Lichens may be disturbed and destroyed by off-road driving, construction, and power line or pipeline maintenance. Increased dust deposition due to human activities reduces the ability of lichens to absorb moisture from fog.

These disturbances have a negative effect on the cover, species composition and physiological functioning of the biological soil crust, and because lichens grow extremely slowly this damage is effectively permanent. An important prevention and mitigation measure is to demarcate roads, turning points and parking areas, and to prohibit off-road driving from the planning phase through operations. Strict adherence to this ban should be enforced and fines should be levied on contractors and drivers who ignore it.

6.10.4 Habitats and sensitivity

Three habitat types were identified in the study area (Figure 6-53 and Figure 6-54):

- Gravel plains;
- Rocky ridges; and
- Drainages.

Arandis and its environs (in which the water supply line, electricity supply line and access road are proposed to be developed) are considered degraded land.

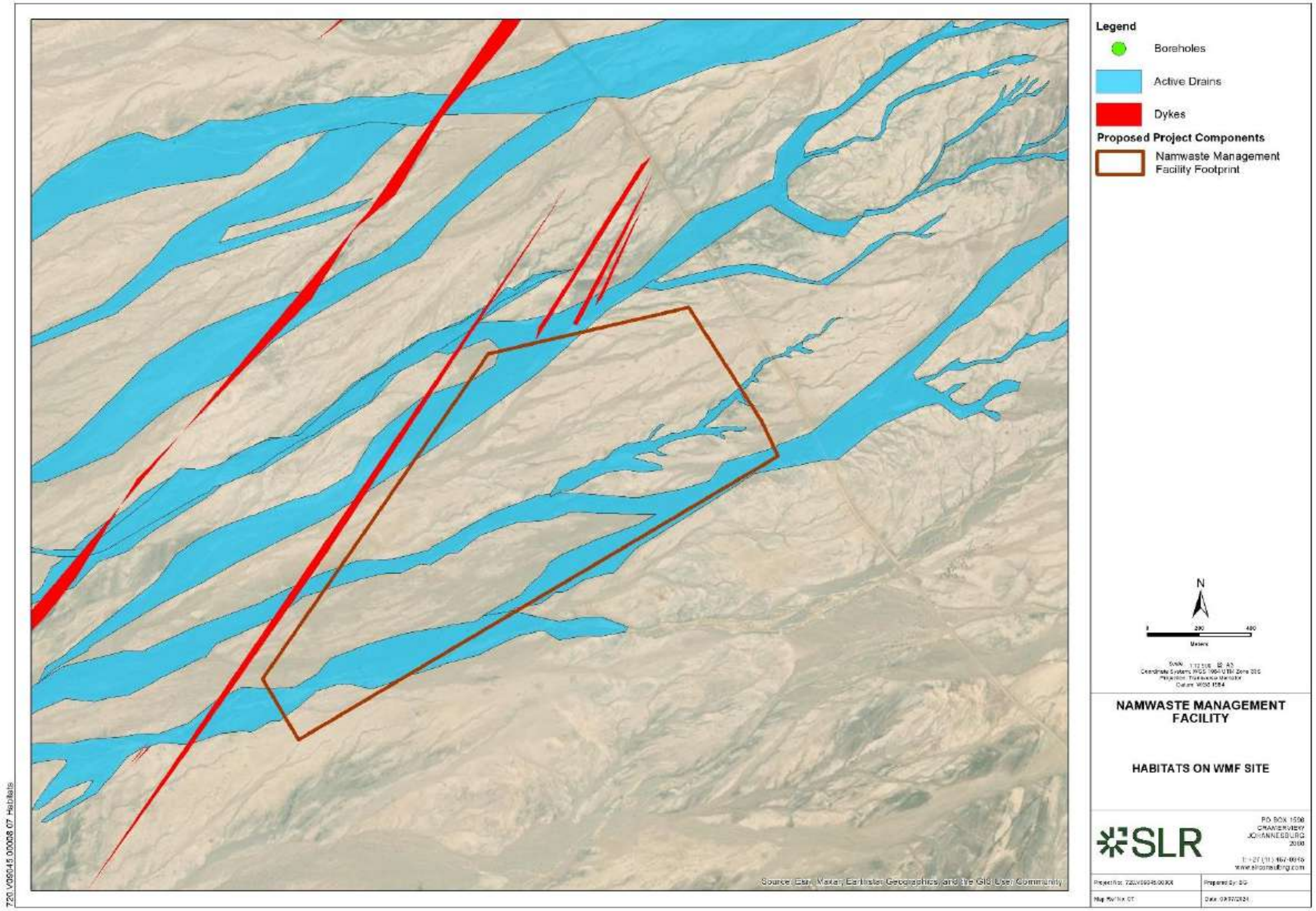

Figure 6-53: Habitat Types for the NMF. Unmarked parts inside the site boundary are gravel plains.

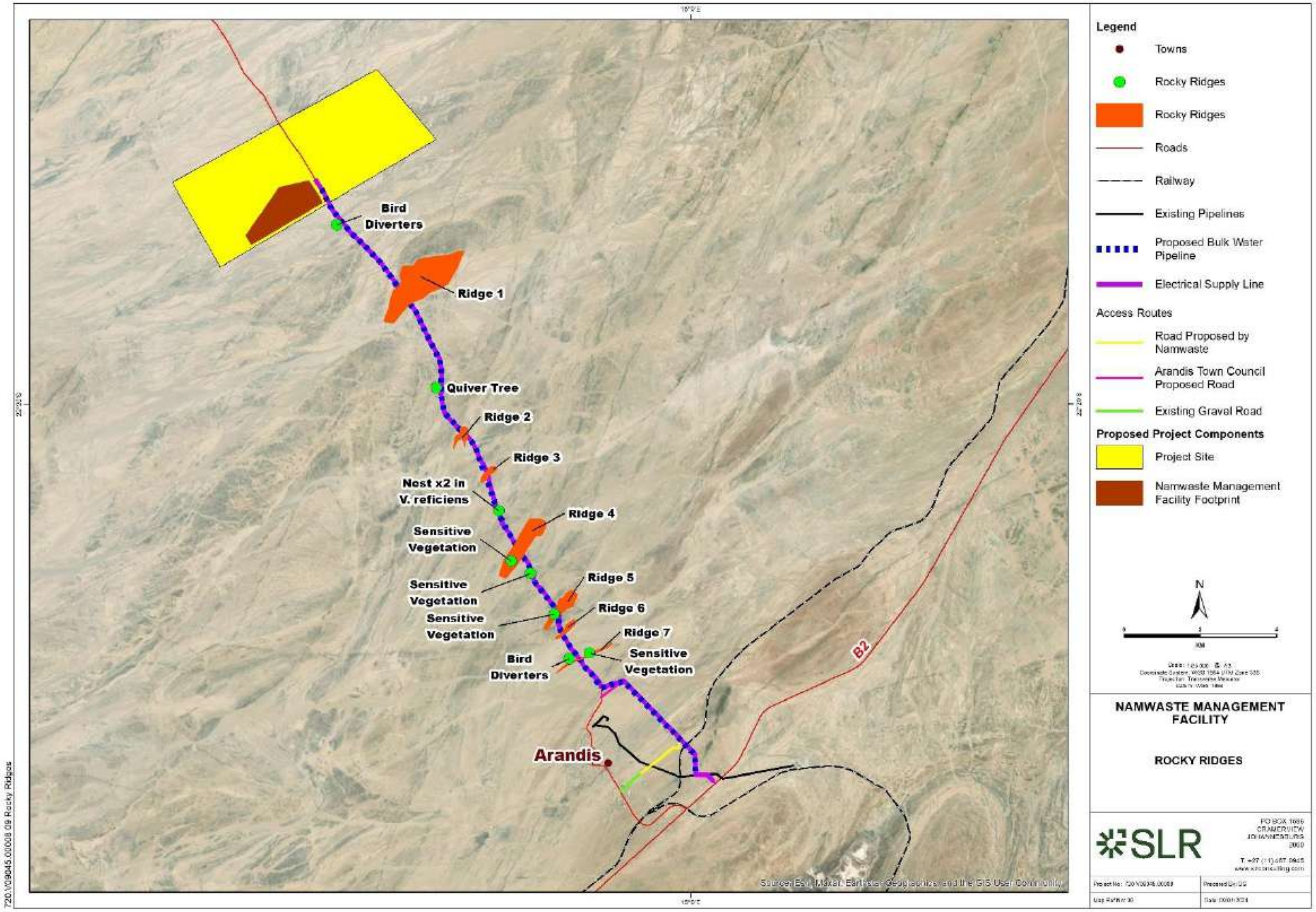

Figure 6-54: Rocky ridge habitats crossed by the powerline/pipeline corridor

6.10.4.1 Gravel plains

The largest part of the project site consists of gravel plains that are crossed by shallow, ephemeral drainages and rocky ridges running southwest towards the Atlantic Ocean. The gravel plains are very flat: less than 1°, and 1° to 5° (SLR Environmental Consulting, 2023). A slope of less than 1° presents drainage constraints and the project design proposes stormwater diversions at the NMF. The gravel plains through which the power line-pipeline corridor runs are intersected by well-defined rocky ridges (Figure 6-54).

The substrate of the plains consists of a quartz gravel surface with very fine soil beneath (Photo Plate 6-5), and the landscape is extremely sensitive to damage by vehicle tracks. Off-road driving could damage the structure of the soil surface and cause soil compaction, resulting in less water availability, and reducing root penetration and plant cover. Where soil crust is damaged, the underlying layer of soil becomes vulnerable to wind erosion and forms dust that settles on plants and interferes with photosynthesis.

Photo Plate 6-5: Substrate of the gravel plains

Source: (Potgieter, 2024)

The plains are mostly bare of vegetation, and it is expected that a thin cover of grass, dominated by *Stipagrostis sp*, would appear after rare rainfall events, alternating with successive years without plant cover. Vegetation includes *Anticharis senegalensis, Blepharis grossa* and *Indigofera auricoma*, *Larryleachia marlothii* (protected and near-endemic), *Lithops sp* (protected) and *Salsola sp*. Endemics include *Anticharis ebracteate, Forsskaeola hereroensis, Heliotropium oliveranum, Hermannia complicata, Zygophyllum cylindrifolium* and *Zygophyllum stapfii*.

Although several endemic and near-endemic species grow on the gravel plains, all of them are widely distributed and not of high concern for this project with the exception of *Lithops sp* and *Larryleachia marlothii*. These two species are threatened by habitat destruction. It is indicative of how under-collected and potentially valuable the region is that an unidentified species of Lithops was found in 2006 in the study area (Mannheimer, 2006).

This habitat contains lichens, a well-developed biological soil crust, Fensteralgae and detritus from ephemeral grasses and forbs. Reptiles and many invertebrate taxa, including the large variety of tenebrionid beetle species that characterise the Central Namib, are dependent on these resources. Although the densities and diversity of macrofauna taxa are low, species such as Springbok, Ostrich, Cheetah, Brown Hyaena, and other carnivores traverse and utilise the gravel plains in response to rainfall events.

This habitat is given a sensitivity rating of: Least sensitive.

6.10.4.2 Rocky Ridges

An assemblage of dolerite dykes and ridges and some marble ridges runs northeast to southwest, most prevalent from Arandis to the NMF, crossing the route of the proposed powerline and pipeline transversely.

Figure 6-54 illustrates the following, which was identified during the site visit undertaken as part of the specialist study:

- Seven ecologically important rocky ridges
- Dense fields of *Aloe asperifolia*, *Sarcocaulon marlothii* and *Commiphora species*; and
- *Vachellia reficiens* shrub with bird nests in a well-vegetated drainage.

Rocky ridges represent a habitat of rich biodiversity providing crucial ecological services in an arid area, especially to vertebrate taxa. Pockets of plant diversity occur in the cracks between rocks where water, nutrients, plant material and wind-blown sand get trapped. These aggregations of plant material provide sustenance for detritivores and invertebrates, and for the vertebrates that feed on them. The rocks and boulders provide shelter for rock-specialist reptiles, bats, and rodents. The endemic Hoesch's Pygmy Toad is highly likely to occur in the ridges and rocky outcrops where they breed in ephemeral rock pools.

Plants in this habitat include *Blepharis gigantea*, *Blepharis grossa*, *Larryleachia marlothii, Ornithogalum stapfii*, and a diverse range of protected plants such as H*oodia currori, Aloe namibensis, Adenia pechuelii, Lithops rushciorum, Sarcocaulon marlothii* (Bushman's Candle, abundant on the ridges) and several *Commiphora* species, all of them endemic or near endemic and at risk from poaching and habitat destruction.

Aloidendron dichotomum and all *Commiphoras* grow slowly, and individuals that are damaged or removed will not recover. They are also threatened by the cumulative impact of continued development in the Central Namib, but the proposed project is unlikely to increase the extinction risk to these plant assemblages with the caveat that all recommended management actions are strictly enforced.

The Rocky Rodges habitat is given a sensitivity rating of: Highly sensitive.

6.10.4.3 Drainages

The gravel plains in the study area are intersected by numerous wide, shallow drainages, most with a substrate of loose sand but some are rocky. In between the ridges the drainages and washes are narrower and better defined. All the drainages are associated with perennial and annual plant assemblages including *Arthraerua leubnitziae*, *Commiphora saxicola, Commiphora dinteri* (endemic and with limited distribution), *Blepharis gigantea, Monechma genistifolium, Zygophyllum cylindrifolium, Zygophyllum stapfii* (endemic) as well as *Brownanthus kuntzei* (near-endemic). *Vachellia reficiens* grows in a drainage on the northern border of the NMF site as both a shrub and a tree, complete with birds' nests as shown in Photo Plate 6-6.

Photo Plate 6-6: Vacchellia reficiens in a drainage on the WMF site

Source: (Potgieter, 2024)

Drainages are characteristic of hyper-arid and marginal zones. Apart from their role in surface and groundwater distribution, they are also a source of recolonisation for surrounding disturbed areas. They support a much richer biodiversity than the surrounding plains, especially woody species such as shrubs, forbs, and the odd tree. In the gravel plains landscape these single trees and shrubs represent the only permanent source of food and shelter for many animals that already live on the edge of survival, and every individual tree and shrubs is of significant ecological value.

Birds in particular rely on drainage lines for shelter, food, and nest and roosting sites. The Lappet-faced Vulture depends on isolated trees for breeding. Migrants and nomads such as flamingos, pelicans, bustards, and raptors use them as supply corridors along their flight paths. The sandy substrate hosts burrowing reptiles such as the near-endemic Namaqua Chameleon and small mammals such as the near-endemic Setzer's Hairy-footed Gerbil and Brush-tailed Hairy-footed Gerbil.

Invertebrates feed on debris and shelter in the vegetation. Bees are abundant in the drainages, and their pollination function is crucial for the continued survival of plant communities. Project and contractor staff should be trained on how to avoid bees instead of killing them and damaging their hives, and no honey may be collected. Staff should also be educated to keep their distance from trees to avoid disturbance.

The drainages and washes provide a movement corridor for macrofauna. Signs of Springbok, Oryx and Ostrich were observed during the site visit, and the pipeline must make provision for their unhindered movement.

Woody plants and many dwarf shrubs grow slowly and rehabilitation of disturbed areas may not be possible to any meaningful extent.

Evidence of flooding was observed in the form of dried mud in several drainages on the NMF site (Photo Plate 6-7). Stormwater diversions may put the surrounding vegetation at risk from drowning during flood events, and downstream from the NMF the accumulated water from the diversions may potentially cause erosion and death of organisms, as well as disruption of the flow of nutrients through the desert landscape. The effect is considered limited because the drainages on site are very shallow and sparsely vegetated, and the wide distribution of plant species minimises the risk of local population extinction. The design of stormwater diversions can mitigate the impact of downstream disruption to very low.

Photo Plate 6-7: Dried mud on the NMF

Source: (Potgieter, 2024)

The water pipeline crosses many drainages where it will act as a barrier for water carried debris, causing damming, damage to surrounding vegetation, and soil erosion. In sandy riverbeds the pipe should be buried, and in rocky drainages they should be raised on pedestals.

This habitat is given a sensitivity rating of: Highly sensitive

6.10.4.4 Arandis area

Arandis is located on gravel plains that have a slowly increasing gradient to the southeast of the town. This increase is part of a system of dolerite dykes and rocky ridges running northeast to southwest in the greater study area.

The area around Arandis is classified as degraded land, characterised by significant alteration of soil structure and chemistry, and with severe disruption of ecological services, functions, and systems. This anthropogenic disturbance is ongoing, and the area is of extremely low ecological value for all taxa with the notable exception of birds that fly over. The current main sources of the disturbance are likely cars and heavy vehicles driving across the plains, domestic animals, and solid waste dispersal.

The proposed pipeline and access road cross this degraded land where the potential for negative impacts on biodiversity is low. The exception is the barrier effect that the pipeline may have on invertebrates, reptiles and small burrowing mammals.

6.11 Archaeology

A Heritage Impact Assessment was undertaken by RCHeritage Services (Appendix M). The study aimed to determine the current archaeological baseline of the Project site and to identify potentially critical impacts of the development proposal on heritage resources (including sites, structures, and artefacts).

Owing to the extensive archaeological investigations of the western Central Namib carried out by the Namib Desert Archaeological Survey as part of the environmental compliance requirements for prospecting-related projects and mining, and the efforts of the Namibian heritage authorities to mitigate the negative impact of modern development on archaeological heritage resources, a wealth of archaeological evidence associated with hunting and gathering and nomadic pastoralist which declined and collapsed in the aftermath of historic contact exists. This provides a comprehensive understanding of detailed archaeological record and pattern of archaeological and historic site distribution reflecting a number of highly specific human adaptations to this arid environment from the late Pleistocene, Holocene and to the early colonial (late 19th century) as shown in Figure 6-55 below.

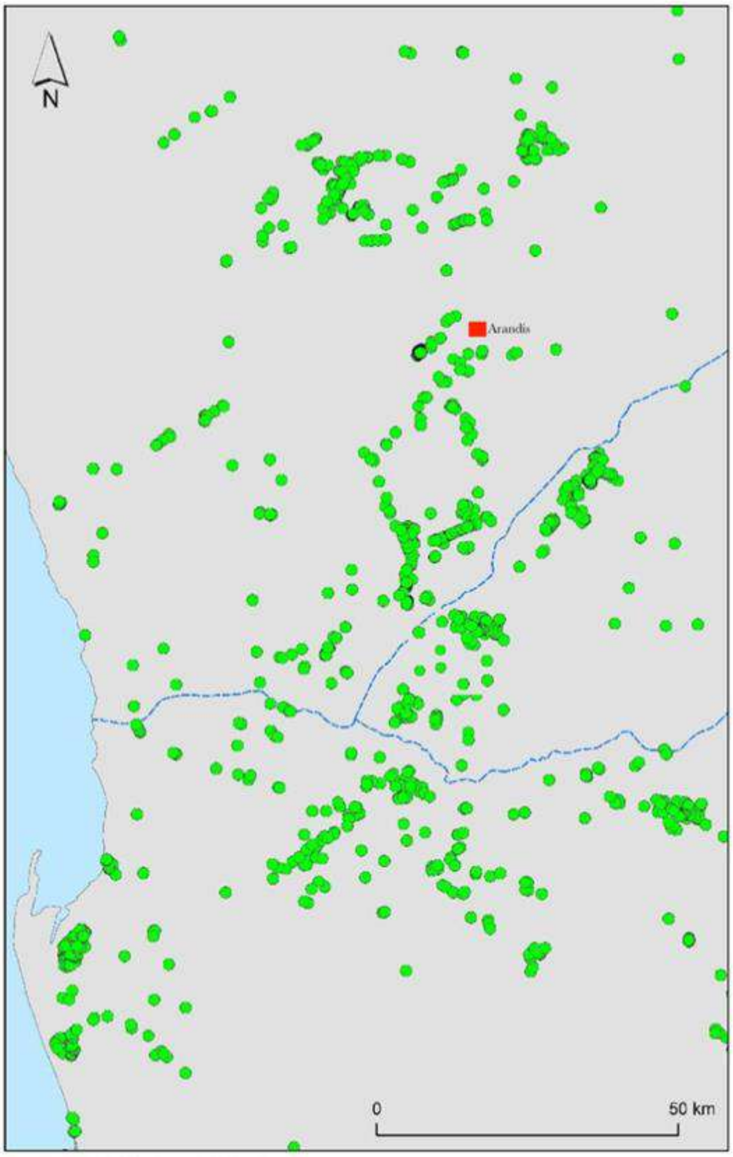

Figure 6-55: Distribution of archaeological sites in the Western Central Namib

Source: (J. Kinahan April 2021: 9)

During the late Pleistocene and Holocene periods human occupation of the central Namib has been recorded mainly in isolated granite outcrops, dolerite dykes, drainage basins, hill saddles, sand gravels with few more sites concentrated along the coast as attested by the presence of local occurrences of lithic raw materials for artefact production (Kinahan 2022). The small basecamps were occupied by the small hunter-gatherer and pastoralists groups who exploited wild grass seed which they dug from the underground caches of harvester ants (Messor spp) (Kinahan 2022). The archaeological evidence related to the exploitation of wild grass seeds has been extensively studied, with available records from du Pisani (1983); Steyn & du Pisani (1984); Kinahan (1986, 2000); Sullivan (1999); and more especially by Kinahan (2010 and 2005) being more useful. The distribution and high density of these sites are reportedly clustering in the vicinity of water and other resources occurring on the eastern margins of the Namib desert, at the foot of the interior escarpment, and predominantly on the gravel plains of the central Namib, between the Khan and !Huiseb Rivers, and their association with particular terrain conditions is reportedly dating to the late first millennium and early second millennium AD (Kinahan 1986).

Ethnographically, the seed gathering economy is associated with nomadic pastoralists and, in particular, Khoekhoegowab-speaking communities that harvested varieties of Stipagrostis grasses during the last five hundred years to supplement the diet (Steyn & du Pisani 1984; Kinahan 2000; 2010). The seeds were apparently ground in the pestle and used to make porridge and sometimes beer, fermented with wild honey (Sullivan, 1999; Kinahan, 2010). According to Kinahan (2005), seed digging subsistence activity coincides with the severe ecological constraints when rainfall patterns become significantly reduced in the Namib Desert. Consequently, diminishing food resources such as hunted wild game prompted occupants to travel to remote locations and exploit harvester ant caches of seed where water sources were reliable, which caused a heavy reliance on wild grass seed. Most of the excavated seed digging sites in the Namib Desert have not yielded any material culture due to the fact that some stored seed germinates after a short rainfall event but does not reach the harvesting stage as it dries up. Furthermore, these seed caches also attract rodents and a range of other animals as a valuable source of food for them. Regrettably, the sites are often poorly preserved, which not only reduces their scientific value but also makes them less understood. Therefore, grass seed exploitation should be viewed as incredibly unique and confined to the Namib Desert only. Such records therefore provide significant evidence for the evolution and development of food storage for food security that promote population growth of hunter-gatherers during the late pre-colonial period (Kinahan 2020).

A number of colonial heritage features from the late 19th and early 20th centuries have been recorded in the Namib desert. Buildings, mainly related to farming and general commercial activities, battlefield grounds, i.e., around Husab plains, Pforte, Jakalswaters, and Trekkopje, historic railway lines, historic routes, regimental insignias, and a number of surfaces, including finds of colonial bottle glass and related debris discarded at different base camps occupied by the European merchants and activities related to the Allied Forces and German Schutztruppe in 1915, are recognisable sections of the historical legacies of the Namib desert.

The field surveys conducted as part of the Heritage Impact Assessment for the proposed NMF discovered a total of 16 heritage resources as detailed in Table 6-21 and shown in Figure 6-56 below.

Table 6-21: Potential archaeological sites and historic heritage resources within and around the proposed project

GPS Coordinates	Location	Description	Typology	Distance from the proposed Namwaste Management Facility	Vulnerability	Significance Rating	Recommendation
22°25'21.83"S/ 15° 0'11.01"E	Near B2 Highway	Diabase bedding on gravel plain	Potential Seed digging of 51m diameter area	48m from the proposed access road.	0	1	No-Go Zone
22°25'17.49"S/ 15° 0'5.10"E	Near B2 Highway	Diabase bedding on gravel plain	Potential Seed digging of 50m diameter area	56m from the proposed access road.	0	1	No-Go Zone
22°25'18.33"S/ 14°59'57.77"E	Near B2 Highway	Calcrete on gravel plain	Potential Seed digging of 45m diameter area	52m from the proposed access road.	0	1	No-Go Zone
22°25'21.11"S/ 14°59'56.35"E	Near B2 Highway	Calcrete on gravel plain	Potential Seed digging of 48m diameter area	43m from the proposed access road.	2	1	No-Go Zone
22° 17' 8.628"S/ 14° 54' 24.852" E	Near site footprint	Calcrete	Potential Hunting Blind	20m from the proposed site footprint.	3	2	Demarcate/ No-Go Zone
22°24'34.66"S / 14°58'43.74"E	Within Arandis Town	Fenced Cemetery	Arandis Cemetery	800m from the proposed access road.	0	5	No-Go Zone

GPS Coordinates	Location	Description	Typology	Distance from the proposed Namwaste Management Facility	Vulnerability	Significance Rating	Recommendation
22°17'19.92"S/ 15° 6'8.07"E	Orano Uranium Mine	Fenced Cemetery	Trekkopje Historic Cemetery	20 km from the site footprint.	0	5	No-Go Zone
22°17'14.50"S/ 15° 6'13.83"E	Orano Uranium Mine	Railway Line	Historic Railway Station	20 km from the site footprint.	0	5	No-Go Zone
22° 25' 5.88" S/ 14° 59' 18.24"E	Found within an undevelope d townland	Calcrete on gravel plain	Potential Seed digging	26.51m from the proposed bulk water pipeline.	2	1	No-Go Zone
22° 25' 7.578"S/ 14° 59' 33.918"E	Found within an undevelope d townland	Calcrete on gravel plain	Potential Seed digging	800m from the proposed bulk water pipeline.	0	1	No-Go Zone
22°23'36.36"S/ 14°58'20.00"E	Orano Uranium Mine	Gravel plain near Calc-silicate rock	Potential Grave 01	67.28m from the proposed bulk electricity and water pipelines.	1	4	No-Go Zone
22°23'36.46"S/ 14°58'20.03"E	Orano Uranium Mine	Gravel plain near Calc-silicate rock	Potential Grave 02	67.28m from the proposed bulk electricity and water pipelines.	1	4	No Go Zone
22° 25' 3.438" S/ 15° 1' 25.57"E	Near Namwater	Limestone outcrop	Y shaped summit mark with copper locker	2.63km from the proposed access road by Namwaste.	0	Indeterminat e	No-Go Zone

GPS Coordinates	Location	Description	Typology	Distance from the proposed Namwaste Management Facility	Vulnerability	Significance Rating	Recommendation
	Rossing Reservoir		(potential historic point?)				
22° 24' 55.398"S/ 14° 59' 58.902"E	Found within an undeveloped townland	Calcrete on gravel plain	Potential Seed digging	Directly within the proposed bulk electricity line.	5	1	No-Go Zone
22° 24' 0.228" S/ 14° 58' 39.252" E	Found near the security gate of Orano Uranium Mine	Isolated finds near Diabase Outcrop	Potential Historic insignias from WWI marked ‘Scott” and “Jesus” with a cross. This could however be a recent addition from a nearby community	32.02m from the proposed bulk electricity line and water pipeline.	0	Indeterminate	No-Go Zone

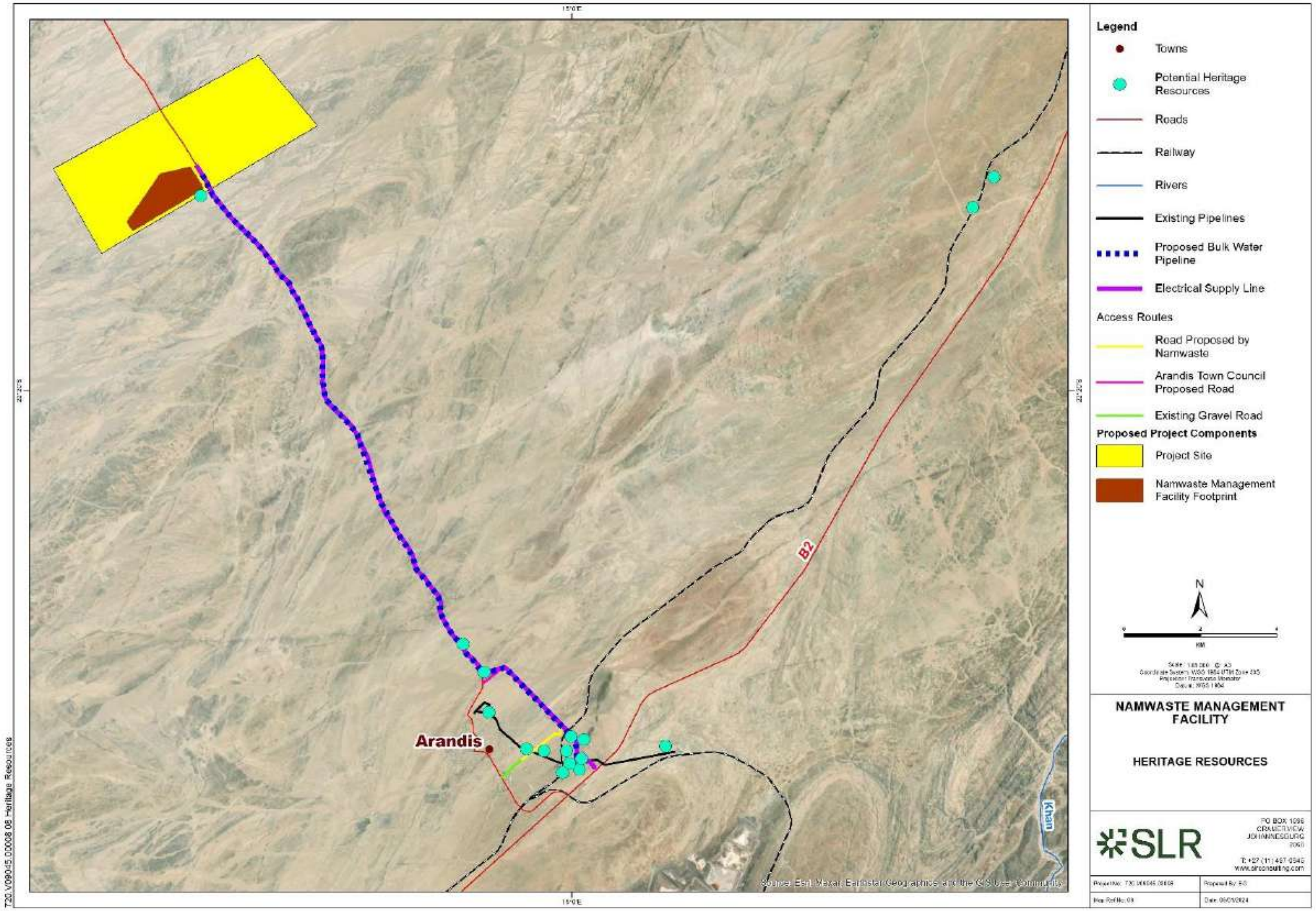

Figure 6-56: Identified Potential Heritage Resources

The sections below discuss the potential heritage resources located close to the NMF and/or it's proposed associated infrastructure.

A potential hunting blind was recorded near (20 meters) the footprint of the proposed site as shown in Photo Plate 6-8. This camouflaged site faces north and overlooks nearly an entire river course. No associated surface artefact has been recorded at the site or its surrounding. Physically, it is a small site strategically resting on top of a calcrete outcrop with a small hole on the northern side of the area where hunters likely stood, sat, or squatted and waited for game to pass through to and from the water points (river course) before they were ambushed and hunted. At this potential hunting locale, wild animals were likely kept under constant surveillance. Hunting blinds provide critical and significant information for understanding the social complexity associated with resource acquisition as well as landscape functionality. While a great deal of information pertaining to human interaction with animals has been well documented through the remains of rock art, lithic artefacts such as projectile points and other microlith tools, faunal remains, etc., hunting locales are less studied. Hunting and scavenging of animals are particularly important for the survival of hunting and gathering communities in this harsh environment. As human populations expanded into new territories, a diet based primarily on the hunting and capturing of animal resources would have likely been a better-suited subsistence strategy than a plant-based diet, which of course supplemented their diet as aridity increased during the Holocene period in this area.

Photo Plate 6-8: Potential Hunting Blind near the footprint of the NMF

Source (RCHeritage, 2024)

Furthermore, two potential burial sites were recorded approximately 67m from the proposed bulk electricity and water pipelines (Figure 6-56). The first potential burial cairn is well preserved and consists of an oval-shaped mound, slightly elevated off the ground to approximately 15cm, and appears to be covered with isolated loose concrete and cement rocks while facing south. The cairn does not bear any headstone or stele but is clearly in primary context. Based on the grave topping, it is possible that such potential graves might likely date from the historic period.

The second potential burial cairn is poorly preserved but equally covered with isolated loose concrete and cement rocks while facing south (Photo Plate 6-9). It is located at least 1 metre from the previous one and does not bear any headstones or steles. Although degraded, the loose concrete and cement rocks appear intentionally placed as opposed to being natural. Fortunately, like all the heritage resources recorded within the project area, the potential graves do not require further mitigation as they are not directly impacted by the proposed infrastructure development.

Photo Plate 6-9: Potential Burial Site

Source: (RCHS, 2024)

A potential seed digging site (disturbed) was recorded on a calcrete gravel plain directly within the proposed bulk electricity line (Photo Plate 6-10). The site has a diameter of about 1.30cmx2m whose orientation in unknown. The ground is disturbed by old vehicle trampling as well as strong aeolian wind erosion which have eroded, possibly transported and redeposited some surface stone features away from the site reducing its scientific value.

Photo Plate 6-10: An eroded potential seed digging site along the proposed bulk electricity line.

Source: (RCHS, 2024)

A potential historic insignia marked ‘SCOTT” and “JESUS” with a cross was equally located near the security gate or structure belonging to Orano Uranium Mine on a diabase outcrop (Photo Plate 6-11). Fortunately, the site is not vulnerable to the proposed bulk electricity line and bulk water pipelines as it lies about 32.02 m away. The significance of such potential heritage is not determined at this stage.

Photo Plate 6-11: Potential historic site behind the security house of Orano Uranium Mine in proximity to the Trekkopje road

Source: (RCHS, 2024)

6.12 Air Quality

An Air Quality Impact Assessment was undertaken by SLR (Appendix E). The study aimed to determine atmospheric impacts associated with the Project.

Air quality in Namibia is generally good and air pollution is broadly not considered a key issue in Namibia. There are few industrial sources mainly associated with mining and smelting activities, which are generally remote from populated areas (FAO, 2001). Vehicle density and use in the urban areas is not currently sufficient to lead to major problems. Particulate Matter (PM) concentrations in Windhoek have been found to be relatively high due to vehicle exhaust emissions and re-suspension of road dust caused by moving vehicles (Hamtui & Beynon, 2017). Socio-economic activities such as minerals exploration and industrial development in Namibia have the potential to promote fugitive dust production (Von Holdt & Eckardt, 2017), whilst dust particles smaller than 10 µm can pose adverse effects to human respiratory and cardiovascular (Chen et al., 2010; Griffin & Kellogg, 2004; Kanatani et al., 2010). Namibia does not currently have air quality policies, regulations or standards in place (Ehsani, 2017).

6.12.1 Background Ambient Air Quality

Background ambient air quality monitoring data was sourced from:

- The Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Province 2018 -2019[2]; and
- A month-long baseline monitoring survey of DFO and ambient gases was undertaken at the proposed NMF boundary. The monitoring report for this survey is appended in **Appendix L**.

6.12.1.1 The Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Province 2018 - 2019

An objective of the SEMP assessment was to determine the contribution of uranium mines to the background dust concentration in the region, especially at the major towns. An air quality study was commissioned in October 2016 and completed in February 2019. Monitoring stations were established at Arandis, Swakopmund, Walvis Bay, Henties Bay and Jakalswater to measure fine dust and radon together with meteorological parameters. Data was also collected from existing monitoring networks run by uranium mines. Relevant PM_{10} data collected during the assessment are presented in Table 6-22.

Table 6-22: PM_{10} concentrations at Arandis (town) and uranium mines

Location	2014	2015	2016	2017	2018	2019
Arandis, Orano	26.1	27.4	26.4	29.3	29.9	No data
Arandis, Rössing	11.4	8.6	15.9	18.8	18.0	15.8
Rössing CMC	No data	21.7	23.3	23.9	25.7	23.4
Husab Mine	28.2	41.0	40.5	77.5	71.0	47.6

For Arandis town, Orano station's highest reading was 195 µg/m³ on 27 August 2018. On the same day, a peak of 140 µg/m³ was measured at the Rössing station in Arandis.

All operating mines, mines in care and maintenance and development projects supplied data from their dust fallout monitoring networks for 2018/2019. The results were evaluated against the South African National Dust Control Regulations (NDCR) limit for residential areas of 600 mg/m^2/day and the limit for non-residential areas of 1200 mg/m^2/day. Relevant findings were as follows:

- Orano Mining Namibia monitored dust fallout at 13 sites on the Trekkopje mine and at Arandis. The average dust fallout rates in 2018/2019 were 9.0-50.6 mg/m^2/day. Dust levels at the two sites in Arandis were low ranging from 19.3 to 26.0 mg/m^2/day. During the current care and maintenance phase, dust is mainly mobilised by traffic on gravel roads.
- Rössing Uranium reported dust fallout results for Arandis and a site on the mine boundary south-west of the open pit where all the fallout dust readings in 2018/2019 were below the South African NDCR limit for residential areas of 600 mg/m^2/day.
- Swakop Uranium monitored 33 dust fallout buckets on and around the Husab mine site in 2018/2019, though only stations outside the operational area were included in this

[2] Ministry of Mines and Energy (2020). The Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Province 2018 -2019, prepared by the Geological Survey of Namibia, 147 pp.

report. All dust concentrations were below the South African NDCR residential limit, varying from <50 mg/m^2/day to maximum values of 128 mg/m^2/day in 2018 and 110 mg/m^2/day in 2019.

6.12.2 NMF Onsite Monitoring Campaign

6.12.2.1 Onsite DFO Monitoring

The deposition of large (>10 µm) solid particulates is a function of the airborne concentration and the particle gravitational speed. The monitoring of fugitive dust is therefore conducted principally by passive dust deposition gauges, whereby an open-mouthed container is partially filled with water and exposed for a designated period (~ 30 days). The container is then collected, and the insoluble particles are removed by filtering the water and weighing, whilst the soluble particle mass is determined after evaporation of a sample of the filtered solution. This is a standardised sampling technique in South Africa, commonly referred to as 'bucket-monitoring' that was originally derived from the American Society for Testing and Materials (ASTM) standard method for collection and analysis of dust fallout (ASTM D1739). It has now been defined in the local context as a South African National Standard (SANS 1929:2005/2009).

DFO measurements for the proposed NMF were collected during a one-month baseline monitoring survey. The monitoring network comprised of four locations, specifically the boundary corners of the proposed NMF footprint. DFO samplers were deployed on 23 February 2024 and collected on 26 March 2024. In the absence of Namibian standards and IFC/WHO guidelines for DFO, results (Table 6-23) are compared to the South African NDCR to assess compliance. Key findings are as follows:

- The DFO rates measured at all sites were well below the South African NDCR residential limit (600 mg/m^2/day).
- This dataset indicates low dust fallout onsite during the monitoring period.

Table 6-23: Onsite baseline DFO measurements

Site ID	DFO1	DFO2	DFO3	DFO4
Latitude (°S)	-22.297720	-22.285106	-22.281890	-22.280010
Longitude (°E)	14.884410	14.907585	14.895120	14.9038890
Deposition rate (mg/m^2/day)	31	137	82	53

The full baseline monitoring report, including field log sheets and laboratory results is provided in **Appendix L**.

6.12.2.2 Onsite Passive Gas Measurements

Passive sampling is a measurement method based on the free flow of analyte molecules from a sample medium (air in this case) to a collection medium (such as activated carbon) due to the difference in chemical potentials between the two media. The net flow of analyte molecules from one medium to the other continues until equilibrium is reached or until the exposure period is terminated[3].

Passive measurements were collected using Radiello® passive diffusive samplers. A Radiello® passive sampler is a solid sorbent in an inert container into which vapours diffuse. The apparatus (Figure 6-57) comprises:

[3] Namieśnik, J. (2002): *Passive Sampling*. Trends in Analytical Chemistry, Vol. 21, No. 4, Pg 276 - 291

- The support plate.
- The diffusive body (varying in permeative properties depending on the target pollutant).
- The chemical absorbing cartridge containing a sorbent material.

Samplers are assembled and deployed for a designated exposure period. The analyte compounds trapped by the sorbent are then extracted and measured in a laboratory, and a time-weighted average can be calculated. Radiello® recommend specific exposure periods depending on the application to allow for adequate adsorption of the target gases onto the sorbent material, but also to avoid saturation point or a result below the detection limit (BDL) of the analytical method. Samples were sent to a South African National Accreditation System (SANAS) laboratory for analysis.

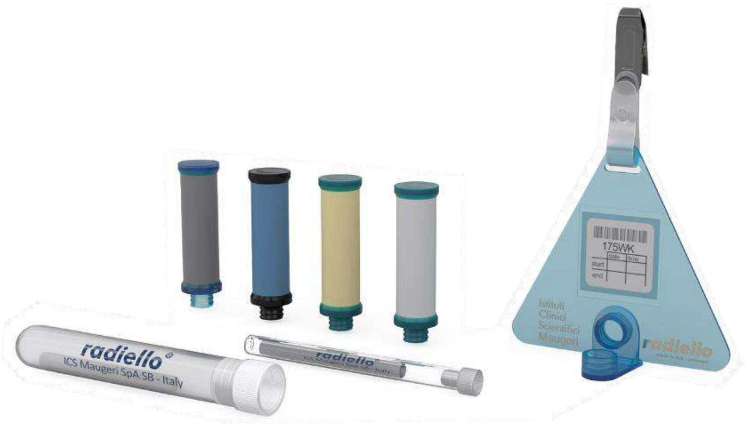

Figure 6-57: Radiello® diffusive sampling components for air quality monitoring

Samplers were deployed on 23 February 2024 and collected on 26 March 2024. Samples were attached to the DFO stands (Table 6-23). Results are summarised in Table 6-24. Annual guidelines are used (where applicable) in this instance as a conservative reference threshold for assessing compliance. It is important to note that these passive monitoring results are based on a one-month exposure period and should not be viewed as the annual average for the site, which may vary seasonally, for example. Key findings are as follows:

- SO_2 concentrations measured well below the annual WHO AQG (50 µg/m^3). The highest concentration was measured at DFO2 (1.19 µg/m^3).
- NO_2 concentrations measured well below the annual WHO AQG (10 µg/m^3). The highest concentration was measured at DFO3 (0.76 µg/m^3).
- All VOCs measured below the detection limit of the analytical technique.
- This dataset indicates low levels of monitored gases over the month of measurement.

Table 6-24: Onsite passive gas concentrations

Site ID	SO_2	NO_2	Benzene	Toluene	Ethyl-benzene	Xylene
DFO1	BDL (<0.05)	0.59	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)
DFO2	1.19	0.61	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)
DFO3	BDL (<0.05)	0.76	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)
DFO4	BDL (<0.05)	0.70	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)
Notes: BDL - Below detection limit						

The full baseline monitoring report, including field log sheets and laboratory results is provided in **Appendix L.**

6.12.3 Emissions Inventory

An emissions inventory is a list of air pollution sources, their physical and chemical parameters, and the calculated rate of release. Emission rates can be directly measured at the source or calculated using emission factors or mass balance approaches, requiring detailed fuel, chemical and activity data inputs.

Activity data required to quantify atmospheric emissions from air quality relevant processes and site activities were provided by Namwaste. An emissions inventory was developed using available activity information, emission factors and emission rate calculators developed by the United States Environmental Protection Agency (US EPA) and Australian National Pollutant Inventory (NPI). Quantified emission sources included landfill gas generation, land clearing and excavations, waste and cover material handling (including dropping, spreading, and compaction), wind erosion of exposed areas and vehicles travelling along paved and unpaved roads. The inventory is presented in the sections that follow.

6.12.3.1 Landfill Gas Generation

Benzene, H_2S, carcinogens and GHG emissions from the NMF were estimated for this assessment using the US EPA's Landfill Gas Emissions Model (LandGEM) version 3.02.

LandGEM is an automated tool for quantifying emissions from the decomposition of landfilled waste based on a first-order decomposition rate equation:

Equation 1

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Where:
Q_{CH4} = annual methane generation in the year of the calculation (m^3/year)
i = 1 year time increment
n = (year of calculation) - (initial year of waste acceptance)
j = 0.1 year time increment
k = methane generation rates ($year^{-1}$)
L_o = potential methane generation capacity (m^3/tonne)
M_i = mass of waste accepted in the ith year (tonnes)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

Based on the design concept provided by Jones and Wagener (2024)[4] the Phase 1 waste body area has a footprint of approximately 403 200 m^2 while Phase 2 will have a footprint area of approximately 817 400 m^2. Phase 1 is further split into Phase 1A and 1B with footprint areas of 248 800 m^2 and 154 400 m^2 respectively. The final height of the landfill as provided in the design concept will be approximately 22.5 m creating an available airspace of approximately 7 287 000 m^3 and 16 716 000 m^3 for Phase 1 and Phase 2 respectively.

Emission rate calculations assume 100% of the waste stream for landfill comprises co-disposal of hazardous waste (excluding arsenic) as a worst-case scenario. Based on the disposal method proposed for arsenic waste streams, this will have no bearing on the LFG generation rate and the arsenic proportion is thus irrelevant to LFG emission rates for both Business Case 1 and 2.

[4] Jones & Wagener (2024): NamWaste Management Facility, Erongo, Basic Assessment Engineering Report Concept Design Report. Report Reference Number: JW558/23/K577 - Rev 1

According to the Namwaste[5] project description provided to SLR on 17 May 2024, a minimum of 30 000 m³ of waste is expected per annum and is anticipated to increase 5% year on year until capacity is reached and the landfill at the NMF is closed. These waste receipt rates are lower than those provided to SLR in February 2024 as used to quantify emission rates. As such, the LFG calculations are environmentally conservative. Tonnages were calculated using waste densities published by the Australian Department of Climate Change, Energy, the Environment and Water[6]. Waste densities and rates of receipt are presented in Table 6-25. LandGEM inputs are summarised in Table 6-26. Closure year LFG generation rates, as the worst-case emission scenario, are presented in Table 6-27.

Table 6-25: Waste stream densities and opening year waste receipt rates

Waste type	Density (kg/m³)	Opening year waste rate (m³) – as provided in February 2024 and used for emission calculation	Opening year waste rate (m³) – as provided May 2024
General hazardous waste	1 [(a)]	11 176	10 000
Contaminated soil	0.9 [(b)]	2 614	3 000
Grease	1 [(a)]	1 700	2 000
Sludge and slops	1 [(a)]	10 180	10 000
Chemicals	1 [(a)]	3 190	3 000
Hydrocarbon contaminated waste	1 [(c)]	960	1 000
Mine tailings	1.7 [(d)]	3 420	-
General waste	1	-	1 000
Average waste density	0.99	-	-
Total mass (opening year)	-	33 240	29 700

Notes:
(a) - Blue Environment (2017) Unit conversion factor – “other”
(b) - Blue Environment (2017) Unit conversion factor – N120
(c) - Blue Environment (2017) Unit conversion factor – J120
(d) - Waggitt (1994)[7]

Table 6-26: LandGEM settings and calculation inputs

Identifier	Operational phase		
	Phase 1A	Phase 1B	Phase 2
Opening year	2025	2055	2065
Closure year	2054	2064	2086
Total waste throughput (tonnes)	136 819	222 863	651 933
Start year waste rate (tonnes/year)	33 240	143 660	234 006
Waste body area (m²)	248 800	154 400	817 400
Methane generation rate, k (year^{-1}) [(a)]	Inventory arid area – 0.02		
Potential methane generation capacity, L_o (m³/tonne) [(a)]	Inventory arid area – 100		
NMVOC concentration (ppm)	CAA – 4000		
Methane content (% by volume)	CAA – 50% by volume		

Notes:
(a) - The USEPA LandGEM User Guide defines arid areas as areas that receive less than 635 mm of rainfall per annum.

[5] Ibid **Error! Bookmark not defined.**
[6] Blue Environment (Pty) Ltd and Ascend Waste and Environment (2017): Unit conversion factors prepared for the Australian Department of Environment and Energy (URL: https://www.dcceew.gov.au)
[7] Waggitt, P. (1994): A review of worldwide practices for disposal of uranium mill tailings. Australian Government Public Service.

Table 6-27: Estimated LFG generation rates

Pollutant	Emission rate (tonnes/annum)		
	Phase 1A	Phase 1B	Phase 2
Benzene	2.40E-01	2.09E-01	1.01E+00
H_2S	3.43E-01	2.98E-01	1.44E+00
Methane	2.24E+03	1.95E+03	9.44+03

6.12.3.2 Particulate Emissions

Significant atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. The dust-generation process is caused by two basic physical phenomena[8]:

- Pulverization and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.).
- Entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind speeds over 5.4 m/s.

As such, any process operations that move or manipulate dusty material can cause fugitive emissions of PM[9]. Activities resulting in fugitive dust emissions at the proposed NMF include:

- Phased cell excavation and construction activities (e.g. sub-phase drainage, etc.).
- Material handling including waste treatment, tipping and application of surface cover material.
- Vehicle movement along paved and unpaved roads/surfaces.
- Wind erosion of exposed surfaces.

In line with client information, it was assumed in this study that arsenic waste will be fully contained with no emissions to the environment under normal operating scenarios.

The combustion of fuel (e.g. diesel) in equipment and vehicles operating in the respective process areas will also generate gaseous emissions and fine particulate exhaust emissions. These sources were not simulated in this study due to high uncertainty and low confidence in the estimate. The expected contribution from these sources to the facility wide emissions profile is expected to be negligible. No details were provided for fuel storage onsite, and this too has not been simulated.

Emission calculations for fugitive sources and the respective input information is presented in Table 6-28. Fugitive source parameters and estimated emissions are provided in Table 6-29.

Unmitigated emissions were assessed as a worst-case scenario.

[8] US EPA (1995): AP 42, 5th ed, Vol 1 Chapter 13.2 – Introduction to Fugitive Dust Sources
[9] NPI (2012): Emission Estimation Technique Manual for Fugitive Emissions (v 2.0)

Table 6-28: Emission rate equations and emission factors used to quantify fugitive emission rates

Operational activity	Emission Equation Category	Emission equation/ Emission factor
Land clearing and excavation	Bulldozing overburden [(a)]	**Equation 2** $$E = \frac{2.6(s)^{1.2}}{M^{1.3}}$$ Where: E = emissions of PM_{Total} (kg/hr per bulldozer) s = material silt content % (6.9%[(b)] applied here) M = material moisture content % (7.9%[(b)]) Emission rates for other particle size fractions are scaled in line with US EPA AP-42[(a)] guidance as follows: • 10.5% of total PM emissions fall within the $PM_{2.5}$ size fraction • 75% of total PM emissions fall within the PM_{10} size fraction Controls: None (i.e. unmitigated)
Dropping of cover material	Aggregate handling [(c)]	**Equation 3** $$E = k(0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$ [(c)] Where: E = emission factor (kg/Mg) k = particle size multiplier (PM_{Total} = 0.74, PM_{10} = 0.35, $PM_{2.5}$ = 0.053) U = mean wind speed in m/s (3.45 m/s as calculated) M = material moisture content % (7.4%[(d)]) Controls: None (i.e. unmitigated)
Spreading and compaction of cover material	Grading [(a)]	**Equation 4** $$E = 0.0034 \times S^{2.5}$$ [(a)] Where: E = emissions of PM_{Total} in kg/vehicle km travelled k = mean vehicle speed in kph (20 kph applied here) Emission rates for other particle size fractions were scaled in line with US EPA AP-42[(a)] guidance as follows: • 3.1% of total PM emissions fall within the $PM_{2.5}$ size fraction. • 60% of total PM emissions fall within the PM_{10} size fraction. Controls: None (i.e. unmitigated)
Exposed surfaces	Open air wind erosion [(e)]	$PM_{Total} = 0.4\ kg/ha/hr$ [(e)] $PM_{10} = 0.2\ kg/ha/hr$ [(e)]

Operational activity	Emission Equation Category	Emission equation/ Emission factor
		Emission rates for other particle size fractions are scaled in line with US EPA AP-42[(f)] Appendix B.2. guidance as follows: • 15% of total PM emissions fall within the $PM_{2.5}$ size fraction Controls: None (i.e. unmitigated)
Vehicles on paved roads	Vehicles on dry paved road [(g)]	**Equation 5** $$E = k(sL)^{0.91} \times W^{1.02}$$ [(g)] Where: E = emission factor (g/VKT) k = particle size multiplier (PM_{Total} = 3.23, PM_{10} = 0.62, $PM_{2.5}$ = 0.15) [(h)] sL = road silt loading in g/m^2 (7.4 g/m^2[(i)]) W = average weight (tonnes) of the vehicles travelling on the road Controls: None (i.e. unmitigated)
Vehicles on unpaved roads	Vehicles on unpaved roads at industrial sites [(j)]	**Equation 6** $$E = k\left(\frac{s}{12}\right)^{a} \times \left(\frac{w}{3}\right)^{b}$$ [(j)] Where: E = emission factor (lb/VMT) k = particle size multiplier (PM_{Total} = 4.9, PM_{10} = 1.5, $PM_{2.5}$ = 0.15) [(k)] s = surface silt content % w = mean vehicle weight in tons (21.4 as calculated) a = particle size constant (PM_{Total} = 0.7, PM_{10} = 0.9, $PM_{2.5}$ = 0.9) [(k)] b = particle size constant (PM_{Total} = 0.45, PM_{10} = 0.45, $PM_{2.5}$ = 0.45) [(k)] Controls: None (i.e. unmitigated)

Notes:
(a) - US EPA (1998): AP-42, 5th ed, Vol 1 - Chapter 11.9: Western Surface Coal Mining - Table 11.9-2
(b) - US EPA (1998): AP-42, 5th ed, Vol 1 - Chapter 11.9: Western Surface Coal Mining - Table 11.9-3
(c) - US EPA (2006): AP-42, 5th ed, Vol 1 - Chapter 13.2.4: Aggregate Handling and Storage Piles – Equation 1
(d) - US EPA (2006): AP-42, 5th ed, Vol 1 - Chapter 13.2.4: Aggregate Handling and Storage Piles – Table 13.2.4-1: Municipal solid waste landfills: Sand
(e) - NPI (2012): Emission Estimation Technique Manual for Fugitive Sources (v 2.0) – Section 3.2.5.3
(f) - US EPA (1996): AP-42, Appendix B.2 – Generalised Particle Size Distribution: Category 3
(g) - US EPA (2011): AP-42, 5th ed, Vol 1 - Chapter 13.2.1: Paved Roads – Equation 1
(h) - US EPA (2011): AP-42, 5th ed, Vol 1 - Chapter 13.2.1: Paved Roads – Table 13.2.1-1
(i) - US EPA (2011): AP-42, 5th ed, Vol 1 - Chapter 13.2.1: Paved Roads – Table 13.2.1-3: Municipal solid waste landfill
(j) - US EPA (2011): AP-42, 5th ed, Vol 1 - Chapter 13.2.2: Unpaved Roads – Equation 1
(k) - US EPA (2011): AP-42, 5th ed, Vol 1 - Chapter 13.2.2: Unpaved Roads – Table 13.2.2-2

Table 6-29: Fugitive emission source parameters and emission rate estimates

Assessment scenario	Business Case 1			Business Case 2		
Operational phase	Phase 1A	Phase 1B	Phase 2	Phase 1A	Phase 1B	Phase 2
Activity	**Particulates less than 10 microns (PM_{10}) emission rate (tonnes/annum)**					
Land clearing and excavation	1.78E+01	2.90E+01	8.48E+01	8.90E+00	1.45E+01	4.24E+01
Dropping of cover material	9.10E-06	1.48E-05	4.34E-05	4.70E-06	7.65E-06	2.24E-05
Spreading and compaction of cover material	4.71E+02	7.67E+02	2.24E+03	2.35E+02	3.84E+02	1.12E+03
Exposed surfaces	4.36E+01	7.10E+01	2.08E+02	4.36E+01	7.10E+01	2.08E+02
Vehicles on paved roads	4.97E+00	1.03E+01	4.95E+01	2.47E+00	5.11E+00	2.46E+01
Vehicles on unpaved roads	3.59E+02	5.86E+02	1.71E+03	2.05E+02	3.34E+02	9.78E+02
Cumulative	8.97E+02	1.46E+03	4.30E+03	4.96E+02	8.09E+02	2.38E+03
Activity	**Particulates less than 2.5 microns ($PM_{2.5}$) emission rate (tonnes/annum)**					
Land clearing and excavation	9.64E+00	1.57E+01	4.59E+01	2.41E+00	3.92E+00	1.15E+01
Dropping of cover material	1.38E-06	2.24E-06	6.57E-06	7.11E-07	1.16E-06	3.39E-06
Spreading and compaction of cover material	6.61E+01	1.08E+02	3.15E+02	3.30E+01	5.38E+01	1.57E+02
Exposed surfaces	6.54E+00	1.07E+01	3.12E+01	6.54E+00	1.07E+01	3.12E+01
Vehicles on paved roads	1.20E+00	2.48E+00	1.20E+01	5.98E-01	1.24E+00	5.96E+00
Vehicles on unpaved roads	3.59E+01	5.86E+01	1.71E+02	2.05E+01	3.34E+01	9.78E+01
Cumulative	1.19E+02	1.95E+02	5.75E+02	6.31E+01	1.03E+02	3.04E+02
Activity	**Total particulate matter (PM) emission rate (tonnes/annum)**					
Land clearing and excavation	9.45E+01	1.54E+02	4.50E+02	4.72E+01	7.69E+01	2.25E+02
Dropping of cover material	1.92E-05	3.13E-05	9.17E-05	9.93E-06	1.62E-05	4.73E-05
Spreading and compaction of cover material	2.13E+03	3.47E+03	1.02E+04	1.07E+03	1.74E+03	5.08E+03
Exposed surfaces	8.72E+01	1.42E+02	4.15E+02	8.72E+01	1.42E+02	4.15E+02
Vehicles on paved roads	2.59E+01	5.35E+01	2.58E+02	1.29E+01	2.66E+01	1.28E+02
Vehicles on unpaved roads	1.33E+03	2.17E+03	6.34E+03	7.61E+02	1.24E+03	3.62E+03
Cumulative	3.67E+03	5.99E+03	1.76E+04	1.97E+03	3.22E+03	9.47E+03

6.12.4 Dispersion Modelling

Atmospheric dispersion modelling mathematically simulates the transport and fate of pollutants emitted from a source to the atmosphere. Algorithms incorporate source criteria, surface topography, land use and meteorology to predict the downwind concentrations of these pollutants. Dispersion modelling is a useful tool to ascertain the spatial and temporal patterns of ground level pollutant concentrations arising from point, line, area, and volume emission sources.

To simulate the ground-level impacts of emissions, dispersion modelling was undertaken using the internationally recognised AERMOD modelling software suite. Emission rates of ambient air pollutants were input to an AERMOD dispersion model to simulate pollutant dispersion for all operational project phases (i.e. Phase 1A, Phase 1B and Phase 2). Outputs for the worst-case emission scenario (i.e. Business Case 1, Phase 2) were compared to international guidelines in the absence of national ambient air quality standards for Namibia. Guidance from the following international bodies was applied to assess the degree of impact:

- The International Finance Corporation (IFC) and associated World Health Organisation (WHO) Air Quality Guidelines (AQG) set for criteria pollutants and odour nuisance;
- The South African National Dust Control Regulations (NDCR) for nuisance dust; and
- The US based Agency for Toxic Substances and Disease Registry (ATSDR) acceptable ranges for excess lifetime cancer risk.

6.12.4.1 Dispersion Modelling Results

The results of the dispersion modelling are presented in the sections that follow. In the absence of national standards, concentrations are compared with international guidelines. Outputs are presented as statistical tables showing the peak concentration simulated across the modelling domain as well as concentrations simulated for discrete sensitive receptors.

To understand and assess facility specific impacts from the NMF's operations, the model simulated concentrations exclude background contributions (i.e. contributions from surrounding emission sources – background ambient air quality is discussed in Section 6.12).

Particulate Matter Less than 10 Microns

Table 6-30 presents simulated concentrations of PM_{10}, averaged over 24 hours and one-year, for all assessment scenarios. Key findings for Business Case 1, Phase 2 (as the worst-case PM emission scenario) are described below and presented in Figure 6-58 (annual) and Figure 6-59 (24-hour):

- P99 24-hour PM_{10} concentrations at all sensitive receptors exceed the WHO AQG of 25 µg/m^3 but fall well within Interim Target 4 (50 µg/m^3).
    - It is highlighted that the simulations represent environmentally conservative assumptions and did not include the impact of mitigation recommendations.
    - It is reasonable to infer that these exceedances are the result of increased vehicular transport (associated with the landfill activities) on the Trekkopje Road.
    - Road wetting or the addition of chemical binding agents can reduce wind blown and wheel entrained dust from unpaved roads.
        - ~ A 50% reduction in PM_{10} emissions, which could be achieved through road wetting/addition of chemical binding agents, would bring 24-hour PM_{10} to below the AQG at all sensitive receptors.
        - ~ It is highlighted that this is an assessment of the proposed NMF's contribution to ambient PM_{10} and does not include contributions from other sources. These contributions will become increasingly relevant if the Orano Uranium Mine recommences operations after Care and Maintenance. The SEMP (section 6.12.1.1) indicated a baseline ambient PM_{10} measurement of 195 µg/m³ in Arandis (no averaging period supplied) in 2018. This suggests the PM contributions from the NMF activities should be reduced as far as feasible to limit the number of exceedances of health guidelines in the town. As such, it is SLR's view that the responsible road authorities should consider paving of high-use gravel roads in proximity to Arandis. PM monitoring at sensitive receptors in Arandis should be undertaken to inform on the sources of PM. As a minimum, Namwaste must wet or apply chemical binding agents to the unpaved sections of the bypass and Trekkopje Road. This will become increasingly relevant as traffic on this road increases over the lifetime of the NMF. The frequency of application and

type (water/binding agent) of control should be informed by monitoring at a sensitive receptor in Arandis, increasing if exceedances are recorded. If monitoring indicates ongoing exceedances of short-term PM10 health guidelines at a sensitive receptor, which emissions are arising from the bypass or Trekkopje Road, it would likely be necessary to pave the bypass and Trekkopje Road in proximity to Arandis. Responsibility for paving of roads which are the source of PM emissions should be proportional to the users thereof.

- Concentrations simulated for all sensitive receptors comply with the annual WHO AQG.
- The peak PM_{10} concentrations predicted to occur on the site are 5 670 µg/m^3 on a 24-hour averaging period and 423 µg/m^3 on an annual averaging period.

Table 6-30: Model simulated PM_{10} concentrations (µg/m^3)

Averaging period	Annual			P99 24-hour		
WHO AQG	15			25		
Operational phase	Phase 1A	Phase 1B	Phase 2	Phase 1A	Phase 1B	Phase 2
Business Case 1						
SR 1	3.36E-01	5.64E-01	1.62E+00	8.11E+00	1.24E+01	3.60E+01
SR 2	5.74E-01	8.86E-01	2.60E+00	8.78E+00	1.47E+01	4.18E+01
SR 3	6.27E-01	1.06E+00	2.99E+00	5.70E+00	1.02E+01	2.56E+01
SR 4	8.18E-01	1.36E+00	3.81E+00	6.75E+00	1.30E+01	3.10E+01
SR 5	8.27E-01	1.28E+00	3.82E+00	9.08E+00	1.61E+01	4.60E+01
Model domain peak	9.01E+01	1.46E+02	4.23E+02	1.21E+03	2.10E+03	5.67E+03
Business Case 2						
SR 1	1.90E-01	3.18E-01	9.16E-01	4.62E+00	7.09E+00	2.05E+01
SR 2	3.24E-01	5.01E-01	1.47E+00	5.01E+00	8.40E+00	2.39E+01
SR 3	3.55E-01	5.96E-01	1.69E+00	3.21E+00	5.76E+00	1.44E+01
SR 4	4.63E-01	7.71E-01	2.16E+00	3.82E+00	7.41E+00	1.74E+01
SR 5	4.68E-01	7.28E-01	2.16E+00	5.19E+00	9.20E+00	2.60E+01
Model domain peak	5.07E+01	8.22E+01	2.38E+02	6.88E+02	1.19E+03	3.20E+03
Notes: Red - Exceeds WHO AQG						

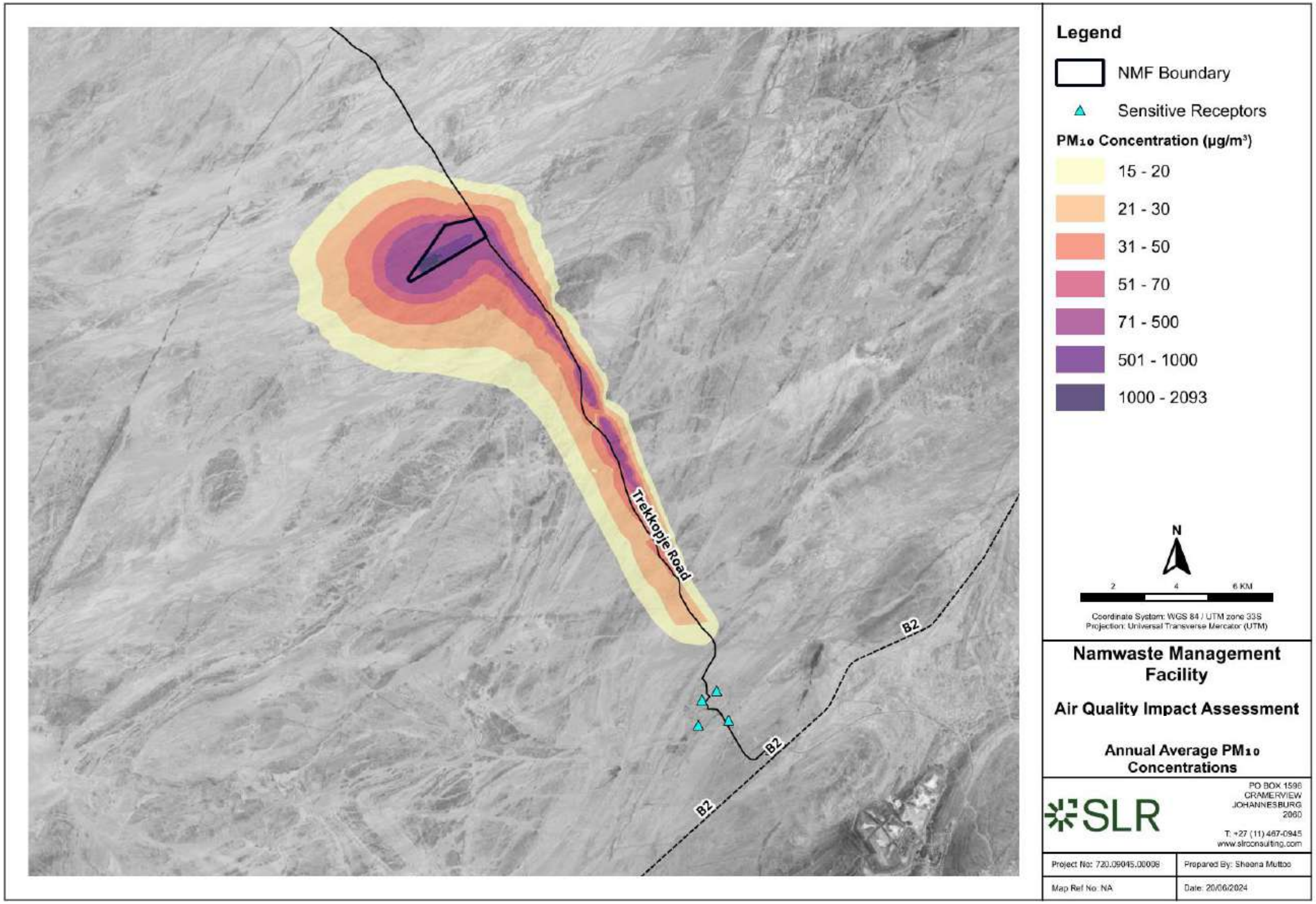

Figure 6-58: Business Case 1, Phase 2 - Annual average PM_{10} concentrations (µg/m³)

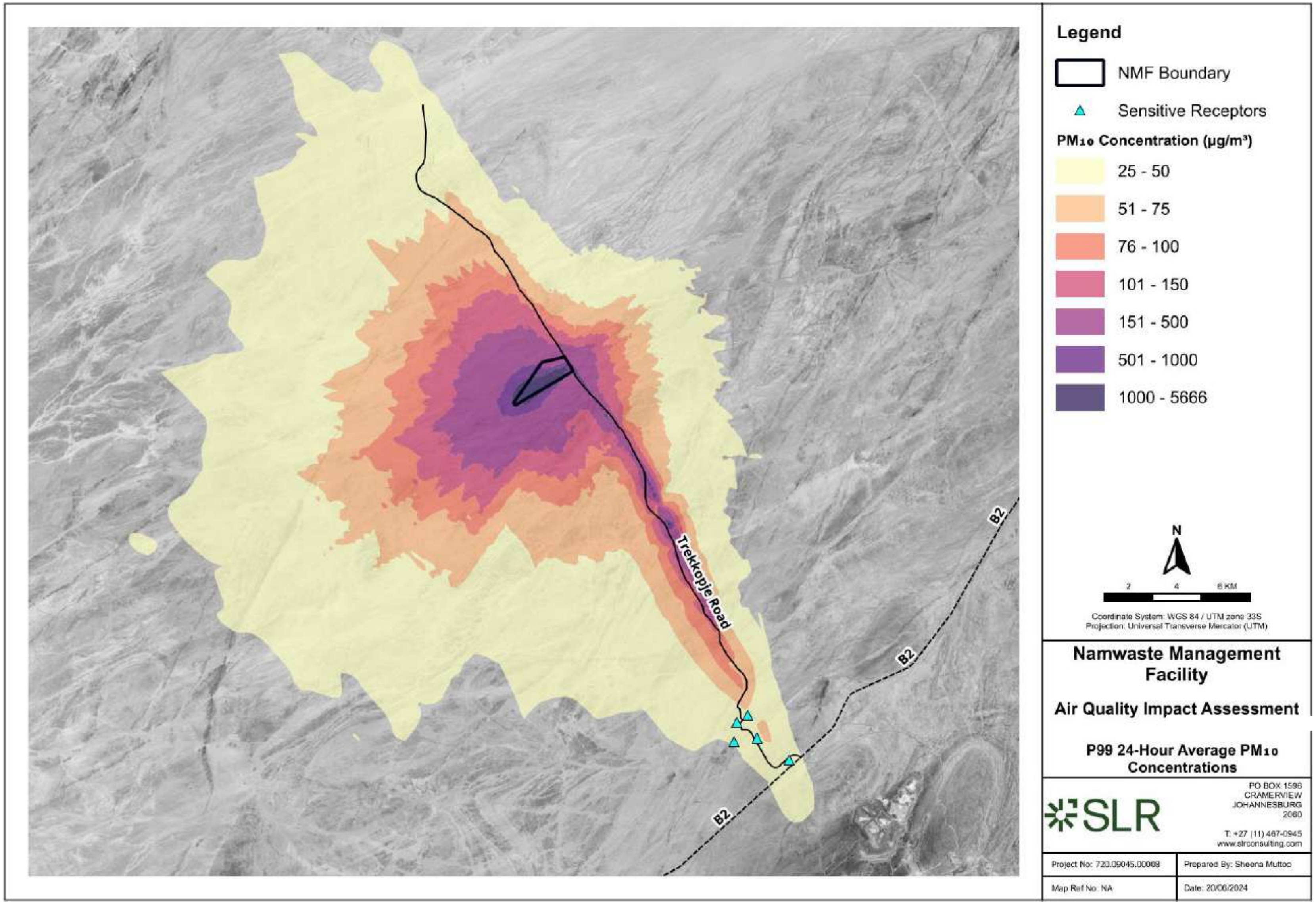

Figure 6-59: Business Case 1, Phase 2 - P99 24-hour average PM_{10} concentrations (µg/m³)

Particulate Matter Less than 2.5 Microns

Table 6-31 presents simulated concentrations of $PM_{2.5}$, averaged over 24 hours and one-year, for all assessment scenarios. Key findings for Business Case 1, Phase 2 (as the worst-case PM emission scenario) are described below and presented in Figure 6-60 (annual) and Figure 6-61 (24-hour):

- P99 24-hour $PM_{2.5}$ concentrations at sensitive receptors fall below the WHO AQG of 15 µg/m^3.
- Annual $PM_{2.5}$ concentrations at sensitive receptors fall below the WHO AQG of 5 µg/m^3.
- Peak $PM_{2.5}$ concentrations over 24-hour (8 430 µg/m^3) and one-year (67.4 µg/m^3) are predicted to occur onsite.

Table 6-31: Model simulated $PM_{2.5}$ concentrations (µg/m^3)

Averaging period	Annual			P99 24-hour		
WHO AQG	5			15		
Operational phase	Phase 1A	Phase 1B	Phase 2	Phase 1A	Phase 1B	Phase 2
Business Case 1						
SR 1	3.77E-02	6.39E-02	1.83E-01	8.52E-01	1.36E+00	3.76E+00
SR 2	6.43E-02	9.72E-02	2.87E-01	1.02E+00	1.66E+00	4.18E+00
SR 3	6.87E-02	1.17E-01	3.29E-01	7.04E-01	1.18E+00	2.68E+00
SR 4	8.85E-02	1.49E-01	4.09E-01	8.10E-01	1.64E+00	3.19E+00
SR 5	8.98E-02	1.36E-01	4.10E-01	1.13E+00	1.74E+00	4.71E+00
Model domain peak	1.44E+01	2.33E+01	6.74E+01	2.06E+02	3.45E+02	8.43E+02
Business Case 2						
SR 1	2.08E-02	3.52E-02	1.01E-01	4.65E-01	7.56E-01	2.08E+00
SR 2	3.55E-02	5.41E-02	1.59E-01	5.37E-01	9.07E-01	2.39E+00
SR 3	3.82E-02	6.50E-02	1.83E-01	3.75E-01	6.55E-01	1.51E+00
SR 4	4.94E-02	8.30E-02	2.29E-01	4.48E-01	8.73E-01	1.79E+00
SR 5	5.01E-02	7.65E-02	2.29E-01	5.75E-01	9.20E-01	2.69E+00
Model domain peak	7.99E+00	1.29E+01	3.74E+01	1.10E+02	1.87E+02	4.73E+02

Notes:
Red - Exceeds WHO AQG

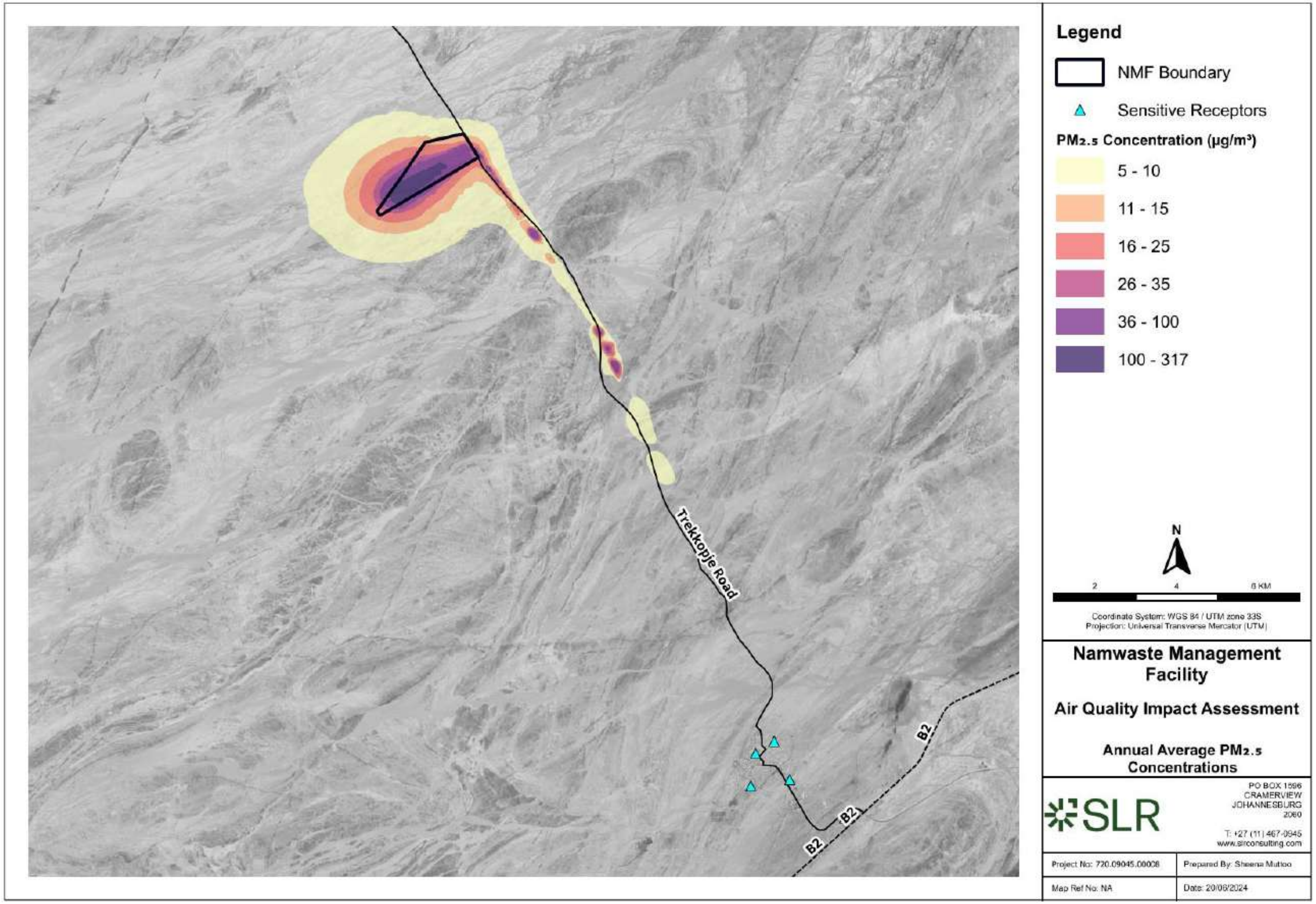

Figure 6-60: Business Case 1, Phase 2 - Annual average $PM_{2.5}$ concentrations (µg/m³)

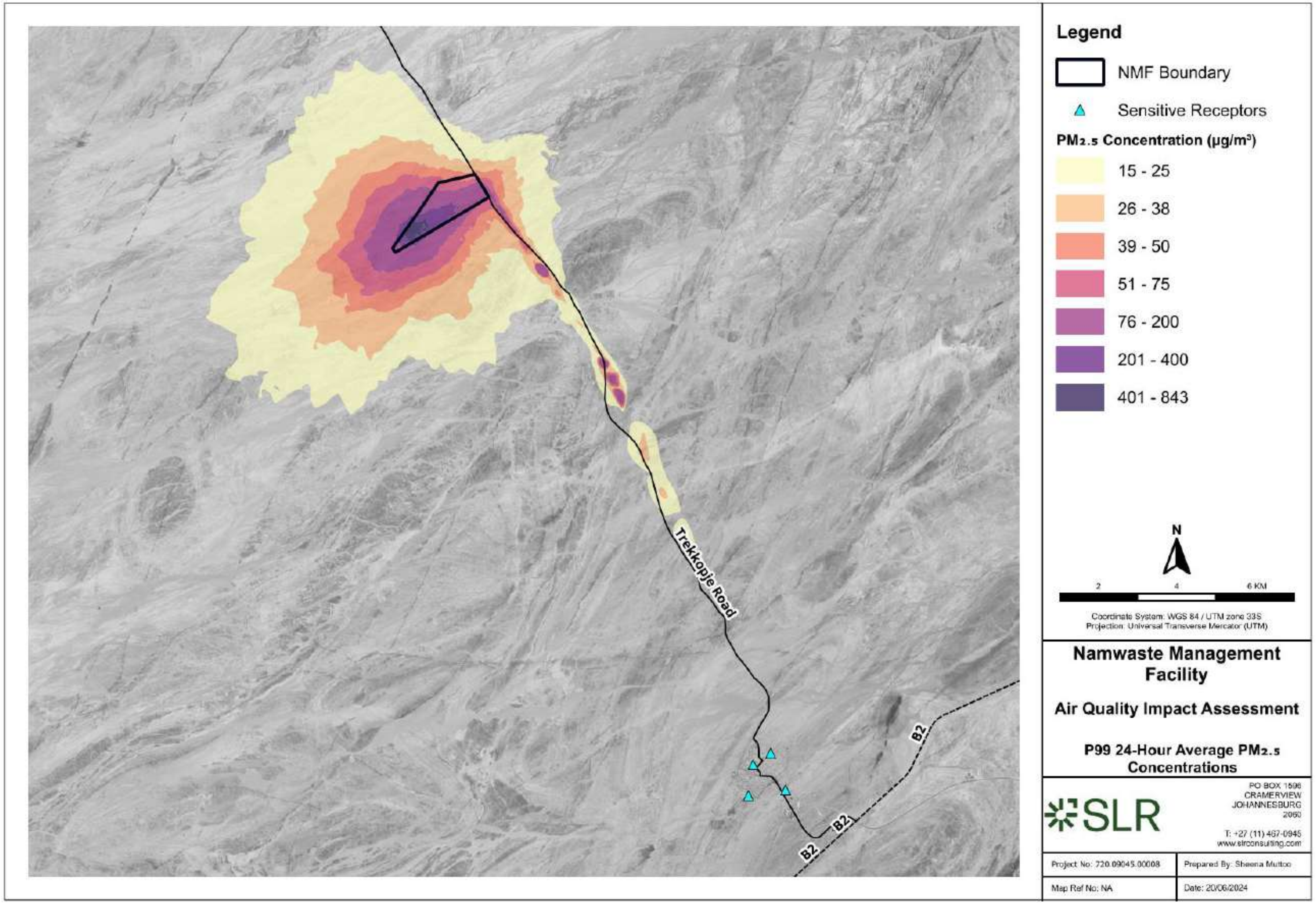

Figure 6-61: Business Case 1, Phase 2 - P99 24-hour average $PM_{2.5}$ concentrations (µg/m³)

Total Particulate Matter (as Dust Fallout)

Table 6-32 presents peak DFO rates averaged over one month, for all assessment scenarios. Key findings for Business Case 1, Phase 2 (as the worst-case PM emission scenario) are described below and presented in Figure 6-62:

- P100 one-month DFO deposition at sensitive receptors fall below the South African NDCR residential (600 mg/m^2/day) and non-residential limit (1 200 mg/m^2/day).
- Peak deposition rates (15 713 mg/m^2/day) are predicted to occur onsite.

Table 6-32: Model simulated DFO deposition rates (mg/m^2/day)

Averaging period	**Peak month**		
South African NDCR	600 (residential areas) and 1 200 (non-residential areas)		
Operational phase	Phase 1A	Phase 1B	Phase 2
Business Case 1			
SR 1	9.03E-01	1.42E+00	4.46E+00
SR 2	1.10E+00	1.78E+00	5.36E+00
SR 3	9.40E-01	1.51E+00	4.25E+00
SR 4	1.34E+00	2.00E+00	5.95E+00
SR 5	1.69E+00	2.79E+00	8.30E+00
Model domain peak	3.32E+03	5.26E+03	1.57E+04
Business Case 2			
SR 1	5.13E-01	8.09E-01	2.52E+00
SR 2	6.25E-01	1.01E+00	3.03E+00
SR 3	5.22E-01	8.22E-01	2.37E+00
SR 4	7.40E-01	1.11E+00	3.34E+00
SR 5	9.62E-01	1.58E+00	4.70E+00
Model domain peak	1.88E+03	2.97E+03	8.90E+03

Notes:
Red - Exceeds South African NDCR residential and non-residential limit

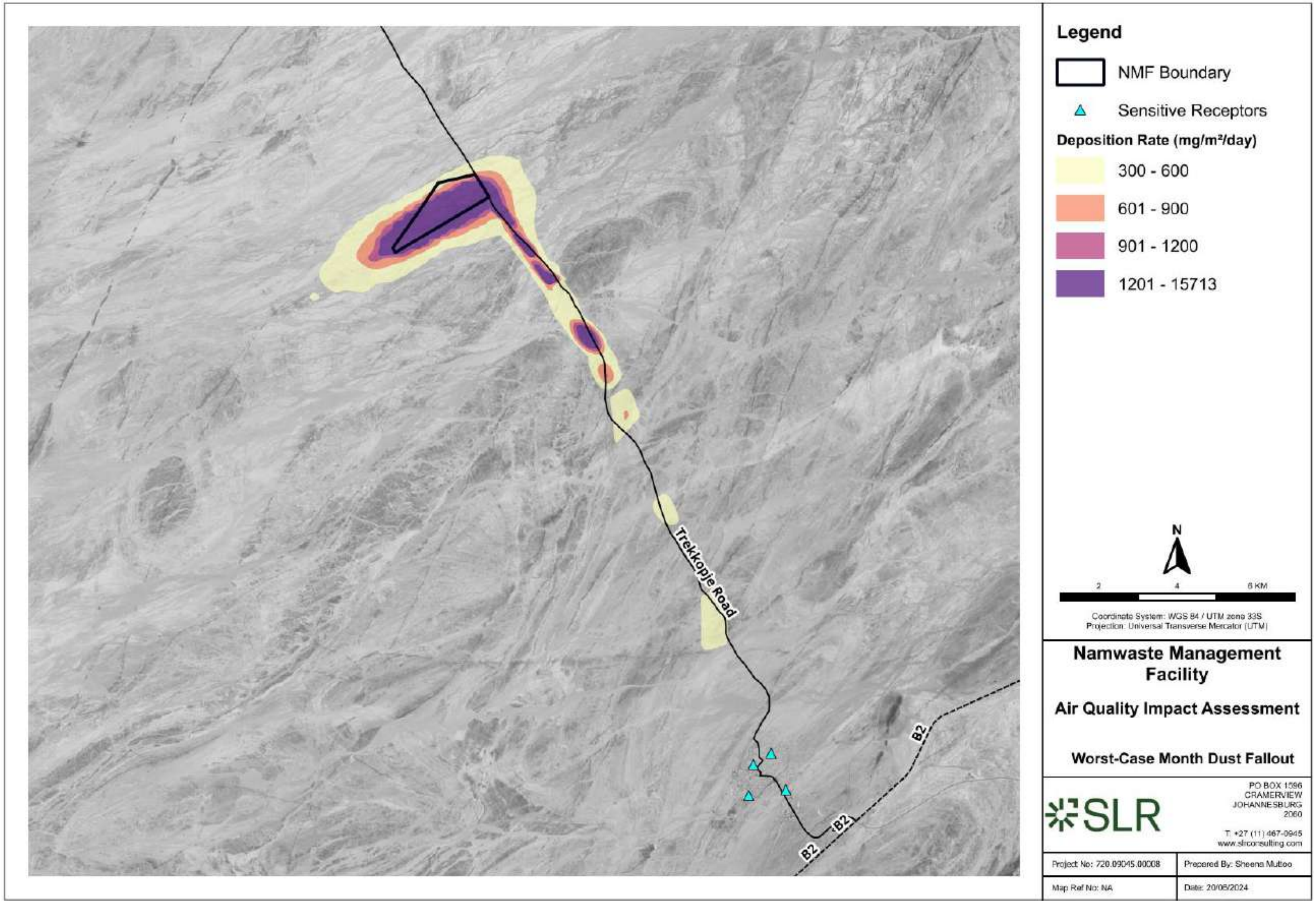

Figure 6-62: Business Case 1, Phase 2 – P100 peak month DFO deposition rate (mg/m^2/day)

Hydrogen Sulphide

Table 6-33 presents simulated concentrations of H_2S, averaged over one hour, for all operational phases. Gaseous emissions remain the same between the two business case scenarios. Key findings for Phase 2 (as the worst-case LFG emission scenario) are described below and presented in Figure 6-63 (24-hour) and Figure 6-64 (1-hour):

- P100 1-hour H_2S concentrations at sensitive receptors fall below the WHO odour nuisance AQG of 7 µg/m³. The WHO H_2S odour nuisance AQG is applicable to a 30-minute averaging period and the comparison of the worst-case 1-hour model output to this shorter-term threshold is considered environmentally conservative.
- P100 1-hour H2S concentrations fall below the H_2S odour threshold at all sensitive receptors.
- P100 24-hour H_2S concentrations at sensitive receptors fall well below the WHO 24-hour health AQG of 150 µg/m³.
- Complaints of landfill odour are not expected from sensitive receptors based on the conservative modelling estimates.
- Peak H_2S concentrations over 1-hour (40.57 µg/m³) and 24-hours (3.76 µg/m³) are predicted to occur onsite.

Table 6-33: Model simulated H_2S concentrations (µg/m³)

Averaging period	**P100 24-hour**			**P100 1-hour**		
WHO AQG	150 (health)			7 (odour)		
Operational phase	Phase 1A	Phase 1B	Phase 2	Phase 1A	Phase 1B	Phase 2
SR 1	3.14E-03	4.72E-03	1.04E-02	7.52E-02	1.13E-01	2.06E-01
SR 2	5.26E-03	3.58E-03	8.84E-03	1.26E-01	8.52E-02	2.12E-01
SR 3	8.66E-03	7.78E-03	1.35E-02	2.08E-01	1.87E-01	3.24E-01
SR 4	7.10E-03	4.50E-03	7.72E-03	1.71E-01	1.02E-01	1.85E-01
SR 5	4.62E-03	3.40E-03	9.47E-03	1.09E-01	8.07E-02	2.27E-01
Model domain peak	3.20E+00	4.24E+00	3.76E+00	3.14E+01	3.92E+01	4.06E+01

Notes:

Red - Exceeds WHO AQG

Figure 6-63: Phase 2 – P100 24-hour average H_2S concentrations (µg/m³)

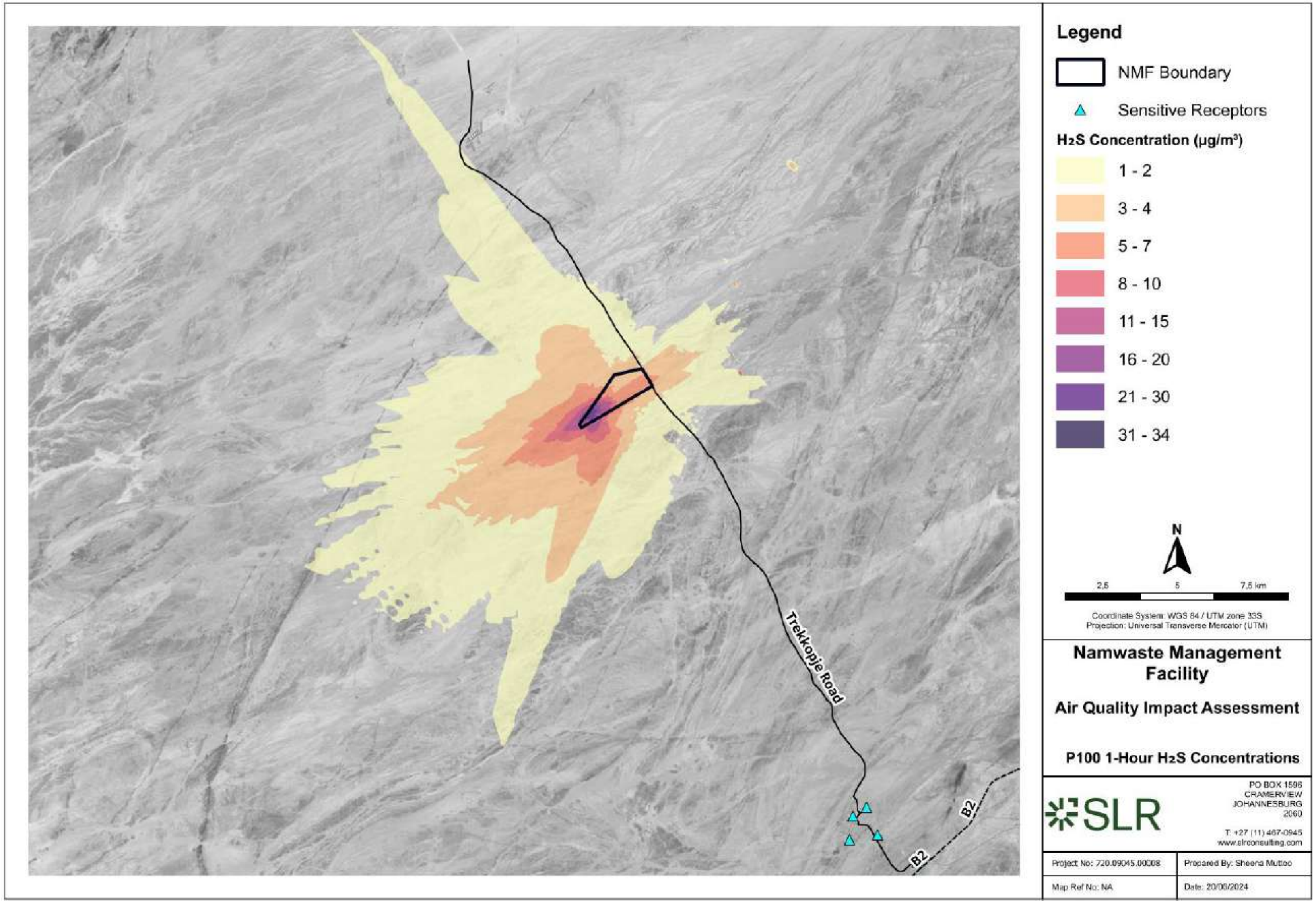

Figure 6-64: Phase 2 – P100 1-hour average H_2S concentrations (µg/m³)

Benzene

Table 6-34 presents simulated concentrations of benzene, averaged over one-year, for all operational phases. Gaseous emissions remain the same between the two business case scenarios. Key findings for Phase 2 (as the worst-case LFG emission scenario) are described below and presented in Figure 6-65:

- The peak concentration of benzene over one-year (0.829 µg/m^3) is predicted to occur onsite.
- Highest benzene concentrations (0.0002 µg/m^3) simulated for a sensitive receptor are predicted at SR3 (Stadium Arandis).
  - This is significantly lower than the continuous exposure concentrations of airborne benzene associated with an excess lifetime risk of 1:10 000 for leukaemia (17 µg/m^3).
  - However, carcinogenic risks should be assessed cumulatively as presented in the section that follows (Excess Cancer Risk).

Table 6-34: Model simulated benzene concentrations (µg/m^3)

Averaging period	**Annual**		
WHO AQG	(a)		
Operational phase	Phase 1A	Phase 1B	Phase 2
SR 1	3.27E-05	3.24E-05	1.45E-04
SR 2	5.59E-05	3.68E-05	1.81E-04
SR 3	4.83E-05	5.01E-05	2.04E-04
SR 4	5.45E-05	5.49E-05	1.94E-04
SR 5	5.76E-05	3.46E-05	1.92E-04
Model domain peak	6.52E-01	8.86E-01	8.29E-01

Notes:
(a) - Benzene is carcinogenic to humans and no safe levels of exposure can be recommended by the WHO. The continuous exposure concentrations of airborne benzene associated with an excess lifetime risk of 1:10 000 for leukaemia is 17 µg/m^3.

Figure 6-65: Phase 2 – Annual average benzene concentrations (µg/m³)

Excess Cancer Risk

The quantifiable carcinogens assessed in this study for which URFs are established by the US EPA's IRIS are presented in **Appendix L.** The URF is the increase in cancer risk of an individual who is exposed for a lifetime (70-years) to 1 µg/m^3 of each compound in air. Table 6-35 presents model simulated cancer risk for all operational phases. Gaseous emissions remain the same between the two business case scenarios. Key findings for Phase 2 (as the worst-case LFG emission scenario) are described below and presented in Figure 6-66:

- Peak excess lifetime cancer risk (2.19 in 1 000) is predicted to occur onsite and exceeds the ATSDR lower range limit for acceptable inhalation exposure (i.e. 1 in 10 000).
- Highest excess lifetime cancer risk simulated for a sensitive receptor is predicted at SR3 (Stadium Arandis), however the anticipated risk is 0.54 in 1 000 000 and thus considered negligible.

Table 6-35: Model simulated excess lifetime cancer risk associated with carcinogenic compounds in LFG

Averaging period	**Lifetime (70 years)**		
US EPA guideline [(a)]	1.00E-04 to 1.00E-06		
Operational phase	Phase 1A	Phase 1B	Phase 2
SR 1	8.64E-08	8.55E-08	3.84E-07
SR 2	1.48E-07	9.72E-08	4.79E-07
SR 3	1.28E-07	1.32E-07	5.40E-07
SR 4	1.44E-07	1.45E-07	5.12E-07
SR 5	1.52E-07	9.15E-08	5.08E-07
Model domain peak	1.72E-03	2.34E-03	2.19E-03

Notes:

(a) - Excess cancer risk within a range of 1 in 10 000 and 1 in 1 000 000 is considered by the US EPA to be acceptable. Excess cancer risk less than 1 in 1 000 000 is considered negligible.

Red - Exceeds US EPA lower range limit (i.e. > 1 in 10 000)

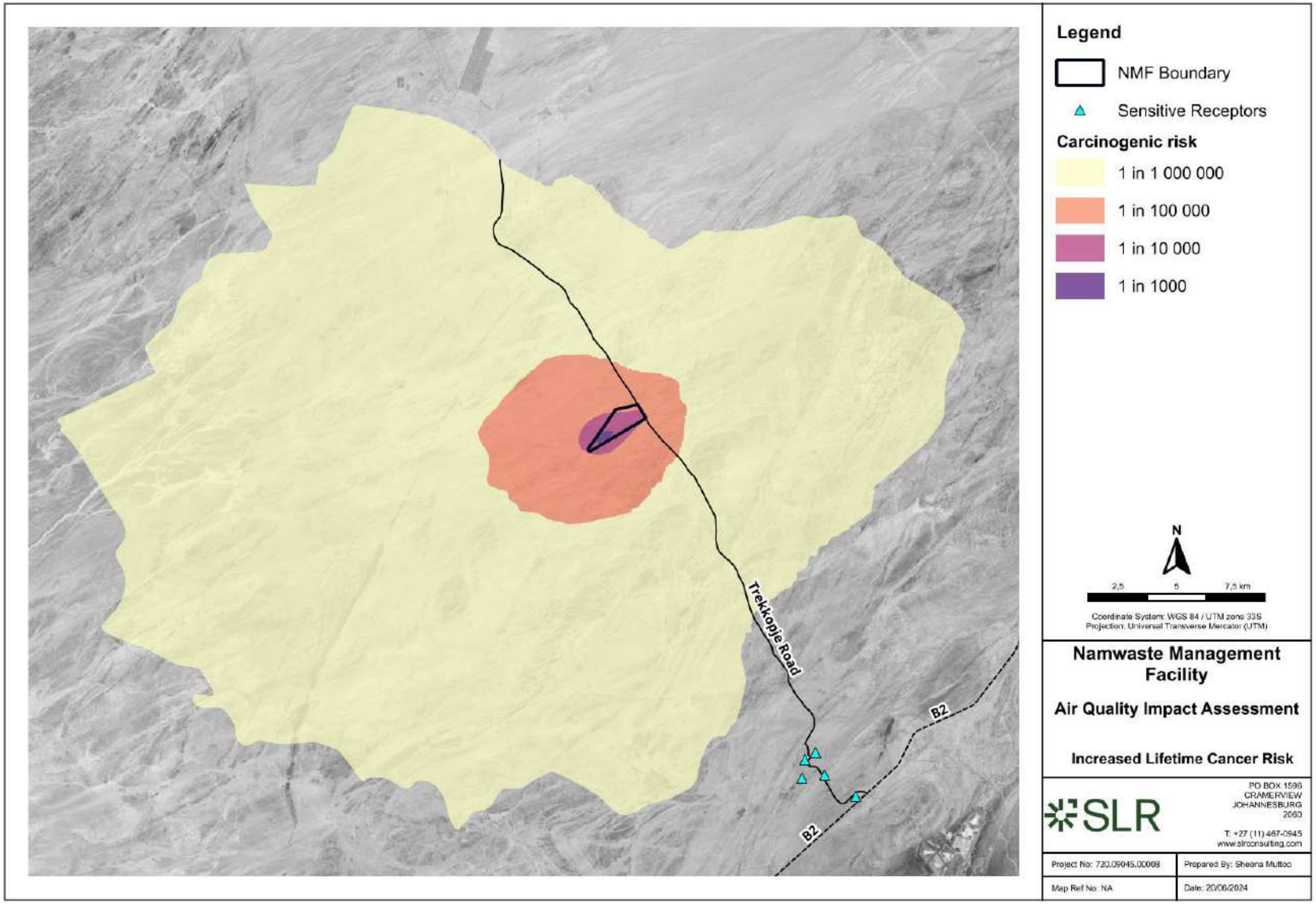

Figure 6-66: Phase 2 – Excess lifetime cancer risk associated with carcinogenic LFG emissions from the NMF

6.13 Socio-economic

A Socio-economic Impact Assessment was undertaken by SLR (Appendix L). The study aimed to determine the current socio-economic baseline to gain a better understanding of the Project site and to identify potentially critical impacts of the development proposal in terms of socio-economic aspects.

6.13.1 Demographics

6.13.1.1 Population

At the time of the 2011 Census the population in the Erongo Region was reported to be 150,809 people, an increase of 43,146 people since the 2001 Census. The increase equates to an annual population increase of 3.4% between 2001 and 2011 (NSA, 2014). With a total area of 63,586 square km (approximately 7.7% of Namibia's total area), the population density in the region is 2.4 persons per square km, marginally lower than the average population density for the country as a whole which was reported to be 2.6 persons per square km (NSA, 2012). Based on projections it is estimated that in 2023 the population within the Erongo Region was 247,137 people (HDX, 2024), indicating a slight increase in the annual population growth.

The population within the Arandis Constituency was reported to be 10,093 persons during the 2011 Census, accounting for 6.7% of the population within the Erongo Region. Between 2001 and 2011 the constituency experienced an annual population growth rate of 3.3%, similar to that of the region as a whole (NSA, 2014). With a total land area of 13,490 square km the population density of the constituency is 0.7 people per square km noticeably lower than for the region and country. Based on projections it is estimated that in 2023 the population within the constituency would be 15,022 people (HDX, 2024), indicating a slight increase in the annual population growth.

The Arandis urban centre had a population of 5,100 people in 2001 and 7,509 people in 2011, an annual increase of 3.1%. With a total area of 33.4 square km the Arandis urban area is has a population density 152.6 persons per km^2 (Erongo Regional Council, 2024).

6.13.1.2 Age and sex breakdown

Within the Erongo Region 52.9% of the population was male and 47.1% female at the time of the 2011 Census. Findings from the census also indicate that a high proportion of the population was reported to be under the age of 15 (27.5%), with 66.9% of the population between the ages of 15 and 59 and 5.6% of the population over the age of 60 (NSA, 2014). These figures indicate that the population within the district can be classified as young with a high proportion of the population under the age of 15.

Based on population projections it was estimated that in 2023 25.6% of the population would be under the age of 15. The proportion of the population between the ages of 15 and 59 (accounting for most of the economically active persons) is anticipated to grow slightly to 69.2%, while the proportion of the population over the age of 60 is anticipated to remain relatively consistent at 5.2% (HDX, 2024). Figure 6-67 illustrates the projected 2023 age and sex breakdown for the Erongo Region.

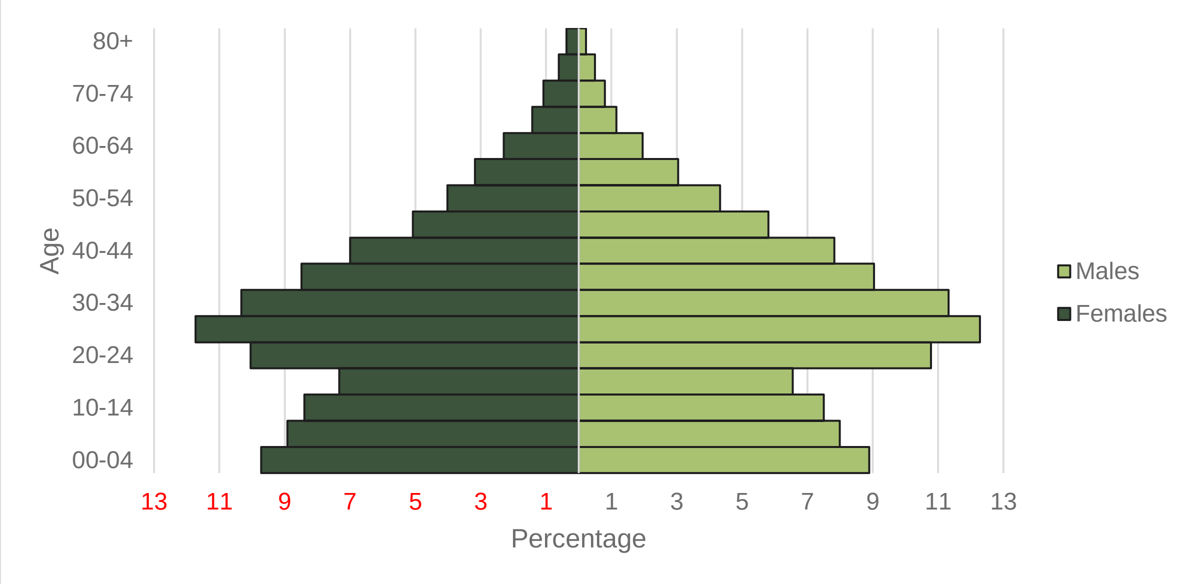

Figure 6-67: Population pyramid for the Erongo Region

The age and sex breakdown within the Arandis Constituency is similar to that of the region with 28.1% of the population under the age of 15, 63.9% between the ages of 15 and 59 and 8% over the age of 60. The population was also made up of a higher proportion of males than females, 51.9% and 48.1% respectively (NSA, 2014).

It was projected that by 2023 26.7% of the population would be under the age of 15, representing a slight decline in the proportion of the population in this age bracket, 65.5% between the ages of 15 and 59, and 7.9% over the age of 65 (HDX, 2024).

As shown in Figure 6-68 the projected population structure of the Arandis Constituency is anticipated to remain similar to the Erongo Region with a large proportion of the population classified as young and a smaller proportion of the population in the older age cohorts. Such a profile viz. a large base and narrow apex, is typical of a population with a high fertility and mortality rate (NSA, 2014).

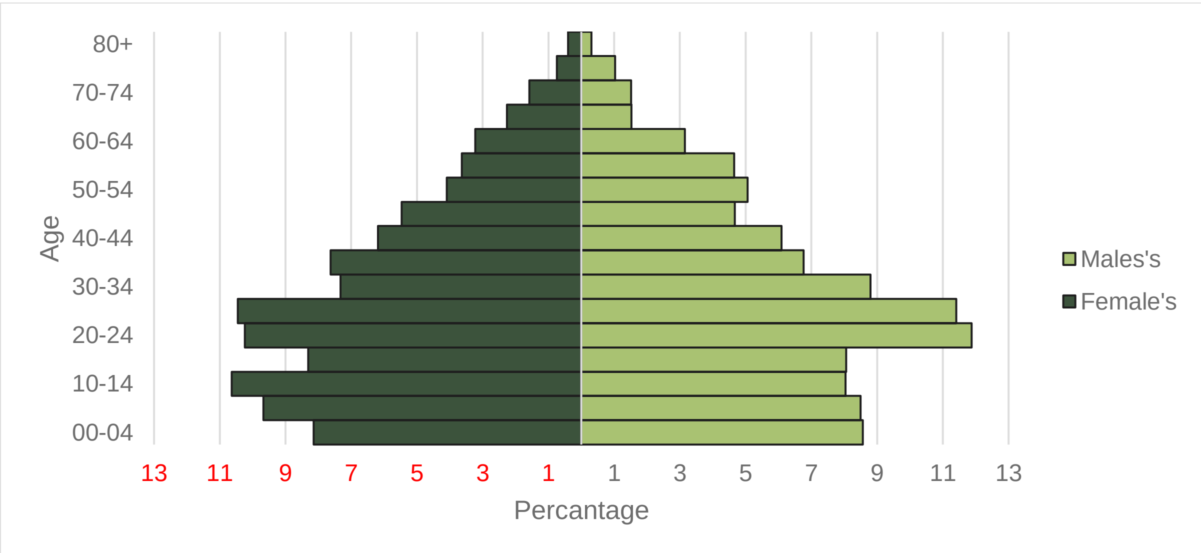

Figure 6-68: Population pyramid for the Arandis Constituency

6.13.2 Education

6.13.2.1 Access to education

At the time of the 2011 Census, 29.8% of the population over the age of 15 years in the Erongo Region were reported to have completed secondary school, while 6.7% reported some form of tertiary education. A total of 44% of the population over the age of 15 years reported having only completed primary school, while 18.7% reported to have started primary school but not completed it. The proportion of the population over the age of 15 years reported to have never received any formal education was 0.8% (NSA, 2014). These findings indicate that, at the time of the 2011 census, over 60% of the population that commenced with schooling in the Erongo Region drop out before secondary school. Anecdotal information collected during consultation indicated that the dropout rate among students remains high with stakeholders noting it as a key concern among the youth (SEIA specific consultation, 2024).

In general access to education among females and males was similar. Data from the Education Management Information Systems (EMIS, 2022) for the Erongo District supports this where it is noted that, while overall females have a marginally higher rate of enrolment than males, the difference is slight. Access to education among the entire population as well as among males and females is illustrated in Figure 6-69.

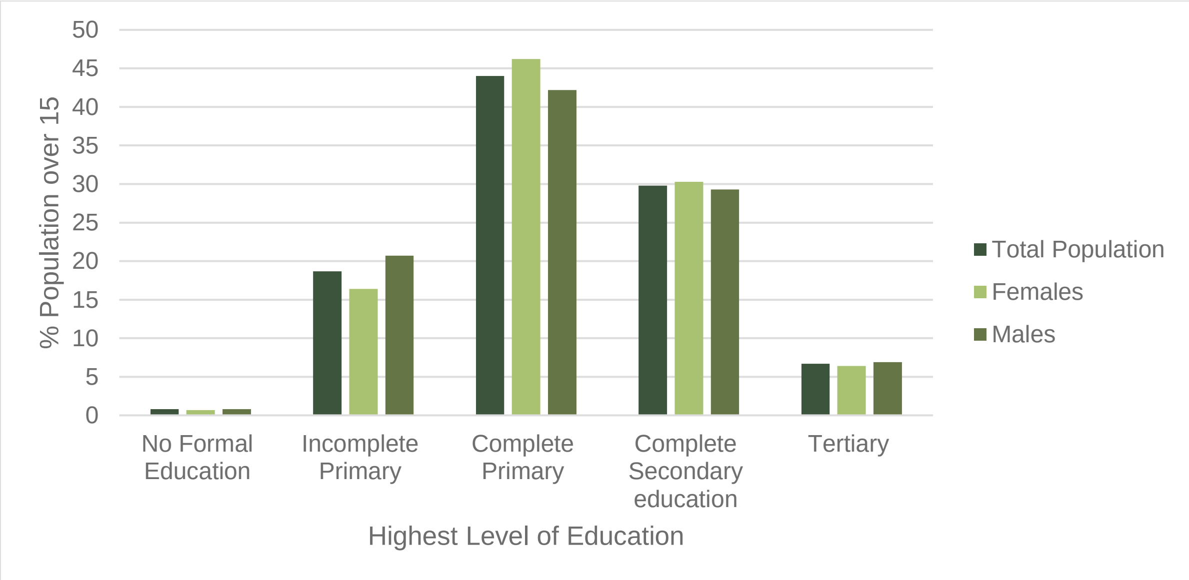

Figure 6-69: Highest level of education population over the age of 15

Data on access to education within the Arandis Constituency and urban area was not readily available, however, based on anecdotal information obtained through consultation it is assumed that similar trends exist within these areas to those of the district as a whole, i.e. while access to education is generally good, there remains a high dropout rate among students.

6.13.2.2 Literacy rates

The literacy rate among the population 15 years and older is high within the Erongo Region and Arandis Constituency with 97% of males and 98% of females over the age of 15 reported to be literate at the time of the 2011 Census (NSA, 2014).

Literacy rates within the rural parts of the Erongo Region were however lower than in the urban centres (83% compared to 98%) (NSA, 2014). This is not unique to the area with access to education and by inference literacy levels are generally higher in urban centres than the surrounding rural areas (Sumida and Kawata, 2021)

6.13.3 Employment

6.13.3.1 Employment status

At the time of the 2011 Census 29.9% of the population over the age of 15 years within the Erongo Region reported to be unemployed, with unemployment higher among the females (39.9%) than males (22.0%). Overall unemployment within the rural areas of the Erongo Region were reported to be higher than the urban areas, 34.5% and 29.3% respectively. Overall unemployment among females was reported to be higher than average with unemployment among females reported to be 39.1% in urban areas and 47.6% in rural areas (NSA, 2014). The overall unemployment rate reported at the time of the 2011 Census, despite being high, did show an improvement since the 2001 Census where unemployment within the district was reported to be 34.0% (NSA, 2003).

Unemployment within the Arandis Constituency was reported to be 28% at the time of the 2011 Census, an improvement since 2001 where unemployment was reported to be 36% (NSA, 2014). While a breakdown of unemployment between the urban and rural parts of the constituency is not readily available, it is assumed that there is a similar trend to that within the Erongo Region viz. higher levels of unemployment within rural areas than in urban centres. Findings from engagement with key stakeholders indicate that this is the case with high levels of unemployment in rural areas, and specifically the #Gaingu Conservancy and among the youth, identified as a key challenge (SEIA specific consultation, 2024). This trend is not unique to the area with it reported that nationally approximately 38% of the urban youth are unemployed compared to 52% of the rural youth (Mulama and Nambinga, 2023).

6.13.3.2 Sectors of employment

The manufacturing industry is the largest employer within the Erongo Region accounting for 13.8% of the employed population. The other main contributors to employment include the mining and quarrying sector (11.7%), the agriculture, forestry and fishing sector (11.5%), construction sector (9.5%) and wholesale and retail trade sector (9.2%). Collectively these five industries account for 55.7% of employment within the Erongo Region (NSA, 2014). These trends are similar to those reported in 2001 where these same five industries were the primary source of employment, albeit in 2001 they accounted for 49.8% of all employment (NSA, 2003). A breakdown of all employment sectors is provided in Table 6-36.

Table 6-36: Industries of employment within the Erongo Region

Industry	% of employed population
Agriculture Forestry and Fishing	11.5
Mining And Quarrying	11.7
Manufacturing	13.8
Electricity Gas Steam and Air conditioning supply	0.4
Water Supply Sewerage Waste Management and Remediation activities	0.5
Construction	9.5
Wholesale and Retail trade	9.2
Transportation and Storage	5.3
Accommodation and Food Service activities	4.5
Information and Communication	0.8
Financial Insurance Activities	2.1

Industry	% of employed population
Real estate Activities	0.4
Professional Scientific and Technical activities	1.6
Administrative and Support service activities	8.3
Public Administration and Defence; compulsory social security	4.0
Education	3.1
Human Health and Social work activities	2.5
Arts Entertainment and Recreation	1.0
Other Services activities	3.4
Activities of Private Households	5.7
Don't Know	0.7

6.13.3.3 Labour force participation

The labour force participation rate is defined as the proportion of the potentially economically active people, actively participating in the economy (inclusive of unemployed people) (NSA, 2014). The labour force participation provides an indication of the percentage of the potentially economically active population who are not economically active, or attempting to become economically active, and are therefore dependents. These parties include students, homemakers, pensioners, unemployed persons no longer seeking employment and the ill or disabled (NSA, 2014).

Within the Erongo Region at the time of the 2011 Census the labour force participation rate was 78.8%, an improvement since 2001 where labour force participation was 71.0% (NSA, 2014 and NSA, 2003). Generally labour force participation was higher in urban areas and among males. Within the Arandis Constituency, labour force participation was on average lower than the region at 70.4% and higher among males (74.1%) than females (67.3%) (NSA, 2014). These figures suggest that within the Arandis Constituency there is likely to be higher level of dependence than in the region as a whole. This was alluded to during consultation with stakeholders identifying the low level of permanent employment and economic opportunities as a challenge in the Arandis Constituency (SEIA specific consultation, 2024). Details of labour force participation are provided in Table 6-37.

Table 6-37: Labour force participation

Area	Total	Female	Male
Erongo	78.8%	74.7%	82.4%
Erongo (Urban)	79.9%	76.1%	83.3%
Erongo (Rural)	70.4%	63.0%	76.1%
Arandis	70.9%	67.3%	74.1%

6.13.3.4 Consumption and income sources

At a regional level Erongo Region exhibited the second highest per capita consumption in terms of Namibian Dollars and the third highest average household consumption. Overall, the average annual household consumption within the Erongo Region was N$ 128,617.00, above the Namibian average of N$ 119,065.00 (NSA, 2015/2016). This implies that on average households within the Erongo Region spend more money than the average households in Namibia, suggesting a higher level of income and standard of living. Nationally, within urban areas, consumption per capita and average household consumption, was almost double that in rural areas, indicative of the income gap between urban and rural areas (NSA, 2015/2016). Findings from consultation with key stakeholders indicated that access to services and employment opportunities in rural areas were limited (SEIA specific consultation, 2024). It is assumed that the trend of urban areas having higher per capita consumption and higher average household consumption also exists in the Erongo Region and Arandis Constituency.

In terms of income, the majority of households within the Erongo Region reported their main source of income being from formal wages or salary (72.8%), followed by business activities not related to agriculture (9.2%), while 6.2% of households were reported to be reliant on pensions (NSA, 2014). This is similar to the trend reported during the 2001 Census however a reduced reliance on pensions was evident with an increase in households earning wages or a salary (NSA, 2003). Within rural areas there is a far higher reliance on agriculture (19.2%) and pensions (19.7%). The main source of household income reported during the 2011 Census are illustrated in Figure 6-70.

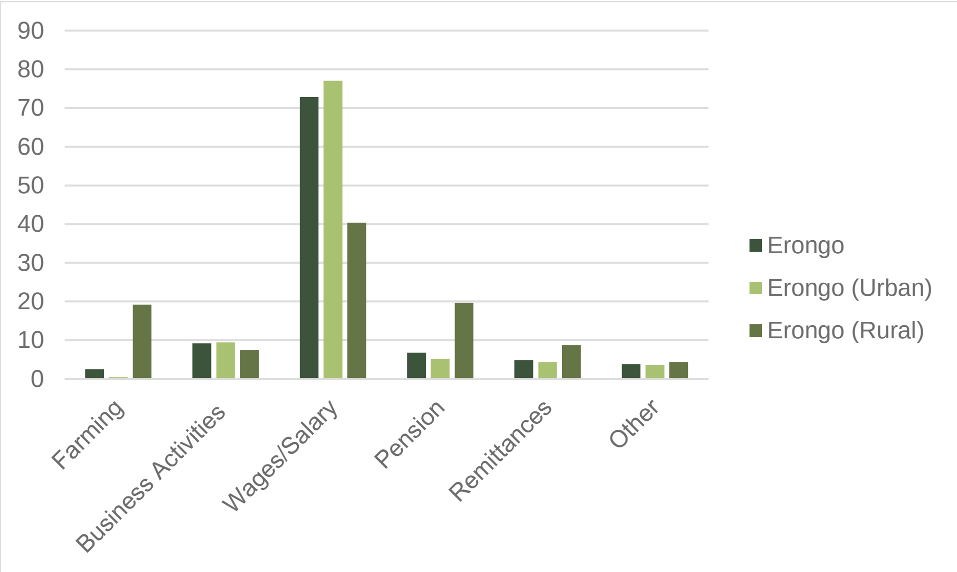

Figure 6-70: Main source of household income

Within the Arandis Constituency the trend is the same with the majority of households reporting their main source of income to be wages or salary (71.7%). There is however a higher reliance on pensions (10.3%), possibly indicative of the reported lack of economic opportunities and high unemployment, while business activities other than farming is the third largest source of income (6.1%) (NSA, 2014). Since 2001 however there has been a reduction in the reliance on pensions (14.5% to 10.3%) and an increase in wages or salary as the main source of income (64.7% to 71.7%) (NSA, 2003). A breakdown of the main sources of income for households within Arandis Constituency for 2001 and 2011 is provided in Figure 6-71.

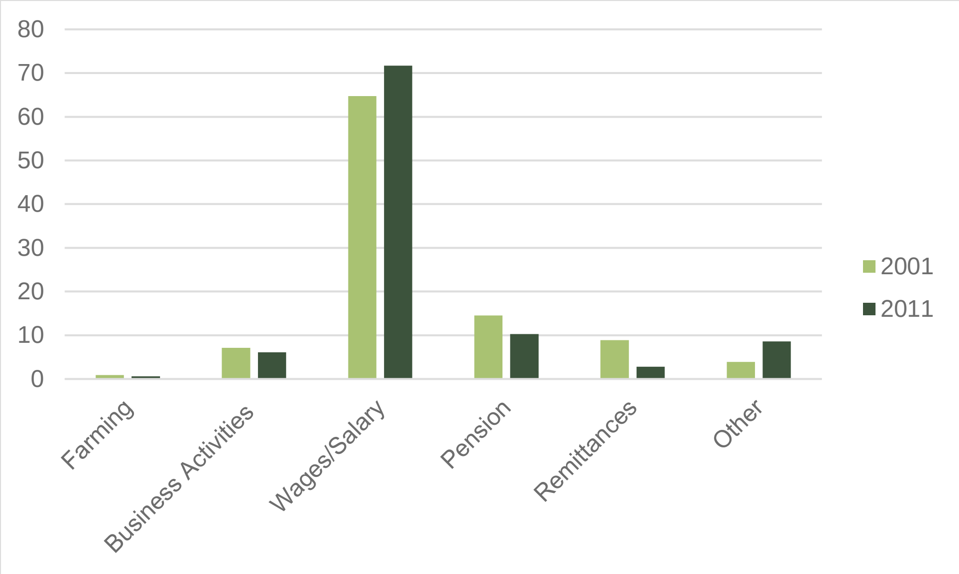

Figure 6-71: Main sources of household income in Arandis Constituency

6.13.4 Access to services

6.13.4.1 Electricity for lighting

Within the Erongo Region the majority of households (81.3%) reported using electricity for lighting with candles the second most common source of energy used (12.5%). Access to electricity within the urban centres of the district is far better than in rural areas with 87.7% of urban households reported to have access to electricity for lighting. Within the rural parts of the district there was a greater reliance on candles (30.5%) and paraffin / kerosene (29.5%), while only 31.3% of households reported to use electricity (NSA, 2014). Sources of electricity for lighting are provided in Table 6-38.

Table 6-38: Sources of electricity within the Erongo Region

Area	Elec from mains	Elec from generators	Gas	Paraffin/ Kerosene	Wood / Charcoal	Candles	Solar Energy	Other
Erongo	81.3%	0.5%	0.1%	4.4%	0.2%	12.5%	0.8%	0.2%
Erongo (Urban)	87.7%	0.3%	0.1%	1.2%	0.2%	10.2%	0.2%	0.1%
Erongo (Rural)	31.3%	1.7%	0.3%	29.5%	0.3%	30.5%	5.9%	0.5%

Within the Arandis Constituency 81.4% of households reported having access to electricity from mains with 16.2% of households making use of candles (NSA, 2014). While the data was not disaggregated for the urban and rural portions of the Arandis Constituency, during consultation it was noted that access to electricity in the rural parts of the Arandis Constituency was a challenge (SEIA specific consultation, 2024). It is thus assumed that a similar trend exists in the Arandis Constituency as in the region as a whole, where on average access to electricity is noticeably better within urban centres. Sources of energy for lighting purposes within the Arandis Constituency are provided in Table 6-39.

Table 6-39: Sources of electricity within the Arandis Constituency

Area	Elec from mains	Elec from generators	Gas	Paraffin/ Kerosene	Wood / Charcoal	Candles	Solar Energy	Other
Arandis	81.4%	0.4%	0.1%	0.9%	0.1%	16.2%	0.5%	0.4%

6.13.4.2 Access to water

The majority of households (96.3%) within the Erongo Region reported having access to safe drinking water. However, the source of the water varied with 50.4% reporting access to piped water within their dwelling and 33.4% access to piped water outside of the dwelling. Within the urban centres of the district 99.5% of households reported access to safe drinking water with a marginally higher proportion having access within their dwelling (55.3%) and 35.4% having access to piped water outside of their dwelling. Access within the rural areas of the district was lower with 71.2% of households reporting access to safe drinking water with the most common sources being boreholes (25.7%) and piped water outside of their dwelling (18%) (NSA, 2014). The level of access to water within the Erongo Region is shown in Table 6-40.

Table 6-40: Access to water within the Erongo Region

Area	Piped (Inside Dwelling)	Piped (Outside Dwelling)	Public Pipe	Borehole	Well (Protected)	Well (Unprotected)	River/Dam	Other
Erongo	50.4%	33.4%	9.2%	3.1%	0.5%	0.4%	2.0%	1.0%
Erongo (Urban)	55.3%	35.4%	8.7%	0.1%	0.0%	0.0%	0.0%	0.5%
Erongo (Rural)	11.8%	18.0%	12.2%	25.7%	3.7%	2.6%	15.0%	7.0%

Within the Arandis Constituency 99% of households reported access to safe water. The majority of households reported access within their dwelling (75.2%) with 17.1% reporting access to piped water outside of their dwelling (NSA, 2014). While access to water within the Arandis Constituency is above average for the region, during consultation it was noted that the biggest challenge facing rural households is access to water both for human consumption as well as agricultural purposes (SEIA specific consultation, 2024). The different sources of water are provided in Table 6-41.

Table 6-41: Access to water within the Arandis Constituency

Area	Piped (Inside Dwelling)	Piped (Outside Dwelling)	Public Pipe	Borehole	Well (Protected)	Well (Unprotected)	River/Dam	Other
Arandis	75.2%	17.1%	6.6%	0.2%	0.2%	0.2%	0.2%	0.3%

6.13.4.3 Access to sanitation

Less than half (47.6%) of households in the Erongo Region reported having access to their own waterborne sanitation either through a connection to a sewer or through a septic tank. A further 35% of households reported having access to waterborne sanitation however the toilet was shared with other households. Throughout the entire district 10.6% of households reported no access to sanitation. There is however a noticeable difference between access in urban households compared to rural households, with 5.1% of urban households reported to have no access to sanitation and 53% of rural households reporting to have no access to sanitation (NSA, 2014). A breakdown of access to sanitation within the Erongo Region is provide in Table 6-42.

Table 6-42: Access to sanitation within the Erongo Region

Area	Private (sewer)	Shared (sewer)	Private (septic tank)	Shared (septic tank)	Ventilated Pit Latrine	Unventilated Pit Latrine	Bucket	None	Other
Erongo	45.8%	33.4%	1.8%	1.6%	3.2%	2.7%	0.6%	10.6%	0.3%
Erongo (Urban)	49.3%	37.1%	1.4%	1.5%	2.8%	2.0%	0.5%	5.1%	0.3%
Erongo (Rural)	18.2%	4.8%	5.3%	2.5%	6.3%	8.1%	1.7%	53.0%	01.%

Access within the Arandis Constituency was reported to be, on average, better than the district, with 71.7% of households reported to have access to their own waterborne sanitation and a further 15.7% reported to have shared access to waterborne sanitation. A smaller proportion (8.7%) of households reported having no access to sanitation (NSA, 2014). The level of access to sanitation within the Arandis Constituency is provided in Table 6-43.

Table 6-43: Access to sanitation within the Arandis Constituency

Area	Private (sewer)	Shared (sewer)	Private (septic tank)	Shared (septic tank)	Ventilated Pit Latrine	Unventilated Pit Latrine	Bucket	None	Other
Arandis	65.1%	14.6%	6.6%	1.1%	0.3%	1.4%	2.0%	8.7%	0.2%

6.13.4.4 Access to healthcare

The Erongo regional health directorate currently has the following facilities: Four hospitals, two healthcare centres, 18 primary health care clinics and 170 outreach points. In addition to this there are a number of private healthcare facilities in the region (Erongo Regional Council, 2022).

The majority of the population in the Erongo Region live in relatively close proximity to healthcare facilities. Table 6-44 provides a breakdown of the distance people are required to travel to access healthcare.

Table 6-44: Distance households travel to a healthcare facility in the Erongo District

0 – 1 km	2 – 5 km	6 – 10 km	11 – 25 km	26 – 40 km	40+ km
62.7%	26.7%	1.6%	4.8%	1.2%	1.3%

6.13.5 Waste removal

Within the Erongo Region the majority of households (79.8%) reported general waste being collected on a regular basis. There was, however, a notable difference between urban and rural areas, with only 9.4% of rural households reporting refuse removal on a regular basis. Refuse removal in Arandis Constituency was reported to be better than for the district as a whole with 91.5% of households reporting that waste is collected on a regular basis. A breakdown of waste disposal means for the district as well as Arandis Constituency is provided in Table 6-45.

Table 6-45: Access to waste removal

Area	Regularly collected	Irregularly collected	Burning	Roadside dumping	Rubbish pit	Others
Erongo	79.8%	3.5%	8%	4.6%	4.0%	0.1%
Erongo (Urban)	88.8%	3.6%	0.7%	4.5%	2.3%	0.1%
Erongo (Rural)	9.4%	2.2%	64.8%	6.0%	16.8%	0.8%
Arandis	91.5%	2.7%	1.4%	0.1%	4.2%	0.1%

6.13.6 Regional Overview

6.13.6.1 Arandis

Arandis is the nearest town to the Project site (15 km for the Project site). Arandis is located about 60 km east of Swakopmund and was established in 1970 to house employees of Rössing Uranium Limited (RUL); it was proclaimed a municipality in 1994. It has good transport links and infrastructure, and the town is well-laid out (Ashby Associates, 2023). Key areas such as the business centre and municipal offices are easily accessible to the whole population which was 5 100 people in 2011 (NSA, 2014). No data is available on household sizes and composition.

Although the town has always been economically dependent on RUL, it has made great effort to attract other industries. Since the construction and opening of the Husab mine, Arandis has experienced considerable population growth and has built housing in Extension 5 and 7, mainly for workers at the Husab mine. The number of ratepayers has grown to 3 700 (domestic and business), a 61% increase since 2017. The town has no informal settlement, but many houses have backyard shacks[10].

6.13.6.2 The #Gaingu Conservancy

The NMF will be constructed within the #Gaingu Conservancy area. The #Gaingu Conservancy covers an area of 7 721 km^2, bordering with the Dorob National Park to the east, the Omaruru River to the north, the Erongo Mountains and Usakos to the west, and south. It additionally covers the land surrounding Trekkopje, Arandis and the old Khan Mine with the B2 trunk road cutting through its south-eastern border. It was registered as a conservancy in 2004 and has an entirely rural population of approximately 3 000 people who make a living from farming with goats and livestock, relying considerably on cash remittances from family members who have jobs elsewhere and from social welfare grants for children and pensioners (Ashby Associates, 2023).

The #Gaingu Conservancy is a legally recognised community conservation organization, gazetted in 2004, that enables the people living in the communal area to have rights to actively manage natural resources in that area and to generate returns from them. Conservancies are typically defined by social ties uniting groups of people with the common goal of conservation.

[10] Pers Com. Geraldine Tjiramba, Accountant, ATC on 15/3/2023 (Ashby Associates, 2023)

The 2021 Namibian Association of Community Based Natural Resource Management (CBNRM) Support Organisations (NACSO) institutional report on the conservancy noted that it maintains excellent communication with stakeholders and conservancy members hold its management committee accountable. Its main enterprise is the Spitzkoppe Community Campsite which employed 21 staff of whom 17 were women in 2021. Some conservancy members are small scale miners for semi-precious stones which can be found in some of the mountains in the region (NACSO, 2023).

6.13.6.3 Vulnerable Populations Living in the Project Area

Namibia signed the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007. The Constitution of Namibia emphasises equality and freedom from discrimination on the grounds of sex, race, colour, ethnic origin, religion, creed or social or economic status (Article 10).

"While most people in Namibia can be characterized in a strict sense as indigenous to the area, the San, Himba, Ovatua, Ovatjimba, and Ovazemba are recognized by the Government as particularly marginalized groups. The conditions of these groups, especially relative to other segments of the population of Namibia, can be identified as similar to those of groups identified as indigenous worldwide" (Anaya, 2013).

The 2011 census identified 37 San-speaking households living in urban areas in the whole of the Erongo Region but did not differentiate within Otjiherero-speaking peoples, which includes the Himba. Should any indigenous peoples be living in the coastal towns, it is expected that their households are known to local level political structures, such as councillors, as they are entitled to food aid distributed by government (Ashby Associates, 2023).

There were no specific vulnerable/indigenous people identified to be present/living at the site proposed for the NMF and its surrounds.

6.13.7 Economy

The Erongo region of Namibia is a vital economic zone within Namibia, renowned for its mining, fishing and tourism industries. The section below provides an overview of the key economic sectors within the Erongo Region.

6.13.7.1 Mining

Mining plays an important role nationally, consistently contributing approximately 14% to the Namibian Gross Domestic Product (GDP) (National Planning Commission, 2023). The Erongo Region houses a number of mines with uranium, gold and salt production the dominant activities while the processing of marble and granite are secondary mining activities (Erongo Regional Council, 2022). A number of small scale semi-precious stone mines also operate in the region (Erongo Regional Council, 2024).

The Mining Sector in the Erongo Region has been characterised by the establishment and expansion of a number of Uranium mines over the past decade due to an increased demand for this energy source. Currently the following mines are either actively mining or are in the process of readying for production in the Erongo Region (Erongo Regional Council, 2024):

- Rossing Uranium
- Langer Heinrich
- Orano (formerly AREVA Resources)
- Swakop Uranium
- Bannerman Resources
- Valencia Uranium Project

- Reptile Uranium

The Rossing Uranium Mine the closest operational mine to the Project area and is a significant employer in the region, while the salt works in Walvis Bay and to the south of Swakopmund produce salt for export to southern and western Africa (Erongo Regional Council, 2024).

Small-scale mining provides a livelihood to a number of households in the region. There are approximately 2,000 small-scale miners in the Erongo Region, operating in cooperatives, with the semi-precious stones sold on the roadside or to local buyers (Erongo Regional Council, 2022). During consultation it was noted that the mining of semi-precious stones is a key livelihood strategy for households within the Erongo Region as well as the conservancy (SEIA specific consultation, 2024).

As detailed in Section 6.13.3.2 the mining sector is also one of the key contributors to employment both within the Erongo Region as well as the Arandis Constituency.

6.13.7.2 Fishing

The fishing industry is the third largest economic sector contributed about 6.6% to the GDP and is the country's second biggest export earner of foreign currency after mining (Erongo Regional Council, 2024).

Within the Erongo Region the fishing industry is directly responsible for approximately 160 businesses and the employment of 8,000 people (Erongo Regional Council, 2022). As detailed in Section 6.13.3.2, the agriculture, forestry and fishing sector is the third biggest employer in the region.

Fishing related activities are mostly confined to the coastal towns of Swakopmund, Walvis Bay and Henties Bay. No fishing related activities are taking place within Arandis which is the closest town to the Project site. However, there may be people employed within the fishing industry who reside in Arandis.

6.13.7.3 Agriculture

Approximately 47% of the Namibian population is reliant on agricultural activities to sustain their livelihoods, the majority of which is in the form of subsistence agriculture (Erongo Regional Council, 2024). The eastern part of the Erongo Region is characterised by livestock farming on commercial farms as well as in communal areas, while limited commercial crop farming is practiced in isolated areas (Erongo Regional Council, 2024). As detailed in Section 6.13.3.4 agriculture remains a key source of income for households with rural parts of the Erongo Region.

During consultation it was noted that within the #Gaingu Conservancy, within which the Project is proposed, agriculture is a key livelihood strategy with households using communal land for the grazing of sheep and goats while produce is grown in home gardens (SEIA specific consultation, 2024).

Whilst agriculture is a key economic driver in the region, no significant agricultural activity takes place within the Project area.

6.13.7.4 Tourism

Tourism is a key sector within the regional economy making a big contribution to job creation both directly and indirectly (Erongo Regional Council, 2022). The tourism sector is based largely around the natural environment and history of the area. The coastal area is a popular tourist destination for both local and international tourists while there are also two national parks, a seal reserve, four communal conservancies and a number of private game reserves within the district (Erongo Regional Council, 2022).

While the NMF is located within the #Gaingu Conservancy there are no existing tourism facilities or tourist attractions in close proximity to the proposed site (SEIA specific consultation, 2024). The closest tourism facilities within the #Gaingu Conservancy are located at Spitzkoppe approximately 50 km northeast of the site. The access road to Spitzkoppe does not pass the proposed site.

6.13.8 Waste management

Waste disposal is one of the major concerns with the current solid waste management system in Namibia (MEFT, 2017), with the disposal of general waste the responsibility of the local authorities. In this regard within the Erongo Region each municipality is responsible for their own general waste. During consultation it was noted that a number of these facilities are reaching capacity and are faced by various challenges including proximity to residential areas and controlled access to the site (SEIA specific consultation, 2024).

Namibia currently only has two hazardous landfill sites, one in Windhoek and the other in Walvis Bay within the Erongo Region. While the Kupferberg facility in Windhoek reportedly has two years airspace remaining, and the facility in Walvis Bay is not an engineered disposal facility (SLR, 2024).

The majority of the hazardous waste generated by mines within the Erongo Region as well as waste from the Walvis Bay Port, medical waste and asbestos is currently disposed of at the Walvis Bay facility (SEIA specific consultation, 2024). In 2018 it was estimated that the facility had sufficient capacity for a further 10 years, suggesting it now has approximately four years capacity remaining (Walvis Bay, 2021). During consultation it was noted that the biggest challenge facing the facility is preventing ‘scavengers’ accessing the site. The ‘scavengers’ access the site to salvage various items for personal use and sale. This has been identified as a significant liability risk for the municipality as well as the parties disposing of their waste at the site. As a result of this at the time when consultation was undertaken the site had been temporarily closed with mines and other businesses having to store hazardous waste on their sites (SEIA specific consultation, 2024). It was noted anecdotally during consultation that while complaints are received from communities in Walvis Bay about smoke and dust generated by the general waste section of the Walvis Bay facility, concerns have not been raised regarding the hazardous waste site section of the facility (SEIA specific consultation, 2024).

6.13.9 Health and social concerns

Health services throughout the Erongo Region are by in large located within the urban centres with limited access in rural areas. By inference most medical staff are therefore also based in urban centres with a shortage of public sector medical staff in rural areas (Erongo Regional Council, 2022).

The most common social issues identified within the Erongo Region included (Erongo Regional Council, 2022):

- Poverty-related issues
- COVID-19
- Marital-cohabitation cases
- Stress and depression
- Gender Based Violence (GVB)
- Substance abuse
- Bereavement death
- Attempted suicide

- HIV and AIDS
- Psychiatric cases

During consultation it was noted that the issues such as lack of permanent employment (contributing to poverty), unemployment and substance abuse were the biggest social challenges facing communities in the region (SEIA specific consultation, 2024).

6.13.10 Connectivity

Currently road transport is the main means of transporting goods in Namibia with only five percent of goods from Walvis Bay (the largest commercial port in Namibia) transported by rail (Erongo Regional Council, 2022). Arandis town is strategically located along the B2 which connects the coast with Windhoek and forms part of the Trans-Caprivi and Trans-Kalahari highways (Erongo Regional Council, 2022). As a major transport route within Namibia the road carries significant amounts of traffic, and in particular trucks. During consultation it was noted anecdotally that the section of B2 between Swakopmund and Okahandja was considered one of the more dangerous sections of road in terms of traffic accidents in the country (SEIA specific consultation, 2024). This was corroborated by the Erongo Regional Council (2022) where it is noted that the 50 km east and west of the Arandis Junction (the exit off the B2 to Arandis town) has been identified as one of the most accident-prone sections of road in Namibia.

6.14 Traffic

A Traffic Impact Assessment (TIA) was undertaken by Burmeister and Partners for the proposed Project (Appendix G). The study aimed to establish the baseline conditions in terms of transport/traffic infrastructure at the Project site and surrounds and identify potential impacts, identify appropriate mitigation measures and upgrading requirements.

Available information pertaining to the existing traffic on the proposed routes to be used by project traffic as well as adjoining roads was requested from the Namibian Roads Authority (RA). The RA has established traffic counting stations throughout the national road network and readily provides traffic count data when requested. Table 6-46 below gives a summary of data collected from counting station 021 which is located on the B2 national road between Swakopmund and Arandis, see Figure 6-72 below. This information was correlated with data gathered during the TIA traffic count with the note that the RA data is an average of data gathered continuously over 348 days whereas the traffic counts were carried out over a 12-hour period during 1 day.

Table 6-46: Count Summary Swakopmund - Arandis Road

Station 021	Lane 1	Lane 2	Road
Light	1254	1052	2306
Heavy	531	446	977
%HV	29.7%	29.8%	29.8%
ADT	1785	1498	3283

Figure 6-72: Location of Counting Station 021

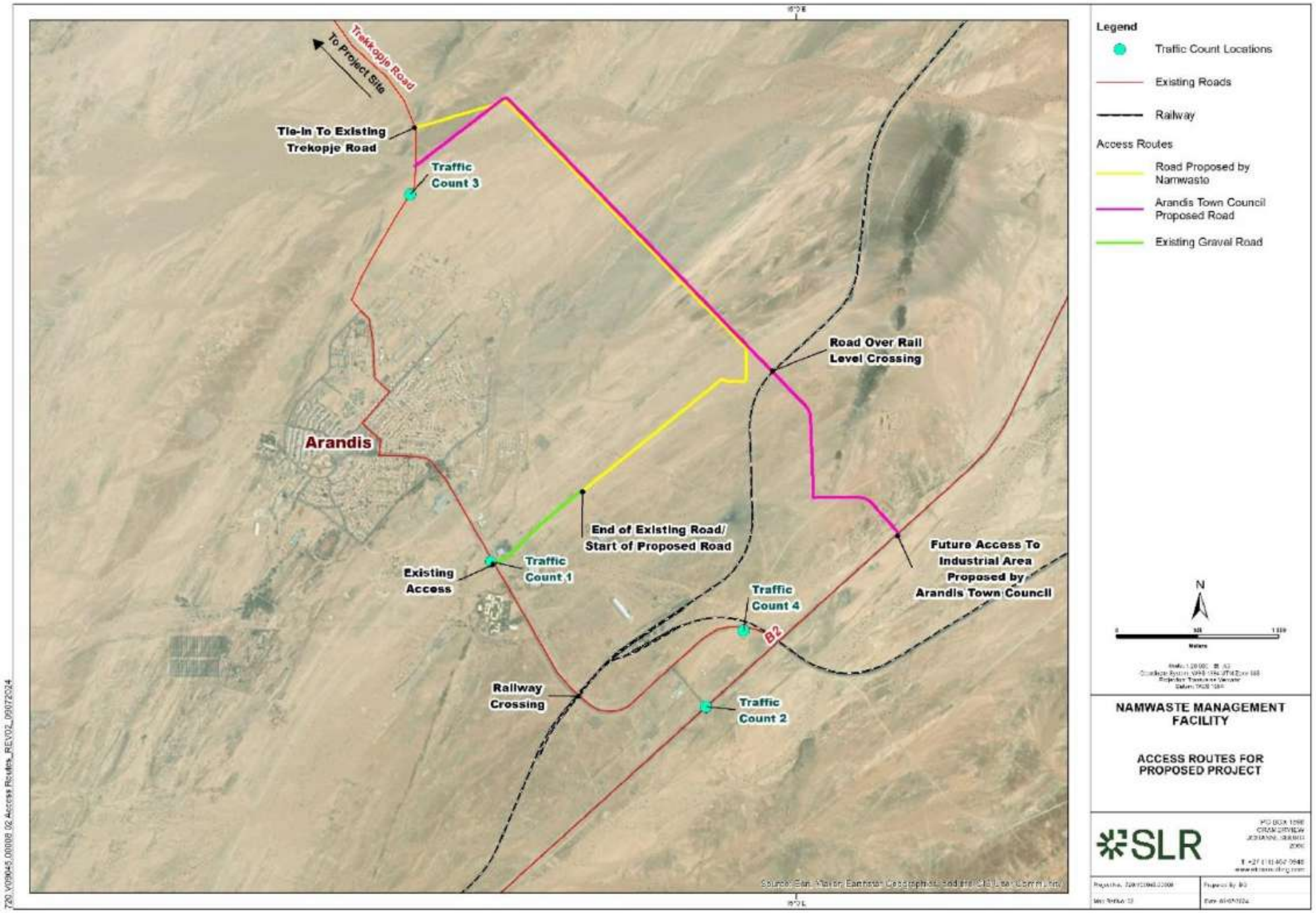

Figure 6-73: Proposed NMF access routes and Burmeister traffic count locations

On-site traffic counts were done on the 16th of February 2024 to complement the data gathered from the RA and provide a basis for the level of service (LoS) analysis at the route intersections. Counters were positioned at the locations shown in Figure 6-73 and the traffic counts were done over a 12-hour period starting at 06h30. The consultant also used this time to assess safety related aspects along the proposed routes. Table 6-47 below shows a summary of the traffic count data, and Figure 6-74 presents schematic layouts of the intersections with different vehicular movements.

Table 6-47: Traffic Count Summary

Position	Control Condition	12-hour Count Total	% Heavy Vehicles
Traffic Count 1	Stop along North-South leg	3135	23
Traffic Count 2	Stop along North-South leg	864	38
Traffic Count 3	Stop along East-West leg	1253	12
Traffic Count 4	No intersection	10	0

As can be seen in Figure 6-74 below, the existing intersection incorporates dedicated turning lanes for traffic turning off the B2 towards Arandis. This allows for safe turning manoeuvres on a road with significant traffic volumes.

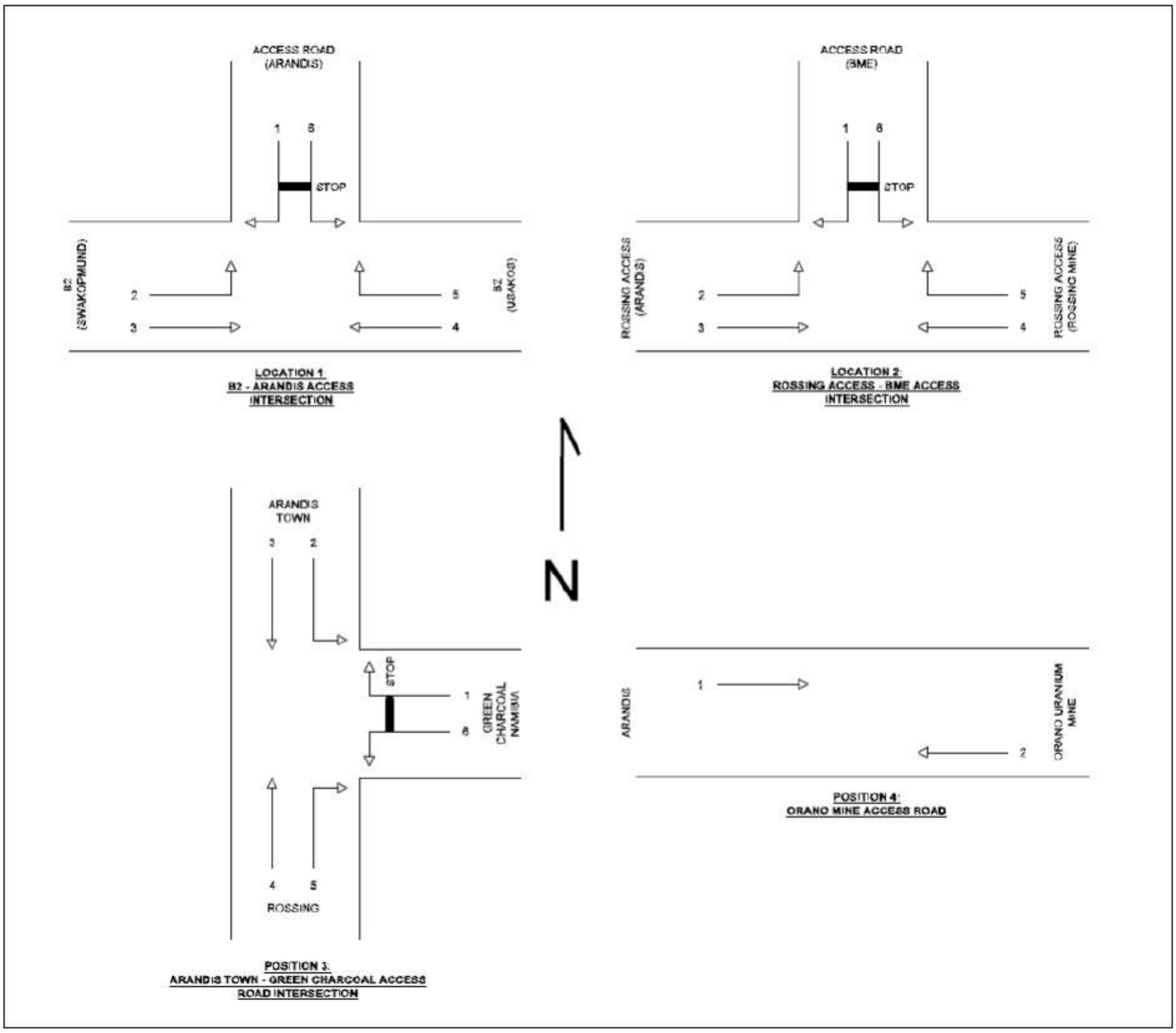

Figure 6-74: Schematic layout of intersection

The AutoJ Traffic Analysis software was used to determine the existing LoS experienced at the intersections along the proposed route and thereby established a baseline against which to measure the impact of the additional traffic generated by the Namwaste project. Table 6-48 below gives an overview of the factors considered, as well as their applicable ranges, for the final LoS rating calculated for an intersection.

Table 6-48: Level of Service Summary

Level of Service	V/C	Delay (seconds)	General Description
A	< 0.5	< 10	Free flow
B	0.5 < x < 0.8	10 < x < 15	Stable flow (slight delay)
C	0.8 < x < 0.9	15 < x < 25	Stable flow (acceptable delay)
D	0.9 < x < 0.95	25 < x < 35	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	0.95 < x < 0.99	35 < x < 50	Unstable flow (intolerable delay)
F	0.99 < x	50 < x	Forced flow (jammed)

Note: Volume to Capacity ratio [v/c], a value more than 0.99 indicates forced flow conditions at the intersection – improvements should be considered before this value is reached.

Average delay, in seconds, experienced by vehicles decelerating, waiting to be served, and finally accelerating. A delay of more than 50 seconds is considered unacceptable, and as with the v/c ratio, improvements should be considered before this point is reached.

The baseline LoS calculated using the traffic count data is shown in the tables below, this is the existing LoS experienced by drivers using the intersections at count locations 1-3. The existing traffic volumes allow for an A rating at the relevant intersections.

Table 6-49: Intersection 1 existing LoS

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
Control type		PI	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
Priority	Xns	79%		0.07	0.04	0.20	0.06		9	9	9	4

Table 6-50: Intersection 2 existing LoS

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
Control type		PI	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
Priority	Xns	92%		0.12	0.01	0.06	0.05		9	9	9	2

Table 6-51: Intersection 3 existing LoS

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
Control type		PI	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
Priority	Xwe	96%		0.04	0.02	0.06	0.04		0	0	0	0

It is further noted that the RA has commenced proceedings for the upgrading of the B2 road between Swakopmund and Usakos. The AutoJ summary below (Table 6-52 to Table 6-54) shows the LoS experienced at count locations 1-3 during the construction period.

Table 6-52: Intersection 1 LoS during construction phase

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
		Perf Index	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
best ICD	Xns	79%		0.07	0.04	0.22	0.06		9	9	10	4
best signal	2	45%		0.11	0.07	0.18	0.09		25	18	16	14

Table 6-53: Intersection 2 LoS during construction phase

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
		Perf Index	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
best ICD	Xns	92%		0.07	0.01	0.06	0.04		9	9	9	3
best signal	2	45%		0.12	0.02	0.09	0.07		21	15	25	10

Table 6-54: Intersection 3 LoS during construction phase

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
		Perf Index	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
best ICD	Xwe	96%		0.04	0.02	0.06	0.04		0	0	0	0
best signal	2	36%		0.06	0.04	0.08	0.05		3	20	25	5

A construction period of 8 months was assumed as well as:

- Stone will be delivered from the nearest available quarry.
- Concrete will be delivered from Swakopmund.

Construction phase traffic is therefore predominantly expected along the B2 from the west, with an approximate 6 vehicles per hour (vph) added by the stone and concrete trucks.

In assessing the capacity along this route, the following should be noted:

- The B2 national road can be classified as a Class I two-lane highway in accordance with the Highway Capacity Manual (HCM), overtaking on such roads is done by passing vehicles via the oncoming traffic lane when a safe passing opportunity is presented.
- A road of this class can theoretically accommodate 1800 vph.
- Passing opportunities on such roads are dictated by gaps in opposing traffic and sight distances for safe passing, and ultimately affect the vph rating – fewer passing opportunities mean vehicles get caught in slow-moving platoons while waiting to pass.
- The Swakopmund-Arandis road has no dedicated passing areas but extensive sections with sufficient passing sight distances – the consultant does not anticipate a significant decline in the theoretical vph rating which can be accommodated on the road.

As per the AutoJ Traffic analysis based on the traffic data collected during the traffic counts, the highest peak traffic at location 1 is from the West and equates to 199 vph with a total Average Daily Traffic of 3749 – this corresponds to a LoS rating of A-C which is acceptable. With an additional 6 vph the LoS is not expected to be severely degraded. No mitigation or monitoring is recommended.

The Business Case 1 traffic is expected to be the worst-case scenario regarding the LoS at the relevant intersections. The summary tables (Table 6-55 to Table 6-57) presented below show the LoS which can be expected at the intersections once the NMF starts operations. The consultant applied a 1% annual growth in traffic over the course of 62 years.

Table 6-55: Intersection 1 LoS operational phase

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
		Perf Index	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
best ICD	RR	82%		0.16	0.07	0.22	0.12		7	6	7	7
best signal	2	47%		0.22	0.14	0.36	0.18		26	18	18	15
Control type		PI	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
Priority	Xns	75%		0.15	0.10	0.61	0.15		9	9	14	5

A roundabout at the intersection would provide a better LoS with the added traffic however, the existing intersection still provides an A rated LoS.

Table 6-56: Intersection 2 LoS operational phase

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
		Perf Index	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
best ICD	Xns	93%		0.17	0.03	0.13	0.10		9	9	9	3
best signal	2	48%		0.25	0.04	0.20	0.14		22	15	25	11

Table 6-57: Intersection 3 LoS operational phase

			Volume / Capacity (max)					Delay / vehicle (max)				
	weighting	100%		18%	4%	18%	10%		4%	7%	4%	10%
		Perf Index	Peds	AM	off	PM	i/s ave	Peds	AM	off	PM	i/s ave
best ICD	Xwe	96%		0.04	0.02	0.06	0.04		0	0	0	0
best signal	2	36%		0.06	0.04	0.08	0.05		3	20	25	5

Table 6-55 to Table 6-57 indicate that except for Intersection 1, the existing intersections provide the best LoS rating in terms of v/c and delay/vehicle.

Additionally, during the operational phase it is anticipated that 14 vehicles will deliver waste to the facility over a 12-hour period. It is assumed that vehicles will deliver from both East and West legs of the B2 at the Arandis turn-off. This is based on Business Case 1, the worst-case scenario, and amounts to approximately 2 additional vehicles per hour added to the relevant peak. With a 1% annual growth rate applied over 62 years, the additional traffic will not degrade the level of service along the B2 significantly.

7.0 Impact Description and Assessment

This chapter describes potential issues and presents the evaluation of potential impacts associated with the proposed project.

7.1 Summary of Impacts Assessed

The Scoping phase identified several impacts to biological/biodiversity, socio-economic and physical aspects of the environment. These key issues and impacts were identified by the EIA project team with inputs made by I&APs (where applicable). A Plan of Study to evaluate the significance of these impacts was presented in the Scoping Report along with Terms of Reference for the specialist studies. In the EIA phase, these impacts were assessed further by SLR or, where necessary, by specialist consultants who were required to confirm the potential impacts, as well as identify any others, and assess the significance thereof.

This chapter describes and assesses the significance of the potential impacts identified and provides a description of the interactions between the Project activities and the receiving environment.

All recommended mitigation measures and monitoring requirements, regardless of impact significance, have been incorporated in the EMP (Appendix O).

Table 7-1 below provides a summary of the potential impacts identified and assessed before and after mitigation related to the Project's interaction with the physical, biological, socio-economic and archaeological aspects of the environment. The results of the assessment of the various impacts are presented in sections 7.3 to 7.5.3.

Table 7-1: Summary of potential impacts assessed for all Project Phases

Type of impact	Activity	Status of potential impact prior to mitigation	Indicative approach to assessment
Land uses and capability			
Direct and Cumulative	Loss of Land Capability, Soil Erosion and Compaction	Negative	• Assessment of agricultural and land use potential to determine potential loss – Soils and Agricultural Assessment.
Biodiversity			
Direct and Cumulative	Destruction of Habitat and Organisms	Negative	• Assessment of flora and fauna to determine potential loss – Biodiversity Assessment. • Assessment of alteration of surface water flows – Hydrological Assessment.
Direct and Cumulative	Disturbance of Animals and Interference with their Behaviour	Negative	• Assessment of fauna to determine potential risks – Biodiversity Assessment.
Direct and Cumulative	Soil and Water Contamination	Negative	• Assessment of flora and fauna to determine potential risks – Biodiversity Assessment. • Assessment of surface and groundwater contamination – hydrological and hydrogeological assessments

Type of impact	Activity	Status of potential impact prior to mitigation	Indicative approach to assessment
Indirect and Cumulative	Vehicle Tracks	Negative	• Assessment of flora and fauna to determine potential risks – Biodiversity Assessment.
Direct and Cumulative	Light Pollution	Negative	• Assessment of flora and fauna to determine potential risks – Biodiversity Assessment.
Social			
Direct	Increased employment opportunities	Positive	• Assessment of potential benefits – Socio-economic Assessment.
Direct	Increased opportunities for local contractors and businesses	Positive	• Assessment of potential benefits – Socio-economic Assessment.
Direct and Cumulative	Reduced road safety	Negative	• Assessment of potential risks – Socio-economic Assessment.
Indirect	Increased spread of disease	Negative	• Assessment of potential risks – Socio-economic Assessment
Indirect	Increased tension and conflict	Negative	• Assessment of potential risks – Socio-economic Assessment.
Direct	Increased permanent employment opportunities	Positive	• Assessment of potential benefits – Socio-economic Assessment.
Direct	Compliance with waste management standards	Positive	• Assessment of potential benefits – Socio-economic Assessment.
Direct	Loss of revenue for the Walvis Bay Municipality	Negative	• Assessment of potential risks – Socio-economic Assessment.
Direct	Increased support for community	Positive	• Assessment of potential benefits – Socio-economic Assessment.
Direct	Perceived health risks associated with hazardous waste	Negative	• Assessment of potential risks to health – Air Quality Impact Assessment
Indirect	Perceived risks due to the transportation of hazardous waste	Negative	• Assessment of potential risks – Socio-economic Assessment. • Assessment of potential safety risks – Traffic Impact Assessment
Indirect	Perceived risk associated with increased traffic	Negative	• Assessment of potential risks – Socio-economic Assessment. • Assessment of potential risks – Traffic Impact Assessment
Climate change			
Direct and Cumulative	Greenhouse gas emission contributions (climate protection)	Negative	• Air Quality Impact Assessment to quantify potential greenhouse gas emissions.
Traffic			
Direct	Increased volume of heavy vehicles on the access roads and high-risk nature of the loads of hazardous waste on the vehicles resulting in road safety concerns.	Negative	• Traffic Impact Assessment to assess the potential change in vehicle volumes and the likely impacts on road safety.

Type of impact	Activity	Status of potential impact prior to mitigation	Indicative approach to assessment
Direct	Increased volume of heavy vehicles on the access roads causing degradation to road infrastructure and level of service.	Negative	• Traffic Impact Assessment to consider the suitability of the access roads and intersections for the potential traffic load.
Heritage			
Direct	Destruction of heritage resources on the site	Negative	• Assessment of heritage resources to determine potential risks – Heritage Assessment.
Hydrogeology			
Direct	Disruption of natural groundwater recharge conditions	Negative	• Assessment of potential risks – Hydrogeological Impact Assessment
Direct and Cumulative	Groundwater contamination through development over existing borehole (WW206579)	Negative	• Sensitive receptors to be identified. • Specialist Hydrogeological Impact Assessment to model the dispersion plume and assess impacts on identified receptors.
Direct and Cumulative	Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems	Negative	• Specialist Hydrogeological Impact Assessment to determine the contaminant sources, model the dispersion plume and assess impacts on groundwater quality.
Direct and Cumulative	Groundwater contamination as a result of leachate seepage from facility	Negative	• Specialist Hydrogeological Impact Assessment to determine the contaminant sources, model the dispersion plume and assess impacts on groundwater quality.
Direct	Local aquifer drawdown as a result of groundwater abstraction	Negative	• Assessment of potential risks – Hydrogeological Impact Assessment
Hydrology			
Direct	Contamination of surface water resources	Negative	• Hydrological Assessment to consider potential risks during construction and operation.
Direct	Alteration of natural drainage paths and flows	Negative	• Hydrological Assessment to determine management of storm water during construction and operations.
Direct	Flood risk to the NMF from upstream surface flows. Reduction in runoff volumes to the catchment from containment of runoff	Negative	• Hydrological Assessment to determine typical and extreme flows. • Consideration of designs of storm water facilities by EAP and hydrological specialist to ensure maximum diversion of clean storm water to the environment.
Air Quality			
Indirect	Increase in local dust fall levels resulting in nuisance at receptors	Negative	• Air Quality Impact Assessment to compile emissions inventory to identify sources; undertake modelling to predict emissions and estimate dispersion

Type of impact	Activity	Status of potential impact prior to mitigation	Indicative approach to assessment
			plumes for dustfall, particulates and criteria air pollutants.
Direct	Increase in odours at receptors	Negative	• Air Quality Impact Assessment to assess potential for odour generating activities and to consider dispersion of such gases to receptors.
Direct	Increase in gaseous emissions	Negative	• Air Quality Impact Assessment to compile emissions inventory to identify sources; undertake modelling to predict emissions and estimate dispersion plumes for dustfall, particulates and criteria air pollutants.
Direct	Increase in ambient levels of criteria air pollutants at receptors	Negative	• Air Quality Impact Assessment to assess emissions of criteria air pollutants against legislated limits.
Indirect	Health impacts (acute and chronic) and nuisance at sensitive receptors	Negative	• Air Quality Impact Assessment to compare modelling and dispersion results against legislated and best practice limits to assess health risks to key receptors.

7.2 Methodology for Assessing Impacts

7.2.1 Environmental assessment methodology

Part A (Table 7-2) 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 (Table 7-3) and Part C (Table 7-5). The interpretation of the impact significance is given in Part D (Table 7-5). Both mitigated and unmitigated scenarios are considered for each impact.

Table 7-2: Criteria for assessing impacts

PART A: DEFINITIONS AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, spatial extent and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.

	M	Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**VL**	Very short, always less than a year. Quickly reversible
	L	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	M	Medium-term, 5 to 10 years.
	H	Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)
	VH	Very long, permanent, +20 years (Irreversible. Beyond closure)
Criteria for ranking the EXTENT of impacts	**VL**	A part of the site/property.
	L	Whole site.
	M	Beyond the site boundary, affecting immediate neighbours
	H	Local area, extending far beyond site boundary.
	VH	Regional/National

Table 7-3 presents the matrices used for determining the consequence of the impact. The consequence is a product of the intensity, duration and extent of the impact.

Table 7-3: Matrices used for determining the consequence of the impact

PART B: DETERMINING CONSEQUENCE – APPLIES TO POSITIVE OR ADVERSE IMPACTS						
		EXTENT				
		Site	Whole site	Beyond the site, affecting neighbours	Local area, extending far beyond site	Regional/ National
INTENSITY = VL						
DURATION	Very long term /permanent	Low	Low	Medium	Medium	Medium
	Long term	Very Low	Low	Low	Medium	Medium
	Medium term	Very Low	Low	Low	Low	Medium
	Short term	Very low	Very Low	Low	Low	Low
	Very short term	Very low	Very Low	Very Low	Very Low	Low
INTENSITY = L						
DURATION	Very long term /permanent	Low	Medium	Medium	High	High
	Long term	Low	Medium	Medium	Medium	High
	Medium term	Low	Low	Medium	Medium	Medium
	Short term	Very low	Low	Low	Medium	Medium
	Very short term	Very low	Very low	Low	Low	Low
INTENSITY = M						
DURATION	Very long term /permanent	Medium	Medium	High	High	Very High

	Long term	Low	Medium	Medium	High	High
	Medium term	Low	Medium	Medium	Medium	High
	Short term	Low	Low	Medium	Medium	Medium
	Very short term	Very low	Low	Low	Low	Medium
INTENSITY = H						
DURATION	Very long term /permanent	Medium	High	High	Very High	Very High
	Long term	Medium	Medium	High	High	Very High
	Medium term	Low	Medium	Medium	High	High
	Short term	Low	Medium	Medium	Medium	High
	Very short term	Very low	Low	Low	Medium	Medium
INTENSITY = VH						
DURATION	Very long term /permanent	Medium	High	Very High	Very High	Very High
	Long term	Medium	High	High	Very High	Very High
	Medium term	Medium	Medium	High	High	Very High
	Short term	Low	Medium	Medium	High	High
	Very short term	Low	Low	Medium	Medium	Medium

Table 7-4 presents the matrix used to determine the significance or overall rating of the impact. The significance of the impact is a product of consequence and probability of the impact occurring. The interpretation of the significance of the impact is provided in Table 7-5 below.

Table 7-4: Matrix used for determining the significance of the impact

PART C: DETERMINING SIGNIFICANCE - APPLIES TO POSITIVE OR ADVERSE IMPACTS

PROBABILITY (of exposure to impacts)	**Definite/ Continuous**	**VH**	**Very Low**	**Low**	**Medium**	**High**	**Very High**
	Probable	**H**	**Very Low**	**Low**	**Medium**	**High**	**Very High**
	Possible/ frequent	**M**	**Very Low**	**Very Low**	**Low**	**Medium**	**High**
	Conceivable	**L**	**Insignificant**	**Very Low**	**Low**	**Medium**	**High**
	Unlikely/ improbable	**VL**	**Insignificant**	**Insignificant**	**Very Low**	**Low**	**Medium**
			VL	**L**	**M**	**H**	**VH**
			CONSEQUENCE				

Table 7-5: Interpretation of the significance of the impact

PART D: INTERPRETATION OF IMPACT SIGNIFICANCE		
Significance		Description
Very High -	Very High +	Represents a key factor in decision-making. Adverse impact would be considered a potential fatal flaw unless mitigated to lower significance.
High -	High +	These beneficial or adverse impacts are considered to be very important considerations and must have an influence on the decision. In the case of adverse impacts, substantial mitigation will be required.
Medium -	Medium +	These beneficial or adverse impacts may be important but are not likely to be key decision-making factors. In the case of adverse impacts, mitigation will be required.
Low -	Low +	These beneficial or adverse impacts are unlikely to have a real influence on the decision. In the case of adverse impacts, limited mitigation is likely to be required.
Very Low -	Very Low +	These beneficial or adverse impacts will not have an influence on the decision. In the case of adverse impacts, mitigation is not required.
Insignificant		Inconsequential, not requiring any consideration.

7.2.1.1 Additional assessment criteria

Table 7-6 presents a description of the additional assessment criteria that were taken into consideration in the impact assessment process to further describe the impact and support the interpretation of significance in the impact assessment process.

Table 7-6: Description of additional assessment criteria

Criteria	Description
Degree to which the impact can be reversed	
Irreversible	Where the impact cannot be reversed and is permanent.
Partially reversible	Where the impact can be partially reversed and is temporary.
Fully reversible	Where the impact can be completely reversed.
Degree of irreplaceable resource loss	
None	Will not cause irreplaceable loss.
Low	Where the activity results in a marginal effect on an irreplaceable resource.
Medium	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
High	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Degree of to which the impact can be avoided	
None	Impact cannot be avoided and consideration should be given to compensation and offsets.
Low	Impact cannot be avoided but can be mitigated to acceptable levels through rehabilitation and restoration.
Medium	Impact cannot be avoided, but the significance can be reduced through mitigation measures.

Criteria	Description
High	Impact can be avoided through the implementation of preventative mitigation measures.
Degree to which the impact can be mitigated	
None	No mitigation is possible or mitigation even if applied would not change the impact.
Low	Some mitigation is possible but will have marginal effect in reducing the impact significance rating.
Medium	Mitigation is feasible and will may reduce the impact significance rating.
High	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the impact significance rating.
Potential for cumulative impacts	
Unlikely	Low likelihood of cumulative impacts arising.
Possible	Cumulative impacts with other activities or projects may arise.
Likely	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

7.2.2 Heritage Impact Assessment Methodology

In Namibia, the significance and vulnerability rating of heritage impact assessment follow standard methodology devised by the National Heritage Council with its "Guidelines for Heritage Impact Assessment of the National Heritage Council (2021)" shown in Table 7-7 and Table 7-8 and those adopted by the Council on the basis of an evaluation developed by the Quaternary Research Services (Kinahan 2012).

Table 7-7: Heritage Significance rating table as per the National Heritage Council, 2021.

LEVEL OF SIGNIFICANCE	GRADING	DESCRIPTION
Exceptional/upper higher	5	• Major national heritage resources. • Rare & outstanding example. • Containing unique evidence of high regional & national significance.
Considerable high	4	• Very important to the heritage of the region. • High degree of integrity/ authenticity. • Multi-component site and objects • High research potential
Moderate	3	• Contributes to the heritage of the locality and region • Has 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 find in undisturbed primary context, with diagnostic materials

LEVEL OF SIGNIFICANCE	GRADING	DESCRIPTION
		• Makes some contribution to the heritage of the locality, usually in the combination with similar places or objects.
Little	1	• Makes 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

Table 7-8:The vulnerability rating table with key attributes adopted by the National Heritage Council, 2021.

VULNERABILITY RATING
0. Not Vulnerable 1. No threat posed by current or proposed development activities 2. Low or indirect threat from possible consequences of development (e.g. soil erosion) 3. Probable threat from inadvertent disturbance due to proximity of development 4. High likelihood of partial disturbance or destruction due to close proximity of development 5. Direct and certain threat of major disturbance or total destruction

In an effort to measure the sensitivity of archaeological sites considering their significance and vulnerability rating in Tables 7-7 and 7-8, the assessment also estimated the extent of the possible impact, the magnitude of the impact, and the duration of these impacts on sensitive heritage resources. The scales of estimation developed by Quaternary Research Services (Kinahan 2012) are replicated below in Table 7-9.

Table 7-9: Assessment criteria for the evaluation of cumulative impacts on archaeological heritage sites adopted by the National Heritage Council, 2021

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	National Regional Local	Within Namibia Within the Region On site or within 200m of the site impact
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 Social and/or natural functions and/ or processes remain unaltered

CRITERIA	CATEGORY	DESCRIPTION
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

7.3 Impacts on the Physical Environment

7.3.1 Soils, Land Use, Land Capability and Agriculture

7.3.1.1 Potential Impact: Loss of Land Capability, Soil Erosion and Compaction - Construction Phase

Description of the Impact

The proposed development will result in the stripping of soils and alterations to the existing land uses. The changes in the land use will be from natural processes to infrastructure (i.e. waste management facility).

Construction of the waste management facility infrastructure and cells will take place together with the erection of transmission lines and pipelines (e.g. bulk water). During the construction phase, clearing would have to be undertaken for all other infrastructure associated with the proposed project. Access roads will be created with cut and fill for platforms, cell basin excavation and trenches being dug for the installation of relevant drainage systems. Contractor and laydown yards will also be cleared with construction material being transported to laydown yards. Cell construction will be on-going at intervals throughout the lifetime of the Project. The removal of vegetation and changes to the local topography could result in an alteration to surface run-off dynamics.

Impact Assessment

The proposed activities will impact on areas expected to be of low to very low potential, with some aspects affecting low sensitivity areas. It is possible that natural land resources, with a medium and sometimes higher sensitivity, could become fragmented notably along drainage lines and ridges.

The impact as it relates to the loss of land capability, soil erosion and soil compaction during the construction phase is given a significance of **Medium** without mitigation and **Low** with mitigation measures. The assessment of the impact is provided in Table 7-10.

Table 7-10: Impact assessment related to the loss of the land capability, soil erosion and compaction during the construction phase of the proposed NMF

Loss of the land capability, soil erosion and compaction		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Medium (Moderate)	Low (Minor)

Loss of the land capability, soil erosion and compaction		
Duration	Permanent (> 20 years)	Medium-term (5 to 10 years)
Extent	Whole site	Portion of site
Consequence	Medium	Low
Probability	Highly likely/definite/continuous	Probable/likely
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable (Available soils are highly prone to soil erosion, also associated to calcites which when disturbed with the increased traffic on-site lose their morphological structure as well. Possible occurrence of contamination of soils or hydrocarbon spills can affect the soil fertility as the plant nutrients are leached away. Once rocky surfaces are bare the surface overland flow and run-offs tend to have an increased velocity with a high sediment movement, also reducing the soil water holding capacity. These activities are the most disruptive to natural soil horizon distribution and cause soil mixing and layer inversion. It will impact on the current soil hydrological properties and functionality of the soil and may also result in a loss of topsoil. It will impact on the current soil chemical properties such as Cations Exchange Capacity (CEC) and functionality of the soil due to the loss of topsoil layers with a high base status for plant growth and rooting zone. Usually sodium concentrations above 200 mg/kg as observed in some samples, promotes particle deflocculation and dispersal of soil particle making them susceptible to transportation process like erosion. These activities are the most disruptive to natural soil horizon distribution and cause soil mixing and layer inversion. It will impact on the current soil hydrological properties and functionality of the soil and may also result in a loss of topsoil.	
Degree to which impact may cause irreplaceable loss of resources	High (The commuting of heavy and high traffic volumes on existing and new roads during the construction phase, erection of infrastructure compacts large micro-pores into smaller pores resulting in reduced plant available water, restriction in the plant rooting, reduced water infiltration rates and high runoffs. These impacts on soil functionality are mainly irreversible. Without proper mitigation measures, soil erosion can be a permanent impact)	
Degree to which impact can be avoided	Medium (During this phase soil resource losses are unavoidable; mitigation measures can be implemented from the onset to conserve the available soils)	
Degree to which impact can be mitigated	Medium (Naturally these soils are already prone to potential degradation, mitigation measures will preserve them and promote habitat development to support both flora and fauna.	
Residual impacts	Possible (If not properly mitigated these impacts will go beyond the life of the project.)	
Cumulative Impacts		
Nature of cumulative impacts	Possible (Associated infrastructure will be carried over into the operation phase of the project. Cumulative impacts are expected to occur with other activities or projects may arise)	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Insignificant
Management and Mitigation		
• Minimise project footprint as far as possible.		

Loss of the land capability, soil erosion and compaction
• Manage the location of building laydown foundations, laydown areas and topsoil stockpiles. • Strip, recover and stockpile all topsoil for later reuse. • Strip and stockpile topsoil and subsoil separately. • Demarcate topsoil stockpile areas and prevent stockpile erosion and contamination. • Handle soils with care from the construction phase through to the decommissioning phase. • The stockpiles themselves must be placed in locations of low land capability. • The topsoil stockpiles must be placed in their final location and must not be moved until the time comes to use the soil for rehabilitation. The topsoil should not be higher than 4m and dumped off the back of the dump truck into its final location. • No shaping of the topsoil stockpile is allowed, and no vehicles are allowed to drive on top of the stockpiles at any time. • Off-road vehicle activity must be strictly prohibited. • Local drainage lines outside of the project development area must remain strictly undisturbed. • Disturbed areas, not occupied by infrastructure, should be effectively rehabilitated post-construction. • Rehabilitation must aim to establish surface profiles and textures that fit with the landscape and only utilise locally appropriate, indigenous plant species. • Rehabilitated areas must be inspected and maintained until they are stable and self-sustaining. • Make use of existing roads or upgrades tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum. Usually, areas with sandy soils are avoided as far as possible for heavy vehicles, since these are the dominant soils, dust suppressions methods should be implemented to reduce wind erosion. • Implementation of embedded controls such as geotextiles, gabion baskets can effectively control soil erosion on-site, where necessary. • Introduce and enforce speed limits on all vehicles; maintain speed limits on site to minimise wind erosion; educate and sensitise personnel to avoid driving on bare rocky hillside prone to soil erosion. • Associated infrastructure foundations must be (preferably) located in already disturbed areas where possible. • Rehabilitation of the area must be initiated from the onset of the project. Soil stripped from infrastructure placement should be used to rehabilitate disturbed areas. • A stormwater management plan (SWMP) must be implemented for the development. Using drainage control measures and culverts to manage surface runoff. The plan must provide input into the road network and management measures. • Losses of fuel and lubricants from vehicles to be contained, use of biodegradable fluids as an alternative to mineral oil (e.g. Lubricants or Hydraulic oils) where feasible, avoid waste disposal on undesignated areas (outside the site proposed for the waste management facility) which are not contained. Clean spills (solid or liquid) up immediately.
Monitoring
• Monitor the activities of construction contractors to ensure that construction work will be restricted to the clearly defined limits of the construction site; and • Monitor the disturbed surfaces, topsoil stockpiles, rehabilitated areas, the functioning of drains and the maintenance of roads.

7.3.1.2 Potential Impact: Loss of Land Capability, Soil Erosion and Compaction – Operational Phase

Description of Impact

During the operational phase, limited impacts are expected. Working areas will be equipped with hard-standing, diversions and drains to reduce soil erosion on exposed areas. Activities will be limited to the footprint areas, to minimise soil and vegetation disturbance of the surrounding area. Soil suppression methods like geotextile sheets, gravel mulch may be carried out on exposed surrounding areas to avoid surface erosion where necessary. Maintenance of these soil covers, and associated infrastructure will have to be carried out throughout the life of the Project. It is expected that these maintenance practices can be undertaken by means of specialised labour.

The operational phase of the facility includes anthropogenic movement and activities. Possible compaction and erosion caused by increased traffic and surface water run-off for the area can be expected during this phase.

Impact Assessment

The impact as it relates to the loss of land capability, soil erosion and soil compaction during the operational phase is given a significance of **Medium** without mitigation and **Low** with mitigation measures. The assessment of the impact is provided in Table 7-11.

Table 7-11: Impact assessment related to the loss of land capability, soil fertility, soil erosion and compaction during the operational phase of the proposed NMF

Loss of land capability, soil fertility, soil erosion and compaction		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Operations	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Permanent (> 20 years)	Short- term (1 to 5 years)
Extent	Whole site and nearby surroundings	Part of site/and property
Consequence	High	Medium
Probability	Possible/ frequent (Medium)	Possible/frequent (Medium)
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	Loss of land capability and soil fertility: Partially reversable (Possible soil losses can occur on-site during this phase, which affect soil resources and quality of the water sources around the site due to sedimentation. Possible occurrence of contamination of soils or hydrocarbon spills will be carried over from the construction phase which can affect the soil fertility as the plant nutrients are leached away. Acidic bases or toxic heavy metals can accumulate in the soil profiles affecting the fertility of the soils. Alkaline bases like Ca can further increase due to possible contamination, which can enhance increased fixation of essential plant nutrients like P which are already low in the soils. It will impact on the current soil chemical properties such as Cations Exchange Capacity (CEC) and functionality. Possible soil contaminations can occur on-site during this phase, which affect soil resources and quality of the wate sources around the site. Soil particle disturbance is expected especially along access roads and on-site. Dust challenges can also promote wind erosion as operational material or by-products are transported back and forth) Soil erosion and compaction: Partially reversable (Possible soil contaminations can occur on-site during this phase, which affect soil resources and quality of the wate sources around the site.) Soil particle	

Loss of land capability, soil fertility, soil erosion and compaction		
	disturbance is expected especially along access roads and on-site. Dust challenges can also promote wind erosion as operational material or by-products are transported back and forth.	
Degree to which impact may cause irreplaceable loss of resources	Medium (With proper mitigation measures, soil erosion, compactions and soil fertility losses can be improved)	
Degree to which impact can be avoided	Medium (During this phase soil resource losses will reduce, as mitigation measures will already have been implemented on-site)	
Degree to which impact can be mitigated	Medium (Proper implemented degradation measures will be able to preserve the soil resources within the project footprint of the waste management facility)	
Residual impacts	Possible (If not properly mitigated these impacts will go beyond the life-span of the project.)	
Cumulative Impacts		
Nature of cumulative impacts	Possible (Associated infrastructure will be carried over into the operation phase of the project. Cumulative impacts are expected to occur with other activities or projects may arise)	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	Insignificant
Management and Mitigation		
• Ensure maintenance of the surface water management infrastructure so that no erosion results. • Prevent the disturbance of land beyond the approved infrastructure footprint. • Rehabilitation of the waste cells and associated infrastructure must be initiated from the onset of the Project or progressively as soon as practically possible through the operation phase. Topsoil stripped from infrastructure placement should be used for rehabilitation of disturbed areas. • Rehabilitation must aim to establish surface profiles and textures that fit with the landscape and only utilise locally appropriate, indigenous plant species. • Rehabilitated areas must be inspected and maintained until they are stable and self-sustaining. • Dust suppression methods should be implemented on access roads with higher traffic volumes to minimise wind erosion and dust. • Introduce and enforce speed limits on all vehicles; maintain speed limits on site to minimise wind erosions; educate and sensitise personnel to avoid driving on bare rocky hillside and other areas prone to soil erosion. • Ensure that soil is well aerated and not waterlogged due to site drainage by ensuring minimal water leakage periods from any possible leakages (e.g. faulty pipelines) from stormwater channels/drains within the site, though limited due to the arid conditions (the solubility of most toxins and pollutants increases under reducing conditions such as those found in waterlogged soils). • Timely maintenance and repair of the waste management facility components (leachate dams, stormwater management infrastructure, waste treatment facilities etc.) to reduce uncontrolled leakages to the soil.		
Monitoring		
• Bi-annual or annual monitoring of soil resources by a qualified specialist should be considered. • If necessary, the soil results parameters which were analysed in the specialist report (Appendix D) can be re-assessed to monitor any possible soil chemical degradations as an option for the project. • The baseline soil reference chemistry must be considered when selecting the road dust suppression method which will be implemented on-site, to ensure minimal potential soil resource degradations occur during the life-span of the project.		

7.3.2 Air Quality Impact Assessment

7.3.2.1 Potential Impact: Health impacts (acute and chronic) and nuisance at sensitive receptors

Description of the Impact

Dispersion modelling was undertaken by SLR to simulate the transport and fate of emissions emitted from the NMF to the atmosphere. The results of the simulated emission dispersion are presented in section 6.12.5. Impact Assessment

Overall impacts to air quality and health from the proposed NMF activities are assessed to range from low to medium. Impacts during the construction phase are considered temporary with a very low impact rate. Similarly, impacts during the decommissioning phase are considered lower than the operational phase, decreasing towards zero once capping and rehabilitation is achieved. Thus, the rating is **very low**. The impact rating for offsite air quality impacts is presented in Table 7-12.

Table 7-12: Impact Assessment for air quality related impacts at local sensitive receptors

Impact description	Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors		Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors		Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors		Short-term WHO odour nuisance AQG exceedances for H_2S emissions and the potential for nuisance impacts offsite		Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.	
Source of impact	Dust sources: - Land clearing and cell excavations - Dropping of cover material - Spreading and compaction of cover material - Exposed surfaces - Vehicles on paved roads - Vehicles on unpaved roads						Gas sources: - Waste decomposition			
Type of Impact	Direct						Direct			
Nature of Impact	Negative						Negative			
Phase	Operational						Operational			
Significance Rating										
Scenario	**Proposed**	**Mitigated**	**Proposed**	**Mitigated**	**Proposed**	**Mitigated**	**Proposed**	**Mitigated**	**Proposed**	**Mitigated**
Intensity	Moderate	Low	Low	Low	Low	Low	Very Low	Very Low	Very Low	Very Low
Duration	Long term	Long term	Long term	Long term	Long term	Long term	Long term	Long term	Long term	Long term
Extent	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local
Consequence	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Low
Probability	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Significance	Medium	Medium*[11]	Medium	Medium*	Medium	Medium*	Low	Low	Low	Low
Additional Assessment Criteria										

[11] * Impact rating is medium because the existing air quality baseline in Arandis related to particulate emissions was taken into account in the assessment. The air quality specialist study found that particulate emissions due to NMF activities could be mitigated to an acceptable level at all sensitive receptors.

<table>
<tr><th>Impact description</th><th colspan="2">Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors</th><th colspan="2">Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</th><th colspan="2">Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</th><th colspan="2">Short-term WHO odour nuisance AQG exceedances for H_2S emissions and the potential for nuisance impacts offsite</th><th colspan="2">Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.</th></tr>
<tr><td>Degree to which impact can be reversed</td><td colspan="10">Ambient air quality impacts on health can result in permanent damage to the respiratory and cardiovascular systems of receptors.</td></tr>
<tr><td>Degree to which impact may cause irreplaceable loss of resources</td><td colspan="2">NA</td><td colspan="2">NA</td><td colspan="2">NA</td><td colspan="2">NA</td><td colspan="2">NA</td></tr>
<tr><td>Degree to which impact can be avoided</td><td colspan="2">Unavoidable</td><td colspan="2">Unavoidable</td><td colspan="2">Unavoidable</td><td colspan="2">Unavoidable</td><td colspan="2">Unavoidable</td></tr>
<tr><td>Degree to which impact can be mitigated</td><td colspan="2">High</td><td colspan="2">High</td><td colspan="2">High</td><td colspan="2">Medium</td><td colspan="2">Medium</td></tr>
<tr><td>Mitigation and monitoring recommendations</td><td colspan="10">Refer to mitigation measures in the table below</td></tr>
<tr><th colspan="11">Cumulative Impacts</th></tr>
<tr><td>Nature of cumulative impacts</td><td colspan="10">Emissions of particulates from local mining activities. Gaseous emissions from activities in Arandis.</td></tr>
<tr><td>Extent to which a cumulative impact may arise</td><td colspan="10">Cumulative particulate emissions are expected. Cumulative emissions of gases associated with the NMF is considered low for the population level and activities in Arandis and the activities at nearby mines.</td></tr>
<tr><td rowspan="2">Rating of cumulative impact</td><td>Proposed</td><td>Mitigated</td><td>Proposed</td><td>Mitigated</td><td>Proposed</td><td>Mitigated</td><td>Proposed</td><td>Mitigated</td><td>Proposed</td><td>Mitigated</td></tr>
<tr><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><th colspan="11">Management and Mitigation</th></tr>
<tr><td colspan="11"><u>General</u>
• Maintain appropriate operational controls (e.g. adhere to repair and maintenance requirements for all equipment, including vehicles, etc.)
• Conduct training of the workforce at all levels (i.e. workers, foremen, managers) in awareness of air emissions. This can be included in site induction courses and should focus on promoting understanding as to why operational controls are in place and should be adhered to.</td></tr>
</table>

<table>
<tr><th>Impact description</th><th>Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors</th><th>Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</th><th>Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</th><th>Short-term WHO odour nuisance AQG exceedances for H_2S emissions and the potential for nuisance impacts offsite</th><th>Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.</th></tr>
<tr><td colspan="6">

Develop protocols and emergency response plan to manage emission incidents such as fires or spills or other upset conditions resulting in uncontrolled/ abnormal releases. This should include the management of complaints, identification of operations at the time, weather conditions, procedures for communicating with complainants, and incident reporting to the relevant authority, etc.
The burning of waste must be explicitly prohibited.

<u>Routine Reporting and record-keeping</u>

Complaints and any actions arising from a complaint must be recorded in a complaints register maintained by site management. The investigation of complaints and the outcomes thereof must be recorded for inspection by the authorities.
Maintain meticulous record keeping of site activities including waste quantities received per waste category, vehicle fleets, etc, to allow for a more accurate accounting of site activities and emission inventory updates should future assessment be required.

<u>Fugitive dust sources</u>

General housekeeping, including the regular maintenance and sweeping of internal roads, machinery, and their surrounding areas to remove deposited dust and minimise the load available for entrainment during high wind speed events.
Install porous windbreaks/ fencing around the facility or at a minimum alongside areas of high erosion potential (e.g. cell excavations and active cells where cover material is being spread and compacted frequently). As the air moves through the windbreak, its velocity is decreased, which in turn decreases the energy available to transport dust particles (encouraging deposition near to source). It is estimated that the ideal porosity for a windbreak is 40-50% (where 0% would be a solid wall).
Initiate or increase the frequency (as applicable) of water sprays and consider the addition of surfactants/ chemical suppressants for areas / activities of concern (i.e. active cells), along unpaved roads and exposed surfaces. Additional spraying may be required during high wind speed (> 5.4 m/s) or gusty conditions.
Cover open-bodied trucks when the truck is carrying materials that can be released into the air.
Consider windbreaks, contouring and material covers or enclosures for soil stockpiles.
Minimum practical drop heights should be adhered to when offloading wastes and cover materials. The handling of friable materials should be halted during high wind speed (>5.4 m/s) or gusty conditions or alternatively wetted prior to disposal/application.
Reduce the size of active cells as far as practicable. Cover material must be applied daily.
Where applicable, initiate rehabilitation (e.g. revegetation with appropriate species, even if sparse, in line with the surrounding landscape, or coarse material covers) to reduce entrainment as far as feasible on the surface of inactive cells.

</td></tr>
</table>

<table>
<tr><th>Impact description</th><th>Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors</th><th>Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</th><th>Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</th><th>Short-term WHO odour nuisance AQG exceedances for H_2S emissions and the potential for nuisance impacts offsite</th><th>Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.</th></tr>
<tr><td colspan="6">

The responsible road authorities should consider paving of high-use gravel roads in proximity to Arandis. PM monitoring at sensitive receptors in Arandis should be undertaken to inform on the sources of PM.
To limit project contributions to cumulative impacts at sensitive receptors in Arandis, PM emissions from use of the access road to the proposed facility need to be reduced as far as feasible. As a minimum, Namwaste must wet or apply chemical binding agents to the unpaved sections of the bypass and Trekkopje Road. This will become increasingly relevant as traffic on this road increases over the lifetime of the NMF. The frequency of application and type (water/binding agent) of control should be informed by monitoring at a sensitive receptor in Arandis, increasing if exceedances are recorded. If monitoring indicates ongoing exceedances of short-term PM10 health guidelines at a sensitive receptor, which emissions are arising from the bypass or Trekkopje Road, it would likely be necessary to pave the bypass and Trekkopje Road in proximity to Arandis. Responsibility for paving of roads which are the source of PM emissions should be proportional to the users thereof.
Speed limits, truck weights and the number of vehicles using unpaved roads/ surfaces should be reduced as far as practicable. Speed limits should be below 20 km/h onsite. Speed limits should also be controlled on the Trekkopje Road (unpaved). For example a speed reduction from 64 km/h to 32 km/h reduces dust emissions by up to 65%.

<u>LFG Generation</u>

Maintain appropriate operational controls (e.g. ensure active cell faces are covered daily with appropriate materials, maintain pH levels to prevent excess generation of H2S, etc).
Investigate the need/practicality of installing an LFG collection and control system for the destruction of carcinogenic and odorous gases.

<u>Odour</u>

Particularly odorous waste streams should be pre-scheduled for priority treatment, disposal and covering.
Leachate and contaminated runoff must be managed in accordance with best practice to minimise emissions.
Should there be odour complaints from receptors (e.g. in Atlantis), the viability of covering the leachate dams (using hexacovers, for example) should be assessed.
Develop an odour management plan (OMP) including elements to prevent or reduce odour nuisance beyond the operational boundary. The OMP should include:

Protocol containing actions and timelines.
Protocol for conducting odour monitoring (e.g. fenceline passive monitoring).
Protocol for response to identified odour incidents (including the management of complaints, identification of operations at the time, weather conditions, procedures for communicating with the complainant and the authority, etc.).

</td></tr>
</table>

Impact description	Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors	Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors	Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors	Short-term WHO odour nuisance AQG exceedances for H_2S emissions and the potential for nuisance impacts offsite	Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.
• Open communication and warning communities when to expect potential odour events (e.g. during upset conditions) will generate increased trust and facilitate communication between parties.					
Monitoring					
• Maintain a fenceline DFO monitoring network for ongoing assessment of fugitive dust impacts in accordance with South African NDCR as a guideline. Should non-compliances be recorded, a detailed dust management plan must be drafted to establish and manage emission reduction strategies. • Undertake passive monitoring of BTEX and H2S along the facility's fenceline and at the closest sensitive receptors (e.g. closest household in Arandis). Periodic (e.g. quarterly) monitoring campaigns are recommended. • A fine particulate screening survey to measure PM10 and PM2.5 at two locations (e.g. at the NMF site office and at a proximate sensitive receptor such as SR5 – Arandis Primary) is recommended to verify simulated offsite impacts. • It is recommended that repeat monitoring campaigns use the same sampling locations for comparing results and tracking trends over time. Should results indicate negligible to very low impact, monitoring requirements and the frequency thereof can be revised (e.g. reduced monitoring network, or biannual measurement, etc). • The installation of an onsite weather station will provide site specific meteorological data that can assist with the interpretation of monitoring results and source identification for investigating air quality complaints.					

7.3.3 Climate Change

The potential GHG emissions of the proposed Project were calculated using LandGEM simulations of LFG arising from each of the three operational phases. The GHG emissions, as CO_2 equivalent (CO_2e), were calculated using Intergovernmental Panel on Climate Change (IPCC) global warming potential for non-fossil sources of methane (i.e. 27.2 $kgCO_2e/kgCH_4$). Calculations are based on the 'general waste' component of received wase (Table 5-6). It is assumed that the other waste streams are relatively inert and that the methane emissions from these waste streams are negligible. Based on the above, it was calculated that the annual GHG emissions from the Project would range between 40 tCO_2e in 2026 and 8557 tCO_2e in 2086.

In 2020, Namibia's national GHG emissions were calculated to be 24.12 million tonnes CO_2 equivalent ($MtCO_2e$). Assuming that national GHG emissions remain unchanged over the life of the Project, the contribution of the proposed NMF to the country's national GHG emissions would range between <0.0002% in 2026 and 0.035% in 2086[12]. In 2020, it was calculated that Namibia's waste sector contributed 0.55 $MtCO_2e$ or 2.3% to the national GHG emissions. Assuming that GHG emissions from the country's waste sector remain unchanged over the life of the Project, the contribution of the proposed Project to the country's GHG emissions from the waste sector would range between 0.007% in 2026 and 1.56% in 2086. Namibia's first *Nationally Determined Contribution*, which was updated in 2021, includes a commitment to reduce the country's national GHG emissions to 2.18 $MtCO_2e$ by 2030[13]. Assuming that national GHG emissions remain unchanged from 2030 over the life of the Project, the contribution of the proposed Project to the country's national GHG emissions would range between 0.008% in 2056 and 0.39% in 2086.

Presently, there are no generally accepted benchmarks which can be used to assess the significance of the proposed Project's contribution to Namibia's national GHG emissions. In the absence of commonly agreed benchmarks, the thresholds presented in **Table 7-13** can be used as a proxy to rate the significance of the anticipated Project's GHG emissions[14]. These thresholds are used by the European Bank for Reconstruction and Development (EBRD) as an early indicator of the Project's likely contribution to the Bank's GHG inventory and carbon intensity of the Bank's investment portfolio. Based on these thresholds, the significance of the Project's GHG emissions ranges between ***Negligible*** in 2026 and ***Low*** in 2086.

It is not expected that emissions from this facility will be significant but we highlight that potential emissions from hazardous waste categories have not been assessed here. It is SLR's experience (including methane monitoring at hazardous waste sites) that the methane emissions from a hazardous waste landfill are generally lower than for general waste. However, to confirm this assumption, more detailed information and complex modelling would be required.

Table 7-13: Thresholds for significance of the Project's annual GHG emissions

Benchmark thresholds (tCO_2e / annum)	Significance rating [(a)]
Negligible	Very low
< 20 000	Low
> 20 000 and < 100 000	Medium-low
> 100 000 and < 1 million	Medium-high
> 1 million	High
Notes:	

[12] ClimateWatch (2024): Namibia. URL: www.climatewatchdata.org (Date accessed 17 May 2024)
[13] Republic of Namibia (2021): Namibia's Updated Nationally Determined Contribution. URL: unfccc.int (Date accessed 17 May 2024)
[14] EBRD (2010): EBRD Methodology for Assessment of Greenhouse Gas Emissions. Version 7, 6 July 2010.

Benchmark thresholds (tCO_2e / annum)	Significance rating [(a)]
(a) - Projects in the *Negligible* Emission Category typically involve activities with negligible emissions. This includes for example, telecommunications, civil construction projects, industrial wastewater treatment, and small-size built environment projects (i.e. overall floor area < 1,000 m^2). For projects in this category, a CCRA in generally not warranted. Projects in the *Low* and *Medium-Low* categories typically involve activities with very low to low GHG emissions. This includes for example, property developments, light industrial facilities, agricultural processing facilities, road development projects, municipal solid waste landfill, and brick manufacturing. For projects in these categories, a CCRA in generally not warranted, but should be assessed on a project-by-project basis. Projects in the *Medium-High* and *High* Categories, typically involve activities with high GHG emissions. This includes for example, fuel production and processing, glass manufacturing, cement and lime works, metal manufacturing and processing plants, and power generating plants. For projects in this category, a CCRA in generally considered to be mandatory.	

7.3.4 Hydrological Impact Assessment

7.3.4.1 Potential Impact: Contamination of surface water resources

Description of the Impact

There are various sources of contaminants from each project phase which have the potential to contaminate surface water, especially in the unmitigated scenario. However, the potential contamination sources are temporary and diffuse in the construction, and closure phases. Although these sources of contamination are considered temporary, they have contamination potential that can be long-term. The operational phase has the highest long-term potential of contamination when compared to other phases.

Impact Assessment: Construction Phase

Water Quality Impacts

- Construction activities that include the use of vehicles and machinery, storage of chemicals, fuels, and materials as well as the storage of domestic and industrial waste have the potential to result in contamination of watercourses.
- Soluble construction materials also have the potential to dissolve in runoff from the area. This can result in the increase of dissolved solids in downstream waterbodies during periods of rainfall and subsequent flow, resulting in a water quality impact.
- Deterioration of water quality during the construction phase is associated with:
  - Clearing of the surface area and site preparation for the new infrastructure which would result in the exposure of soil surfaces to potential erosion. When a large area of vegetation is cleared and topsoil disturbed, it exposes loose material which is susceptible to erosion.
  - Water contamination could result from poor management of waste during the construction phase. Typically, the following contamination sources exist: building materials, lubricants, and sewage or wastewater from the builders camp etc.
  - Water quality deterioration due to discharge of dirty water into the catchment around the project site when unplanned events occur, some of the containment structures may overtop and overflow, causing dirty material to wash into nearby streams.

The impact on surface water quality during the construction phase is assessed to have a moderate intensity and would occur over the short-term (1-5 years). It is likely to impact the minor drainage lines and eventually impact major drainage lines. The significance prior to mitigation is assessed to be **Medium**, while after implementation of mitigation measures, the impact can be reduced to **Low** as shown Table 7-14 below.

Table 7-14: Contamination of Surface Water Resources in Construction Phase

Contamination of Surface Water Resources in Construction Phase		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Beyond site	Beyond site
Consequence	Medium	Medium
Probability	Probable	Conceivable
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	The impact can be partially reversable with the implementation of mitigation measures for the phase outlined in this table.	
Degree to which impact may cause irreplaceable loss of resources	Medium as construction phase last for short period of time, therefore, will result in less pollution.	
Degree to which impact can be avoided	Medium as the impact cannot be avoided, however the significance can be reduced through the application of mitigation measures.	
Degree to which impact can be mitigated	Medium as the recommended mitigations are able to reduce the significance from medium to low.	
Cumulative impact		
Nature of cumulative impacts	There are no known or existing projects in the vicinity of the proposed NMF site. Therefore, cumulative impacts are low.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Low
Residual impact		
Residual impact discussion	The residual impact is considered to be low.	
Management and Mitigation		
• Minimise the disturbance of vegetation and soils as much as possible by restricting construction activities within demarcated areas. • Clear areas only as and when needed for construction-related purposes. • Phasing/scheduling of earthworks should be implemented to minimise the footprint that is at risk of erosion at any given time, or schedule works according to the season. Construction is recommended to take place in months or seasons where there is less rainfall, where feasible.		

- Progressive rehabilitation (such as the planting and maintenance of indigenous vegetation adapted to the desert environment) of disturbed land should be carried out to minimize the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff.
- Traffic and movement over areas stabilised to prevent soil erosion should be controlled (minimised and kept to certain paths), and damage to stabilised areas should be repaired timeously and maintained.
- Storage of potential contaminants in appropriate containers, with secondary containment and/or within bunded areas. Storage areas to be located greater than 50m from drainage lines.
- In case of an occurrence of a discharge incident that could result in the contamination of surface water resources, an emergency response plan should be implemented.
- Maintenance of vehicles/plant to be done in a bunded concrete hardstand area or off-site.
- A spill kit must be kept on-site and be easily accessible.
- Separation of clean and dirty water producing areas, store and convey such water separately to prevent cross contamination.
- Stormwater containment and conveyance structure to be sized with adequate free board as per applicable standards to minimize frequent spillages.

Impact Assessment: Operational Phase

Water Quality Impacts

- Any stormwater runoff from operational areas may carry or wash off potential contaminants such as oils, solvents, paints, fuels and hazardous waste materials into the nearby drainage lines.
- The project could cause pollution of water resources through sediment transport.
- Contamination of the drainage lines during heavy rainfall events or in the case of unplanned events e.g. spills or leaks.

The impact on surface water during the operational phase is assessed to have a moderate intensity and would occur over the long-term (10 to 20 years) during the operational phase. It may impact immediate drainage lines and as such the significance prior to mitigation is **Medium** and after the implementation of mitigation measures it goes down to **Low** significance, shown below in Table 7-15.

Table 7-15: Contamination of Surface Water Resources in Operational Phase

Contamination of Surface Water Resources in Operational Phase		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Beyond site
Consequence	Medium	Medium
Probability	Probable	Possible / frequent

Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	The impact is partially reversible as it is temporary during the operational phase and can be reversed when the operations ends. The SWMP and designs will be effective in mitigating potential impacts during the operational phase.	
Degree to which impact may cause irreplaceable loss of resources	Medium as the operational phase has an extended duration and this implies that there would be high degradation of water quality. However, it should be noted that the drainage lines around the site rarely flow.	
Degree to which impact can be avoided	Medium, as the impact cannot be avoided, however, the significance can be reduced through the application of mitigation measures, rehabilitation, and restoration measures.	
Degree to which impact can be mitigated	Medium by following and implementing best practices in this table under management and mitigation measures for handling waste material, chemicals and managing stormwater the impacts can be mitigated.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impact is assessed to be Low.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Low
Residual impact		
Residual impact discussion	The residual impact is Low.	
Management and Mitigation		

- Dirty water catchments should be separated from clean water catchments as per the conceptual SWMP.
- All mitigation measures recommended based on the concept design must be considered during the detailed design phase.
- All hazardous chemicals (new and used) and all waste streams must be handled in such a manner that they do not contaminate surface water. This will be implemented by means of the following:
  - Pollution prevention through basic infrastructure design such as waste storage containment, hardstanding, and containment bunds.
  - Pollution prevention through education and training of workers (permanent and temporary).
  - A spill clean-up plan must be in place and all employees trained in the use thereof to enable remediation of pollution incidents.
- An emergency response plan should be formulated and adhered to during any occurrence of incident discharge or spillage of chemicals.
- Good housekeeping practices should be implemented and maintained by timeous cleaning up of accidental spillages. In addition, spill cleaning kits and material safety data sheets for chemical and hazardous substances should be accessible and available.

Monitoring

- Monitoring of surface water quality should be undertaken monthly during wet seasons and after storm events or as per the site management schedule.

- Monitoring should be undertaken within each catchment intersecting the NMF, at locations upstream and downstream of the site.
- It is recommended that a detailed monitoring plan be developed outlining what needs to be monitored, monitoring locations, frequency of monitoring and the reporting requirements.
- Monitoring the parameters listed below are regarded as best practice, more parameters may be added as and when needed.
-

Parameters	Parameters
pH	Nitrate as N
Electrical conductivity	Ammonia
Total dissolved solids	Potassium
Total suspended solids	Nickel
Aluminium	Manganese
Calcium	Magnesium
Fluoride as F	Iron
Total alkalinity as $CaCO_3$	Copper
Chloride as Cl	Lead
Sulphate as SO_4	Sodium
Uranium	

7.3.4.2 Potential Impact: Flooding of the NMF

Description of the Impact

Before development happens on a site, the flow of water is normally via natural drainage flow paths. However, development changes the land use and land cover which impacts the hydrological response of the area. The compaction of surfaces during construction increases level of imperviousness of the areas which results in high runoff volumes reporting downstream to receiving drainage lines causing flooding.

Impact Assessment

The flooding risk will continue throughout the construction, operational and closure phases. The significance is Medium in all phases without mitigation, and it reduces to Low with mitigation measures as shown below in Table 7-16.

Table 7-16: Flooding During Construction and Operational & Decommissioning Phase

Flooding During Construction and Operational & Decommissioning Phase		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Negligible change (Very low)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years

Extent	Beyond site	Beyond site
Consequence	Medium	Low
Probability	Probable	Probable
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	The impact is partially reversable with the implementation of recommended mitigation measures.	
Degree to which impact may cause irreplaceable loss of resources	Low as the rivers are non-perennial.	
Degree to which impact can be avoided	Medium provided remedial measures aiming at minimising flooding and other stormwater management measures are implemented.	
Degree to which impact can be mitigated	High with the implementation of mitigation measures.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impacts are assessed to be low only after the application of mitigations	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Low
Residual impact		
Residual impact discussion	The residual impact is Low.	
Management and Mitigation		
• Storm water management infrastructure should be designed to attenuate and divert water away from the NMF infrastructure to prevent flooding of the infrastructure. • Investigate and implement stormwater infrastructure that can attenuate runoff to avoid drastic flow increases in the receiving drainage lines. • Containment and conveyance stormwater infrastructure should be designed in a manner that prevents frequent spills and minimizes flooding. • Rainwater harvesting is also recommended to manage water emanating from impervious areas and minimise flooding. • The principles of the conceptual SWMP should be implemented during the detailed design phase.		
Monitoring		
• Monitoring and inspection of stormwater management infrastructure for signs of erosion, cracking, silting and blockages is recommended, to ensure efficient performance. • Monitoring should be undertaken monthly during the wet season and after storm events or as per the site management schedule, where available.		

7.3.4.3 Potential Impact: Alteration of natural drainage paths and flows

Description of the Impact

Before development takes place in any site, runoff normally flows naturally across the project area via natural flow paths. The site infrastructure and structural stormwater management measures implemented usually alter the natural hydrologic response of the project site and this has a potential to spread beyond the project site if not mitigated.

Impact Assessment

The footprint of the NMF covers minor drainage lines and clusters of drainage lines that facilitate sheet flow. These drainage lines will be diverted via the proposed clean cut-off drains to discharge to the natural environment but at different locations than pre-development.

The flow regime may also be impacted as flows will be channelled and sheet flow will be reduced.

The impact will continue throughout the construction, operational and closure phases. The significance is **Medium** in all phases without mitigation, and it reduces to **Low** with mitigation measures. The impacts of the activities in all the phases were identified and rated using rating Table 7-17 below.

Table 7-17: Alteration of Drainage Patterns and Flows in Construction, Operational & Decommissioning Phase

Alteration of Drainage Patterns and Flows		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Site
Consequence	Medium	Low
Probability	Probable	Probable
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	Medium as the impact may not be avoided as the footprint of the NMF falls within minor drainage lines.	
Degree to which impact may cause irreplaceable loss of resources	Medium as only minor drainage lines are impacted.	
Degree to which impact can be avoided	Medium as the impact may not be avoided as the footprint of the NMF falls within minor drainage lines.	
Degree to which impact can be mitigated	Medium because the recommended stormwater infrastructure will help to reduce the impact from medium to low. Diversion channels/ clean cut-off	

	drains will facilitate the continuation of flows but in different locations to pre-development. The quantity and quality of the clean runoff from the catchment, however, should ultimately remain unchanged through these mitigation measures.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impact is low.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Low
Residual impact		
Residual impact discussion	The residual impact is considered Low.	
Management and Mitigation		
• The change in flow resulting from the development will be managed by using appropriately sized stormwater management infrastructure as per applicable guidelines to closely mimic pre-development flow regimes. • Attenuation of outflows where water has been diverted and/or concentrated must be implemented.		
Monitoring		
• Monitoring and inspection of stormwater management infrastructure outlets for signs of erosion, cracking, silting and blockages is recommended, to ensure efficient performance. • Monitoring should be undertaken monthly during the wet season and after storm events.		

7.3.5 Hydrogeological Impact Assessment

7.3.5.1 Potential Impact: Disruption of natural groundwater recharge conditions

Description of the Impact

For the development to take place there would be a change to the ground surface. During the construction phase, there would be excavations that may change the recharge potential of the natural ground surface. This can lead to increased groundwater recharge in these localised zones. In the operational phase, the disruption may have the opposite effect – with the waste disposal cells (equipped with containment barriers) developed over the natural ground surface, the recharge that would have taken place in this area will be diverted into the stormwater system.

Impact Assessment

The impact is given a **Low** significance with and without mitigation. The assessment of the impact is provided in Table 7-18.

Table 7-18: Impact of Disruption of natural groundwater recharge conditions

Disruption of natural groundwater recharge conditions	
Type of Impact	Direct
Nature of Impact	Negative
Phases	Construction and Operational

Criteria	Without Mitigation	With Mitigation
Intensity	Low (Minor)	Very low (Negligible)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site	Whole site
Consequence	Medium	Medium
Probability	Possible/frequent	Conceivable
Significance	Low	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*The impact is partially reversible if adequate stormwater infrastructure is installed. Additionally, the construction footprint could be minimized by operational activities taking place over areas that were already disturbed during construction.*	
Degree to which impact may cause irreplaceable loss of resources	*Medium. Without mitigation there would be a net loss of groundwater recharge through the life of the facility.*	
Degree to which impact can be avoided	*Low. With adequate mitigation measures, the effects can be minimised but not completely avoided.*	
Degree to which impact can be mitigated	*High. Appropriate mitigation measures can ensure the impact is minimal. The construction footprint could be minimized by operational activities taking place over areas that were already disturbed during construction.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Unlikely. Rainfall in the area is extremely low as well as groundwater recharge. Given the extent of the site there is not expected to be a cumulative impact arising in this regard*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	Very low
Management and Mitigation		

- Avoid, or minimise, the placement of infrastructure in drainage channels likely to support groundwater recharge;
- Minimise the extent of dirty water areas and maximise the return of clean water to the environment;
- Ensure maintenance of the surface water management infrastructure so that no erosion results;
- All impervious surfaces to be monitored to ensure drains, etc., are functional;
- Ensure runoff water from the facility is directed towards a control structure where it is appropriately managed; and
- Prevent sediments from entering the stormwater systems, through appropriate means, and clean sediments from stormwater systems regularly.

7.3.5.2 Potential Impact: Groundwater contamination through development over existing borehole (WW206579)

Description of Impact

Per the facility designs (Jones and Wagener, 2024), the WMF is proposed over the existing WW206579 borehole. Since the borehole could act as a conduit for seepage from the facility into the alluvial aquifer and subsequently to the basement aquifer, it is assumed that the borehole would be appropriately decommissioned and sealed prior to construction. However, it is still possible that seepage could arise from the NMF and flow via the borehole which would mean groundwater contamination through the borehole. The effect of this would only be seen after it has happened, through groundwater monitoring.

Impact Assessment

The impact is given a **Medium** significance without mitigation and can be reduced to **Very Low** with mitigation measures implemented. The assessment of the impact is provided in Table 7-19.

Table 7-19: Impact of Groundwater contamination through development over existing borehole (WW206579)

Groundwater contamination through development over existing borehole (WW206579)		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	High (Prominent)	Low (Minor)
Duration	Long-term (10 to 20 years)	Medium-term (5 to 10 years)
Extent	Beyond (nearby) site	Portion of site
Consequence	High	Low
Probability	Possible/frequent	Conceivable
Significance	Medium	Very Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*The impact is reversible if appropriate spill management and groundwater remediation techniques are employed timeously.*	
Degree to which impact may cause irreplaceable loss of resources	*Medium. Without mitigation long-term damage may occur.*	
Degree to which impact can be avoided	*High. With appropriately decommissioning and sealing the borehole, the impact can be minimized. A monitoring point downgradient of the borehole can detect any potential contamination (should it still occur).*	
Degree to which impact can be mitigated	*High. Appropriate mitigation measures can ensure the impact is minimal.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Possible*	

Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Very low
Management and Mitigation		
• Borehole WW206579 should be appropriately decommissioned according to acceptable standards. In the absence of local regulations in this regard, the SANS10299-9:2003 – The decommissioning of water boreholes, procedure may be used as a guide. • All geotechnical boreholes are to be suitably backfilled and sealed with grout to prevent contaminant migration. Any other excavations such a trenches, auger holes or test pits, etc., are to be backfilled and suitably compacted to minimize seepage of contaminants into the aquifer; • If there are changes to the design or site location, it should be ensured that any existing boreholes overlapping the facility are adequately decommissioned; and • Any new boreholes planned should be installed at a reasonable distance from the facility footprint while still serving its intended purpose.		
Monitoring		
• A groundwater monitoring point, at an appropriate depth, should be installed downgradient of borehole WW206579 and the facility to detect any potential contamination.		

7.3.5.3 Potential Impact: Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems

Description of the Impact

In the construction and operation of the facility, there would be various activities that require the development and use of storage, stockpiles, construction camp facilities, fuel storage, treatment facilities, and domestic sewage systems. Given the nature of the associated activities, contaminants may emanate from each of these site components.

There is a possibility that seepage from a facility can run into active drains and get transported by runoff downstream, where it may percolate into the shallow alluvium aquifer. Hydrocarbons are an example of contaminants that have the potential to impact groundwater resources. Further, due to the erratic nature of rainfall in the region, there is a potential for episodic flash floods following rainfall of high intensity. This has the potential to transport contaminants from the above-mentioned areas/facilities into the active drains and shallow alluvial aquifer system. If the contamination source (should it occur) is not apparent at the time of occurrence, it would only be detected month/years after the contamination event, through groundwater monitoring data. It would then still take time to understand the extent of the contamination plume, concentrations of chemicals of concern, and decide on an appropriate remediation approach. The remediation itself is generally not immediate and depending on various factors, can take up to a few years before the contamination can be considered resolved.

Impact Assessment

The impact is given a **High** significance without mitigation and can be reduced to **Low** with mitigation measures implemented. The assessment of the impact is provided in Table 7-20.

Table 7-20: Impact of soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems

Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems	
Type of Impact	Direct

Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Very high (Severe)	Medium (Moderate)
Duration	Permanent (> 20 years)	Long-term (10 to 20 years)
Extent	Far beyond site	Beyond (nearby) site
Consequence	Very High	Medium
Probability	Possible/frequent	Conceivable
Significance	High	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*The impact is reversible if appropriate spill management and groundwater remediation techniques are employed.*	
Degree to which impact may cause irreplaceable loss of resources	*Medium. Without mitigation long-term damage may occur.*	
Degree to which impact can be avoided	*High. With dedicated mitigation measures and practices put into place, the impact can be mitigated.*	
Degree to which impact can be mitigated	*High. A Class A barrier system will be used in accordance with the South African GNR 636 of August 2013, the "National Norms and Standards for Waste Disposal to Landfill". Appropriate mitigation measures such as the use of drip trays, designated fuel storage area, dedicated groundwater monitoring, etc can ensure the impact is minimal. Diversion channels/ clean cut-off drains should facilitate the continuation of surface water flows but in different locations to pre-development.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Possible*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Very high	Low
Management and Mitigation		

- Ensure the siting of facilities where hazardous goods will be stored, handled or managed, > 50 m away from drainage lines or areas with dykes or very shallow aquifer (<5mbgl), unless appropriate stormwater management infrastructure has been developed.
- Hazardous chemicals should be managed in delineated areas, over impervious surfaces that are bunded.
- There should be designated maintenance areas and truck facilities.
- Spill kits should be available at strategic places on site for immediate use.
- Establish and implement a robust clean-up plan that will be used to handle spills during operations.
- Site staff should be adequately trained to prevent and handle spills of varying natures.
- Stormwater management should be implemented even at temporary site activity areas, e.g., construction yards, etc.

• Stormwater management infrastructure must be developed and maintained to divert clean water away from the facility and contain all dirty water arising on the site, with adequate freeboard to prevent overtopping in the case of a 1:50 year flood event. • Waste should only be managed at sites within the dirty water catchment of the facility.
Monitoring
• Develop and maintain the groundwater monitoring borehole network. • Monitor the groundwater level and quality per the requirements as outlined in the Groundwater Monitoring Plan (Appendix O)

7.3.5.4 Potential Impact: Groundwater contamination as a result of leachate seepage from facility

Description of the Impact

Although the WMF has been designed to prevent seepage and leakage from the facility, and from the arsenic waste and other hazardous waste cells, it is still possible that defects may occur in the containment barriers. As such, there is a risk of groundwater contamination as a result of leachate from the waste cells, leachate and pollution control dams. As such a numerical groundwater model was developed in order to determine the potential migration of the plume from the facility footprint during operations. The results from the numerical groundwater model are detailed in section 6.9.8.

Impact Assessment

The impact is given a **High** significance without mitigation and can be reduced to **Low** with mitigation measures implemented. The assessment of the impact is provided in Table 7-21.

Table 7-21: Impact of groundwater contamination as a result of leachate seepage from facility

Groundwater contamination as a result of leachate seepage from facility		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Very high (Severe)	Medium (Moderate)
Duration	Permanent (> 20 years)	Long-term (10 to 20 years)
Extent	Far beyond site	Beyond (nearby) site
Consequence	Very High	Medium
Probability	Possible/frequent	Conceivable
Significance	High	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*The impact is reversible if appropriate groundwater remediation techniques are employed.*	
Degree to which impact may cause irreplaceable loss of resources	*Medium. Without mitigation long-term damage may occur.*	

Degree to which impact can be avoided	*High. With the appropriate contaminant barrier (Class A), dedicated mitigation measures and groundwater monitoring put into place, the impact can be mitigated.*	
Degree to which impact can be mitigated	*High. Appropriate mitigation measures such as groundwater monitoring, etc can ensure the impact is minimal.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Possible*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	High	Low
Management and Mitigation		
• Ensure that containment barriers and under-drainage system used for the respective cells, leachate and stormwater facilities are suitable for the site, robust enough for the type of waste, in line with acceptable industry standards, and are designed by a suitably qualified civil engineer; • Ensure the application of a Construction Quality Assurance plan during construction of the waste disposal facility; • Maximise the removal of leachate from cells and liquids from subsoil drains and contain this in the appropriate facility; • Stormwater management infrastructure must be developed and maintained to divert clean water away from the facility and contain all dirty water arising on the site, with adequate freeboard to prevent overtopping in the case of a 1:50 year flood event.		
Monitoring		
• Develop and maintain a network of boreholes that enables monitoring of groundwater conditions upstream and downstream of the NMF. • Develop and maintain a network of locations that enables monitoring of surface water quality upstream and downstream of the NMF. • Undertake sampling and analysis of groundwater, surface water, underdrainage sumps and leachate quality via reliable and reproduceable methods. • The groundwater monitoring network (Appendix O) should be strategically developed to detect any potential seepage from the facility. This means, possibly incorporating existing boreholes, as well as considering drilling new boreholes; • Once the facility is operational, test the leachate draining from the facility. Leachate sampling and analysis must be undertaken per waste cell and repeated for any cell where there is a change in waste inputs, operating parameters or an observed change in leachate. The results of the leachate testing should be incorporated into subsequent numerical model updates.		

7.3.5.5 Potential Impact: Local aquifer drawdown as a result of groundwater abstraction

Description of the Impact

It was proposed that groundwater could be considered as a back-up water supply option for operations at the NMF. The groundwater modelling report (SLR, 2024c) used the most feasible existing borehole in terms of yield (WW206578) to simulate groundwater abstraction over a 40-year period (i.e., Phase 1A and Phase 1B operations). Although this is not likely to be the abstraction borehole used and a new borehole would be drilled for this purpose, the borehole was used as an indication of how the water level would drawdown and recover with time.

As recommended in the Hydrogeological Screening Report (SLR, 2023), borehole WW206578 was deemed the most feasible borehole in terms of a backup water supply option, with a tested yield of 1 L/s.

The hydraulic head of 484 mamsl at the start of pumping, is expected to reduce to 380 mamsl after 40 years. The gradual curve seen in Figure 7-1 indicates that the aquifer would be able to be pumped at the proposed rate, without the risk of dewatering critical fractures. From year 40 to year 100, recovery is slow, but the water level should recover to 480 mamsl (i.e., 99 % of the original static water level).

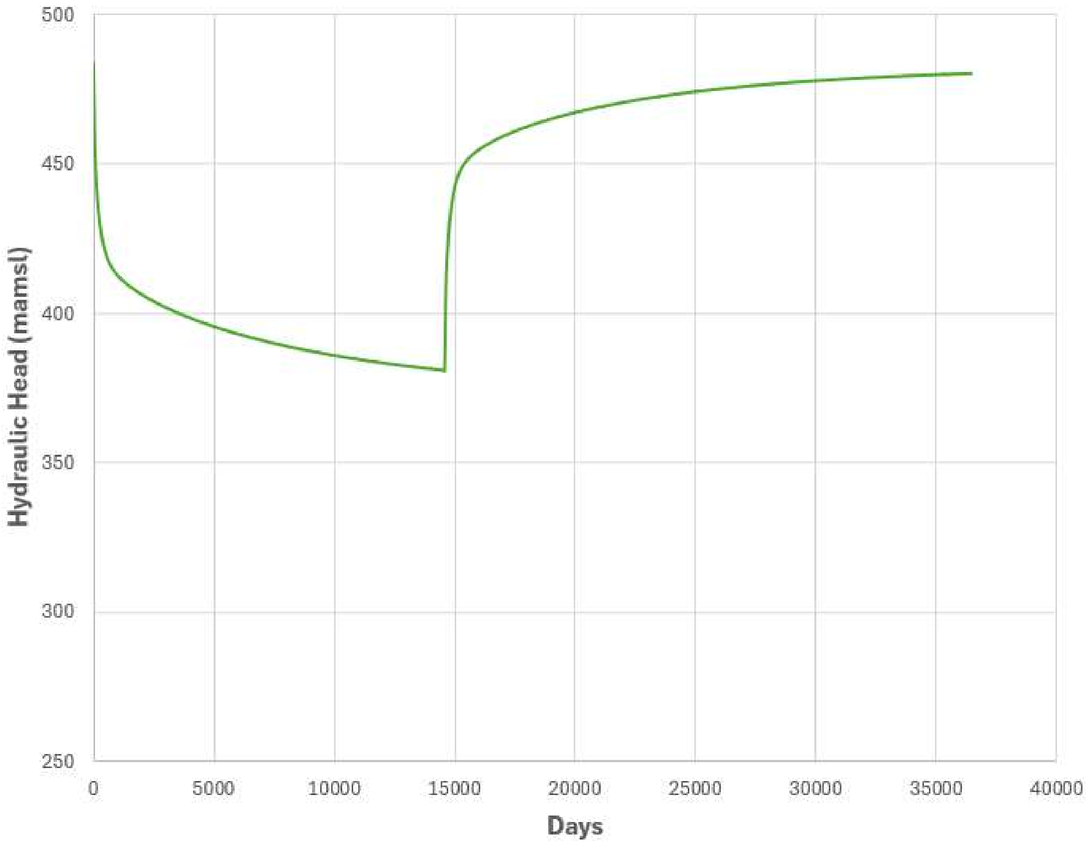

Figure 7-1: Hydraulic head of borehole WW206578 showing pumping for 40 years and then recovery for the next 60 years

Figure 7-2 to Figure 7-4 visually shows the drawdown at WW206578 at the timesteps 0 years, 40 years and 100 years. At year 100, the cone of drawdown should almost completely recover.

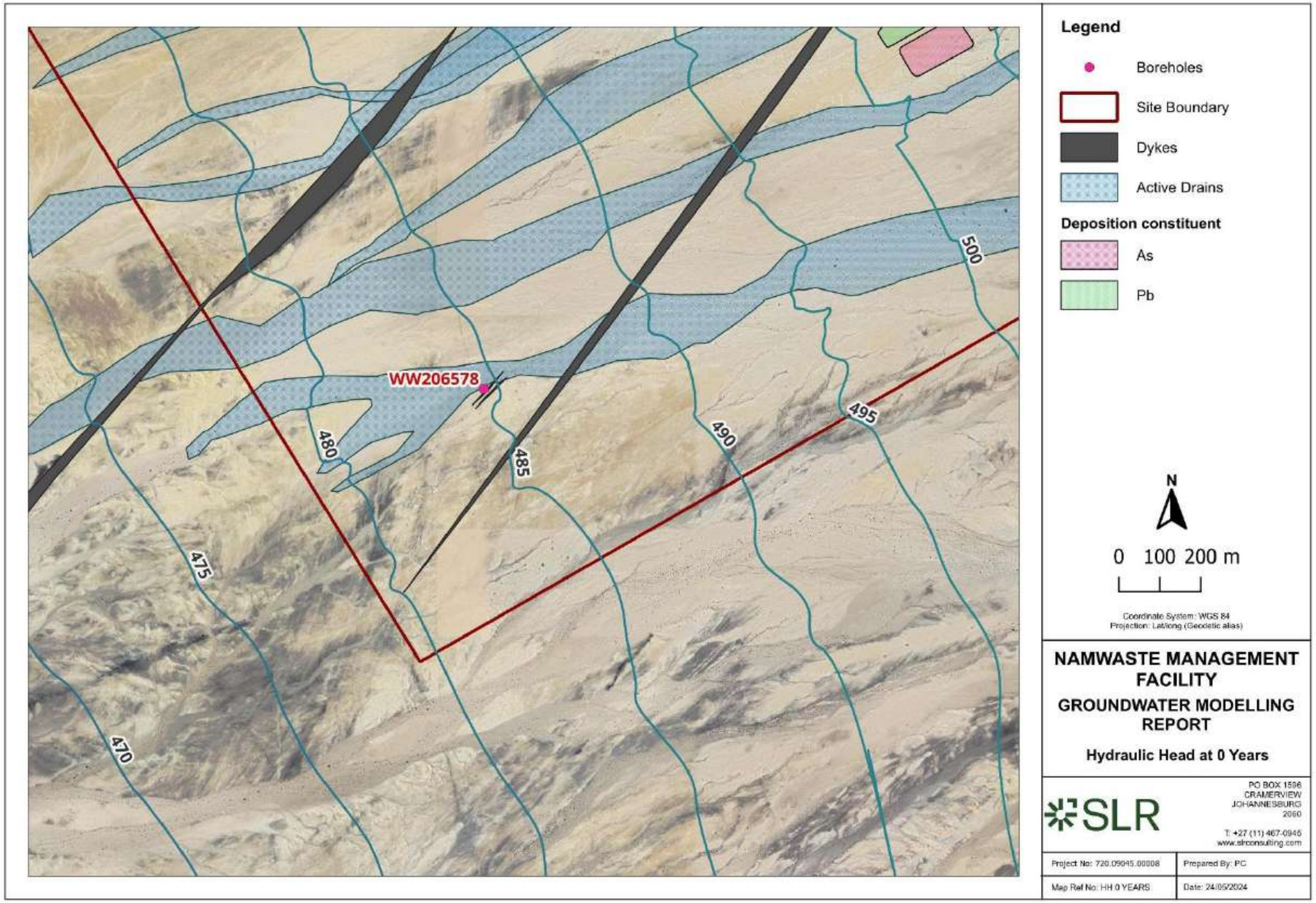

Figure 7-2: Hydraulic Head at 0 years - before operations start

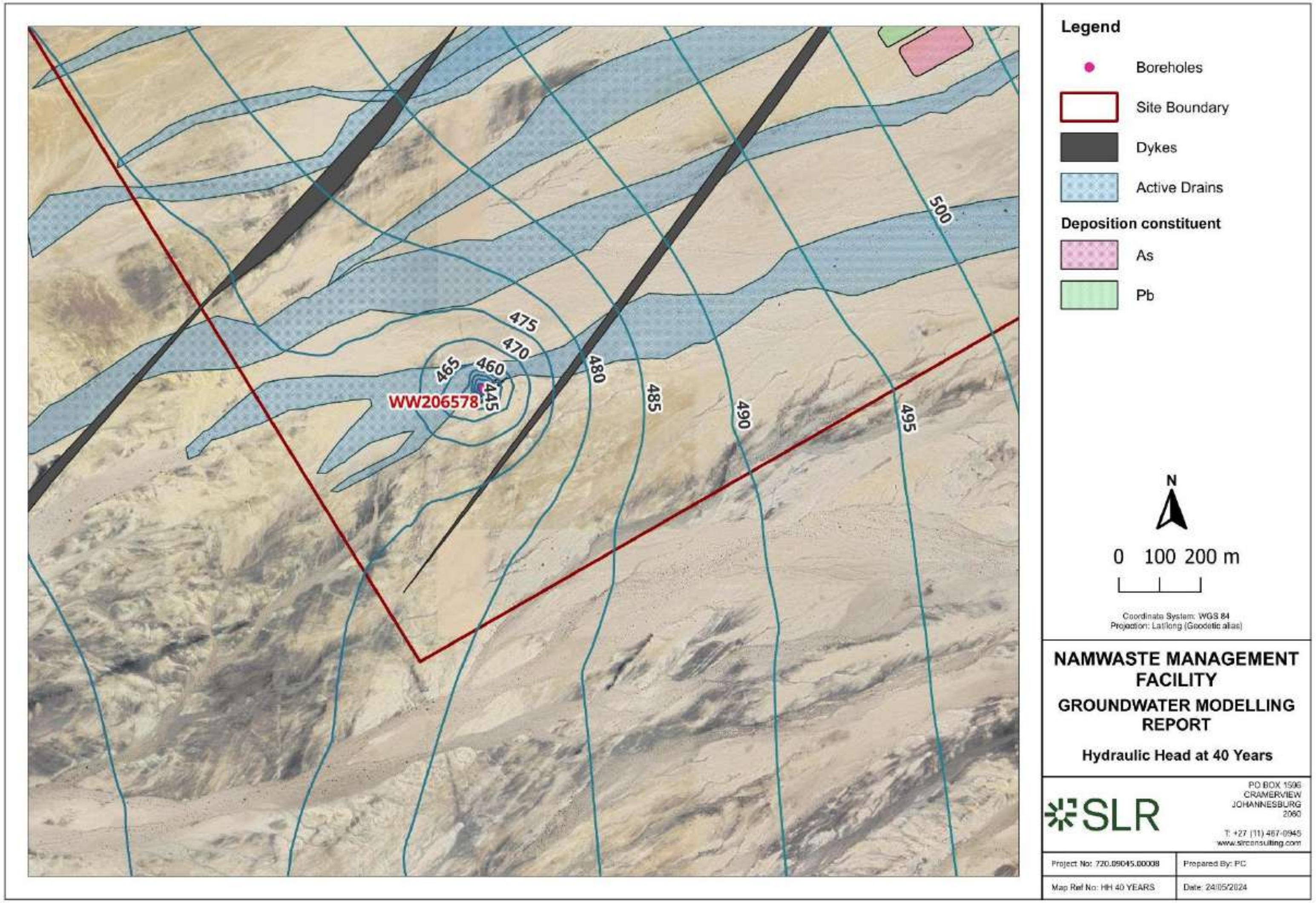

Figure 7-3: Hydraulic Head at 40 years - end of Phase 1B operations

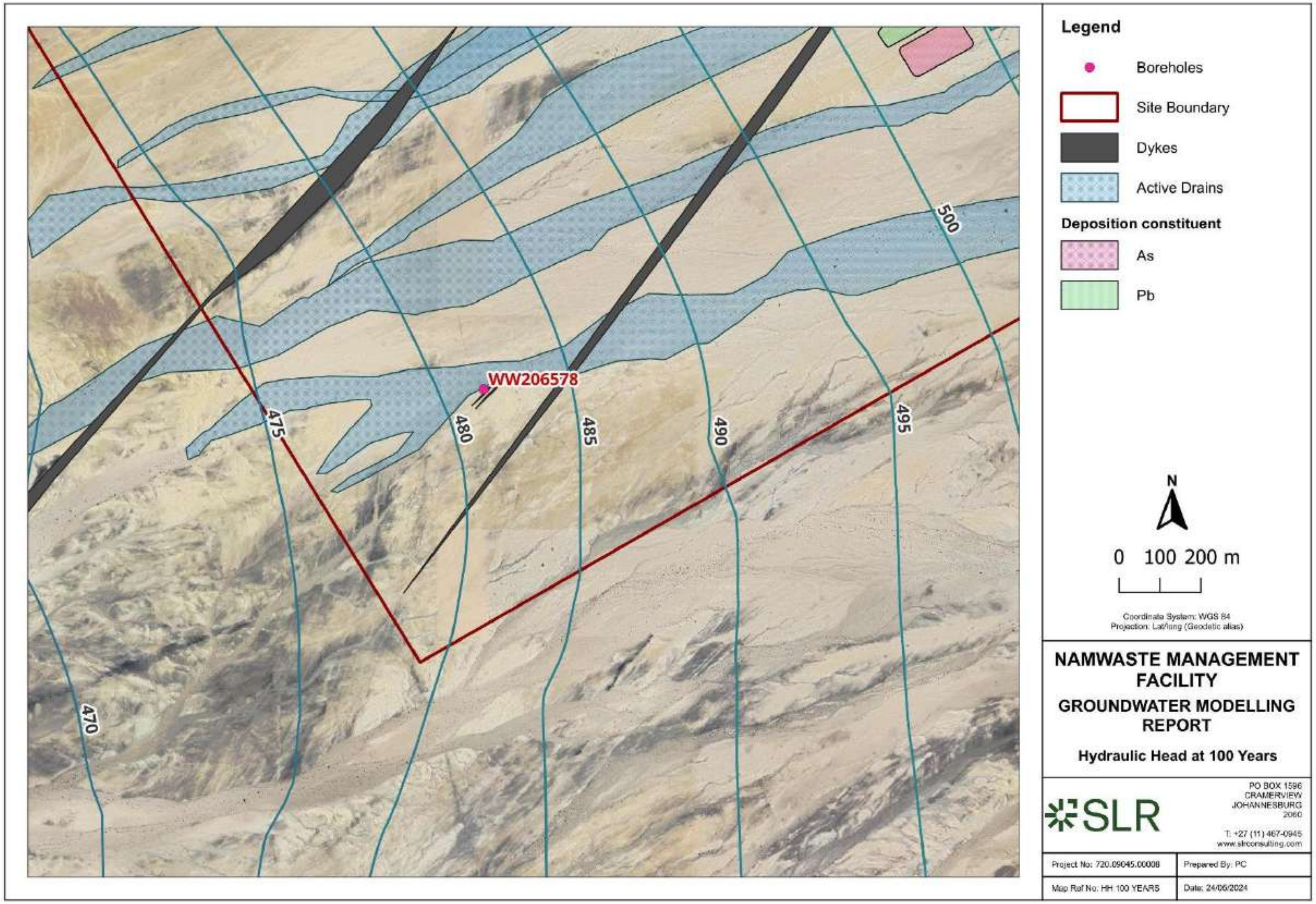

Figure 7-4: Hydraulic Head at 100 years

Given that abstraction would take place for 40 years – there is the risk of drawdown of the local aquifer. The exact impact can only be determined after an actual abstraction borehole is drilled and yield tested as there are various factors that play a role in the drawdown, such as borehole depth, sustainable pumping rate, pumping schedule, fractures intersected (if drilled into basement rock), borehole construction (i.e., screening, slot size, etc), etc.

Impact Assessment

The impact is given a **Medium** significance without mitigation and can be reduced to **Low** with mitigation measures implemented. The assessment of the impact is provided in Table 7-22.

Table 7-22: Impact of local aquifer drawdown as a result of groundwater abstraction

Local aquifer drawdown as a result of groundwater abstraction		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Low (Minor)	Very low (Negligible)
Duration	Permanent (> 20 years)	Short-term (1 to 5 years)
Extent	Beyond (nearby) site	Beyond (nearby) site
Consequence	Medium	Low
Probability	Probable/likely	Probable/likely
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*The impact is reversible if groundwater abstraction ceases after operation and allows the aquifer to recover.*	
Degree to which impact may cause irreplaceable loss of resources	*Low. Without mitigation no long-term or permanent damage is foreseen. The extent of the cone of depression does not extend to any known groundwater user or strategically important aquifer. Further, no downstream groundwater users were identified during the groundwater studies therefore the potential impact is not expected to extend to other users.*	
Degree to which impact can be avoided	*High. If groundwater is not used as a backup water supply source, the impact can be completely avoided.*	
Degree to which impact can be mitigated	*Low. If groundwater is used, there is very little that can be done to reduce the impact. However, pumping at a lower rate and for a shorter period of time can reduce the impact.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Unlikely*	

Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	Very low
Management and Mitigation		

- The placement, drilling, and construction of an abstraction borehole should be informed by a qualified geohydrologist.
- Should a more favourably located abstraction borehole be drilled, the sustainable abstraction rate and proposed period of pumping should be incorporated into the model and drawdown analysed.
- Abstraction from the borehole should not exceed the sustainable yield estimated by the updated model. Records should be kept of monthly abstraction volumes.
- Water abstracted from the borehole should not be made available for human consumption unless chemical analysis indicates it complies with potable water standards.
- Appropriate groundwater monitoring should be implemented to ensure drawdown does not exceed the water level determined through the associated yield analyses. It is expected that the permit issued by Department of Water Affairs will specify monitoring requirements.

7.4 Impacts on the Biodiversity

7.4.1 Fauna and Flora

7.4.1.1 Potential Impact: Destruction of Habitat and Organisms

Description of the Impact

During the different project phases (planning, construction and operation) various activities may lead to the destruction of habitat and organisms at the proposed site of the NMF and the sites proposed for the supporting infrastructure as outlined in the table below.

Project Phase	Activity or aspect
Research and Planning	Off-road driving by contractors, engineers and EIA specialists.
Construction	Ground clearing and diversion of drainage lines
	Construction of access roads
	Laydown areas
	Accommodation for construction staff
	Use of roads by vehicles and heavy machinery
	Off-road driving
	Poaching. Firewood collecting.
	Power line and pipeline construction activities: ground moving for access roads, transporting materials across sensitive rocky ridges, and digging of pipeline supports.
Operation	Increased traffic on access road
	Off-road driving
	Footprint of the WMF, its associated infrastructure, the power line and pipeline
	Human activity and vehicle movements
	Traversing the rocky ridges for power line and pipeline maintenance

The following potential impacts have been identified:

- Animal fatalities may result due to ground clearing, vehicle movement and construction activities, as well as poaching.
- The Brown hyaena is particularly vulnerable to roadkill.
- Loss of plants due to firewood collection.
- Human movement, noise, lights, and dust disturb animals, causing an increase in stress, followed by increased potential mortality.
- Mammal and reptile burrows, burrow habitats and feeding habitats could be destroyed, affecting the viability of the populations of these taxa in the Project area. Parts of territories and home ranges could be destroyed.
- Reptiles are particularly vulnerable because of their restricted ranges and high rate of endemism. Nocturnal reptiles are at risk from vehicles using roads and tracks at night.
- Increased dust levels (during construction) may have a negative effect on the health and growth rate of plants.

- The footprint of the Project results in loss of plants, disturbance and compaction of soil, and alteration of drainage channels. This affects a large area due to the large size of the footprint and represents a permanent loss of habitat.
- Fragmentation of habitat, leading to the loss of movement corridors for various taxa, in turn resulting in the loss of individual organisms and potentially populations. This is a cumulative impact due to increased development in the Central Namib.
- Habitat loss, a cumulative impact due to increased development in the region, affects the following bird species that are of conservation concern:
  - Ludwig's Bustard is dependent on ephemeral grasslands and drainage lines.
  - Rüppell's Korhaan, a gravel plain specialist.
  - Gray's Lark may breed in the area.
  - Martial Eagle, Lappet-faced Vulture and other raptors are placed under stress by the loss of feeding or breeding resources.
- The pipeline route crosses rocky ridges and drainages, both classified as sensitive habitat types. The construction phase could cause severe damage in the stretch between Arandis and the NMF in the absence of mitigation measures.
- Plants with special conservation status grow on the rocky ridges (e.g. *Sarcocaulon marlothii* and the slow growing *Commiphora spp*) and species such as Lithops are not easily seen and may be damaged inadvertently.
- The lichens on the plains could be damaged (if not destroyed) by vehicle and foot traffic, leading to increased wind erosion.

Impact Assessment

Fatalities of organisms and destruction of habitats represent a prominent, permanent loss and degradation that will require intervention. The extent of the impact is the whole project area and its surroundings. However, the cumulative effects of habitat destruction and of interference with water flow could eventually lead to an impact on taxa at population level, and the subsequent irreplaceable loss of resources if left unmitigated.

These adverse impacts are very important considerations and must have an influence on the decision. Substantial mitigation is required and may bring the significance of the impact down to **Low**. It is highly likely that the project will contribute to a cumulative impact with Very High significance, an impact caused by continued development in the Central Namib. The assessment of the impact is provided in Table 7-23.

Table 7-23: Impact of Destruction of Habitats and Organisms

Destruction of Habitat and Organisms		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	High	Medium

Destruction of Habitat and Organisms		
Probability	Probable (High)	Possible / frequent (Medium)
Significance	High	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Irreversible - habitat destruction and death of individuals are permanent*	
Degree to which impact may cause irreplaceable loss of resources	*Medium - the habitat types that will be lost locally are common in other parts of Namibia, and the death of organisms will take place at individual level*	
Degree to which impact can be avoided	*None.*	
Degree to which impact can be mitigated	*Medium, if management and mitigation measures are implemented.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Likely. Development along the coast and inland continues.*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Very high	Low
Management and Mitigation		

- Do not destroy the trees or shrubs in the drainage on the northern border of the NMF.
- Keep the overall development footprint as small as possible.
- NMF: the extent and location of the construction site should be demarcated, and all construction activities should take place within the demarcated area. Adherence should be strictly enforced, with hefty fines for non-compliance.
- During the planning phase, a suitably qualified botanist should be commissioned to assess threatened species, collect seeds/cuttings, and relocate plants where possible. The botanist should share their findings with the National Botanical Research Institute (NBRI) if appropriate.
- Demarcate or fence any sensitive areas that should be avoided, e.g. nests, trees, shrubs, burrows as identified by the biodiversity specialist.
- An invertebrate specialist be engaged prior to construction to supply a baseline description, highlighting taxa that are of conservation concern and providing a description of aspects on site that are important to the continued survival of taxa or populations.
- Power line: Keep construction activities confined to the sites where pylons will be located, and directly underneath the cables. Where the cables cross ridges, ensure that construction staff use only one access route and that they do not make multiple sets of tracks.
- Mitigation actions specifically for the power line-pipeline corridor include:
  1. Keep the corridor as narrow as possible while allowing construction and maintenance access.
  2. Use the same road during construction that will be used for maintenance during operations.
  3. The road should be close to the power line to ensure a narrow strip of disturbance or use the existing road where possible.
  4. Excavated and laid-down soil should be levelled.
  5. Strictly enforce a no-go policy outside the boundaries of the power line/pipeline corridor.
  6. New tracks should be kept to a minimum, and all vehicle and human movements should be strictly confined to existing tracks.
  7. Some construction impacts may be mitigated by putting access roads around instead of across the ridges.
  8. Cross fields of *Sarcocaulon marlothii* (Bushman's Candle) at the narrowest points and avoid areas with high densities.

Destruction of Habitat and Organisms
• All roads and tracks should be planned to minimise fragmentation or disturbance of habitats. • Anti-erosion measures should be taken where roads and tracks cross a drainage. • Water flow in the drainages should be unimpeded: elevate or bury the water pipe where it crosses drainages and washes; plan the location of pylons and other infrastructure to avoid drainages as much as possible; soil stockpiles should avoid drainages. • Carefully plan the placement of stockpiles or laydowns for construction material to avoid sensitive areas. • Limit construction activities to daytime hours to reduce noise and light. • Position temporary construction infrastructure (e.g. ablution, site office) in areas that will definitely be disturbed during operations. • Repair and rehabilitate damage from the construction phase immediately after cessation of the impact, e.g. laydown areas, erosion, rubble. • During the planning phase, a biodiversity specialist should be commissioned to inspect the power line/pipeline corridor specifically to identify nests, dens, burrows, and other breeding locations. These sites must be demarcated and avoided during all phases. If avoidance is not possible, the animals should be relocated by specialists. • Reptiles that are exposed during ground clearing or other activities should not be killed but should be captured for translocation by a qualified expert. Contractors and permanent staff should be educated on the importance of reptiles in the desert environment. • Ongoing education is essential. Educate construction, contractor, and permanent staff as to their environmental obligations. In addition to a thorough induction, project staff should receive repeated environmental training at least yearly. A focus on snakes during education sessions will be a start to changing perceptions and moving towards conservation of this taxon. • All contractors should be held responsible for transgressions, and significant penalties should be levied to ensure compliance. • No collection of plants or wood for any reason whatsoever. • No fires. • No indiscriminate defecating. • Avoid damage to the soil crust by staying on designated roads and restricting foot and vehicle traffic to the project site. • Limit driving to daylight hours because many reptiles are nocturnal and at risk from vehicle collisions.

7.4.1.2 Potential Impact: Disturbance of Animals and Interference with their Behaviour

Description of the Impact

During the operational phase the following activities are expected to cause disturbance of animals and interference with their behaviour:

- Increase in human and vehicle presence and movement resulting from operational activities.
- Loud noise caused by vehicles and machinery. Noise disturbs the normal behaviour of animals, specifically mammals and birds.
- The NMF facility, its associated infrastructure, roads, pipeline, and power line form obstacles to the directional movement of animals.
- Permanent structures form barriers that could lead to fragmentation of habitat and a consequent decrease in habitat quality. Fragmentation also causes impairment of key ecosystem functions by altering nutrient cycles and community composition.

- Habitat fragmentation limits animal mobility, leading to increased competition for limited resources and a potential decline in genetic diversity, especially relevant to taxa with limited ranges, such as reptiles and invertebrates.
- The loss of movement corridors and interference with the feeding habits of the Brown Hyaena in the Central Namib is of grave concern.
- Animals are disturbed while going about their daily activities, such as feeding and breeding, and the loss of movement corridors causes stress and an increased risk of death to various taxa, namely mammals and reptiles.
- Taxa that are most likely to be affected by the pipeline are burrowing mammals, reptiles and invertebrates. A 15 cm diameter pipe poses an insurmountable barrier to these taxa, but this impact is expected to decrease when sand blows over and covers the pipe.
- Bird-specific impacts caused by the power line are dealt with in section 7.4.2.

Impact Assessment

The disturbance of animal foraging and movement habits and the increased risk of mortality represent a prominent change and disturbance that will require intervention. The extent of the impact is beyond the site, especially for mobile taxa such as Brown Hyaena and birds. Some impacts may be prevented, but the footprint of the NMF is unavoidable and permanent.

The loss of ecosystem functions may be irreplaceable when viewed in a regional context, but low animal densities limit the potential loss on species level. These adverse impacts are very important considerations and must have an influence on the decision. Substantial mitigation is required and may bring the significance of the impact down to **Low**.

It is highly likely that the project will contribute to a cumulative impact with High significance, an impact caused by continued development in the Central Namib. The assessment of the impact is provided in Table 7-24.

Table 7-24: Disturbance of animals and interference with their Behaviour

Disturbance of Animals and Interference with their Behaviour		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Long-term (10 to 20 years)	Medium-term (5 to 10 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	High	Medium
Probability	Probable (High)	Conceivable (Low)
Significance	High	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Partially reversible: Impacts of the pipeline and power line can be reversed by implementing management measures, but the footprint of the NMF cannot.*	

Disturbance of Animals and Interference with their Behaviour		
Degree to which impact may cause irreplaceable loss of resources	*Medium*	
Degree to which impact can be avoided	*High: implement management measures.*	
Degree to which impact can be mitigated	*High: implement management measures.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Likely. Development along the coast and inland continues unabated and uncontrolled.*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	High	Low

Management and Mitigation

- The extent of the operation should be clearly demarcated on site layout plans. On the ground it should be either fenced in or marked with clear signposts.
- Areas surrounding the NMF and related infrastructure 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.
- No fires should be allowed.
- Educate all staff, as well as contractors and their staff, how to interact with wildlife in a sensitive and situation-appropriate manner.
- Ensure that wastes and potentially hazardous liquids are inaccessible to animals and birds.
- Design and construct structures (particularly road kerbing, fences, channels and impoundments) to limit their potential to obstruct animal movement and/or trap animals.
- Pipeline and powerline specific mitigation:
  - Minimise the corridor width to a maximum of 3 metres either side of the pipe.
  - Design the power line and pipeline access and maintenance roads so that both can be reached by the same road, and you do not create two parallel corridors.
  - Use the existing road for construction and maintenance access where practical, instead of making new tracks or roads for the linear developments.
  - The pipeline should be elevated in rocky drainages and also at the top of rocky ridges to alleviate the barrier effect and allow invertebrates, reptiles, and amphibians to pass.
  - The pipeline should be buried in sandy drainages and intermittently along its length to alleviate the barrier effect and allow invertebrates, reptiles, and amphibians to pass.
  - Cross drainages by the shortest routes possible and where drainages have a sandy substrate, bury the pipe.

Monitoring

- Inspect the water pipeline on completion and assess the frequency of elevated and buried sections to facilitate animal movement. Where long stretches exist as a barrier, implement additional burial, covering or elevation.
- Inspect the water pipeline where it crosses drainages after significant rainfall events to ensure functionality of the crossing.
- Inspect drainage channels and impoundments for trapped animals. Where particular structures regularly trap animals, implement measures that reduce this occurrence and/or allow the animals to exit the structure.

7.4.1.3 Potential Impact: Soil and Water Contamination

Description of the Impact

This impact is unlikely to arise because the design makes provision for containment, but because of the importance of soil and water for biodiversity and ecological resources far beyond the project site, it is mentioned here for the sake of completeness. All taxa are susceptible to this impact. The activities outlined in the table below may result in impacts related to soil and water contamination.

Project Phase	Activity or aspect
Construction	Hydrocarbons, volatile organic compounds and fine particulate matter emitted by heavy machinery.
	Cement, glues, paints and other toxic chemicals.
Operation	Treatment bays where additives are blended into waste streams that require treatment prior to disposal.
	Silos where additives are stored.
	Warehouse where arsenic waste is off-loaded.
	Hydrocarbons, cement, volatile organic compounds and fine particulate matter emitted by heavy machinery.
	Sewage.
	In the event of a leak, rupture, overflow or other breach of the WMF cells, arsenic and other contaminants may contaminate the soil and water, but this should not occur if the design of the facility is followed and the operation is managed appropriately.

Impact Assessment

The unmitigated significance is Medium, but only because the probability of this impact occurring is low. Provided that the design parameters are followed assiduously during the construction and operational phases, the significance can be mitigated to **Very Low.**

In the unlikely event of a breach of cells, the impact would be permanent, irreversible and cause irreplaceable loss, but the impact can be avoided by following the design and operational parameters. The effects of a breach could be mitigated by pumping out groundwater and capping.

It is unlikely that a cumulative impact may arise, but not impossible, considering the proximity of a uranium mine and the potential of groundwater and soil contamination from other upstream developments. The assessment of the impact is provided in Table 7-25.

Table 7-25: Impact of Soil and Water Contamination

Soil and Water Contamination		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Severe change (Very high)	Minor change (Low)
Duration	Permanent (> 20 years)	Very Short-term (< 1 year)
Extent	Local area, far beyond site	Whole site and nearby surroundings

Soil and Water Contamination		
Consequence	High	Medium
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Medium	Very low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Breach of NMF cells is irreversible. Impact from other activities may be partially reversible.*	
Degree to which impact may cause irreplaceable loss of resources	*Breach of NMF will cause irreplaceable loss. Other activities: low degree.*	
Degree to which impact can be avoided	*Breach of NMF: high, if international highest industry standards are followed from the planning phase, through construction and operations.*	
Degree to which impact can be mitigated	*High - Follow highest industry standards for WMF.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Possible. Groundwater may be affected by other developments in the region, e.g. uranium mine.*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Very high	Very low
Management and Mitigation		
• Follow the highest international industry standards from the planning phase, through construction and during operations. • Refer to mitigation in the hydrological impact assessment (Table 7-14and Table 7-15). • Follow industry-specific containment and reporting guidelines. • Ensure that leachate dams and sewerage system are inaccessible to reptiles and birds.		

7.4.1.4 Potential Impact: Vehicle Tracks

Description of the Impact

The activities outlined in the table below may result in impacts resulting from the creation of vehicle tracks.

Project Phase	Activity or aspect
Research and Planning	Off-road driving by contractors, engineers and EIA specialists.
Construction	Transport of materials for construction of the WMF, its associated infrastructure, the pipeline, power line and access road.
	Cars, heavy vehicles, and machinery traverse the area carrying out construction activities.
Operation	Maintenance of the pipeline, power line and access road.
	People driving to and from the WMF.

The scars of vehicle tracks remain visible in the desert for decades, and the damage caused by traversing a pristine area is wider and more significant than just two visible ruts. Off-road driving damages the structure of the soil surface and causes soil compaction, which results in less water infiltration and availability, limited root penetration and less vegetation cover – conditions that are already severe in a desert.

Where a soil crust is damaged, the fine underlying layer of soil becomes vulnerable to wind erosion and dust is created. Dust settles on plants, interferes with photosynthesis, and causes a decline in habitat quality.

Most compaction of soil occurs on the first pass, and therefore access routes for construction and operations should be planned and laid out before construction starts. The extent of this impact may be reduced by keeping to one set of tracks because driving in the same tracks again does not significantly affect the degree of compaction under the tracks, but it greatly reduces the compacted area (Nortjé, et al., 2012).

Impact Assessment

The degradation resulting from this impact is associated with real and substantial consequences that will require intervention. The extent of the impact is the whole project area, but the surroundings of the access road are also vulnerable.

The impact is irreversible and will last beyond closure. The probability of the impact occurring is high, as proven by the proliferation of tracks in the Central Namib and at the coast: wherever there is a road, there are off-road tracks visible in all directions.

During construction, the impact may be mitigated to cause a moderate disturbance in habitats and ecosystems, limited in extent to the project site and in time to the medium term. During operations, the impact either has a high significance, or it is prevented totally which is the only mitigation possible. The low density of all taxa in the impact area limits the extent of resource loss. The assessment of the impact is provided in Table 7-26.

Table 7-26: Impact of Vehicle Tracks

Vehicle Tracks		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	All	
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Permanent (> 20 years)	Medium-term (5 to 10 years)
Extent	Part of site/property	Part of site/property
Consequence	High	Medium
Probability	Probable (High)	Conceivable (Low)
Significance	High	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Irreversible.*	
Degree to which impact may cause irreplaceable loss of resources	*Low. The low density of resources and the small size of tracks result in few resources being loss.*	
Degree to which impact can be avoided	*High.*	
Degree to which impact can be mitigated	*Low.*	

<table>
<tr><th colspan="3">Vehicle Tracks</th></tr>
<tr><td colspan="3">Cumulative Impact</td></tr>
<tr><td>Extent to which a cumulative impact may arise</td><td colspan="2">Possible</td></tr>
<tr><td rowspan="2">Rating of cumulative impacts</td><td>Without Mitigation</td><td>With Mitigation</td></tr>
<tr><td>High</td><td>Very low</td></tr>
<tr><td colspan="3">Management and Mitigation</td></tr>
<tr><td colspan="3">
Plan and lay out all access routes before construction commences, and plan access tracks with construction, operations, maintenance, monitoring and decommissioning in mind so that the same tracks will serve in all phases of the project.
Establish the site boundary (as presented in this report) at the start of construction and keep all vehicle activities within this boundary.
Prohibit all offroad driving.
Prevent the establishment of single-use tracks. Where unavoidable (or they occur through transgression), ensure immediate rehabilitation via manual sweeping.
Driving next to an existing track and the formation of new tracks should be prohibited.
Vehicle parking and turning should be within defined areas, preferentially located in previously disturbed or low sensitivity areas.
Where access is required for activities (e.g. monitoring, surveys, inspection) away from tracks, stop vehicles on the road and complete access on foot.
Access control: if the only vehicles that use a road are owned by an accountable company (Namwaste and Orano mine) it is possible to prevent off-road driving by installing cameras and GPS trackers in all vehicles and have them monitored in real time by the security team.
Drive around instead of across ridges where possible, and if not possible, then cross ridges at their lowest points and at points where the vegetation is least dense.
Do not put pylons on the tops of ridges but rather between two lower ridges with the cables running over the summit – this avoids the making of an access road to the summits of ridges.
Educate all staff, contractors and construction staff on the reasons and methods for track discipline, and make sure that unskilled labourers are also aware of the severity of the problem, not only top management.
If signs are used next to roads, ensure that the wording is clear and written in an appropriate tone.
Penalty clauses in contracts, fines and removal from site should be used as deterrents, and an environmental officer or ECO (during construction) should be on site at all times to monitor compliance.
</td></tr>
<tr><td colspan="3">Monitoring</td></tr>
<tr><td colspan="3">
Cameras should be installed in all vehicles belonging to the proponent.
New tracks observed by staff must be reported to the ECO, and a team must go out immediately to rehabilitate the site. Manual sweeping is effective where there is a single set of tracks. If possible, the area should be made inaccessible from the road by placing large rocks across the tracks. A written sign may be put up if the area is regularly traversed
</td></tr>
</table>

7.4.1.5 Potential Impact: Light Pollution

Description of the Impact

Invertebrates that are attracted to the light provide an unnatural food source for taxa such as bats and geckos. 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.

Nightly invertebrate fatalities may result from exhaustion or predation, potentially disrupting their population numbers and causing disturbances in ecological processes. Night-flying birds may be disoriented by lights, increasing the risk of predation. Adult bird mortality leads to mortality of dependent chicks.

The impact is at the level of ecosystem processes and increases the risk of extinction of local populations.

Impact Assessment

The significance of the impact is **Medium**, mitigated to **Low**. It is highly possible and relatively cheap to avoid this impact through efficient lighting design; by installing the correct type of lights in the correct locations during construction; by educating staff during the operational phase. A cumulative impact is unlikely to arise since the extent is limited to the NMF site. The assessment of the impact is provided in Table 7-27.

Table 7-27: Impact of Light Pollution

<table>
<tr><th colspan="3">Light Pollution</th></tr>
<tr><td>Type of Impact</td><td colspan="2">Direct</td></tr>
<tr><td>Nature of Impact</td><td colspan="2">Negative</td></tr>
<tr><td>Phases</td><td colspan="2">All</td></tr>
<tr><th>Criteria</th><th>Without Mitigation</th><th>With Mitigation</th></tr>
<tr><td>Intensity</td><td>Moderate change (Medium)</td><td>Negligible change (Very low)</td></tr>
<tr><td>Duration</td><td>Long-term (10 to 20 years)</td><td>Very Short-term (< 1 year)</td></tr>
<tr><td>Extent</td><td>Part of site/property</td><td>Part of site/property</td></tr>
<tr><td>Consequence</td><td>High</td><td>Medium</td></tr>
<tr><td>Probability</td><td>Possible / frequent (Medium)</td><td>Conceivable (Low)</td></tr>
<tr><td>Significance</td><td>Medium</td><td>Low</td></tr>
<tr><th colspan="3">Additional Assessment Criteria</th></tr>
<tr><td>Degree to which impact can be reversed</td><td colspan="2">Fully reversible with adherence to mitigation measures.</td></tr>
<tr><td>Degree to which impact may cause irreplaceable loss of resources</td><td colspan="2">Low. Small extent of impact.</td></tr>
<tr><td>Degree to which impact can be avoided</td><td colspan="2">High.</td></tr>
<tr><td>Degree to which impact can be mitigated</td><td colspan="2">High.</td></tr>
<tr><th colspan="3">Cumulative Impact</th></tr>
<tr><td>Extent to which a cumulative impact may arise</td><td colspan="2">Unlikely</td></tr>
<tr><td rowspan="2">Rating of cumulative impacts</td><th>Without Mitigation</th><th>With Mitigation</th></tr>
<tr><td>Medium</td><td>Insignificant</td></tr>
<tr><th colspan="3">Management and Mitigation</th></tr>
<tr><td colspan="3">• Minimise the use of outdoor lighting. Install motion detector lighting where practical.</td></tr>
</table>

Light Pollution
• Outdoor lights should be directed downwards and not up into the sky. Skyward pointing lights interfere with bats and birds, blinding and disorienting them. • 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.

7.4.2 Avifauna

7.4.2.1 Potential Impact: Birds and Powerline Interactions

Description of the Impact

Power line interactions start as soon as the first support pole goes up and persist for as long as the power line stands.

The two main causes of bird mortality are electrocution and collision, causing thousands of deaths in Namibia every year and contributing greatly to the decline in numbers of protected and endangered species. Species of conservation concern that may be affected in the study area include Ludwig's Bustard, Lappet-faced Vulture, Martial Eagle, Yellow-billed Kite and Great White Pelican. Other species that may be affected include Rock Kestrel, Greater Kestrel, Black-chested Snake Eagle, Pale Chanting Goshawk and Namaqua Sandgrouse.

Electrocution

- Large bird species are especially prone to death by electric shock. Birds are electrocuted when they stretch their wings while perching on an electrical structure, or when droppings touch exposed electrical components.
- In an arid area with few nesting, roosting and perching resources, the likelihood that birds would use electrical support structures is high.

Collision

- Ludwig's Bustard (Endangered in Namibia and globally) is at very high risk of striking power lines. Like other bustards, its eyes are on the sides of its head, it looks down while flying, has a large wingspan and low manoeuvrability, and it often flies in low light.
- Rüppell's Korhaan (near endemic) and Lappet-faced Vulture (Endangered globally and Vulnerable in Namibia) have the same inability to see horizontal lines while flying.
- Ludwig's Bustard and Rüppell's Korhaan use the food and shelter resources in the drainages of the study area, and also the gravel plains after rainfall events, making them vulnerable to collisions where the power line crosses these habitat types.
- Nomadism and flock flying are other traits that increase the risk of collisions: Yellow-billed Kites, Flamingos and Pelicans are vulnerable. Flamingos are at additional risk because their regular migrations take place mostly at night. Unfortunately, all their flight pathways in Namibia are not known with certainty, and flight routes change in response to local weather and food conditions, but it is highly likely that the power line will cross some routes used by flamingos.

Impact Assessment

The potential mortality of birds from power line impacts represents a prominent, permanent loss with real and substantial consequences and will require intervention. The impact extends to the areas surrounding the project site, but the cumulative effects of increased power line development in the Central Namib may eventually lead to an impact on birds at population level, and an irreplaceable loss of resources on a national level.

Collision impacts are more likely in certain sections of the power line. Line marking to increase visibility is currently the most recommended mitigation measure for power line collisions. It is highly effective for large terrestrial birds, with the notable exception of bustards (Shaw, et al., 2021). It is thus recommended that static (e.g. SWANFLIGHT) and/or dynamic (e.g. Viper flappers) bird flight diverters should be installed (Environmental Compliance Consultancy, 2019) (Jenkins, et al., 2010).

These adverse impacts are considered to be very important considerations and must have an influence on the decision. Substantial mitigation is required and may bring the significance of the impact down to **Low**.

It is highly likely that the project will contribute to a cumulative impact with **High** significance, an impact caused by continued development in the Central Namib. The assessment of the impact is provided in Table 7-28.

Table 7-28: Birds and power line interactions

Birds and power line interactions		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site and nearby surroundings	Whole site and nearby surroundings
Consequence	High	Medium
Probability	Definite / Continuous (Very high)	Possible / frequent (Medium)
Significance	High	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Partially reversible through mitigation measures, but once a death occurs it is permanent and irreversible.*	
Degree to which impact may cause irreplaceable loss of resources	*Medium. The impact is mostly at the level of species and individual birds, and not on population level.*	
Degree to which impact can be avoided	*Medium. Mitigation measures are proven to reduce mortality, but are not 100% effective. Bustards remain at risk.*	
Degree to which impact can be mitigated	*High.*	
Cumulative Impact		
Extent to which a cumulative impact may arise	*Likely. The decline in numbers of species of conservation concern in Namibia, specifically Flamingos and Ludwig's Bustard, can be blamed in large part on power line interactions.*	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	High	Low
Management and Mitigation		

Birds and power line interactions
Electrocution mitigation • Adopt a pole / wire configuration design that is considered by industry standards to have the lowest risk of bird electrocution. • Construct and install bird perches and/or anti-perch devices above dangerous structures on poles. This is a measure that can also be retrofitted where monitoring indicates that electrocution is prevalent at a specific pole. • Fit insulation (of appropriate specification for the voltage) to conductor wires and insulators supporting the cables, or the grounded crossarms. • Reconfigure jumper wires to pass under the crossarm rather than over it and offset jumpers where possible. Collision mitigation • It is recommended that the powerline section from -22.393676°, 14.969052° (A in Figure 6-54) to -22.290892°, 14.909888° (B in Figure 6-54) be fitted with diverters. • Diverters should be fitted on the top conductor, 10 meters apart along the full length of each span, and with alternating, contrasting colours (e.g. black alternating with yellow).
Monitoring
• The entire length of the power line should be monitored for bird carcasses at a frequency of once a month for the first year after construction. Thereafter the route should be patrolled every 3 months. • Every carcass or other sign of bird collisions/electrocutions must be recorded, with information that includes the GPS coordinates, distance from centre of power line, distance from support poles and other structures, general habitat, and a photo of the carcass, especially the head. • Results of the monitoring should be used to assess the efficacy of the management and mitigation measures that are in place, and to recommend adaptations and/or additional measures should it be indicated.

7.5 Impact on the Socio-economic Environment

7.5.1 Socio- Economic Impacts – Construction Phase

7.5.1.1 Potential Impact: Increased employment opportunities

Description of the Impact

The construction of the proposed project is anticipated to create various types of employment, including:

- Direct employment of staff and contractors directly associated with the project;
- Indirect employment of sub-contractors and suppliers; and
- Induced employment generated by increased spending at businesses and on services by households earning an income from the project (the multiplier effect).

During the initial construction period Namwaste estimates that 50 direct new jobs will be created over an 8 to 18-month period. Of these 35% (approximately 18 jobs) will be unskilled and will be sourced locally as far as possible. While temporary in nature, considering the relatively high level of unemployment in the area (Section 6.13.3) any potential job opportunities are likely to be viewed in a positive light by the local community. Furthermore, given the relatively high level of unemployment in the area as well as the large portion of the population under the age of 15 (Section 6.13.1.2) employed persons are likely to support a number of dependents.

It is estimated that in Namibia construction projects can have a multiplier effect of about two times the direct jobs created, generated by increased spending at businesses and on services (Kanyenz and Lapeyre, 2012). Given this, it is anticipated that approximately a further 100 induced jobs may be created as a result of construction of the proposed project.

Employment provides various socio-economic benefits to employees and their dependants, including:

- Improved material wealth and standard of living;
- Enhanced potential to invest and improved access to social services such as education and health services;
- Enhanced skills transferred to previously unskilled workers, facilitating employment prospects of such workers; and
- Contribution to a sense of independence, freedom and pride, which may improve quality of life.

Impact Assessment

As noted previously, while the need for employment opportunities in the area is noted, a relatively small number of unskilled positions will be created and only in the very short term. Considering this, the increase in employment opportunities is seen as of **Low Positive** significance both with and without management measures. The assessment of the impact is provided in **Table 7-29**.

Table 7-29: Impact assessment of Increased Employment Opportunities

Increased Employment Opportunities		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change (Low)	Minor change (Low)
Duration	Short-term (1-5 years)	Short-term (1-5 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Low	Low
Probability	Probable (High)	Definite / Continuous (Very high)
Significance	Low +	Low +
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: Following construction the employment opportunities created will cease to exist. It should however be noted that it is likely some of the staff will be retained to undertake construction of additional cells during operation.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	N/A	

Increased Employment Opportunities		
Degree to which impact can be mitigated	Medium: Through prioritising locally employed staff benefits can be felt locally	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Management and Mitigation		
The following management measures are proposed: • Maximise use of local skills and resources through preferential employment of locals where practicable. • Develop, communicate and implement a fair and transparent labour and recruitment policy. • Ensure diversity and gender equality in recruitment, as far as possible. • Provide training to staff before and/or during the construction phase where possible and practicable.		
Monitoring		
The following monitoring is recommended: • Number of locally employed persons. • Number of local persons receiving training.		

7.5.1.2 Potential Impact: Increased opportunities for local contractors and businesses

Description of the Impact

It is estimated that approximately 70% of CapEx required for the project will be spent within Namibia. While not all of this will be spent within the Erongo Region it is anticipated that a portion of it will be and will benefit local contractors and business.

Opportunities for locally based contractors and businesses are likely to include security companies, plant hire companies, road contractors, transport companies, catering businesses, etc.

Where possible these services will be obtained from services providers in Arandis, however it is likely that some services may not be available within the town and will need to be obtained from other centres in the Erongo Region. Considering the amount of industry within the region it is anticipated that most of the required services will be able to be sourced within the region.

Impact Assessment

While increased opportunities for local businesses will have a positive impact for the region and may result in some businesses expanding and employing additional people, it will however be temporary in nature (for the duration of construction) and in relation to other developments in the area e.g. the mining sector, is likely to be relatively small. Considering this, the impact is regarded as being a **Low Positive** both prior to and following management measures. The assessment of the impact is provided in Table 7-30.

Table 7-30: Impact assessment of increased opportunities for local contractors and businesses

Increased opportunities for local contractors and businesses		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change (Low)	Moderate change (Medium)
Duration	Short-term (1-5 years)	Short-term (1-5 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Low	Low
Probability	Probable (High)	Definite / Continuous (Very high)
Significance	Low +	Low +
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: Following construction the opportunities for local contractors will cease to exist. It should however be noted that it is likely some of the contractors will be retained to undertake construction of additional cells during operation.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	N/A	
Degree to which impact can be mitigated	Medium: Through prioritising locally based contractors where possible	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Management and Mitigation		
The following management measures are proposed: • Work with relevant stakeholders to identify local businesses and contractors providing the required services. • Source as many goods and services as possible from the local and regional economy (e.g. use local contractors and accommodation and equipment suppliers as far as possible and purchase perishable goods locally). • Provide suitable training to service providers, where possible and practicable. • Develop and implement a fair and transparent procurement policy.		
Monitoring		
The following monitoring is recommended: • Number of locally appointed businesses and contractors.		

Increased opportunities for local contractors and businesses
• Percentage of Capex spent on goods acquired from local and regional services providers.

7.5.1.3 Potential Impact: Generation of income through property lease

Description of the Impact

The proposed site will be leased by Namwaste from the Namibian Government. While the terms of the lease (i.e. value and duration of the lease) were not available at the time of compiling the SEIA, it is anticipated that the lease would commence prior to construction and continue through to the completion of decommissioning.

Income generated from the lease has the potential to benefit the area, especially considering the lack of economic opportunities and services for the !Oe-#Gan Traditional Authority and for people residing within the #Gaingu Conservancy. Benefits could include investment in services such as water, sanitation and electricity, establishment of education funds, etc. As the terms of the lease are not currently available the significance of the impact could not be provided and no management measures proposed.

7.5.1.4 Potential Impact: Reduced road safety

Description of the Impact

In order to access the project site, construction vehicles will be required to travel on the B2 and then approximately 15 km on the existing Trekkopje Road. It has been estimated that during construction there would be approximately four to five trucks accessing the site on a daily basis in addition to vehicles transporting construction staff. In order to avoid construction vehicles traveling through Arandis town, Namwaste is proposing a solution which bypasses the town (Section 5.5.1).

The increased number of vehicles travelling on the B2, the access road between the B2 and Arandis town as well as the new bypass road may result in reduced road safety for road users, including pedestrians.

While the daily increase in vehicles during construction is relatively small considering the volumes of traffic on the B2, the potential cumulative impact created by traffic accessing the Orano mine also located on the Trekkopje Road needs to be considered. While the mine is currently in ‘care and maintenance’ and thus there is limited traffic accessing the mine, should the construction of the NMF coincide with the operations at the mine commencing there may be a cumulative impact.

Impact Assessment

Considering the relatively small number of vehicles accessing the site daily in relation to existing traffic on the B2, that the construction traffic will largely bypass Arandis town and that it will only be for a relatively short period of time, the significance of the impact is considered to be **Low Negative** both prior to and with mitigation. The assessment of the impact is provided in Table 7-31.

Table 7-31: Impact assessment of reduced road safety

Reduced Road Safety		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation

Reduced Road Safety		
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1-5 years)	Short-term (1-5 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Low	Low
Probability	Definite / Continuous (Very high)	Probable (High)
Significance	Low	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible. Following the completion of construction, construction related vehicles will not access the site.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium: An increase in traffic is inevitable but the degree to which it reduces road safety can be reduced.	
Degree to which impact can be mitigated	Medium: Through traffic management plans	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Low
Management and mitigation measures		
While the mitigation measures provided in the traffic impact assessment should be adhered to, the following is also recommended: • Instruct all construction personnel and contractors to use the nominated bypass route, rather than transit though the centre of Arandis. • Communicate with relevant stakeholders regarding anticipated traffic volumes as and when required. • Communicate with the relevant local stakeholders regarding measures being put in place to monitor and improve road safety as and when required.		
Monitoring		
While the monitoring measures provided in the traffic impact assessment should be followed, the following is also recommended: • Through the use of a complaints register, monitor the number of complaints received regarding traffic safety. • Number of road incidents involving project related vehicles. • Feedback from engagement with relevant stakeholders regarding perceptions on road safety.		

7.5.1.5 Potential Impact: Increased spread of disease

Description of the Impact

Any development which causes the migration of people has the potential to lead to the spread of disease; in particular, HIV and AIDS. Research suggests that the presence of migrant construction workers leads to an increase in activities such as prostitution, with promiscuity often associated with groupings of construction workers and the spread of HIV and AIDS (Weine and Kashuba, 2012). This could lead to scenarios where infected construction workers coming into the area spread disease to locals who in turn spread it locally. Alternatively, an uninfected construction worker could become infected and, on return to his/her place of origin spread the disease there. An increase in the spread of diseases and, in particular, HIV and AIDS, is also likely to be caused by the movement of trucks carrying construction materials moving in and out of the project site, as well as job seekers entering the area, probably in a transient manner.

However, the number of workers required during construction is relatively limited and an estimated 50% will be sourced locally. Considering this, the number of workers entering communities adjacent to the project will be low which should limit the possible impact of a spread in disease.

Impact Assessment

Considering the size of the required workforce during construction and the relatively short construction period the impact is considered to be of a **Low Negative** significance without mitigation and reduced to the V**ery Low Negative** with mitigation. While the impact is not thought to be significant, it should be taken into consideration and the necessary mitigation measures followed. The assessment of the impact is provided in Table 7-32.

Table 7-32: Impact assessment of increased spread of disease

Increased spread of disease		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Short-term (1-5 years)	Short-term (1-5 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Low	Very low
Probability	Probable (High)	Possible / frequent (Medium)
Significance	Low	Very low
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible. Following construction, workers from outside the area will leave the site.	
Degree to which impact may cause irreplaceable loss of resources	None	

<table>
<tr><th colspan="3">Increased spread of disease</th></tr>
<tr><td>Degree to which impact can be avoided</td><td colspan="2">Medium. The likelihood of the impact occurring can be reduced.</td></tr>
<tr><td>Degree to which impact can be mitigated</td><td colspan="2">Medium: Through proposed mitigation measures.</td></tr>
<tr><td colspan="3">Cumulative Impact</td></tr>
<tr><td>Extent to which a cumulative impact may arise</td><td colspan="2">Unlikely</td></tr>
<tr><td rowspan="2">Rating of cumulative impacts</td><td>Without Mitigation</td><td>With Mitigation</td></tr>
<tr><td>Insignificant</td><td>Insignificant</td></tr>
<tr><td colspan="3">Management and Mitigation</td></tr>
<tr><td colspan="3">The following mitigation measures are proposed:
• Include health related training in all induction training for project employees.
• Ensure there is easy access to HIV and AIDS related information and condoms for all workers involved with the proposed programme.
• Encourage voluntary HIV and AIDS counselling and testing.</td></tr>
<tr><td colspan="3">Monitoring</td></tr>
<tr><td colspan="3">The following monitoring is recommended:
• Successful undertaking of project induction.
• Number of staff undertaking voluntary HIV and AIDS counselling and testing.</td></tr>
</table>

7.5.1.6 Potential Impact: Increased incidence of crime

Description of the Impact

Prior to and during construction, the in-migration of job seekers is likely to bring with them criminal opportunists. Although the relatively remote nature of the project site will somewhat limit the likelihood of criminal activities in the direct vicinity of the project site, it was noted during consultation that with previous projects communities have experienced an influx of job seekers (SEIA specific consultation, 2024).

Impact Assessment

The significance of this occurring however is likely to be reduced by the relatively small construction workforce requirements, especially in comparison with mines in the area, the relatively short construction period and the intention to source employment locally. Considering this the impact is considered to be of a **Very Low Negative** significance without mitigation and **Insignificant** with mitigation. The assessment of the impact is provided in Table 7-33.

Table 7-33: Impact assessment of increased incidence of crime

<table>
<tr><th colspan="3">Increased incidence of crime</th></tr>
<tr><td>Type of Impact</td><td colspan="2">Indirect</td></tr>
<tr><td>Nature of Impact</td><td colspan="2">Negative</td></tr>
<tr><td>Phases</td><td colspan="2">Construction</td></tr>
<tr><td>Criteria</td><td>Without Mitigation</td><td>With Mitigation</td></tr>
<tr><td>Intensity</td><td>Minor change (Low)</td><td>Negligible change (Very low)</td></tr>
</table>

Increased incidence of crime		
Duration	Very Short-term (1-5 years)	Short-term (1-5 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Very low	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible. The influx of job seekers and criminal opportunists should cease following construction.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The likelihood of the impact occurring can be reduced.	
Degree to which impact can be mitigated	Medium.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Management and mitigation		
The following mitigation measures are proposed: • Liaise with relevant stakeholders regarding where construction workers will be accommodated before and during construction to inform them of construction status and discuss safety management measures to reduce security risks. • Maintain a visible security presence on site. • Implement a grievance mechanism during the construction phase. • Control site access. • Declare areas outside of the construction site as no-go areas for construction staff. • Regularly inspect the project area and surrounding area for signs of illegal activity.		
Monitoring		
The following monitoring is recommended: • Reported incidence of crime within Arandis during construction. • Number of complaints received through the grievance mechanism. • Feedback from engagement with stakeholders.		

7.5.1.7 Potential Impact: Increased tension and conflict

Description of the Impact

The potential influx of jobseekers and workers into the surrounding communities, particularly Arandis, during construction may result in increased tensions within the local community and potential conflict. Tension between the community and jobseekers and / or workers are likely to be created by the perception that jobs are being provided to and taken up by outsiders and not given to members of the local community as well as due to increased pressure of existing services (housing, water, electricity, etc.) being created by people from outside of the community.

Impact Assessment

In the case of the proposed project it is likely that factors such as the relatively short construction period and small size of the construction workforce as well as the plan to prioritise the employment of people from the local communities will limit the significance of the impact. Considering this, without mitigation the impact is considered to the **Very Low Negative** significance and with mitigation measures it becomes **Insignificant**. The assessment of the impact is provided in Table 7-34.

Table 7-34: Impact assessment of increased tension and conflict

Increased tension and conflict		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Short-term (1-5 years)	Short-term (1-5 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Very low	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible. The influx of job seekers and workers should cease following construction.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The likelihood of the impact occurring can be reduced.	
Degree to which impact can be mitigated	Medium.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Management and Mitigation		

Increased tension and conflict
The following mitigation measures are proposed: • Include relevant training in all induction training for project employees. • Implement a grievance mechanism during the construction phase. • Undertake engagement with relevant stakeholders within Arandis as and when necessary.
Monitoring
The following monitoring is recommended: • Number of complaints received through the grievance mechanism and in the complaints register.

7.5.2 Socio - Economic Impacts - Operation Phase

7.5.2.1 Potential Impact: Increased permanent employment opportunities

Description of the Impact

During operation between 20 and 25 permanent positions will be created to operate the facility. Of these approximately 65% will be skilled positions and 35% semiskilled or unskilled. While initially a few of the skilled positions will be occupied by persons from outside of the project area with the necessary experience and expertise to ensure the facility operates as per design and in line with international best practice, it is proposed that over a period of two to three years the necessary training and skills development take place to allow for all positions to be occupied by Namibian nationals with a focus on people from the immediate area.

In addition to these positions an additional 20 to 25 staff will be required for approximately six months, every second year to construct new waste cells as part of the waste disposal facility which will be constructed in phases.

During consultation one of the biggest challenges highlighted by communities within the Erongo Region was the lack of permanent employment opportunities (SEIA specific consultation, 2024). While the number of employment opportunities is limited, given the high level of unemployment in the area any potential jobs for local persons are viewed in a positive light, especially in cases where there is potential for upskilling. As noted in Section 7.5.1.1 there are various socio-economic benefits associated with employment including:

- Improved material wealth and standard of living;
- Enhanced potential to invest and improved access to social services such as education and health services;
- Enhanced skills transferred to previously unskilled workers, facilitating employment prospects of such workers; and
- Contribution to a sense of independence, freedom and pride, which may improve quality of life.

Impact Assessment

In the case of the proposed development the impact is determined to be of a **Medium Positive** significance with and without management measures. The assessment of the impact is provided in Table 7-35.

Table 7-35: Impact assessment of increased permanent employment opportunities

Increased Employment Opportunities		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible change (Very low)	Minor change (Low)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Beyond site	Beyond site
Consequence	Medium	Medium
Probability	Probable (High)	Probable (High)
Significance	Medium +	Medium +
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversable. Following the completion of the project jobs will no longer exist.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The significance can be improved through management.	
Degree to which impact can be mitigated	Medium: The significance can be improved through management.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Management and Mitigation		
The following management measures are proposed: • Maximise the use of local skills and resources through preferential employment of locals where practicable. • Develop, communicate and implement a fair and transparent labour and recruitment policy. • Ensure diversity and gender equality in recruitment, as far as possible. • Develop a training plan outlining the process for the upskilling and training of Namibian Nationals to ensure the facility is locally run within the proposed timeframes.		
Monitoring		
The following monitoring is recommended: • Number of locally employed persons. • Number of local persons receiving training.		

7.5.2.2 Potential Impact: Compliance with appropriate and safe waste management standards

Description of the Impact

Business and in particular mines operating in the Erongo Region are required to comply with various international regulations regarding the disposal of hazardous waste (e.g. disposal at an authorised facility). Mines operating in the area currently dispose of hazardous waste at the Walvis Bay Facility. It was however noted during consultation that the facility has various challenges including opportunistic ‘scavengers’ which has led to the site being closed for periods of time (SEIA specific consultation, 2024). Mines in the area noted that the construction of the proposed facility would allow for hazardous waste to be disposed of in the correct manner and thus reduce liability for the mines (SEIA specific consultation, 2024).

Impact Assessment

Considering the current situation in Namibia where there is a shortage of suitable hazardous waste sites as well as the growing mining sector, the ability of business to comply with the necessary standards is considered of **Very High Positive** significance both without and with management. The assessment of the impact is provided in Table 7-36.

Table 7-36: Impact assessment of compliance with waste management standards

Compliance with Waste Management Standards		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Regional/National	Regional/National
Consequence	Very high	Very high
Probability	Probable (High)	Probable (High)
Significance	Very high +	Very high +
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversable. Once the site is closed hazardous waste will no longer be received.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The significance can be improved through management.	
Degree to which impact can be mitigated	Medium: The significance can be improved through management.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	

Compliance with Waste Management Standards		
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Management and Mitigation		
The following management measures are proposed: • Ensure that the facility operates as per design and in line with Namibian legislation and international best practice for waste management.		
Monitoring		
The following monitoring is recommended: • Compliance with the ECC, Namibian legislation and international best practice.		

7.5.2.3 Potential Impact: Loss of revenue for the Walvis Bay Municipality

Description of the Impact

Once the NMF is operational it is likely that the volume of hazardous waste being disposed of at the Walvis Bay facility will decrease and the facility could potentially close. This will result in a loss of revenue currently generated by the Walvis Bay Municipality through the operation of the facility.

However, during consultation it was noted that there are various challenges currently facing the Walvis Bay waste site, and in particular the hazardous waste portion of the site, while there are significant costs associated with operating and maintaining the site (SEIA specific consultation, 2024). It was noted anecdotally during consultation that the benefit of the income generated from the site is outweighed by potential liability associated with operating the site as well as the costs involved (SEIA specific consultation, 2024).

Impact Assessment

Considering the risks and liability identified during consultation with the Walvis Bay Municipality, the apparent costs associated with running a facility and the relatively short remaining capacity at the facility the impact is considered of a **Medium Negative** significance both without and with mitigation. The assessment of the impact is provided in Table 7-37.

Table 7-37: Impact assessment of loss of revenue for Walvis Bay Municipality

Loss of revenue for Walvis Bay		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change (Low)	Minor change (Low)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site and nearby surroundings (site in this case is Walvis Bay)	Whole site and nearby surroundings (site in this case is Walvis Bay)
Consequence	Medium	Medium
Probability	Probable (High)	Probable (High)

Loss of revenue for Walvis Bay		
Significance	Medium	Medium
Additional Assessment Criteria		
Degree to which impact can be reversed	Irreversible. The loss of revenue once the site is closed cannot be reversed.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	N/A	
Degree to which impact can be mitigated	None	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Mitigation and Management:		
The following mitigation measures are proposed: • Communicate with the Walvis Bay Municipality regarding the development of the Namwaste Management Facility.		
Monitoring:		
None required.		

7.5.2.4 Potential Impact: Increased support for community

Description of the Impact

Namwaste intend providing support to the communities living in close proximity to the NMF site. Support is likely to be provided through direct employment opportunities and training (Section 7.5.1.1 and 7.5.2.1) as well as in-kind assistance. It is understood that Namwaste is currently in discussions with NamWater, the #Gaingu Conservancy and #Oe Gan Traditional Authority regarding the potential refurbishment, maintenance and operation of an old desalination plant in Spitzkoppe (SEIA specific consultation, 2024). Access to water has been identified as one of the critical issues for communities residing within the #Gaingu Conservancy for both domestic and agricultural use (Appendix L). Other areas identified during consultation where assistance may be provided includes assistance with waste management in the area of Spitzkoppe where waste management is seen as a challenge, assistance with basic solar power for rural areas that are currently not connected and assistance with the registration of small scale mine operations with the relevant government ministry (SEIA specific consultation, 2024). The possibility of collaborating with the mines operating in the area should also be considered so as to align strategies, benefit from lessons learned and not duplicate efforts.

Impact Assessment

The benefits from community investment by Namwaste have the potential to improve the lives of persons living in surrounding area, particularly those residing within the #Gaingu Conservancy. If managed properly the benefits are likely to be felt over the long term. Considering this, it is deduced that through community investment the NMF may have a **High**

Positive impact both without and with management measures. The assessment of the impact is provided in Table 7-38.

Table 7-38: Impact assessment of increased support for community

Increased community support		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 to 20 years)	Permanent (> 20 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	High	High
Probability	Probable (High)	Definite / Continuous (Very high)
Significance	High +	High +
Additional Assessment Criteria		
Degree to which impact can be reversed	Irreversible. Once benefits have been provided to the community, they will continue.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	N/A	
Degree to which impact can be mitigated	Medium. Measure can be put in place to increase the likelihood of long term benefits for the community.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	High +	High +
Mitigation and Management		
The following management measures are proposed: • Engage with community stakeholders to develop meaningful strategies for community development. • Ensure that funding requirements for each project are considered into the future so that projects are viable and sustainable. • Set clear goals for each project and phase out funding once these goals are achieved.		
Monitoring:		
The following monitoring is recommended: • Ensure regular auditing of supported projects. • Consider auditing projects for several years after funding has ceased to ensure their benefits are sustained.		

Increased community support
• Continued monitoring of funded projects to confirm benefits are still being realised.

7.5.2.5 Potential Impact: Perceived health risks associated with hazardous waste

Description of the Impact

There is often a general lack of understanding as to what is classified as hazardous waste, how it is disposed of and stored and what the risks are likely to be (SEIA specific consultation, 2024). During consultation it was noted that it is likely that the public, and in particular those people residing within Arandis town, will have concerns regarding perceived health risks associated with the NMF. Such concerns may result in increased levels of anxiety among community members, may have a polarising impact on the community between those people opposed to the NMF and those associated with it or seen to be benefiting from it, and potentially lead to opposition to the project.

Impact Assessment

The need to educate the communities about the project and associated risks at an early stage and provide ongoing engagement with the community was identified by a number of stakeholders (SEIA specific consultation, 2024). While it is likely that there will be concern regarding the presence of hazardous waste, stakeholders also noted that distance between the proposed site and any permanent settlement should reduce the significance to some degree. Considering this, without mitigation the impact is considered to be of **Medium Negative** significance, however with appropriate mitigation, including early and ongoing engagement it is possible to reduce this to **Very Low Negative** significance. The assessment of the impact is provided in Table 7-39.

Table 7-39: Impact assessment of perceived health risks

Perceived health risks		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Medium-term (5 to 10 years)	Very Short-term (< 1 year)
Extent	Beyond site	Beyond site
Consequence	Medium	Low
Probability	Probable (High)	Possible / frequent (Medium)
Significance	Medium	Very Low
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable: Concerns can be reversed but some are likely to remain even after decommissioning.	

Perceived health risks		
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The impact can be reduced, however it is likely that some concern will always remain.	
Degree to which impact can be mitigated	Medium. Measures can be put in place to educate communities and reduce the significance of the risk.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant
Mitigation and Management		
The following mitigation measures are proposed: • Develop and implement a stakeholder engagement plan. • Educate the community regarding hazardous waste and the potential health impacts and mitigation measures adopted by the facility to prevent potential health impacts. • Provide information sessions to the community regarding the facility as and when required. • Implement a grievance redress mechanism.		
Monitoring:		
The following monitoring is recommended: • Number of complaints, concerns or queries received regarding health risks. • Evidence of opposition to the facility.		

7.5.2.6 Potential Impact: Perceived risks due to the transportation of hazardous waste

Description of the Impact

Hazardous waste will be transported from the source to the NMF site via truck. During operation it is anticipated that 14 trucks will access to site daily. Some of these trucks will be required to travel on the B2 before joining the Trekkopje road. In the event of an accident occurring there may be hazardous waste spills with possible environmental and community health implications. In the case of Arandis, should an accident and spill occur on the access road into town, access in and out of the town could potentially be cut off. As noted in Section 7.5.2.5 risks relating to community health and hazardous waste can lead to increased feelings of anxiety as well as opposition to the proposed project. The potential risk associated with the transportation of hazardous waste on existing roads was identified by key stakeholders as a concern during consultation for which suitable management measures should be established (SEIA specific consultation, 2024).

Impact Assessment

While the risks associated with the transportation of hazardous waste have been considered and addressed in other sections of the EIA (e.g. Arandis bypass road, emergency response plan), from a social perspective (i.e. the risk to the community and potential increases in anxiety and opposition to the project due to the perceived risk of transporting hazardous waste) the risk is considered to be of **Medium Negative** significance both with and without mitigation. The assessment of the impact is provided in Table 7-40.

Table 7-40: Impact assessment of perceived risks due to transportation of hazardous waste

Perceived risks associated with the transportation of hazardous waste		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change (Low)	Minor change (Low)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Regional/National	Regional/National
Consequence	High	High
Probability	Possible / frequent (Medium)	Conceivable (Low)
Significance	Medium	Medium
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable: Concerns can be reversed but some are likely to remain.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The impact can be reduced, however it is likely that some concern will always remain.	
Degree to which impact can be mitigated	Medium. Measure can be put in place to educate communities and reduce the significance of the risk.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Mitigation and Management		
While the mitigation measures identified in the EIA Report should be adhered to the following is also recommended: • Require all waste delivery contractors to cover all waste loads. • Inform relevant stakeholders of management plans to deal with any accidents or hazardous waste spills. • Educate the staff and service providers regarding risks associated with hazardous waste. • Develop and implement a stakeholder engagement plan.		
Monitoring		
The following monitoring is recommended: • Number of complaints, concerns or queries received regarding risks of transporting hazardous waste. • Number of incidents involving vehicles transporting hazardous waste.		

7.5.2.7 Potential Impact: Perceived risk associated with increased traffic

Description of the Impact

During operation it is anticipated that 14 trucks as well as vehicles transporting staff will travel to and from the site daily. Due to this there will be an increase in traffic on the B2 as well as the Trekkopie Mine Road between the B2 and the proposed NMF site. An increase in traffic is likely to result in increased travel time for people commuting on the B2. It was noted during consultation that a large number of people commute between Swakopmund and mines (SEIA specific consultation, 2024) and potentially reduce road safety for road users including pedestrians. The potential cumulative impacts should also be considered as once the Orano mine is operational there will be up to 800 people accessing the site daily as well as additional trucks (SEIA specific consultation, 2024).

Impact Assessment

While a traffic assessment is being compiled for the proposed project that will determine the risks associated with an increase in traffic, from a social perspective (i.e. the potential increased travel time and concerns associated with reduced road safety) the increase in traffic is considered to have a **Medium Negative** significance both without mitigation and with mitigation measures. The assessment of the impact is provided in Table 7-41.

Table 7-41: Impact assessment of reduced road safety

Reduced road safety		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change (Low)	Minor change (Low)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Regional/National	Regional/National
Consequence	High	High
Probability	Possible / frequent (Medium)	Conceivable (Low)
Significance	Medium	Medium
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable: Concerns can be reversed but some are likely to remain.	
Degree to which impact may cause irreplaceable loss of resources	None	
Degree to which impact can be avoided	Medium. The impact can be reduced, however it is likely that some concern will remain.	
Degree to which impact can be mitigated	Medium. Measure can be put in place to educate communities and reduce the significance of the risk.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Likely	

Reduced road safety		
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Medium
Mitigation and Management		
While the mitigation measures provided in the traffic impact assessment should be adhered to the following is also recommended: • Communicate with relevant stakeholders regarding anticipated traffic volumes as and when required. • Communicate with the relevant local stakeholders regarding measures being put in place to monitor and improve road safety as and when required.		
Monitoring		
While the monitoring measures provided in the traffic impact assessment should be followed, the following is also recommended: • Instruct all waste delivery vehicles to only use the nominated bypass route. Any transit through Arandis should result in sanctions to the driver and controlling company. • Number of complaints received regarding traffic safety. • Number of road incidents involving project related vehicles. • Feedback from public engagement regarding perceptions on road safety.		

7.5.3 Visual Impact Assessment

7.5.3.1 Potential Impact: Change in landscape characteristics and key views – Construction Phase

Description of the Impact

Construction activities include the removal of vegetation/natural gravel layers, earthworks required for foundations to structures and infrastructure, and to establish the base for the landfill as well as the upgrade and construction of access roads. Activities would also include foundation preparation for the bulk water line and the powerline. Construction activities would negatively affect the natural landscape and have an impact on the visual quality and sense of place of the landscape relative to its baseline. However, sensitive receptors would not see the activities or would associate the new power line, water pipeline and access road, with the urban context and not consider them to be out of place. A negligible change to the potentially sensitive receptor perception and landscape baseline is predicted.

Impact Assessment

The impact on the visual environment during the construction phase is assessed to have a very low intensity and would occur over the very short term. The unmitigated impact would be localized but would not extend beyond the site boundary and the public would not be able to view the proposed NMF development. The infrastructure proposed in Arandis, would be visible but it would mostly be absorbed into the existing landscape scene and would not appear out of place. The impact is therefore unlikely, and the significance of impact is predicted to be **Insignificant**. The implementation of mitigation is required in the sense of 'good housekeeping'. The assessment of the impact is provided in Table 7-42.

Table 7-42: Impact of change to the landscape characteristics and key views

Change to the landscape characteristics and key views	
Type of Impact	Direct

Change to the landscape characteristics and key views		
Nature of Impact	Negative	
Phase	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible (VL)	Negligible (VL)
Duration	Very short-term	Very short-term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Unlikely	Unlikely
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	*Fully reversible: Where the impact can be completely reversed.*	
Degree to which impact may cause irreplaceable loss of resources	*Low: Where the activity results in a marginal effect on a visual resource*	
Degree to which impact can be avoided	*High: Impact can be avoided through the implementation of preventative mitigation measures.*	
Degree to which impact can be mitigated	*Low: as only good housekeeping and some planning/ management measures could be implemented. These would slightly reduce the impact.*	
Criteria for potential for cumulative impacts	*Possible cumulative impact with other activities or projects may arise.*	
Cumulative impacts		
Nature of cumulative impacts	The project would be a new land-use introduced to the study area that already has existing mining, urbanization and power infrastructure. As such, there is potential for minor cumulative effect with respect to these activities.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	**Low**
Management and Mitigation		
The following measures are recommended: • With the preparation of the land within the full extent of the Project site onto which activities will take place, the minimum amount of existing vegetation and topsoil should be removed. • Construction activities should be limited to between 06:00 and 18:00 or in conjunction with the ECO. • Adopt responsible construction practices that strictly contain the construction/ establishment activities to demarcated areas. • Paint all structures with colours that reflect and compliment the colours of the surrounding landscape. • Earthworks should be executed so that only the footprint and a small 'construction buffer zone' around the proposed activities are exposed. In all other areas, the naturally occurring vegetation/gravel plains should be retained, especially along the periphery of the site and the powerline, bulk water supply pipe and access road.		

Change to the landscape characteristics and key views
• Disturbed areas, not occupied by infrastructure, should be effectively rehabilitated post-construction. • Rehabilitation must aim to establish surface profiles and textures that fit with the landscape and only utilise locally appropriate, indigenous plant species.
Monitoring
Monitoring or reporting of adherence to the proposed management measures should be conducted by an ECO on a bi-weekly basis during the construction phase. This relates mostly to ecological impacts and not visual impacts per se.

7.5.3.2 Potential Impact: Change to the landscape characteristics and key views - Operational Phase

Description of the Impact

Operational activities include waste treatment, vehicle maintenance and disposing of waste. Security lighting and other lighting associated with the potential movement of security vehicles at night. Activities would also include the maintenance of the access road and periodic maintenance of the water pipeline and powerline. These activities along with the physical presence of the Project components day and night, constitute the visual impact.

Impact Assessment

The impact on the visual environment during the operational phase is assessed to have a negligible intensity and would occur over the short-term (although the project is anticipated to last for 62 years, the visual baseline for potential sensitive receptors would remain as per the status quo – hence the short-term rating). The impact is unlikely, and the significance of impact is predicted to be **Insignificant**. The implementation of mitigation is required in the sense of 'good housekeeping'. The cumulative impact during this phase is **Low**. The assessment of the impact is provided in Table 7-43.

Table 7-43: Established NMF and associated infrastructure and maintenance thereof

Change to the landscape characteristics and key views		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible (VL)	Negligible (VL)
Duration	Very short-term	Very short-term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Unlikely	Unlikely
Significance	Insignificant	Insignificant
Additional Assessment Criteria		

<table>
<tr><th colspan="3">Change to the landscape characteristics and key views</th></tr>
<tr><td>Degree to which impact can be reversed</td><td colspan="2">Fully reversible: Where the impact can be completely reversed.</td></tr>
<tr><td>Degree to which impact may cause irreplaceable loss of resources</td><td colspan="2">Low: Where the activity results in a marginal effect on an irreplaceable visual resource</td></tr>
<tr><td>Degree to which impact can be avoided</td><td colspan="2">High: Impact can be avoided through the implementation of preventative mitigation measures.</td></tr>
<tr><td>Degree to which impact can be mitigated</td><td colspan="2">Low: as only good housekeeping and some planning/ management measures could be implemented. These would slightly reduce the impact.</td></tr>
<tr><th colspan="3">Cumulative impacts</th></tr>
<tr><td>Nature of cumulative impacts</td><td colspan="2">The project would be a new land-use introduced to the study area that already has existing mining, urbanization and power infrastructure. As such, there is potential for minor cumulative effect with respect to these activities.</td></tr>
<tr><td rowspan="2">Rating of cumulative impacts</td><th>Without Mitigation</th><th>With Mitigation</th></tr>
<tr><td>Low</td><td>Low</td></tr>
<tr><th colspan="3">Management and Mitigation</th></tr>
<tr><td colspan="3">The following measures are recommended:
• "Housekeeping" procedures should be developed for the Project to ensure that the project site and lands adjacent to it are kept clean of debris, graffiti, fugitive waste, or waste generated on-site.
• Operating facilities should be actively maintained during operation.
• Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the site.
• Minimize the number of light fixtures to the bare minimum, including security lighting.
• Avoid high pole top security lighting along the periphery of the site and use only lights activated on illegal entry to the site.</td></tr>
<tr><th colspan="3">Monitoring</th></tr>
<tr><td colspan="3">Monitoring or reporting of adherence to the proposed management measures should be conducted through a bi-annual audit that relates mainly to ecological issues on site and to ensure that light pollution is contained to the site.</td></tr>
</table>

7.5.4 Traffic Impact Assessment

7.5.4.1 Potential Impact: Level of Service (LoS) of an Intersection – Construction and Operational Phase

Description of the Impact

A capacity analysis was undertaken in the TIA, by comparing the baseline LoS of each intersection with the LoS experienced with the addition of the traffic expected from the Project. Additional traffic from the Project could reduce the LoS at an intersection. The location of each intersection is shown in Figure 6-73.

Impact Assessment

The assessment of the impact of additional project traffic on the LoS for the different intersections is provided in Table 7-44, Table 7-45 and Table 7-46.

Table 7-44: Impact on B2 LoS during construction and operational phase

Impact on B2 LoS during construction and operational phase		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Low (Minor)	Low (Minor)
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Local	Local
Consequence	Low	Low
Probability	Probable/likely	Probable/likely
Significance	Low	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Reversible over time and with planned upgrades*	
Degree to which impact may cause irreplaceable loss of resources	*Low*	
Degree to which impact can be avoided	*Unavoidable*	
Degree to which impact can be mitigated	*Medium*	
Cumulative Impacts		
Nature of Cumulative Impacts	Without Mitigation	With Mitigation
	Medium	Low
Management and Mitigation		
The following is recommended: • Transport planning and logistics to avoid platooning, RA planned upgrades on the B2 will also mitigate impacts.		

Table 7-45: Impact on B2/Rossing Access Intersection (Location 1) during construction and operational phases

Impact on B2/Rossing Access Intersection (Location 1) during construction and operational phases	
Type of Impact	Direct
Nature of Impact	Negative

Impact on B2/Rossing Access Intersection (Location 1) during construction and operational phases		
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Low (Minor)	Low (Minor)
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Beyond (nearby) site	Beyond (nearby) site
Consequence	Medium	Medium
Probability	Probable/likely	Possible/frequent
Significance	Medium	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Reversible over time and with planned upgrades*	
Degree to which impact may cause irreplaceable loss of resources	*Low*	
Degree to which impact can be avoided	*Unavoidable*	
Degree to which impact can be mitigated	*Medium*	
Cumulative Impacts		
Nature of Cumulative Impacts	Without Mitigation	With Mitigation
	Medium	Low
Management and Mitigation		
The following is recommended: • RA planned upgrades to the B2 road will include upgrades of this intersection – probability of impacts will be reduced.		

Table 7-46: Impact on Orano Mine Gravel Access Road during construction and operational phases

Impact on B2/Rossing Access Intersection (Location 1) during construction and operational phases		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Medium (Moderate)	Medium (Moderate)

Impact on B2/Rossing Access Intersection (Location 1) during construction and operational phases		
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Beyond (nearby) site	Beyond (nearby) site
Consequence	Medium	Medium
Probability	Conceivable	Conceivable
Significance	Low	Low
Additional Assessment Criteria		
Degree to which impact can be reversed	*Reversible over time and with planned upgrades*	
Degree to which impact may cause irreplaceable loss of resources	*Low*	
Degree to which impact can be avoided	*Unavoidable*	
Degree to which impact can be mitigated	*Medium*	
Cumulative Impacts		
Nature of Cumulative Impacts	Without Mitigation	With Mitigation
	Medium	Low
Management and Mitigation		
The following is recommended: • Transport planning and logistics, and strict adherence to the gravel road speed limit to avoid platooning, agreement with Orano mine regarding regular blading.		

7.5.4.2 Safety Analysis

It is assumed that the Project traffic will comply with relevant regulations of the Road Traffic and Transport Act 22 of 1999 of Namibia, inclusive of the regulations which relate to the transport of dangerous goods. Due to the nature of the waste which will be transported to the facility and the nature of the vehicles which will be transporting the waste, Namwaste has proposed to develop an alternative access road to bypass the town of Arandis and link to the existing Trekkopje Road. The access road proposed to be developed for the Project will travel east of the town of Arandis, thus diverting all Project traffic around the town to avoid safety risks within Arandis.

A rudimentary safety analysis was done at the proposed route intersections as per the sections below.

- Intersection 1
    - To cross over the Rössing access railway, a bridge was constructed ~500m East of the intersection. The consultant notes that this is on the B2 national road and therefore expects that all relevant sight distances have been complied with. Furthermore, the dedicated turn and through lanes at intersection 1 allow for safer flow of traffic.

  - Traffic control cameras have also been installed along this portion of the B2 with a dedicated traffic control office ~100m from Intersection 1 – this further deters drivers from dangerous driving.
  - Hitchhikers make use of a shaded roadside stop at this intersection, this results in cars and trucks regularly stopping at Intersection 1. This presents a safety risk but should be dealt with by the local authorities.
- Intersection 2
  - This intersection sees the Bulk Mining Explosive [BME] access road connecting to the Rössing access road at a point along a curve in the Rössing road – see Figure 6-73.
  - Sight distances are the biggest safety concern at this intersection. A preliminary assessment indicates that the sight distances from the intersecting road are sufficient in both directions.
- Intersection 3
  - The sight distances from Intersection 3 are affected by a slight rise in the vertical elevation to the North along the road into Arandis town. During the traffic counts the consultant used this intersection multiple times and found that, although slightly problematic, this rise does not constitute a significant safety issue.

Mitigation

- The operator must have an Emergency Preparedness and Response Plan to set out measures in the event of a road traffic incident.

7.6 Impact on Archaeology

7.6.1 Potential Impact: Disturbance, damage or loss of cultural / archaeological resources, artefacts, graves, burial sites

Description of the Impact

During the different project phases (planning, construction and operation) various activities may lead to the disturbance, damage or loss of heritage resources at the proposed site of the NMF and the sites proposed for the infrastructure as outlined in the table below.

Project Phase	Activity or aspect
Research and Planning	Off-road driving by contractors, engineers and EIA specialists.
Construction	Ground clearing
	Construction of access roads
	Laydown areas
	Accommodation for construction staff
	Use of roads by vehicles and heavy machinery
	Off-road driving
	Power line and pipeline construction activities: ground moving for access roads, transporting materials across sensitive rocky ridges, and digging of pipeline supports.
	Off-road driving
	Human activity and vehicle movements

Impact Assessment

All heritage resources recorded in the course of the field surveys for the proposed NMF and associated infrastructure were assessed as to their significance (0–5) and vulnerability (0–5) (see Table 6-21), and recommended measures deemed necessary for mitigation were devised.

In the case of potential archaeological sites such as seed diggings, these resources have a low significance ranking (1/<) because they are currently in extensively disturbed natural settings without diagnostic or associated heritage as a result of existing anthropogenic impacts associated with the industrial development in this area. Additionally, the sites are not vulnerable to the proposed development since they lie between 43 m and 56 m from the site, respectively. Therefore, no further mitigation is required.

Particular attention is required to the potential seed digging located at 22°24'55.398” S, 14°59'58.902” E, whose vulnerability rating is ranked at 5 as it lies directly within the route of the proposed bulk electricity line (Section 6.11). However, its significance in terms of the Heritage Act (No. 27 of 2004) is very low due to the high degree of physical disturbance and lack of associated diagnostic materials hence it can be demarcated as a no-go site.

This is also the case with a hunting blind located at 22°17'8.628” S and 14° 54' 24.852” E (Section 6.11), as it lies 20m from the proposed site footprint, with vulnerability ranked at 3 but has a significance ranking of 2. The hunting blind is an isolated minor find in an undisturbed primary context but without any diagnostic materials. It may likely make some contribution to the heritage of the locality if similar sites are discovered in the immediate vicinity. Therefore, it is considered to be of low archaeological significance at this stage.

The heritage significance of the two identified potential historic sites has not been established or confirmed yet, as these could be linked to recent activities from the Arandis local community or the historic event associated with the military action due to WWI between the Allied Forces and German Forces (Schutztruppe) in this part of Namibia. Fortunately, they are neither vulnerable nor will be impacted by the proposed NMF and associated infrastructure, as they are located between 32.02 m from the proposed bulk electricity line and water pipeline and 2.63 km from the proposed access road by Namwaste. Provided the contractors and the proponents are made aware of these sites to avoid any possible encroachments, they do not require further mitigation, hence the Chance Find Procedure proposed should be implemented.

The most likely impact of the proposed NMF is on the potential archaeological site of a hunting blind in the unlikely event that mitigation measures have not been implemented. Although the site has medium significance in terms of the National Heritage Act (27 of 2004), it could be damaged through inadvertent disturbance of its immediate area if caution is not exercised, and mitigation measures are not implemented. The consequences of the impact must be considered permanent, as the site lies in close proximity to the proposed surface works. However, the extent of the impact would be low in that its direct effect would be within the NMF site itself. As with all impacts on archaeological sites, the duration is considered to be permanent. Given the proximity of the site to the proposed surface works, the probability of the impact is considered to be high.

The extent or spatial influence of impact, magnitude of impact, and duration of impact on the seed diggings and historical heritage resources are non-existent, as all these sites are located between 43m to 48m (seed diggings) from the proposed access road to 800m to 20 km (historical heritage) from the proposed new general and hazardous waste treatment and disposal facility and its ancillary infrastructure development.

Mitigation

- The following sites should be demarcated and treated as a no-go zone in the project
    - Potential hunting blind 22°17'8.628” S and 14° 54' 24.852” E;

  - Potential seed digging 22°24'55.398" S and 14°59'58.902 E; and
  - Potential grave sites 22°23'36.36" S and 14°58'20.00" E, as well as 22°23'36.46 S and 14°58'20.03 E.
- In this case, buffer zones of approximately 10 to 50 m with information and warning signs should be erected, and the site's locality should be integrated into the general sensitivities map of the Project.
- Should any potential heritage resources be discovered the Chance Find Procedure as outlined in the EMP (Appendix O) should be implemented.

7.7 No-Go Alternative

7.7.1 Description of Impact

The 'No-Go' option would result in Namwaste not constructing the NMF or associated infrastructure and where the status quo of the current site and waste management activities in Namibia would prevail. The mines and other customers will continue to dispose of waste at the current facilities or stockpile the waste on their sites. The Kupferberg site will reach capacity, leaving only the Walvis Bay site, which is not an engineered facility, as an option for disposal of hazardous waste. There would therefore be no appropriate capacity for the management of waste from growing industrial sectors such as mining, offshore oil and gas and green hydrogen.

7.7.2 Impact Assessment

Should the NMF not be developed there would be no impact on the existing environmental baseline of the site, but no benefits to the local and regional economies, as well as no contribution toward improved hazardous waste management in Namibia. Without capacity for the management of general and waste from the growth sectors, environmental and social impacts are likely to arise, or the anticipated development may be stifled.

Overall, the No-Go option is considered less favourable than proceeding with the NMF project.

8.0 Conclusion and Recommendations

This chapter concludes on the key impact assessment findings and makes a recommendation regarding the issuing of an ECC for the proposed NMF.

8.1 Summary of impact assessment

The table below presents a summary of the key findings, and positive and negative impacts of the proposed NMF from a physical, biological and social perspective during the construction and operational phases.

Table 8-1: Summary of impact assessment

Potential Impact	Significance of Impacts	
	Without Mitigation	With Mitigation
Soils, Land Use, Land Capability and Agriculture		
Loss of Land Capability, Soil Erosion and Compaction - Construction Phase	Medium	Low
Loss of Land Capability, Soil Erosion and Compaction – Operational Phase	Medium	Low
Air Quality		
Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors	Medium	Medium*[15]
Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors	Medium	Medium*
Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors	Medium	Medium*
Short-term WHO odour nuisance AQG exceedances for H2S emissions and the potential for nuisance impacts offsite	Low	Low
Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.	Low	Low
Visual		
Change in landscape characteristics and key views – Construction Phase	Insignificant	Insignificant
Change to the landscape characteristics and key views - Operational Phase	Insignificant	Insignificant

[15] * Impact rating is medium because the existing air quality baseline in Arandis related to particulate emissions was taken into account in the assessment. The air quality specialist study found that particulate emissions due to NMF activities could be mitigated to an acceptable level at all sensitive receptors.

Potential Impact	Significance of Impacts	
	Without Mitigation	With Mitigation
Traffic		
B2 LoS during construction and operational phase	Low	Low
B2/Rossing Access Intersection (Location 1) during construction and operational phases	Medium	Low
Orano Mine Gravel Access Road during construction and operational phases	Low	Low
Hydrology		
Contamination of surface water resources – Construction Phase	Medium	Low
Contamination of surface water resources – Operational Phase	Medium	Low
Flooding – construction and operational phase	Medium	Low
Alteration of natural drainage paths and flows	Medium	Low
Hydrogeology		
Disruption of natural groundwater recharge conditions	Low	Low
Groundwater contamination through development over existing borehole (WW206579)	Medium	Very Low
Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems	High	Low
Groundwater contamination as a result of leachate seepage from facility	High	Low
Local aquifer drawdown as a result of groundwater abstraction	Medium	Low
Biodiversity		
Destruction of Habitats and Organisms	High	Low
Disturbance of Animals and Interference with their Behaviour	High	Low
Soil and Water Contamination	Medium	Very low
Vehicle Tracks	High	Low
Light Pollution	Medium	Low
Birds and Powerline Interactions	High	Low
Socio-economic		
Increased employment opportunities (construction phase)	Low +	Low +
Increased opportunities for local contractors and businesses	Low +	Low +
Reduced road safety (construction phase)	Low	Low

Potential Impact	Significance of Impacts	
	Without Mitigation	With Mitigation
Increased spread of disease	Low	Very low
Increased incidence of crime	Very low	Insignificant
Increased tension and conflict	Very low	Insignificant
Increased permanent employment opportunities (operational phase)	Medium +	Medium +
Compliance with appropriate and safe waste management standards	Very high +	Very high +
Loss of revenue for the Walvis Bay Municipality	Medium	Medium
Increased support for community	High +	High +
Perceived health risks associated with hazardous waste	Medium	Very Low
Perceived risks due to the transportation of hazardous waste	Medium	Medium
Perceived risk due to increased traffic (operational phase)	Medium	Medium
Archaeology		
Disturbance, damage or loss of cultural / archaeological resources, artefacts, graves, burial sites	Low	Low

8.2 Summary of impacts and mitigation measures

Based on the known conditions of the baseline receiving environment and the infrastructure and activities proposed for the NMF, the majority of the potential negative biophysical and socio-economic impacts were assessed to have a medium to low significance prior to the implementation of mitigation actions. With the exception of the following impacts which significance was assessed to be high pre-mitigation:

- Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems
- Groundwater contamination as a result of leachate seepage from facility
- Destruction of Habitats and Organisms
- Disturbance of Animals and Interference with their Behaviour
- Birds and Powerline Interactions

Mitigation actions, as included in the EMP, were identified across all impacts that would reduce the significance of negative impact. All negative impacts, including those of high significance, could have mitigation applied to reduce significance to medium or lower significance, except three socio-economic assessment criteria (loss of revenue for the Walvis Bay Municipality, perceived risks due to the transportation of hazardous waste and perceived risk due to increased traffic(operational phase)) for which mitigation could not be applied to reduce their significance from medium. The great majority of impacts were assessed as being of low significance post mitigation. A summary of the impacts with mitigation measures is shown in Table 8-2.

Table 8-2: Summary of the Impacts and Mitigation measures

Potential Impact	Mitigation Measures
Soils, Land Use, Land Capability and Agriculture	
Loss of Land Capability, Soil Erosion and Compaction - Construction Phase	• Minimise project footprint as far as possible. • Manage the location of building laydown foundations, laydown areas and topsoil stockpiles. • Strip, recover and stockpile all topsoil for later reuse. • Strip and stockpile topsoil and subsoil separately. • Demarcate topsoil stockpile areas and prevent stockpile erosion and contamination. • Handle soils with care from the construction phase through to the decommissioning phase. • The stockpiles themselves must be placed in locations of low land capability. • The topsoil stockpiles must be placed in their final location and must not be moved until the time comes to use the soil for rehabilitation. The topsoil should not be higher than 4m and dumped off the back of the dump truck into its final location. • No shaping of the topsoil stockpile is allowed, and no vehicles are allowed to drive on top of the stockpiles at any time. • Off-road vehicle activity must be strictly prohibited. • Local drainage lines outside of the project development area must remain strictly undisturbed. • Disturbed areas, not occupied by infrastructure, should be effectively rehabilitated post-construction. • Rehabilitation must aim to establish surface profiles and textures that fit with the landscape and only utilise locally appropriate, indigenous plant species. • Rehabilitated areas must be inspected and maintained until they are stable and self-sustaining. • Make use of existing roads or upgrades tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum. Usually, areas with sandy soils are avoided as far as possible for heavy vehicles, since these are the dominant soils, dust suppressions methods should be implemented to reduce wind erosion. • Implementation of embedded controls such as geotextiles, gabion baskets can effectively control soil erosion on-site, where necessary. • Introduce and enforce speed limits on all vehicles; maintain speed limits on site to minimise wind erosion; educate and sensitise personnel to avoid driving on bare rocky hillside prone to soil erosion.

Potential Impact	Mitigation Measures
	• Associated infrastructure foundations must be (preferably) located in already disturbed areas where possible. • Rehabilitation of the area must be initiated from the onset of the project. Soil stripped from infrastructure placement should be used to rehabilitate disturbed areas. • A stormwater management plan (SWMP) must be implemented for the development. Using drainage control measures and culverts to manage surface runoff. The plan must provide input into the road network and management measures. • Losses of fuel and lubricants from vehicles to be contained, use of biodegradable fluids as an alternative to mineral oil (e.g. Lubricants or Hydraulic oils) where feasible, avoid waste disposal on undesignated areas (outside the site proposed for the waste management facility) which are not contained. Clean spills (solid or liquid) up immediately.
Loss of Land Capability, Soil Erosion and Compaction – Operational Phase	• Ensure maintenance of the surface water management infrastructure so that no erosion results. • Prevent the disturbance of land beyond the approved infrastructure footprint. • Rehabilitation of the waste cells and associated infrastructure must be initiated from the onset of the Project or progressively as soon as practically possible through the operation phase. Topsoil stripped from infrastructure placement should be used for rehabilitation of disturbed areas. • Rehabilitation must aim to establish surface profiles and textures that fit with the landscape and only utilise locally appropriate, indigenous plant species. • Rehabilitated areas must be inspected and maintained until they are stable and self-sustaining. • Dust suppression methods should be implemented on access roads with higher traffic volumes to minimise wind erosion and dust. • Introduce and enforce speed limits on all vehicles; maintain speed limits on site to minimise wind erosions; educate and sensitise personnel to avoid driving on bare rocky hillside and other areas prone to soil erosion. • Ensure that soil is well aerated and not waterlogged due to site drainage by ensuring minimal water leakage periods from any possible leakages (e.g. faulty pipelines) from stormwater channels/drains within the site, though limited due to the arid conditions (the solubility of most toxins and pollutants increases under reducing conditions such as those found in waterlogged soils); • Timely maintenance and repair of the waste management facility components (leachate dams, stormwater management infrastructure, waste treatment facilities etc)to reduce uncontrolled leakages to the soil.

<table>
<tr><th>Potential Impact</th><th>Mitigation Measures</th></tr>
<tr><td colspan="2">Air Quality</td></tr>
<tr><td>Short-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for acute health impacts at sensitive receptors</td><td rowspan="5"><u>General</u>
• Maintain appropriate operational controls (e.g. adhere to repair and maintenance requirements for all equipment, including vehicles, etc.)
• Conduct training of the workforce at all levels (i.e. workers, foremen, managers) in awareness of air emissions. This can be included in site induction courses and should focus on promoting understanding as to why operational controls are in place and should be adhered to.
• Develop protocols and emergency response plan to manage emission incidents such as fires or spills or other upset conditions resulting in uncontrolled/ abnormal releases. This should include the management of complaints, identification of operations at the time, weather conditions, procedures for communicating with complainants, and incident reporting to the relevant authority, etc.
• The burning of waste must be explicitly prohibited.
<u>Routine Reporting and record-keeping</u>
• Complaints and any actions arising from a complaint must be recorded in a complaints register maintained by site management. The investigation of complaints and the outcomes thereof must be recorded for inspection by the authorities.
• Maintain meticulous record keeping of site activities including waste quantities received per waste category, vehicle fleets, etc, to allow for a more accurate accounting of site activities and emission inventory updates should future assessment be required.
<u>Fugitive dust sources</u>
• General housekeeping, including the regular maintenance and sweeping of internal roads, machinery, and their surrounding areas to remove deposited dust and minimise the load available for entrainment during high wind speed events.
• Install porous windbreaks/ fencing around the facility or at a minimum alongside areas of high erosion potential (e.g. cell excavations and active cells where cover material is being spread and compacted frequently). As the air moves through the windbreak, its velocity is decreased, which in turn decreases the energy available to transport dust particles (encouraging deposition near to source). It is estimated that the ideal porosity for a windbreak is 40-50% (where 0% would be a solid wall).
• Initiate or increase the frequency (as applicable) of water sprays and consider the addition of surfactants/ chemical suppressants for areas / activities of concern (i.e. active cells), along unpaved</td></tr>
<tr><td>Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</td></tr>
<tr><td>Long-term WHO AQG exceedances for fine particulate emissions (i.e. PM <10 and <2.5 µm) and the potential for chronic health impacts at sensitive receptors</td></tr>
<tr><td>Short-term WHO odour nuisance AQG exceedances for H2S emissions and the potential for nuisance impacts offsite</td></tr>
<tr><td>Lifetime excess cancer risk exceeding acceptable levels due to carcinogenic LFG emissions and the potential for chronic health impacts at sensitive receptors.</td></tr>
</table>

Potential Impact	Mitigation Measures
	roads and exposed surfaces. Additional spraying may be required during high wind speed (> 5.4 m/s) or gusty conditions. • Cover open-bodied trucks when the truck is carrying materials that can be released into the air. • Consider windbreaks, contouring and material covers or enclosures for soil stockpiles. • Minimum practical drop heights should be adhered to when offloading wastes and cover materials. The handling of friable materials should be halted during high wind speed (>5.4 m/s) or gusty conditions or alternatively wetted prior to disposal/application. • Reduce the size of active cells as far as practicable. Cover material must be applied daily. • Where applicable, initiate rehabilitation (e.g. revegetation with appropriate species, even if sparse, in line with the surrounding landscape, or coarse material covers) to reduce entrainment as far as feasible on the surface of inactive cells. • The responsible road authorities should consider paving of high-use gravel roads in proximity to Arandis. PM monitoring at sensitive receptors in Arandis should be undertaken to inform on the sources of PM. • To limit project contributions to cumulative impacts at sensitive receptors in Arandis, PM emissions from use of the access road to the proposed facility need to be reduced as far as feasible. As a minimum, Namwaste must wet or apply chemical binding agents to the unpaved sections of the bypass and Trekkopje Road. This will become increasingly relevant as traffic on this road increases over the lifetime of the NMF. The frequency of application and type (water/binding agent) of control should be informed by monitoring at a sensitive receptor in Arandis, increasing if exceedances are recorded. If monitoring indicates ongoing exceedances of short-term PM10 health guidelines at a sensitive receptor, which emissions are arising from the bypass or Trekkopje Road, it would likely be necessary to pave the bypass and Trekkopje Road in proximity to Arandis. Responsibility for paving of roads which are the source of PM emissions should be proportional to the users thereof.
Visual	
Change in landscape characteristics and key views – Construction Phase	• With the preparation of the land within the full extent of the Project site onto which activities will take place, the minimum amount of existing vegetation and topsoil should be removed. • Construction activities should be limited to between 06:00 and 18:00 or in conjunction with the ECO. • Adopt responsible construction practices that strictly contain the construction/ establishment activities to demarcated areas.

Potential Impact	Mitigation Measures
	• Paint all structures with colours that reflect and compliment the colours of the surrounding landscape. • Earthworks should be executed so that only the footprint and a small 'construction buffer zone' around the proposed activities are exposed. In all other areas, the naturally occurring vegetation/gravel plains should be retained, especially along the periphery of the site and the powerline, bulk water supply pipe and access road. • Disturbed areas, not occupied by infrastructure, should be effectively rehabilitated post-construction. • Rehabilitation must aim to establish surface profiles and textures that fit with the landscape and only utilise locally appropriate, indigenous plant species.
Change to the landscape characteristics and key views - Operational Phase	• "Housekeeping" procedures should be developed for the Project to ensure that the project site and lands adjacent to it are kept clean of debris, graffiti, fugitive waste, or waste generated on-site. • Operating facilities should be actively maintained during operation. • Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the site. • Minimize the number of light fixtures to the bare minimum, including security lighting. • Avoid high pole top security lighting along the periphery of the site and use only lights activated on illegal entry to the site.
Traffic	
B2 LoS during construction and operational phase	• Transport planning and logistics to avoid platooning, RA planned upgrades on the B2 will also mitigate impacts
B2/Rossing Access Intersection (Location 1) during construction and operational phases	• RA planned upgrades to the B2 road will include upgrades of this intersection – probability of impacts will be reduced.
Orano Mine Gravel Access Road during construction and operational phases	• Transport planning and logistics, and strict adherence to the gravel road speed limit to avoid platooning, agreement with Orano mine regarding regular blading.
Hydrology	
Contamination of surface water resources – Construction Phase	• Minimise the disturbance of vegetation and soils as much as possible by restricting construction activities within demarcated areas. • Clear areas only as and when needed for construction-related purposes.

Potential Impact	Mitigation Measures
	• Phasing/scheduling of earthworks should be implemented to minimise the footprint that is at risk of erosion at any given time, or schedule works according to the season. Construction is recommended to take place in months or seasons where there is less rainfall, where feasible. • Progressive rehabilitation (such as the planting and maintenance of indigenous vegetation adapted to the desert environment) of disturbed land should be carried out to minimize the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff. • Traffic and movement over stabilised areas should be controlled (minimised and kept to certain paths), and damage to stabilised areas should be repaired timeously and maintained. • Storage of potential contaminants in appropriate containers, with secondary containment and/or within bunded areas. Storage areas to be located greater than 50m from drainage lines. • In case of an occurrence of a discharge incident that could result in the contamination of surface water resources, an emergency response plan should be implemented. • Maintenance of vehicles/plant to be done in a bunded concrete hardstand area or off-site. • A spill kit must be kept on-site and be easily accessible. • Separation of clean and dirty water producing areas, store and convey such water separately to prevent cross contamination. • Stormwater containment and conveyance structure to be sized with adequate free board as per applicable standards to minimize frequent spillages.
Contamination of surface water resources – Operational Phase	• Dirty water catchments should be separated from clean water catchments as per the conceptual SWMP. • All mitigation measures recommended based on the concept design must be considered during the detailed design phase. • All hazardous chemicals (new and used) and all waste streams must be handled in such a manner that they do not contaminate surface water. This will be implemented by means of the following: ○ Pollution prevention through basic infrastructure design such as waste storage containment, hardstanding, and containment bunds. ○ Pollution prevention through education and training of workers (permanent and temporary). ○ A spill clean-up plan must be in place and all employees trained in the use thereof to enable remediation of pollution incidents.

Potential Impact	Mitigation Measures
	• An emergency response plan should be formulated and adhered to during any occurrence of incident discharge or spillage of chemicals. • Good housekeeping practices should be implemented and maintained by timeous cleaning up of accidental spillages. In addition, spill cleaning kits and material safety data sheets for chemical and hazardous substances should be accessible and available.
Flooding – construction and operational phase	• Storm water management infrastructure should be designed to attenuate and divert water away from the NMF infrastructure to prevent flooding of the infrastructure. • Investigate and implement stormwater infrastructure that can attenuate runoff to avoid drastic flow increases in the receiving drainage lines. • Containment and conveyance stormwater infrastructure should be designed in a manner that prevents frequent spills and minimizes flooding. • Rainwater harvesting is also recommended to manage water emanating from impervious areas and minimise flooding. • The principles of the conceptual SWMP should be implemented during the detailed design phase.
Alteration of natural drainage paths and flows	• The change in flow resulting from the development will be managed by using appropriately sized stormwater management infrastructure as per applicable guidelines to closely mimic pre-development flow regimes. • Attenuation of outflows where water has been diverted and/or concentrated must be implemented.
Hydrogeology	
Disruption of natural groundwater recharge conditions	• Avoid, or minimise, the placement of infrastructure in drainage channels likely to support groundwater recharge; • Minimise the extent of dirty water areas and maximise the return of clean water to the environment; • Ensure maintenance of the surface water management infrastructure so that no erosion results; • All impervious surfaces to be monitored to ensure drains, etc., are functional; • Ensure runoff water from the facility is directed towards a control structure where it is appropriately managed; and • Prevent sediments from entering the stormwater systems, through appropriate means, and clean sediments from stormwater systems regularly.

Potential Impact	Mitigation Measures
Groundwater contamination through development over existing borehole (WW206579)	• Borehole WW206579 should be appropriately decommissioned according to acceptable standards. In the absence of local regulations in this regard, the SANS10299-9:2003 – The decommissioning of water boreholes, procedure may be used as a guide. • All geotechnical boreholes are to be suitably backfilled and sealed with grout to prevent contaminant migration. Any other excavations such a trenches, auger holes or test pits, etc., are to be backfilled and suitably compacted to minimize seepage of contaminants into the aquifer; • If there are changes to the design or site location, it should be ensured that any existing boreholes overlapping the facility are adequately decommissioned; and • Any new boreholes planned should be installed at a reasonable distance from the facility footprint while still serving its intended purpose.
Soil and groundwater contamination from treatment facility, storage, stockpiles, construction camp facilities, fuel storage and domestic sewage systems	• Ensure the siting of facilities where hazardous goods will be stored, handled or managed, > 50 m away from drainage lines or areas with dykes or very shallow aquifer (<5mbgl), unless appropriate stormwater management infrastructure has been developed. • Hazardous chemicals should be managed in delineated areas, over impervious surfaces that are bunded. • There should be designated maintenance areas and truck facilities. • Spill kits should be available at strategic places on site for immediate use. • Establish and implement a robust clean-up plan that will be used to handle spills during operations. • Site staff should be adequately trained to prevent and handle spills of varying natures. • Stormwater management should be implemented even at temporary site activity areas, e.g., construction yards, etc. • Stormwater management infrastructure must be developed and maintained to divert clean water away from the facility and contain all dirty water arising on the site, with adequate freeboard to prevent overtopping in the case of a 1:50 year flood event. • Waste should only be managed at sites within the dirty water catchment of the facility.
Groundwater contamination as a result of leachate seepage from facility	• Ensure that containment barriers and under-drainage system used for the respective cells, leachate and stormwater facilities are suitable for the site, robust enough for the type of waste, in line with acceptable industry standards, and are designed by a suitably qualified civil engineer; • Ensure the application of a Construction Quality Assurance plan during construction of the waste disposal facility;

Potential Impact	Mitigation Measures
	• Maximise the removal of leachate from cells and liquids from subsoil drains and contain this in the appropriate facility; • Stormwater management infrastructure must be developed and maintained to divert clean water away from the facility and contain all dirty water arising on the site, with adequate freeboard to prevent overtopping in the case of a 1:50 year flood event.
Local aquifer drawdown as a result of groundwater abstraction	• The placement, drilling, and construction of an abstraction borehole should be informed by a qualified geohydrologist. • Should a more favourably located abstraction borehole be drilled, the sustainable abstraction rate and proposed period of pumping should be incorporated into the model and drawdown analysed. • Abstraction from the borehole should not exceed the sustainable yield estimated by the updated model. Records should be kept of monthly abstraction volumes. • Water abstracted from the borehole should not be made available for human consumption unless chemical analysis indicates it complies with potable water standards. • Appropriate groundwater monitoring should be implemented to ensure drawdown does not exceed the water level determined through the associated yield analyses. It is expected that the permit issued by Department of Water Affairs will specify monitoring requirements.
Biodiversity	
Destruction of Habitats and Organisms	• Do not destroy the trees or shrubs in the drainage on the northern border of the NMF. • Keep the overall development footprint as small as possible. • NMF: the extent and location of the construction site should be demarcated, and all construction activities should take place within the demarcated area. Adherence should be strictly enforced, with hefty fines for non-compliance. • During the planning phase, a suitably qualified botanist should be commissioned to assess threatened species, collect seeds/cuttings, and relocate plants where possible. The botanist should share their findings with the National Botanical Research Institute (NBRI) if appropriate. • Demarcate or fence any sensitive areas that should be avoided, e.g. nests, trees, shrubs, burrows as identified by the biodiversity specialist. • Power line: Keep construction activities confined to the sites where pylons will be located, and directly underneath the cables. Where the cables cross ridges, ensure that construction staff use only one access route and that they do not make multiple sets of tracks.

Potential Impact	Mitigation Measures
	• Mitigation actions specifically for the power line-pipeline corridor include: 9. Keep the corridor as narrow as possible while allowing construction and maintenance access. 10. Use the same road during construction that will be used for maintenance during operations. 11. The road should be close to the power line to ensure a narrow strip of disturbance or use the existing road where possible. 12. Excavated and laid-down soil should be levelled. 13. Strictly enforce a no-go policy outside the boundaries of the power line/pipeline corridor. 14. New tracks should be kept to a minimum, and all vehicle and human movements should be strictly confined to existing tracks. 15. Some construction impacts may be mitigated by putting access roads around instead of across the ridges. 16. Cross fields of *Sarcocaulon marlothii* (Bushman's Candle) at the narrowest points and avoid areas with high densities. • All roads and tracks should be planned to minimise fragmentation or disturbance of habitats. • Anti-erosion measures should be taken where roads and tracks cross a drainage. • Water flow in the drainages should be unimpeded: elevate or bury the water pipe where it crosses drainages and washes; plan the location of pylons and other infrastructure to avoid drainages as much as possible; soil stockpiles should avoid drainages. • Carefully plan the placement of stockpiles or laydowns for construction material to avoid sensitive areas. • Limit construction activities to daytime hours to reduce noise and light. • Position temporary construction infrastructure (e.g. ablution, site office) in areas that will definitely be disturbed during operations. • Repair and rehabilitate damage from the construction phase immediately after cessation of the impact, e.g. laydown areas, erosion, rubble. • During the planning phase, a biodiversity specialist should be commissioned to inspect the power line/pipeline corridor specifically to identify nests, dens, burrows, and other breeding locations. These sites must be demarcated and avoided during all phases. If avoidance is not possible, the animals should be relocated by specialists.

Potential Impact	Mitigation Measures
	• Reptiles that are exposed during ground clearing or other activities should not be killed but should be captured for translocation by a qualified expert. Contractors and permanent staff should be educated on the importance of reptiles in the desert environment. • Ongoing education is essential. Educate construction, contractor, and permanent staff as to their environmental obligations. In addition to a thorough induction, project staff should receive repeated environmental training at least yearly. A focus on snakes during education sessions will be a start to changing perceptions and moving towards conservation of this taxon. • All contractors should be held responsible for transgressions, and significant penalties should be levied to ensure compliance. • No collection of plants or wood for any reason whatsoever. • No fires. • No indiscriminate defecating. • Avoid damage to the soil crust by staying on designated roads and restricting foot and vehicle traffic to the project site. • Limit driving to daylight hours because many reptiles are nocturnal and at risk from vehicle collisions.
Disturbance of Animals and Interference with their Behaviour	• The extent of the operation should be clearly demarcated on site layout plans. On the ground it should be either fenced in or marked with clear signposts. • Areas surrounding the NMF and related infrastructure 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. • No fires should be allowed. • Educate all staff, as well as contractors and their staff, how to interact with wildlife in a sensitive and situation-appropriate manner. • Ensure that wastes and potentially hazardous liquids are inaccessible to animals and birds. • Design and construct structures (particularly road kerbing, fences, channels and impoundments) to limit their potential to obstruct animal movement and/or trap animals. • Pipeline and powerline specific mitigation: ○ Minimise the corridor width to a maximum of 3 metres either side of the pipe, where feasible.

Potential Impact	Mitigation Measures
	○ Design the power line and pipeline access and maintenance roads so that both can be reached by the same road, and you do not create two parallel corridors. ○ Use the existing road for construction and maintenance access where practical, instead of making new tracks or roads for the linear developments. ○ The pipeline should be elevated in rocky drainages and also at the top of rocky ridges to alleviate the barrier effect and allow invertebrates, reptiles, and amphibians to pass. ○ The pipeline should be buried in sandy drainages and intermittently along its length to alleviate the barrier effect and allow invertebrates, reptiles, and amphibians to pass. • Cross drainages by the shortest routes possible and where drainages have a sandy substrate, bury the pipe.
Soil and Water Contamination	• Follow the highest international industry standards from the planning phase, through construction and during operations. • Refer to mitigation in the hydrological impact assessment (Table 7-14and Table 7-15). • Follow industry-specific containment and reporting guidelines. • Ensure that leachate dams and sewerage system are inaccessible to reptiles and birds.
Vehicle Tracks	• Plan and lay out all access routes before construction commences, and plan access tracks with construction, operations, maintenance, monitoring and decommissioning in mind so that the same tracks will serve in all phases of the project. • Establish the site boundary (as presented in this report) at the start of construction and keep all vehicle activities within this boundary. • Prohibit all offroad driving. • Prevent the establishment of single-use tracks. Where unavoidable (or they occur through transgression), ensure immediate rehabilitation via manual sweeping. • Driving next to an existing track and the formation of new tracks should be prohibited. • Vehicle parking and turning should be within defined areas, preferentially located in previously disturbed or low sensitivity areas. • Where access is required for activities (e.g. monitoring, surveys, inspection) away from tracks, stop vehicles on the road and complete access on foot.

Potential Impact	Mitigation Measures
	• Access control: if the only vehicles that use a road are owned by an accountable company (Namwaste and Orano mine) it is possible to prevent off-road driving by installing cameras and GPS trackers in all vehicles and have them monitored in real time by the security team. • Drive around instead of across ridges where possible, and if not possible, then cross ridges at their lowest points and at points where the vegetation is least dense. • Do not put pylons on the tops of ridges but rather between two lower ridges with the cables running over the summit – this avoids the making of an access road to the summits of ridges. • Educate all staff, contractors and construction staff on the reasons and methods for track discipline, and make sure that unskilled labourers are also aware of the severity of the problem, not only top management. • If signs are used next to roads, ensure that the wording is clear and written in an appropriate tone. • Penalty clauses in contracts, fines and removal from site should be used as deterrents, and an environmental officer or ECO (during construction) should be on site at all times to monitor compliance.
Light Pollution	• Minimise the use of outdoor lighting. Install motion detector lighting where practical. • Outdoor lights should be directed downwards and not up into the sky. Skyward pointing lights interfere with bats and birds, blinding and disorienting them. • 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.
Birds and Powerline Interactions	Electrocution mitigation • Adopt a pole / wire configuration design that is considered by industry standards to have the lowest risk of bird electrocution. • Construct and install bird perches and/or anti-perch devices above dangerous structures on poles. This is a measure that can also be retrofitted where monitoring indicates that electrocution is prevalent at a specific pole. • Fit insulation (of appropriate specification for the voltage) to conductor wires and insulators supporting the cables, or the grounded crossarms. • Reconfigure jumper wires to pass under the crossarm rather than over it and offset jumpers where possible.

Potential Impact	Mitigation Measures
	Collision mitigation • It is recommended that the powerline section from -22.393676°, 14.969052° (A in Figure 6-54) to -22.290892°, 14.909888° (B in Figure 6-54) be fitted with diverters. • Diverters should be fitted on the top conductor, 10 meters apart along the full length of each span, and with alternating, contrasting colours (e.g. black alternating with yellow).
Socio-economic	
Increased employment opportunities (construction phase)	• Maximise use of local skills and resources through preferential employment of locals where practicable. • Develop, communicate and implement a fair and transparent labour and recruitment policy. • Ensure diversity and gender equality in recruitment, as far as possible. • Provide training to staff before and/or during the construction phase where possible and practicable.
Increased opportunities for local contractors and businesses	• Work with relevant stakeholders to identify local businesses and contractors providing the required services. • Source as many goods and services as possible from the local and regional economy (e.g. use local contractors and accommodation and equipment suppliers as far as possible and purchase perishable goods locally). • Provide suitable training to service providers, where possible and practicable. • Develop and implement a fair and transparent procurement policy.
Reduced road safety (construction phase)	• Instruct all construction personnel and contractors to use the nominated bypass route, rather than transit though Arandis. • Communicate with relevant stakeholders regarding anticipated traffic volumes as and when required. • Communicate with the relevant local stakeholders regarding measures being put in place to monitor and improve road safety as and when required.
Increased spread of disease	• Include health related training in all induction training for project employees. • Ensure there is easy access to HIV and AIDS related information and condoms for all workers involved with the proposed programme. • Encourage voluntary HIV and AIDS counselling and testing.

Potential Impact	Mitigation Measures
Increased incidence of crime	• Liaise with relevant stakeholders regarding where construction workers will be accommodated before and during construction to inform them of construction status and discuss safety management measures to reduce security risks. • Maintain a visible security presence on site. • Implement a grievance mechanism during the construction phase. • Control site access. • Declare areas outside of the construction site as no-go areas for construction staff. • Regularly inspect the project area and surrounding area for signs of illegal activity.
Increased tension and conflict	• Include relevant training in all induction training for project employees. • Implement a grievance mechanism during the construction phase. • Undertake engagement with relevant stakeholders within Arandis as and when necessary.
Increased permanent employment opportunities (operational phase)	• Maximise the use of local skills and resources through preferential employment of locals where practicable. • Develop, communicate and implement a fair and transparent labour and recruitment policy. • Ensure diversity and gender equality in recruitment, as far as possible. • Develop a training plan outlining the process for the upskilling and training of Namibian Nationals to ensure the facility is locally run within the proposed timeframes
Compliance with appropriate and safe waste management standards	• Ensure that the facility operates as per design and in line with Namibian legislation and international best practice for waste management.
Loss of revenue for the Walvis Bay Municipality	• Communicate with the Walvis Bay Municipality regarding the development of the Namwaste Management Facility
Increased support for community	• Engage with community stakeholders to develop meaningful strategies for community development. • Ensure that funding requirements for each project are considered into the future so that projects are viable and sustainable. • Set clear goals for each project and phase out funding once these goals are achieved.
Perceived health risks associated with hazardous waste	• Develop and implement a stakeholder engagement plan.

Potential Impact	Mitigation Measures
	• Educate the community regarding hazardous waste and the potential health impacts and mitigation measures adopted by the facility to prevent potential health impacts. • Provide information sessions to the community regarding the facility as and when required. • Implement a grievance redress mechanism.
Perceived risks due to the transportation of hazardous waste	• Require all waste delivery contractors to cover all waste loads. • Inform relevant stakeholders of management plans to deal with any accidents or hazardous waste spills. • Educate the staff and service providers regarding risks associated with hazardous waste. • Develop and implement a stakeholder engagement plan
Perceived risk due to increased traffic (operational phase)	• Communicate with relevant stakeholders regarding anticipated traffic volumes as and when required. • Communicate with the relevant local stakeholders regarding measures being put in place to monitor and improve road safety as and when required.
Archaeology	
Disturbance, damage or loss of cultural / archaeological resources, artefacts, graves, burial sites	• The following sites should be demarcated and treated as a no-go zone in the project ○ Potential hunting blind 22°17'8.628” S and 14° 54' 24.852” E; ○ Potential seed digging 22°24'55.398” S and 14°59'58.902 E; and ○ Potential grave sites 22°23'36.36" S and 14°58'20.00" E, as well as 22°23'36.46 S and 14°58'20.03 E. • In this case, buffer zones of approximately 10 to 50 m with information and warning signs should be erected, and the site's locality should be integrated into the general sensitivities map of the Project. • Should any potential heritage resources be discovered the Chance Find Procedure as outlined in the EMP (Appendix O) should be implemented.

8.3 Environmental Impact Statement

8.3.1 Concluding recommendations of the EAP

The ‘No-Go’ option would result in Namwaste not constructing the NMF or associated infrastructure and where the status quo of the current site and waste management activities in Namibia would prevail. The assessment of this option requires a comparison between the impacts of proceeding with the Project with that of no change. In this scenario, the potential negative impacts would not occur, and the baseline environment (Chapter 6) would persist. The No Go option would, however, forgo the positive opportunities and benefits associated with the project.

While several potential negative environmental impacts have been identified for the proposed NMF, the majority of these are considered to be of medium to low significance without mitigation. Mitigation to reduce the significance of all impacts, including those of high significance, to acceptable levels has been identified. All specialists have confirmed that no fatal flaws have been identified and ultimately conclude that the proposed Project can be authorised. The measures to mitigate and manage potential impacts associated with the proposed Project have been provided and incorporated into the EMP for implementation. Additionally, the proposed Project is aligned with Namibia’s planning objectives and will address the pressing shortage of solutions for industrial general and hazardous waste management in Namibia and contribute to the protection of the environment, whilst also creating employment opportunities and fostering economic growth.

On this basis, it is SLR’s opinion that, subject to the implementation of the EMP, the proposed Namwaste Management Facility should be approved and granted an ECC.

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Appendix A Curriculum vitae

Namwaste Management Facility

Final Environmental Impact Assessment Report

Namwaste (Pty) Ltd

SLR Project No.: 720.09045.00008

9 September 2024

Appendix B Public consultation documentation

Namwaste Management Facility

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Appendix C Authority correspondence and documentation

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Appendix D Specialist soils and agriculture impact assessment

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Appendix E Specialist air quality impact assessment

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Appendix F Specialist visual impact assessment

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Appendix G Specialist traffic impact assessment

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Appendix H Specialist hydrological impact assessment

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Appendix I Numerical modelling report

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Appendix J Specialist hydrogeological impact assessment

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Appendix K Specialist terrestrial biodiversity impact assessment

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Appendix L Specialist socio-economic impact assessment

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Appendix M Specialist heritage impact assessment

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Appendix N Alternative Access Roads Investigation Report

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Appendix O Environmental Management Plan

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